PUBLIC AND PRIVATE INITIATIVES FOR REGIONAL DEVELOPMENT – AN INVESTIGATION OF KNOWLEDGE TRANSFER AND SOCIAL ENTREPRENEURSHIP

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I. SUMMARY

The attractiveness of a region from the perspective of the population is a complex system with many dependent influence factors. This dissertation covers two of the most significant determinants: Economic prosperity and social balance. In other words the attractiveness of a region mainly depends on the value it creates and the distribution of that value. The first part of this dissertation offers insights to the cooperation between industry and science to improve on the value creation whereas part two explores the role of social entrepreneurship in the redistribution of that value. So far, both issues have been insufficiently analyzed in the literature.

The economic prosperity of a region itself largely depends on the existing economic structure and is usually measured as contribution to the GDP. In general, the governmental goal to increase a regions contribution to GDP can be reached either by attracting new firms or by supporting the present economy to exploit their existing or develop new innovation potentials. Over the last decade literature has highlighted the growing role of research institutions as source and driver of innovations. Part one of this dissertation (paper 1 and 2) considers the role of university-industry knowledge transfer (henceforth UIKT) in economic value creation.

Knowledge-based innovations are a main driver for economic development of countries and a key factor in global competition. Beside large firms research institutions have the necessary potential, infrastructure and knowledge, to be regional drivers of innovations. They develop innovative ideas on their own and even more important support R&D-activities of the local economy. Knowledge commercialization is the identification of knowledge involving economic potential or the exploitation of ideas from the market point of view (Fiet et al., 2007). Economic policies already promote the cooperation between firms and research industries. Still the transfer of knowledge is in the fledgling stages. It is therefore necessary to explore both sides of the market for transfer-affine knowledge, the industrial demand and the scientific supply. We identify a lack of transparency and missing transfer structures at scientific institutions as the major obstacle to exploit the existing potential of cooperation between research institutions and firms.

The first paper is motivated by the fact that in Germany and to a large part as well in the entire EU necessary structures and processes to transfer knowledge between science and economy are inadequately developed (Siegel et al., 2007; Gulbranson and Audretsch, 2008). In order to become regional drivers of innovation research institutions first of all have to implement a knowledge management decision support system to be able to gather, locate and transparently process available knowledge with economic potential before traditional transfer channels can be used (Huggins and Kitagawa, 2012). Paper 1 is the first attempt to offer a methodological framework for exploring this potential. The importance of inventions, publications and third-party funds as objective indicators is highlighted, and an additive value function is introduced to aggregate the informational value of all indicators to a single measure of the potential for commercialization.

We finally tested our suggested approach at the Otto-von-Guericke University Magdeburg to illustrate its applicability and transferability. Decision makers within research institutions might use the proposed systematic process to better manage the scouting of ideas and the evaluation of transfer relevant knowledge (Nosella et al., 2008). Therefore our approach meets the political mission of the EU to expand research transfer activities by approaching suitable monitoring as well as evaluation systems (European Commission, 2012). As result of our empirical study we also present a first analysis of the current commercialization potential within this institution, the supply side as we defined. By applying different models to aggregate subjective expert weights, we find surprisingly robust rankings of university units with respect to per-capita and overall potential for commercialization.

Consequently, in paper 2 we offer a methodological framework for exploring the industrial demand for scientific knowledge of research institutions. As a direct survey among firms has major drawbacks we propose an inquiry of different intermediates, especially cluster managers. In the last decade public policy has promoted diverse cluster strategies to improve regions innovativeness as key driver of economic value creation. Local governments thereby concentrated on developed industries with many established firms where a region already has or will most likely be able to gain a competitive advantage. Simultaneously the cluster initiative focused on the generation

of synergies among firms especially in knowledge-intensive industries as these have shown the highest innovation potential in the past. We provide reasoning that cluster managers are suitable intermediaries to estimate the demand for scientific knowledge. An online questionnaire among all cluster managers is developed to show the applicability of the proposed methodology. In our case study we present the estimated regional demand in Saxony-Anhalt. Finally, to analyze the market for transfer-affine knowledge, we introduce an illustration to contrast both the demand and the supply side. This is especially valuable as measures of both sides have different dimensions. We thereby constitute a first strategic tool for transfer relevant decisions of research institutions and allow to align governmental support to the real transfer potential that strengthens a region`s economic development.

The distribution of economic value in a market-oriented social democracy is unregulated to a large degree. It is an important incentive in modern societies that effort and reward are mainly negotiated free. Nevertheless, the societal stability is threatened if income imbalance becomes too large. A progressive tax system, governmental redistribution measures and administration of labor markets are fundamental instruments to preserve the societal balance. If economic wealth is distributed extremely uneven, people perceive their life situation as unfair and do not see a legal way to improve. Negative effects are thus manifold. In history we have seen even some extreme developments, with a social uprising of the disadvantaged at the end. Even though a market-oriented social democracy can lead to an increasing inequality in society there are some forces that work against it. Typically social entrepreneurship voluntarily redistributes wealth from the rich to the poor. There are many motives for social entrepreneurs to engage, for social financiers to fund and for private persons to donate. Their redistribution decreases economic differences and is ultimately a crucial factor for the stabilization of society.

A second legitimization of social entrepreneurship is the existence of significant market failures. Modern welfare economics are based on the insight that external intervention is justifiable only if market failures can be verified. Several causes for such market failures exist, e.g., asymmetric information, natural monopolies, externalities, and public goods. Although baring responsibility, government is not correcting all

identified market failures which gives social entrepreneurs the opportunity to step in. They create social value through a privately organized reallocation of external funds, e.g., donations or grants. Among scientists it is well-known that internalizing externalities caused by poverty is the major challenge for social value creation. Social entrepreneurs provide many goods and services that are not sufficiently covered by public authorities. They serve certain motivations of the rich and reduce the negative impact of poverty on society. Both explanations show the critical role of social entrepreneurs determining regions attractiveness.

Thus, part two of this dissertation (paper 3 and 4) investigates optimal market failure correction through private initiative. More specifically, we theoretically investigate the optimal allocation of external funds by poverty-fighting social entrepreneurs. Therefore it is necessary to understand the basic motivations of all stakeholders, especially social financiers and social entrepreneurs. Over the last decades government funding of social entrepreneurship has decreased significantly. There is a huge potential for private initiatives to reduce differences in the distribution of wealth independent of governmental measures because most individuals are not purely selfish but show different social motives, especially various forms of altruism. This means some individuals perceive a disutility if the level of satisfaction of other individuals is low, especially as far as basic human needs are concerned. Nevertheless social entrepreneurs' engagement and impact crucially depends on the framework they are confronted with. If we improve our understanding of how social entrepreneurs act and of the main drivers for social funding we may derive policy recommendations to stimulate redistribution without costly direct involvement of central authorities. It could even show that the observed reduction of governmental funding is efficient, if social entrepreneurs prove to better internalize the described externalities.

We start in paper 3 with an investigation of donors and social investors as main funding source of social entrepreneurs, as this determines the scope of entrepreneurial activities. More specifically, how should an entrepreneur design her operations in order to meet the objectives of external financiers? The analysis of such issues requires, in the first instance, to examine by which motivation stakeholders are typically governed. In literature various explanations are offered for social investors' willingness to sacrifice a

part of their profits. Obviously these general preferences are less applicable to predict the funding behavior of investors in response to the social entrepreneur's operational decisions.

Those behavioral issues, however, have been analyzed in the public-economics literature which reveals a number of well specified motivations. First, we seek to identify a simple common motivation by which diverse types of social financiers are guided, not only charity donors. We reveal typical decision structures of social financiers and find that the structures are almost identical to two famous experimental settings analyzed in the literature on public economics, viz., the dictator game and the public-good game. Most prominently, Fehr and Schmidt (1999) found that in such experiments individuals are governed by inequality aversion. We argue that this preference specification is also a promising candidate to explain the behavior of social financiers in general. Subsequently, we show that inequality aversion is sufficiently precise to allow for the deduction of generally valid implications concerning the optimal behavior of social entrepreneurs who aim at maximizing external funds. Specifically, we derive several propositions concerning the basic behavior of social financiers and indicate how such findings should shape the operational decisions of social entrepreneurs in general.

Since social entrepreneurs need to attract a maximum amount of funds to maximize the social impact of their activities, it is plausible to assume that their action is guided by the same motivation as social investors: inequality aversion. With the general insights on the motivation of entrepreneurs funding sources at hand paper 4 studies the behavior of social entrepreneurs to gain a deeper understanding of the realization of social value creation. We present a model, where social entrepreneurs observe a number of differently poor individuals who are unable to satisfy a basic human need. The entrepreneur intends to allocate a social good to needy individuals under the umbrella of a nonprofit organization. She thereby decides on the quantity and poverty composition of recipients as well as on the quality of the social good or service. With a given amount of third-party funds, however, she cannot serve all applicants at maximum quality. As a consequence, the entrepreneur needs to ration the quantity of served individuals and/or dilute social good`s quality. We offer an insight in how social entrepreneurs solve this

tradeoff depending on their level of inequity-aversion and find that less inequity-averse entrepreneurs prefer to serve wealthier individuals at high reference quality. In contrast, more inequity-averse entrepreneurs care for the poorest individuals but offer minimum quality. Variations in the given amount of third-party funds are considered and the influence of a change in input costs is analyzed. Among other insights we found that as input costs increase entrepreneurs with low inequity aversion change the target group, while entrepreneurs with high aversion do not. Our results yield implications for stakeholders of nonprofit organizations whose objectives are related to quality, quantity and the composition of recipients.

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II. AN INDICATOR-BASED DETERMINATION OF COMMERCIALIZATION POTENTIAL OF RESEARCH INSTITUTIONS

An Indicator-Based Determination of Commercialization Potential of Research Institutions

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Abstract This paper develops a practical knowledge management decision support tool for research institutions. We build on the most established indicators: inventions, publications and third-party funds. With the help of the Simple Multi-Attribute Rating Technique (SMART-Method) we combine these different indicators to a single measure that represents the existing scientific knowledge within research institutions that potentially can be commercialized using traditional transfer channels. A case study of a typical German university illustrates the applicability and transferability of our approach. We present several fields for future research and discuss a range of practical applications.

Keywords: knowledge transfer, commercialization, decision support system

JEL Classification: I23, O31, D81

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1. Introduction

Economists have long confirmed that R&D is the central determinant of GDP-growth and hence of employment as well (Solow, 1956; Swan, 1956; Romer, 1990; Grossman and Helpmann, 1990). Among politicians this is already a strong conviction. Innovations constitute the core element of the ”EUROPE 2020“-Strategy to improve growth and employment stimuli (European Commission, 2011). Innovations are the result of R&D activities, are key to problem solving by creating technological, economical as well as social renovation and involve an economic commercialization (Damanpour and Wischnevsky, 2006). It is widely known that most R&D activities are carried out by a small number of large firms (Konzack et al., 2011). However, more than 99 percent of the European economy is characterized by SMEs. Normally these firms do not possess the necessary financial and personnel resources to accomplish high-risk R&D-investments (Saunila and Ukko, 2014). Regions which are mainly stamped by a small-sized structure in their economy have a significant competitive disadvantage by fighting for economic growth and wealth. In future, research institutions, especially universities, shall operate as regional drivers of innovation (Fransman, 2008; Rampersad et al., 2012). They possess the resources, in particular the required infrastructure and knowledge, to not only create distinct innovations but even more important to support R&D activities of the local economy (Philpott et al., 2011).

At the bottom line this assignment can be translated into a context of decision-making. From the perspective of research institutions the task to maximize income steaming from commercializing existing knowledge by means of traditional transfer channels shall sufficiently support the economy (Kester et al., 2009). With this in mind knowledge commercialization is the identification of knowledge involving economic potential or the exploitation of ideas from the market point of view, respectively (Fiet et al., 2007). Developing this thought, we evaluate economic potential of institutions by focusing on their existing research knowledge, which can be commercialized by means of traditional transfer channels. Economy can create innovations by applying this knowledge (Saunila and Ukko, 2014). In Germany, the biggest industrial nation in the EU, all necessary requirements to implement this strategy are currently not met. An insufficiently developed culture of exploiting ideas within the German landscape of universities, which traditionally

focus on research and teaching, is a major reason. Consequently, necessary structures and processes to transfer knowledge between science and economy are inadequately developed (Siegel et al., 2004; Gulbranson and Audretsch, 2008). This explains why currently 90 percent of all transfer activities between research and economy are bypassing transfer units of universities or are non-observable, respectively (Meier and Krücken, 2011).

In order to become regional drivers of innovation research institutions first of all have to be able to gather, locate and transparently process available knowledge with economic potential before traditional transfer chancels can be used (Huggins and Kitagawa, 2012). Such methods or tools are known as "knowledge management decision support systems" (Cooper, 2003), "performance measurement systems for research activities" (Chiesa et al., 2008) or "decision support systems" (Nosella et al. 2008). Nonetheless, the identification of innovation potential and the application of such tools is strictly limited to firms so far (Schoenecker and Swanson, 2002; Hagedoorn and Cloodt, 2003; Roper et al., 2008). All of these basic approaches are not offhand transferable to research institutions. There are few approaches in literature directly focusing on the commercialization potential of universities. In general they aim to provide insights on the basis of single output indicators such as inventions, patents and licenses (Arundel and Bordoy, 2008). Additionally, research financing differentiated with respect to funding sources is analyzed as input indicator (Langford et al., 2006). Rasmussen (2008) includes the number of start-ups as a further indicator. On the other hand, Matsumoto et al. (2010) explore the influence of scientific output (publications and patent applications) on the economic development of different industries with a four-phase model. The interleaving of both aspects derives the following research questions addressed by us in the current paper.

- Which indicators can reproduce the entirety of existing knowledge of research institutions?
- How can these indicators in terms of "knowledge management decision support systems" be gathered, aggregated and transparently processed for knowledge transfer?
- Is the application of this basic approach able to deliver practical solutions and implications for decision makers in the context of knowledge transfer?

Our main research contribution is the first-time development of a theoretical framework for a knowledge management decision support system for research institutions. On the basis of the acknowledged scientific output indicators *invention activities*, *third-party funds* and *research activities* a tool to support decision makers in the field of research accrues. By means of the SMART-method indicators are aggregated to one single measure which represents the current stock of knowledge of units within research institutions, which have potential to be commercialized via traditional transfer channels in the future. Furthermore, we disclose existing restrictions of our approach and derive the necessity of research in the fields of econometrics, tacit knowledge as well as the regional economic demand and its absorptive capacity. The case study of a typical German university has led to distinct results and shows the practicability of our decision support system. In the sequel, university decision makers are now able to improve knowledge transfer between science and economy. Therefore our approach meets the political mission of the EU to expand research transfer activities by approaching suitable monitoring as well as evaluation systems (European Commission, 2012). Our approach strengthens universities in medium structured economic regions to act as local drivers of innovation.

The paper is structured as follows. Within chapter two we analyze different dimensions of scientific output proposed in various fields of literature. On this basis suitable indicators to evaluate the overall band width are conducted. At the end of chapter two the SMART-method and its set of instruments is introduced in order to aggregate the identified assessment measures. By means of a case study we verify the practical applicability and transferability of our derived approach in chapter three. Using the example of a technical university in Germany we illustrate the methodical proceeding. Moreover, gained results are presented and discussed. Concluding in chapter four we underline the increment value of our work concerning research, practical experience and politics and endorse by existing restrictions of the approach combined with a prospectus for further research.

2. Theoretical Approach

This section presents a theoretical approach to support the identification of the commercialization potential within existing research institutions. Chiesa et al. (2008) refer to the task of designing a "performance measurement system" as a decision support tool. Necessary therefore is the implementation of a systematic scouting and evaluation process with the goal to identify existing knowledge regarding new and superior technologies (Fiet et al., 2007; Nosella et al., 2008). For decision-making processes Cooper (2003) highlights the systematic data analysis as basic characteristic of "knowledge management decision support systems". According to Cooper, this is a tool to acquire and gain access to valuable knowledge. The resulting transparency reduces the R&D costs of scientific institutions (Pacharn and Zhang, 2006). Such systems are fundamental preconditions for firms to optimally exploit R&D activities with the goal to secure competitive advantages and improve (their) market position. However, for research institutions an evaluation system has to consider differing output formats. In many decision-making contexts past performance is a suitable approximate for potential (in terms of future performance). Research institutions with well-established transfer structures and a clear focus on the commercialization of knowledge could base their optimal comparison of structural units, e.g., institutes or chairs, solely on past annual revenues generated by transfer efforts.

Since most universities in Europe, especially in Germany, do not have the necessary commercialization culture and history, alternative methods for measuring existing knowledge for transfer have to be sought. In the transfer literature of research institutions there are only few attempts to measure the existing knowledge for commercialization (Langford et al., 2006; Arundel and Bordoy, 2008; Rasmussen, 2008). Existing analyses are primarily output-comparisons of different universities. For instance in Germany, Pohlmann (2010) investigates the transfer potential of identical departments of Hessian universities with the efficiency based Data Envelopment Analysis method. These papers normally focus on some but do not cover the full scope of available indicators of the commercialization potential through the exploitation of existing knowledge and do not justify their choice. We build our approach on the transfer literature of research institutions and add a discussion of the relevance of different research output indicators for firm

innovations. Additionally, we contribute by integrating all transfer relevant indicators to a single measure.

To develop an approach for a knowledge management decision support system for research institutions in the context of technology transfer and to derive policy implications we need to take the following pivotal steps: first, a literature based identification and discussion of possible indicators to measure transfer-relevant knowledge and second, the aggregation of chosen indicators using a legitimated value function.

2.1 Indicators

Although literature features a multitude of operating figures, so far no scientific approach for measuring the potential of innovations has gained full acceptance among researchers (Hagedoorn and Cloodt, 2003). Innovations are based on existing knowledge. In research institutions such knowledge is created as output of scientific activity in different forms. With respect to the transfer of the relevant economic impact of output formats significantly vary between research fields (Martinelli et al., 2008). Single operating figures having advantages and disadvantages can only explain a certain part of the commercialization potential. To our knowledge there is no approach to combine different output criteria to a single measure that represents the total knowledge of a structural unit and hence could be the basis for strategic decision-making (processes). Therefore, a combination of the most accepted indicators can deliver a more comprehensive evaluation of the commercialization potential (Hollenstein, 1996; Hagedoorn and Cloodt, 2003).

In general, quantitative criteria are preferred to measure output as they are characterized by a simple data collection, direct evaluation and a higher level of objectivity (Chiesa et al., 2008). Qualitative assessments of commercialization or innovation potential usually originate from expert interviews. Personal preferences of participants may distort these results, and hence their comparability is limited. Moreover, the collection of a multitude of expert opinions comes at a great expense. Business and market innovation, for example, are indicators for corporate assessment with a qualitative character (Acs et al., 2002; Kleinknecht et al., 2002). Internal decision makers are responsible for evaluating whether an invention is classified as a market innovation or only as new to the company. In case of additional insights or missing information a combination of quantitative and

qualitative indicators is possible (Chiesa et al., 2008). In this sub-section we enrich the set of possible indicators discussed in the literature and reveal their positive features and shortcomings. In Figure 1 we structure all proposed indicators into three categories of indicators: *invention activities*, *research activities* and *third-party funds*.

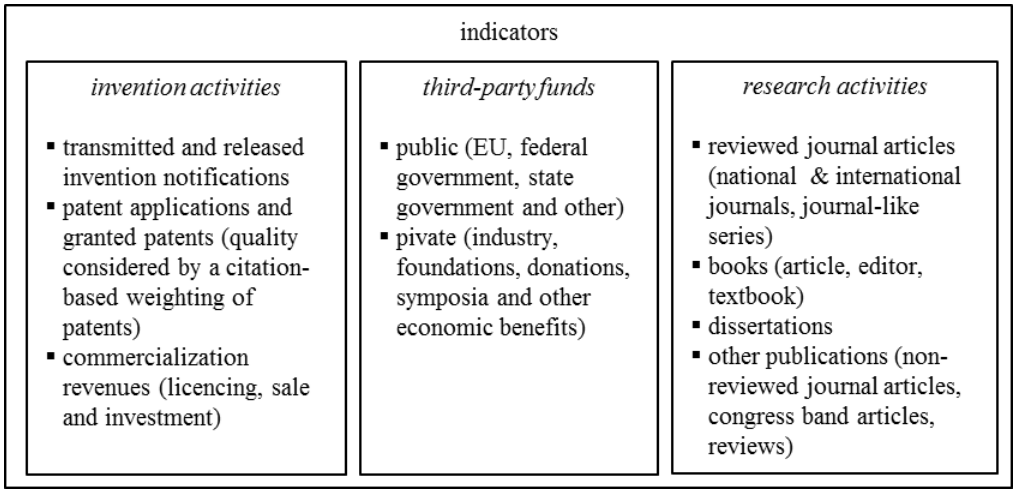


Fig. 1 Indicators for the commercialization potential

The relevance of these three dimensions for the innovation and commercialization potential of research institutions is confirmed in theoretical and empirical literature (van Raan, 2006; Langford et al., 2006; Matsumoto et al., 2010). *Research activities*, which is the most indirect category as a check for marketability, are usually missing. Nevertheless, it measures new knowledge at an early stage which is not covered by the other two. On the other hand, an indicator is listed in the category *invention activities*, if first steps towards an invention or a commercialization of research results are initiated, e.g., the protection of proprietary rights. Most indicators in literature belong to this category. However, it does not characterize the commercialization potential from direct cooperation with industries. Often this research must not be published and the industry partner receives all proprietary rights. Direct knowledge transfer to cooperation partners can be captured by the category *third-party funds*. The higher the amount of these external funds, the higher the expected economic value of the transferred knowledge. Subsequently, we discuss the measurement of possible indicators in greater detail.

2.1.1 Invention activities

Most indicators are intended to offer insights to the input-output process in the context of firm innovations, on which basis performance comparisons of innovations are conducted. Input indicators such as R&D-expenditures (Fritsch and Franke, 2004; Lööf and Heshmati, 2006) and R&D-personnel (Brouwer and Kleinknecht, 1999; Frascati, 2002) are often applied since they can be determined with low effort and without ambiguity. Nevertheless, these ratios do not consider efficiency and cannot easily be transferred to the context of research institutions. Instead, we concentrate on the following output indictors for invention activities: transmitted and released invention notifications (Arundel and Bordoy, 2008), patent applications (Edler and Schmoch, 2001; Roper et al., 2008), granted patents (Acs and Audretsch, 1988), patent citations (Hall et al., 2005), return from past knowledge transfer (Langford et al., 2006), and number of spin-offs (Rasmussen, 2008).

Since the German privilege for scientific staff to commercialize their own findings was repealed in 2002 (ArbEG §42), a German university now possesses all intellectual property rights that originate within the university. All employees have to register research outcomes that can be commercialized. Usually this obligation to report inventions already in an early stage should lead to a reliable indicator for the commercialization potential. This indicator has a high predictive value, but only if the research institution has a sufficient incentive structure to report inventions. In practice, however, there is often a low awareness towards this obligation due to insufficient communication. Moreover, the incentive structure is not optimal and a penalty mechanism is missing. Hence, there is no reliable data on registered inventions available. For example, since a patent information center conducts an intensive patent examination before an invention is officially notified, the overall number of registered inventions is considerably lower. As an alternative, we use the three often available indicators that represent the output of the transfer process: transmission of inventions to external research partners, release to inventors, and property rights intended to be realized by the university.

A second class of indicators discussed in literature is related to patents. Granted patents are suitable indicators for new knowledge that can be commercialized (Hülsbeck, 2011) because the patenting process follows a standardized and transparent procedure (Pohlmann, 2010). Thereby a significant progress in the development of an invention is

guaranteed. On the other hand, proprietary rights cannot be acquired for all inventions so that part of the existing potential is neglected. The propensity to patent also differs considerably between industries and faculties (Brouwer and Kleinknecht, 1999). Moreover, a head start is sometimes more important to realize value creation, and a patenting process is avoided to keep information closed. Additionally, patent test procedures are time consuming (Roper et al., 2008, Hülsbeck, 2011) and indicate commercialization potential with a large time lag. Using patent applications instead avoids this problem, but, again, inventions are considered at the beginning of the process. A third disadvantage is the considerable difference in the quality of granted patents, respectively the likelihood to successfully commercialize them. For this reason Trajtenberg (1990) argues that the pure count of patents is an insufficient predictor for the value of innovations and proposes a combination of indicators. This paper uses the number of patents weighted by patent citations and finds evidence for a higher informational value. Thus, patent citations measure the quality of patents as they reveal being state of the art or influencing a broad field of knowledge (Harhoff et al., 1999; Hall et al., 2005).

To sufficiently estimate the market relevance of inventions, literature discusses different measures of the return flow from the commercialization of patents, in particular revenues from licensing and sale. These reflect most directly the market demand and confirm a patent's applicability. However, as the commercialization process typically takes years, this indicator reveals past activities but does not show the current potential for future transfer. Moreover, transfer payments are not a suitable indicator for universities with a poor commercialization culture. Generated revenues do not necessarily represent the real economic value and the required data are missing. We observe this problem in any research institutions in Germany (Fritsch, 2009; Astor et al., 2010).

The choice among the set of possible indicators depends on the available information infrastructure at a research institution. We conclude that a combination of different indicators could improve the measure of invention activities.

2.1.2 Third-party funds

Third-party funds have a growing importance as indicator for the scientific productivity of research institutions (Zißler, 2011). There is a direct relation between the success to acquire third-party funds and the research performance (Hornborstel, 2001;

Schmoch and Schubert, 2009). Due to the simple determination and unambiguousness, this operating figure is widely accepted in science as a performance measure (Pohlmann, 2010). Over the last decades, declining federal funding increased the importance of external funds. As a result, universities more frequently used these funds as internal performance measure and based the allocation of additional financial means on that indicator. Therefore, a high competition for limited third-party funds can be noted.

In general third-party funds are seen as input for future research efforts independent of the funding source. However, we follow the output-oriented approach of Jansen et al. (2007) which accounts granted third-party funds as the output of a peer review process, where international reviewers evaluate the innovation potential and the quality of a project proposal (Garcia and Sanz-Menéndez, 2005). With respect to the source of funds, we distinguish between private and public third-party funds. This structural separation is applied in different countries (Geuna and Martin, 2003; Langford et al., 2006). Public funds are intended to reward research quality and are often used to increase fundamental research capacity. In contrast, private third-party funds are mainly provided by the industry and rather characterize direct knowledge transfer assignments. Therefore, industry funds are a direct measure for the transfer orientation of a research institution, since firms mostly commission to solve clearly defined problems. This contract research constitutes the most direct form of transferring concrete and applicable scientific research results. Typically, the channels of the traditional transfer model like consultancy, contract and cooperation research as well as qualification fall into that category (Debackere and Veugelers, 2005; Chiesa et al., 2008, Geuna and Muscio, 2009; Perkmann et al., 2013). Thereby, research areas and industries prefer different knowledge transfer channels (Bekkers and Boda-Freitas, 2008). Additionally, the commercialization potential differs among the various transfer forms and demands different support mechanisms in research institutions (Wright et al., 2008). So far this traditional transfer model is insufficiently applied by science and economy. First, it is not clear where in an institution transfer-affine knowledge can be found and of what size. Second, the necessary structures to transfer knowledge are insufficiently established. In this context we focus on the evaluation of existing knowledge as a necessary but not sufficient condition for the application of the traditional transfer model.

An empirical analysis calls for the distinction between public and private third-party funds, allowing testing the hypothesis that private third-party funds stronger stimulate research output which can be commercialized. Literature even postulates that within these two classes different funding sources have different quality in signalizing performance potential (Schmoch and Schubert 2009). This might apply to scientific research performance in general, but not for the measurement of commercialization potential. While professional peer reviews may be an indicator for a higher quality of research, they are not necessarily a superior measure for the marketability of research. For this reason we compare research units or scientists on the basis of the unweighted sum of funds, i.e., we propose to independently evaluate the two classes of funding sources but not to discriminate within.

2.1.3 Research activities

In general, publications are the most important indicator to measure research performance, yet research results only indirectly characterize the innovation and research potential of a structural unit. A higher quantity of research output tends to result in a higher expected return from research transfer. Publications keep record of the latest research results and determine among others the market price for external research contracts via related reputations of scientists in the academic community (van Raan, 2005: Zißler, 2011). In general, research areas considerably differ in their way to publish research output, e.g., they vary significantly in the average number of coauthors, citation culture, size of community and preferred type of publication. Therefore, academic productivity and simultaneously the reputation of researchers need to be measured by bibliometric procedures with quantitative (the amount of publications) and qualitative indicators (peer review and citation analysis). The pure number of publications is no suitable indicator for the evaluation of researchers as it does not control for significant differences in several dimensions. Literature has provided fractional numbers of publications as solution, accounting for the number of authors and the length of research papers (Skolnik, 2000).

The measurement of research quality, on the other hand, is extremely controversial (Moed et al., 1985; Narin et al., 1994; Seglen, 1998). Traditionally, a double blind peer review of at least two experts is used by journals to evaluate quality but often proves to be subjective and is sometimes compared with a lottery (Rinia et al., 1998). Alternatively,

citation analysis uses the number of citations to estimate the relevance of research for the scientific community (Osareh, 1996). Like other approaches citation analysis also has significant shortcomings. It is necessary to control, among other aspects, for self-citations and the number of coauthors (Costas and Bordons, 2007). Moreover, this quality measure still depends on subjective evaluations and has a significant time lag. To compare publications in different journals raises the additional problem of measuring the quality of journals. Literature offers several methods to determine the reputation of journals, e.g., the journal impact factor as most prominent measure. Nevertheless, there is substantial criticism of their explanatory power (van Raan, 2006; Garfield, 2006). Additionally, it is difficult to measure and compare the scientific performance of different disciplines due to their specific characteristics (Pohlmann, 2010).

Although not free of criticism, a combination of quantitative and qualitative procedures currently represents the best available basis for an evaluation of scientific results. Modern rankings for researchers, like e.g., the German ranking of the newspaper Handelsblatt for economists, also consider qualitative aspects and have a considerable informational value at least within certain disciplines. Nevertheless, we found no evidence in literature that the quality of research positively correlates with the transfer orientation of research institutions (Edler and Schmoch, 2001). For a complete evaluation of research achievements we need to consider books, dissertations, miscellanies, reviews and editorial scripts as well (Münch, 2006). This necessity can be attributed to the diverse publication preferences of different disciplines. We acknowledge this aspect and, hence, propose to approximate the publication performance by the unweight sum of all publications, if possible adjusted for the number of authors and the length of publications. We abstain from a qualitative weighting to avoid interdisciplinary distortions, e.g., often medical and economics faculties focus on peer-reviewed journal articles, whereas in mechanical engineering many researchers publish monographs.

2.2 Aggregation of Proposed Indicator Categories

So far, literature has a limited explanatory power, as existing approaches only contrast some of the available indicators. As a multi-criteria comparison is often ambiguous, results are interpreted carefully. Our goal is to aggregate the full set of indicators to a single measure of the commercialization potential of research institutions.

In decision making the employment of different indicators describes the setting of a multi-criteria decision problem. To compare alternatives (here: structural units of a university) we have to aggregate different information with a value function. So far, a value function has not been used in literature to determine the commercialization potential of research institutions. With the approved SMART-method (Simple Multi-Attribute Rating Technique) we can form a single operating measure which combines different influence factors (Goodwin and Wright, 1998). This method allows us to interpret performance differences of alternatives and is typically used to determine the best available alternative. On the other hand, the funding allocation among several alternatives should be based on their marginal productivity but can hardly be determined in practice. If we want to use the resulting ranking to directly conclude on the allocation of special transfer funds among structural units we need a further assumption. The SMART-based ranking is a good approximate to allocate a fixed budget to a fixed number of structural units to be supplied, e.g., a university wants to financially support the best 20 departments. Therefore, the proportion of the given budget allocated to each of these departments is determined by the relation of their performance value to the sum of the top 20 performance values.

In order to apply the SMART-method, the critical assumptions need to be examined. Particularly, the indicators used to approximate commercialization potential must be additive and separable. This basically requires that all indicators can be evaluated independently. Otherwise it could lead to distortions from over- or underweighting. In that case we need statistical procedures that control for autocorrelation of explanatory variables.

We normalize the performance value per-capita to account for the different dimensions of all indicators. In this scoring approach the structural unit with the best performance for an indicator receives 100, the worst 0 points. All other performance values have to be scored accordingly within this range. The weights w_i of the value function are based on expert opinions. We propose to ask field and transfer experts for swing weights (Goodwin and Wright, 1998), because they express the relative importance of an indicator as well as the magnitude within indicators. For small differences between all structural units an indicator will receive a lower weight and hence will have a lower influence on the overall value. The received swing weights are normalized and, therefore, add up to one.

$$v(SU_j) = \sum_{i=1}^{4} w_i \cdot v(x_j^i) \quad \text{with} \quad \sum_{i=1}^{4} w_i = 1$$

The overall value v (SU_j) of structural unit j (j=1…n) is the sum of all per-capita performance values $v_i(x_i^j)$ for the relevant indicators x_i^j weighted individually with w_i. Our four independent indicators (*invention activities, research activities, private third-party funds and public third-party funds*[1]) provide different evidence for a high potential of commercialization of knowledge per structural unit. With the above provided additive and separable value function we can compare all structural units on the basis of a single effectiveness measure v (SU_j). The per-capita commercialization potential of each structural unit is accordingly valued within a range of 0 to 100 points. Multiplied, respectively, with the number of full-time equivalent employees, we receive the overall commercialization potential per unit as a second decision basis. The next section presents an empirical test of our methodology and discusses different models to determine the weights for our indicator bundles.

3. Methodology

To practically test our theoretical approach we have chosen to call in a case study. Hereafter, the area of analysis - the university structure - is delineated, before the selection (data basis) and the loading of indicators (interviews of experts and models) is described in detail. Finally, we present the results of our case study and provide a discussion of the implications.

3.1 Area of Analysis and University Structure

The case study we executed at the Otto-von-Guericke University of Magdeburg (subsequently OvGU), is a middle sized university in the German federal state of Saxony-Anhalt. R&D-activities of economy and science of this region can be accounted for being representative for numerous states in Germany (Bühnemann, 2012) and for several regions within the EU as well (Bocken et al., 2014). On this account an OECD case study

[1] To analyze the influence of the sources of external funds on commercialization potential, we suggest separating them and, hence, consider four different sets of indicators. This split does not distort results insofar as the weighting process of indicators takes into consideration their similar character.

examined the economic region in order to gain insights into the existing structure and the related processes (Proto et al., 2012). The economic structure can be characterized by more than 98 percent of small and medium-sized businesses (subsequently SMEs), in many cases with an annual turnover of less than two million Euros. Moreover, these firms operate most of the time on local and regional markets with marginal export rates. With on average 1.15 percent of the GDP, R&D-activities of these SMEs are exceedingly small and in addition intensively government-funded (65 percent of the expenses). Cooperation between science and economy is rarely established. We identified several reasons for this lack of cooperation: research foci of academics do not largely correspond to companies` R&D-demand and the cooperation potential is not sufficiently identified. Exemplarily, the OvGU's technology transfer center aiming to promote transfer between economy and science is not perceived adequately.

Based on these findings federal politicians invite universities, e.g. the OvGU, to promote innovation and to support regional economic growth. Necessary structures and processes for an intensive transfer between science and economy have to be developed and implemented immediately (Becker et al., 2013). Just like many other universities within Germany the OvGU has not yet established structures of commercialization. In order to structure a market-oriented unit focusing on the commercialization of research-based knowledge considerable investments are necessary (Genua and Muscio, 2009). Following these arguments the OvGU is supporting the conducted case study by giving access to information which are unique in scope (data basis) and quality (interviews with experts) in the analyzed field. Objective is the transparent identification of structural units (institutes as well as chairs) with a high level of economically usable research-based knowledge as a fundament for decisions concerning future activities in the area of transfer. Additionally, our analysis is the prerequisite to develop the monitoring and evaluation system for transfer structures postulated by the EU (European Commission, 2012).

Our data collection and analysis follows the organizational structure of the OvGU, graphically shown in figure 2. All faculties are assigned to the university's three foci: mint, medicine and social sciences. In parentheses the number of institutes per faculty is given. Therefore, in total 113 structural units have been included in our analysis.

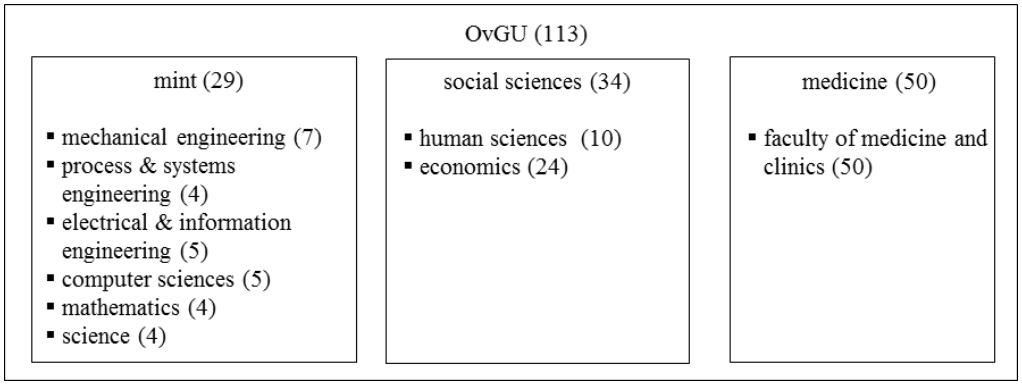


Fig. 2: Organizational structure of the OvGU[2]

3.2 Indicators and Data Base

On the basis of the available information infrastructure we detail how to determine and to aggregate the sub-indicators for each category as discussed before. *Invention activities* are approximated by the sum of patent applications, released inventions, and transmitted property rights. Two types of distortions are possible: First, inventions that cannot be patented and are commercialized by the university are not considered by the approximation. Second, an overlap of these three categories could happen, e.g., an invention is patented and later the right to commercialize is returned to the inventor. This double count is expected to have a low distortive impact, because a scoring takes place before the different indicators are summarized in a value function. Therefore, the absolute number is always between 0 and 1.

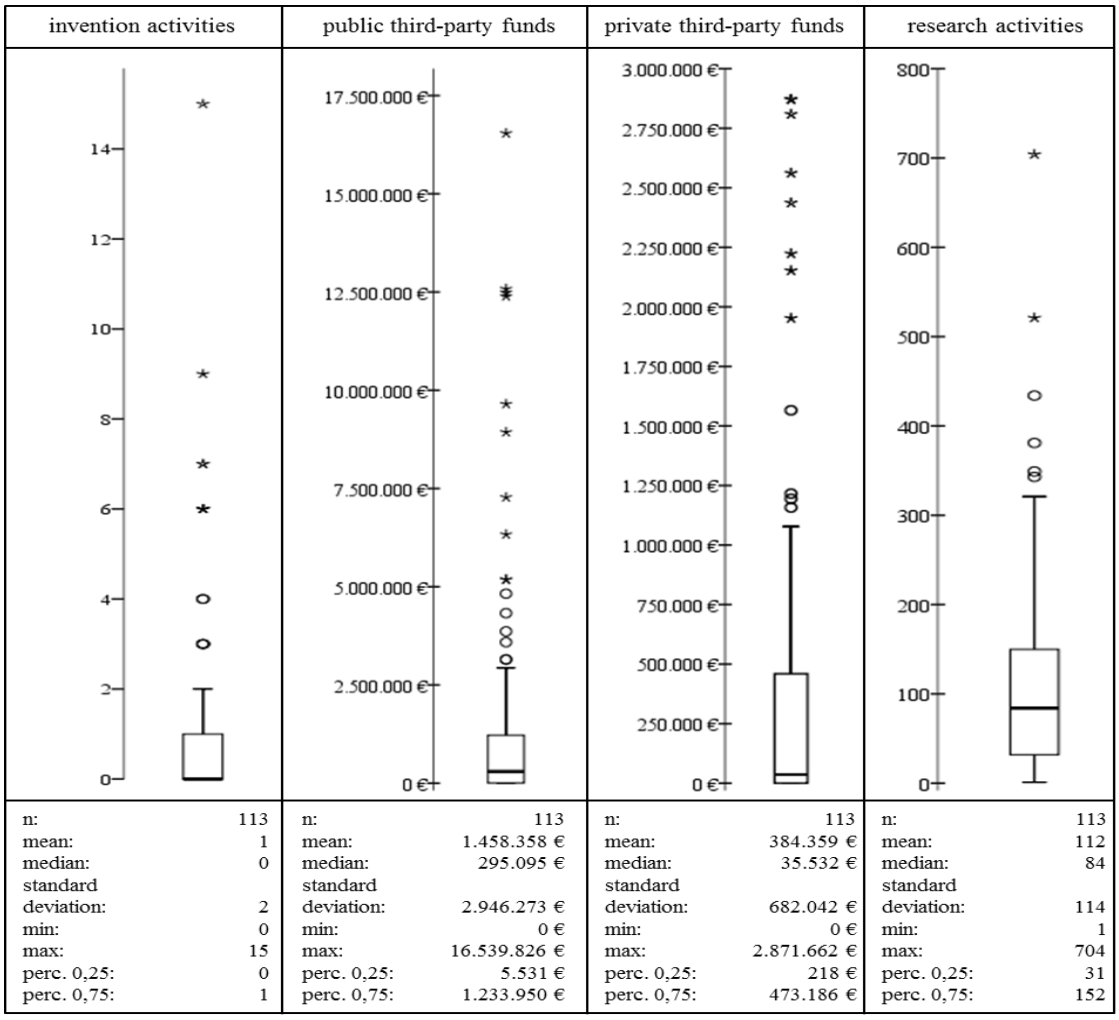
As the OvGU is currently preparing a commercialization infrastructure and, therefore, has no sufficient commercialization history, we do not consider the return from commercialization of inventions. For the category *research activities* we equally weight all types of publications and, hence, use the sum of all as indicator for interdisciplinary comparisons. For reason of simplicity we do not control for differences in length, number of authors, etc. and are aware of some minor structural distortions that may result. In particular, we observe a tendency of medical faculties to list more authors on relatively short papers compared to other disciplines, and we account for this and other influences in our interpretation. With respect to *third-party funds* we follow the résumé of section 2.1.2 and abstain from a discrimination of the sources of financial support. Hence, we take the

[2] At the faculty of economics the institutional level does not exist. In some cases chairs were included in our analysis in place of the institutional level.

unweight sum of all funds classified according to their origin in public and private external funds measured in Euro.

In order to test our approach we collected data with respect to the four proposed indicators from 2007 up to 2011 for all structural units predominantly from the university information system (HIS) and the annual publication report provided by the Technology-Transfer-Office (TTO). HIS contains data about third-party funds and the number of employees per structural unit. Not until the number of employees is considered is it possible to receive a significant comparison of all structural units. The annual publication report of Saxony-Anhalt additionally lists all scientific publications, invention notifications, released inventions and patent applications.

An explorative data analysis of all indicators provides an overview of OvGU-performance measures aggregated over the five year survey period. The boxplot in figure 4 summarizes this information and highlights outlying as well as extreme values for all variables (Johnson et al., 2002). Descriptive statistics offer further details to the indicators.



invention activities		public third-party funds		private third-party funds		research activities	
n:	113	n:	113	n:	113	n:	113
mean:	1	mean:	1.458.358 €	mean:	384.359 €	mean:	112
median:	0	median:	295.095 €	median:	35.532 €	median:	84
standard deviation:	2	standard deviation:	2.946.273 €	standard deviation:	682.042 €	standard deviation:	114
min:	0	min:	0 €	min:	0 €	min:	1
max:	15	max:	16.539.826 €	max:	2.871.662 €	max:	704
perc. 0,25:	0	perc. 0,25:	5.531 €	perc. 0,25:	218 €	perc. 0,25:	31
perc. 0,75:	1	perc. 0,75:	1.233.950 €	perc. 0,75:	473.186 €	perc. 0,75:	152

Fig. 3: Boxplots and descriptive statistics of the four indicators

In order to apply the value function introduced in section 2.2 we need to control for possible dependencies between indicators. Naturally, a large structural unit is expected to create more inventions, collect more third-party funds and have a greater number of papers published. The resulting high correlation between indicators can be eliminated by comparing the indicators on a per-capita basis. Thus, all indicators are set in relation to the amount of full-time equivalent positions in our value function. A correlation analysis of all per-capita indicators can confirm their independency. For the OvGU we determined the annual per-capita indicators as average over the period 2007 - 2011. Table 1 summarizes the results of the correlation analysis. The correlation matrix confirms only a moderate positive correlation between private and public third-party funds per-capita on a one

percent level of significance. Nevertheless, the scatter plot reveals no systematic dependency between both indicators.

Tab. 1: Correlation coefficients between all per-capita indicators

Correlation matrix of average standardized indicators (2007-2011, cases n=565)		*research activities/st*	*invention activities/st*	*public third-party funds/st*	*private third-party funds/st*
research activities/st	correlation (Pearson)	1			
	significance (double sided)				
invention activities/st	correlation (Pearson)	.020	1		
	significance (double sided)	.641			
public third-party funds/st	correlation (Pearson)	.013	.045	1	
	significance (double sided)	.758	.288		
private third-party funds/st	correlation (Pearson)	.012	.079	.137**	1
	significance (double sided)	.773	.060	.001	

**. The correlation is significant on the 0.01 level (double sided). st-staff

3.3 Indicator Weighting

We have identified 113 structural units of the OvGU, divided into medicine (50 units), social sciences (34 units) and mint (29 units). Nevertheless, depending on the available information, structural units on each level could be explored, i.e., even an analysis per person is possible. A comparison of all structural units on the basis of our four indicators reveals some basic insights, but does not allow a consistent ranking. In order to derive clear implications, all structural units should be represented by a single measure. The value function proposed in chapter 2.2 requires a weighting of the scored performances for the introduced indicators. So far, literature does not provide any accepted empirical attempt to establish weights for indicators of commercialization potential.

In our case study we ascertain these weights on the basis of expert interviews with 18 transfer relevant decision makers of the OvGU. The selected individuals are all capable to answer our questionnaire since they possess the necessary expert knowledge and are acquainted with the universities' internal structures (Liker and Sindi, 1997). We have applied the CAPI method conducting face-to-face computerized interviews of roughly 30 minutes (Hamman and Erichson, 2000). To receive a broad range of information we have used four open questions to evaluate the present transfer activities, the status of transfer

within the university and necessary future measures to restructure knowledge and technology transfer at the OvGU. A closed question concerning the relevance of our four indicators, motivated in section 2.1, followed in order to measure the commercialization potential of transfer relevant research results. The answers were mainly based on the experts' past experience.

Experts were chosen according to an analysis of possible transfer key players at the OvGU (Häder, 2006). We have identified nine central transfer agents belonging to the organizational unit of the rectorate, the technology transfer center as well as pertinent research units. Additionally, we have included one transfer-affine expert from each faculty in our survey, most often the dean due to his/her representative position. Hence, this broad expert base delivers a unique qualitative cross-section. We have identified significant differences in weights between the involved experts. Table 2 summarizes the results and indicates different faculty attitudes towards technology transfer (Martinelli et al., 2008).

Tab. 2: Weighting of indicators by transfer experts and representatives of all faculties

area / indicator	position	invention activities	public third-party funds	private third-party funds	research activities
transfer area					
patent information center	head	0,200	0,350	0,350	0,100
technology transfer center	patent respons.	0,300	0,200	0,200	0,300
rector's office	vice rector	0,600	0,150	0,200	0,050
technology transfer center	head	0,400	0,200	0,300	0,100
research department	head	0,050	0,375	0,375	0,200
data & knowledge engineering group	head	0,200	0,200	0,200	0,400
rector's office	rector	0,200	0,300	0,300	0,200
chair of entrepreneurship	head	0,400	0,200	0,100	0,300
chair of innovation management	head	0,000	0,100	0,900	0,000
faculty					
electrical & information engineering	vice dean	0,100	0,200	0,300	0,400
mechanical engineering	dean	0,100	0,400	0,300	0,200
science	dean	0,100	0,800	0,100	0,000
process & systems engineering	dean	0,100	0,300	0,300	0,300
mathematics	dean	0,100	0,300	0,200	0,400
computer science	vice dean	0,300	0,200	0,300	0,200
economics	dean	0,000	0,200	0,050	0,750
human science	dean	0,050	0,400	0,050	0,500
medicine	dean	0,050	0,350	0,250	0,350

There is no ultimate way to handle diversity in expert opinions. Various opinions exist, especially with respect to the competences of transfer and faculty experts. In general, with differing expert opinions diverse weighting philosophies can lead to significant variations in the ranking of structural units. The expected consequences are even more severe the smaller the transfer budget. If results critically depend on the chosen weighting model we expect a difficult discussion among decision makers. Our methodology could become a helpful guide in this process, since the enhanced transparency enables better matching of university targets and consequences of resulting measures. Nevertheless, our set of proposed weighting models is not closed and institution-specific adaptations are recommended. An ex-ante comparison of different weighting models could even serve as a mediator, stimulating a better alignment of transfer relevant structures.

We present seven different concepts aggregating 18 collected expert opinions. The resulting weights for all models are summarized in table 3.

- The first model represents the average of the weights of all 18 experts against the background of an equal consideration of transfer agents and representatives of the faculties.
- For model 2 we assume that only transfer experts possess the relevant know-how and hence calculate the weights as arithmetic mean of the nine transfer agents.
- In contrast, model 3 exclusively indicates the view of the nine faculty representatives by calculating the weights as their arithmetic mean.
- Model 4 accounts for the differences between the faculties with respect to the importance of indicators. Here, the performance of all structural units is directly weighted with the particular faculty representatives rating while transfer experts are ignored.
- Model 5 is also only based on the faculty representative's weights, but concentrating on the average of the university's focus areas mint, medicine and social sciences.
- Model 6 is a combination of model 2 and 4 pari passu. Hence, we consider the experience of the transfer experts and the individual preferences of faculties at the same time.
- Finally, model 7 accounts for situations in which a single person within a university has the sole responsibility for knowledge transfer. This central decision maker

nominates weights for the indicators based on a profound transfer expertise and allocates resources and takes other transfer measures on the basis of the resulting rankings.

Tab. 3: Different weighting models

indicator / model	invention activities	public third-party funds	private third-party funds	research activities
model 1 - university average	0,181	0,290	0,265	0,264
model 2 - transfer experts' average	0,261	0,231	0,325	0,183
model 3 - facultuies' average	0,100	0,350	0,206	0,344
model 4 - single faculties	data single faculties			
model 5 - mint/social siences/medicine	0.133/0.050/ 0.025	0.367/0.350/ 0.300	0.250/0.250/ 0.050	0.250/0.350/ 0.625
model 6 - combination model 2 and 4	equal weighting of model 2 and 4			
model 7 - central planner	0,200	0,300	0,300	0,200

3.4 Results

An application of all weighting models delivers seven different rankings of commercialization effectiveness and, hence, represents various philosophies. Table 4 shows the ten best structural units of the OvGU anonymized and arranged according to model 1 (the arithmetic mean of all opinions) in descending order. The rankings provide valuable information. As the commercialization of knowledge is gaining in importance, a university can use the rankings to decide which fields of commercialization can be addressed best. A comparison of the seven rankings reveals isolated strong deviations in the performance of some structural units, but we observe relatively robust ranking orders.

Tab. 4: TOP 10 ranking - knowledge potential for commercialization per unit & employee

model / unit	m 1	m 2	m 3	m 4	m 5	m 6	m 7
mobile systems	44.93	49.54	40.35	46.24	43.98	47.77	47.54
medical psychology	39.27	41.92	36.56	36.63	36.63	41.62	38.39
micro & sensor systems	38.19	42.42	33.91	30.19	36.79	41.28	39.88
manufacturing	38.14	42.04	34.33	41.67	37.35	33.88	40.65
material engineering	36.93	40.76	33.13	35.99	34.66	36.66	38.21
mathematical optimization	36.43	29.02	43.92	40.15	43.73	28.95	36.17
electric energy systems	30.89	32.19	29.61	34.23	30.12	30.82	31.44
psychology II	29.47	23.65	35.35	55.28	34.19	18.52	28.62
thermodynamics	29.38	30.16	28.61	31.57	28.09	28.40	29.23
logistics	29.08	27.59	30.55	26.95	28.04	26.37	27.45

For the OvGU only structural units with extreme differences in the performance of the four indicators are prone to significant variations in the overall per-capita commercialization potential depending on the weighting model. Robust rankings have a crucial advantage: they facilitate a fast decision and foster the acceptance of resulting measures. If different priorities lead to similar results a discussion about the appropriateness of the involved philosophies is redundant which reduces costs and complexity of decision making. As the origin of aggregated weights might be controversial we suggest a transparent determination process with broad participation. A central decision maker could even initiate a general discussion and delegate the selection/design of a weighting model that meets a high level of acceptance. Although this will have little influence on the resulting strategic measures for robust rankings it signals democratic participation of lower management levels.

The per-capita commercialization potential is interesting in the long-run since it has strategic implications for universities. However, this leads to the question which institute or faculty should be targeted first by the transfer unit? In the short-run it is more important to identify the existing overall potential of commercialization for each structural unit. We multiply the per-capita value of all alternatives with the number of full-time equivalent employees. The structural units with the highest overall commercialization potential within the OvGU are ranked in table 5 in descending order according to model 1.

Tab. 5: TOP 10 ranking – total knowledge potential for commercialization per unit

model / unit	m 1	m 2	m 3	m 4	m 5	m 6	m 7
information systems	1	3	1	1	1	1	1
mobile systems	2	1	3	2	3	2	2
micro & sensor systems	3	2	4	9	4	3	3
process engineering	4	5	2	3	2	5	4
radiology & nuclear medicine	5	4	11	13	11	4	5
electric energy systems	6	7	6	4	6	6	6
machine design	7	6	9	6	8	9	7
manufacturing	8	8	10	7	9	10	8
neurology	9	12	5	5	5	12	10
electronic engineering	10	10	8	8	10	11	11

A comparison of all seven weighting models on the basis of overall commercialization potential reveals that the resulting rankings are quite robust as well. Although the overall performance of some structural units strongly depends on the weighting philosophy (e.g., structural unit 5 ranges between position 4 and 13), the rank order is stable all together. The comparison of the two presented rankings contains valuable information about the type, the source, and the composition of the commercialization potential of a research institution. We have identified a large discrepancy between table 4 and 5. Among the 30 best structural units in the per-capita commercialization potential, 1/3 of all institutes differs to the top 30 of overall commercialization potential, since many of the structural units with a high commercialization effectiveness are quite small in size. Overall, we found interesting patterns. As expected, the structural units belonging to the MINT-area perform clearly above average in both rankings independently of the considered weighting model. Almost 2/3 of all units in top 30 rankings are assigned to the MINT-area. Structural units belonging to the medical faculty account for 25 percent. Hardly any unit from the social sciences was able to enter any of the top rankings. Within the mint-area the mechanical engineering faculty performed extraordinarily well. All structural units from this faculty are among the top 30 rankings.

4. Contribution

Our investigation supports the public perception of universities as leading drivers of innovations, especially in economic areas characterized by small and medium enterprises. Thereby, we provide multiple implications for research, practice and politics.

To our knowledge our approach is the first theoretical attempt to set up a "knowledge management decision support system" for research institutions. Our measure uses three generally accepted output indicators: *invention activities*, *third-party funds* and *research activities*. We apply the SMART-method to combine all indicators to a single measure for different research entities that represent the actual research knowledge asset for future commercialization using traditional transfer channels. The case study of a representative German university indicates the applicability of this approach. Using data from a rampant German information system of universities we guarantee the transferability of our approach. Nevertheless, our study has several limitations that simultaneously offer starting points for future research.

First, subjective evaluations of experts within research institutions might lead to a strong distortion of the results (Ganzach et al., 2000). This motivates the development of an econometric model with the income from knowledge commercialization as dependent and our indicators as independent variable. This should quantify the influence of each indicator on the knowledge commercialization income within different fields of research. Second, so far our approach assumes that existing knowledge can be transferred independent of scientists involved. However, it is proven that the responsible researcher is a main driver of knowledge transfer (Saunila and Ukko, 2014). This "tacit knowledge" is not simply transferable and deserves more attention in future research (Collins and Hitt, 2006). Within the above sketched econometric model a significant error term might indicate a strong influence of a/the researcher on the successful knowledge transfer of a unit. As a third research approach we propose to integrate this personalized factor as dummy variable in that model. As our study considers the average of all indicators over a period of five years we can directly derive a third research approach. We propose to analyze the variation of single structural units over time as "longitudinal approach". We are able to derive multiple insights, in particular, what drives the economic potential of academic knowledge (e.g. change in professorship or investment in infrastructure). Fourth, the range of suitable indicators needs further investigation. Empirical studies might

approximate the real weights of indicators and prove the independence of proposed variables as precondition to apply the SMART-method. We suppose a basic level of dependence between *invention activities* und *research activities* as publications before patent application might circumvent the commercialization of research results. As fifth and last contribution our paper might be a basis to determine the transfer-affine research potential of institutions. Additionally, for a successful regional knowledge transfer it is necessary to take the perspective of regional firms and to determine their demand for academic knowledge. A question related to that is whether the regional economy is able to use academic knowledge (Zahra and George, 2002; Bishop et al., 2011; Mäkinen and Vilkko, 2014). Damanpour and Wischnevsky (2006) call that „absorptive capacity".

The results of our investigation have some practical implications as well. Decision makers within research institutions might use the proposed systematic process to better manage the scouting of ideas and the evaluation of transfer relevant knowledge (Nosella et al., 2008). Our work guides the further development of so far insufficient commercialization structures at most German universities. A professional transfer unit is a necessary precondition for a successful cooperation of science and economy. At least all universities that use the data management system HIS can directly adapt our „decision support system". Our first case study has already delivered several insights. Despite huge differences all structural units within research institutions can be compared with respect to the commercialization potential of their research results in total or per capita. This approach reduces searching costs (Pacharn and Zhang, 2006). Rewards on the basis of our proposed rankings as part of an incentive scheme might strengthen the perception of knowledge transfer within research institutions (Perkmann et al., 2013). A sustainable transfer system has to meet the following demands. First, our theoretical approach has to be tailored to the individual requirements like the existing data basis. Second, we recommend automatizing this process to continuously collect data.

The horizon 2020-strategy of the European Union focuses a stronger cooperation of science and economy as key to increase total R&D-activities and generate economic growth. Our approach contributes to the development of an evaluation and monitoring system at research institutions. Applying such systems delivers transparent results. This is said to be the best instrument to stimulate the exchange between science and economy (Geuna and Muscio, 2009). The realization of that political target is compulsory for all

countries within the European Union (European Commission, 2012). Political decision makers intend to strengthen the role of knowledge transfer as third main task of universities and improve the researchers' awareness (Becker et al., 2013). In Germany, universities are traditionally financed by federal states. The current need to economize forces universities to open up new financial resources. A professional commercialization of knowledge might replace decreasing federal funding. Our paper delivers an instrument for decision makers to locate knowledge with high commercialization potential. Additionally, we argue that further processes and structures need to be implemented to use traditional transfer channels.

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III. INVESTIGATING THE INDUSTRIAL DEMAND FOR SCIENTIFIC KNOWLEDGE

Investigating the industrial demand for scientific knowledge

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Abstract University-Industry knowledge transfer is a key factor for the economic development and competitiveness of regions. A low level of transparency on the market for academic knowledge is the major obstacle in exploiting the existing innovation potential of cooperation between research institutions and firms. This paper offers a methodological framework for exploring the industrial demand for scientific knowledge of research institutions, especially universities. As a direct survey among firms has major drawbacks we propose an inquiry of different intermediates, especially cluster managers. The applicability of the presented methodology is demonstrated with the case of a technical university in Germany. Finally, we introduce an illustration to contrast supply and demand. This constitutes a strategic tool for transfer relevant decisions of research institutions and allows to align governmental support to the real transfer potential that strengthens a region`s economic development.

Keywords: University-Industry Knowledge Transfer, Informational Gap, Cluster, Demand Determination

JEL Classification: I23, O31, D81

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1. Introduction and Research Question

The economic prosperity of a region largely depends on the existing economic structure and is usually measured as contribution to the national GDP. In general, economic growth can be reached either by attracting new firms or by supporting the present economy to exploit their existing innovation potentials. Knowledge-based innovations are a main driver for economic development of countries and a key factor in global competition. We consider the role of university-industry knowledge transfer (henceforth UIKT) in regional economic value creation. Over the last decade the literature has highlighted the growing role of research institutions as a source and driver of innovations. With their infrastructure and broad knowledge base they are able to develop innovative ideas on their own and, even more important, to support R&D-activities of the local economy. Economic policies already promote the cooperation between firms and research industries with the aim of improving the marketability of new knowledge and the implementation orientation of researchers. Except for multi-national firms the industry has often not the necessary financial capacity to carry out risky R&D in the long run. They profit from the systematic solution of usual technology problems or screen research results for opportunities. The better the integration of both partners, the higher the knowledge spillover between them, which generates a higher expected economic value.

Still, in many regions the commercialization potential of knowledge is insufficiently exploited. (Langford et al. 2006) Among many explanations for that observation the primary cause can be seen in the lack of available information (Yusuf 2008). We identify a low level of transparency on the market for academic knowledge as the major obstacle to exploit the existing potential of cooperation between research institutions and firms due to the following reason: At present, only few companies have information about the available technical infrastructure, the research foci, and the research quality of local universities. Even existing intermediates like cluster managers are faced with a limited access to scientific institutions. Simultaneously faculty members hardly know the specific research questions of firms and therefore, have limited information on potential industry partners. An improved matching requires exploring the demand as well as the supply side of that market.

Yet, there is no specialized literature concerned with the closure of the identified informational gaps. Nevertheless, three bodies of literature might guide our investigation. First, as a quite young field, the research on the entrepreneurial university analyzes the transformation process of universities towards a knowledge transfer-oriented agent (See e.g., Etzkowitz (2013), Urbano and Guerrero (2013), Slaughter and Leslie (1997) as well as Gulbrandsen and Slipersaeter (2007)). Here, a possible alignment to the industrial demand or, in other words, a stronger customer-orientation, is discussed critically. This might explain why universities` attempts to identify the industrial needs are limited in practice. Second, the research on university-industry linkages typically builds on surveys among existing cooperation, but does not focus on market transparency. As relationships are often underdeveloped and the goal is to estimate the potential for common innovations it is plausible to determine demand breadthways referring to the content (research foci) and not on existing coops. (D'Este and Patel 2007) Thus, we propose to investigate the demand among all relevant firms of a region based on the research foci of all structural units of local research institutions. Third, there is a broad literature on general demand estimation in marketing. We use standard marketing tools to explore the knowledge demand in a scientific context, particularly, techniques for online surveys and data analyses.

The special literature branch on matching research institutions and industries analyzes the aims of both sides and their mutual selection calculus but usually assumes availability of all information necessary to match. They only account for the information asymmetry with respect to the quality of researchers (Carayol 2003). Bekkers and Freitas (2008) find a wide range of active transfer channels between universities and industry on a national and international level and conclude that informational gaps are rather low. But, this result is driven by the large firms in their sample and not automatically valid for regions where most firms are small or medium. Siegel et al. (2003) identified several informational barriers to effective UIKT at the supply side. At most European universities the structures to manage a portfolio of intellectual property are not sufficiently established, and there is no experience regarding best practice. Additionally, academics deny UIKT as they fear a shift from basic to applied research and its influence on education (Stephan 2001). On the knowledge market demand and supply side just do not possess sufficient information about each other (Klerkx and Leeuwis 2008). Often universities are even not able to identify the in-house commercialization potential.

This paper builds on Bühnemann and Burchhardt (2013) who offered a methodological framework to investigate the potential for commercialization within research institutions, especially universities. Specifically, the paper highlights the importance of inventions, publications and third-party funds as objective indicators, and an additive value function is introduced to aggregate the informational value of all indicators to a single measure of the potential for commercialization. Finally, the applicability of the presented methodology is demonstrated with the case of a technical university in Germany. Bühnemann and Burchhardt (2013) thereby focus on the supply side. However, to derive profound policy recommendations we need to contrast supply with demand. This paper fills the gap and shows how the industrial demand for scientific knowledge can be systematically determined. As Bühnemann and Burchhardt (2013) we introduce a value function to receive a single measure for industrial demand. As a direct survey among firms has major drawbacks we propose an inquiry of different intermediates. We provide reasoning that cluster managers are suitable intermediates to estimate the demand for scientific knowledge.

2. Literature Review on Technology Transfer

There is a massive literature on UIKT which, according to Agrawal (2001), is classified in four categories: firm characteristics, university characteristics, geography in terms of localized spillovers and transfer channels. The first category offers a basic result which is important to our analysis: The propensity to conduct an R&D project with an academic partner depends on the ‘absolute size’ of the industry firm. Larger firms are more likely to collaborate as they have higher absorptive capacities. (Cohen et al. 2002, Mohnen and Hoareau 2003, Laursen and Salter 2004, Arundel and Geuna 2004 as well as Fontana et al. 2006).

The second literature category focuses on the determinants that distinguish successful from other research institutions. The balance between centralization and decentralization within academia, the design of appropriate incentive structures, and the implementation of appropriate decision and monitoring processes within the technology transfer office are central contributions of the literature on university characteristics (e.g., Debackere and

Veugelers 2005). Our work contributes especially to the literature on monitoring and performance measurement.

The third category refers to transfer geography. Theoretical and empirical findings suggest that knowledge spillovers are regionally concentrated or, put differently, most innovative systems have a rather regional focus (Acs et al. 1992, Audretsch and Feldman 1996 and Anselin et al. 1997). Fritsch and Franke (2004), therefore, conclude that the level of knowledge spillovers constitutes a key factor for regional innovativeness. Numerous studies confirm that geographic proximity facilitates spillover effects between university and industry using evidence from e.g., patenting and publishing activities (Arundel and Geuna 2004, Levy et al. 2009). On the basis of this literature we argue that public initiatives for regional development should focus on research institutions within and close to regions.

The fourth literature category explores the different types of transfer channels and discusses their relative importance for economic value creation. We follow Reamer et al. (2003) who assign all transfer channels to five pathways of knowledge migration: (1) Cooperative research and development. (2) Licensing or sale of intellectual property (IP) and spin-offs. (3) Technical assistance. (4) Information exchange. (5) Hiring skilled people. The determination of the commercialization potential within universities typically concentrates on the second pathway as revenues from intellectual property can be measured well. In contrast Bühnemann and Burchhardt (2013) consider all transfer channels except the last one.

A second valuable body of literature concentrates on the role of intermediates for the UIKT. To create a sustainable linkage between research institutions and industry, among others, technology development, networking, and financing are necessary activities. Typically, intermediates perform these activities and thereby create value for all partners in a network. Klerkx and Leeuwis (2008) provide an overview of various responsibilities: facilitate the formation and maintenance of innovation networks, articulate demand, coordinate, support the innovation process management, help building capacity with regard to competences needed for innovation, help acquiring necessary information and so forth. Howells (2006), Yusuf (2008) and Bruneel et al. (2010) also highlight the importance of independent intermediates. This literature also devotes a key role to the government as a market facilitator (Oughton et al. 2002). Local governments and the European Union are

aware of this role in promoting intermediation. Since 2000 numerous national and regional programs have been initiated which include intermediation through industry-near cluster networks and through science-near technology transfer centers. The informational gap can be closed directly by universities but as literature proposes intermediates like e.g., cluster managements will perform superior in that task (Yusuf 2008). We refer to this research and argue that a determination of industries' knowledge demand can best be approximated by a survey among well-established intermediates.

Four literature implications are relevant for our analysis: First, it is important to work on both the demand and the supply side of the innovation system (Oughton et al. 2002). On the one hand governments should support firms in increasing its absorptive capacity, while, on the other hand we need efficient transfer structures within research institutions that set an appropriate framework for cooperation. Second, an efficient transfer unit must be implemented that uses a suitable mixture of all relevant transfer channels (Agrawal 2001). Third, an integration of activities from different sectors enhances network success (Rondé and Hussler 2005). Fourth, there is no cure all, policy measures should depend on the regional context (Azagra-Caro et al. 2006). This is in line with Oughton et al. (2002) who state strong complementarities between business, education and government spending on R&D. Especially in structurally weak regions local innovation strategies should increase both private and public sector investments in innovation activities. Despite the prominent role of public authorities the literature indicates that this effort only leads to sustainable regional development if universities and firms together take the responsibility to ensure cooperation (Siegel et al. 2003). The following section is a first attempt to reduce the identified informational gap by determining the industrial demand for scientific knowledge.

3. Methodology

The design of our demand measure is guided by the ultimate target to contrast supply of scientific knowledge with industrial demand. From the governmental perspective with the aim to promote regional development a complete survey among all firms within that region might be interesting. There are two reasons for a limitation of that survey. First, the cost to receive a full sample of all firms will be prohibitively expensive. Even if costs could be

kept low by using existing channels like the Chamber of Industry and Commerce or the Chamber of Crafts the size of the sample would be significantly limited by the low participation rate of entrepreneurs and managers. Hence, a typical investigation of customer preferences would use a representative sample of the target group and make a projection on the total number. Second, as policy makers try to stimulate the innovativeness of their region one should concentrate on the knowledge-intensive part of the region`s industry, especially on technology-driven firms. Usually the lion`s share of firms has no demand for new scientific knowledge, respectively a cooperation would not generate any benefit. The selection of relevant firms is a substantial but non-trivial task.

We suggest screening the region for organizations that represent the target group as close as possible. In Germany e.g., during the last decade, the cluster initiative created different industry representative offices in almost all regions according to a clear pattern. The government evaluated the local economy and implemented a cluster for each knowledge-intensive industry sector where a region reached a critical mass of firms capable of competing internationally or at least nationally. Based on existing competencies and studies of present and future market developments this concentration on core areas promised to deliver the highest synergies.

We provide several arguments that a survey among organizations representing these industrial core areas is a suitable approximation of firms` demand for scientific knowledge. Most important, for policy measures we only need to identify structural patterns or general insights. Thus, a medium level of demand information is necessary to e.g., propose a change in the scientific long-term orientation. The exact assessment of firms' current research demand is not needed and would significantly increase complexity. An investigation on the industry sector level shows the additional advantage that the influence of strategic behavior is reduced. Specifically, an independent organization, especially if publicly funded, is less likely to exaggerate the demand. If available, the survey can be conducted among different industry experts. Here the Delphi method can be applied. It is one of the most widely used and recognized instruments to make predictions and facilitate decision-making in almost all contexts (Landeta 2006). Despite a list of theoretical shortcomings using expert opinions to forecast e.g., local demand, has proven to be superior.

In order to estimate the explanatory power of a survey among cluster experts we need to check for two aspects: first, whether the existing cluster structure represents all economically relevant industries that are demonstrably knowledge-driven and second, whether each cluster really represents a significant proportion of existing firms. As often not all firms belonging to an industry sector are part of the cluster the percentage share is a suitable measure to control cluster manager`s predictive power. Additionally, one could question, whether cluster manager possess the necessary information to estimate the overall demand of firms they represent. Nevertheless, a possible distortion will be rather low if a cluster offers a broad range of support for free and has an intensive contact on a regular basis. Contrary, surveying experts might have significant advantages. In their role as an industry's gateway cluster manager will more likely be able to identify firms` technological developments. At the same time they are more familiar with structures and research foci of universities and thus might be more suitable to identify structural units that match firms` demand.

3.1 Questionnaire

Having argued that the cluster managements are appropriate intermediates bundling industries' variety of interests we now discuss our methodology to survey demand. Demand approximation needs to be based on two dimensions in our context: the number of interested firms and the average firm demand. We propose a questionnaire which can be found in the appendix. The basic idea to reduce complexity and receive standardized information on firms' needs is to confront the regional demand with the existing supply of knowledge. This first requires transparency within near-by research institutions. Naturally, to receive the full picture we also integrate the opportunity to supplement demand for research areas and foci that are not covered by regional players.

The first part of the questionnaire raises information that is necessary to characterize a cluster and to determine their relative weight for the considered region. It contains the sum of employees in all firms and their economic power, the number of firms currently belonging to a cluster and their average annual expenditures for external R&D, subdivided into three standard size categories. The differentiation in size and the information on expenditures for R&D is used to discriminate their influence on the overall demand. The second part of the questionnaire presents all foci of identified research units in the region

of interest which enables cluster manager to get an overview of the competences each unit possesses. On this basis cluster managers estimate the number of represented firms for which the stated research foci are relevant. To account for possible demand uncertainty we allow cluster managers to state the number of firms in an interval. In case of perfect information the lower and upper boundary would just be identical. We suppose that stated intervals will have a narrow range as insights of cluster managers will be precise enough to specify a general relevance.

In contrast, the average firm demand dimension is likely to involve a higher uncertainty. Hence, cluster manager will not be able to state the demand intensity on an individual level. We allow for that fact by inquiring the qualitative demand along an interval in three standard size categories. A precise estimation of firms` demand would ask for the value that is created by research in a specified field. Nevertheless, we found that cluster managers are not able to satisfactorily approximate the financial impact of specific R&D. This is not surprising as even managements of firms cannot precisely determine financial consequences of their own research activities. We solve that problem by using the informational level cluster managers regularly possess. Hence, we ask them to judge the average influence of specific R&D on firms business in a range from 0 (no expected financial impact) to 100 (very high expected financial impact). This score measure should also indicate the monetary contribution of past R&D to business success, e.g. a revenue increase through product innovation or a cost reduction through process innovation. A separate specification for each size category allows us to contribute to the literature that assigns the highest innovation capacity to large firms, while the value of networking is greatest for middle-sized firms.

3.2 Demand Function

In case of perfect information the overall demand would be determined as the sum of firms` individual demand over all firms in all clusters. If information on firm level is not available an estimation of the demand for scientific knowledge must account for the number of firms as well as the size of the expected benefit from cooperation in a research field. The demand of cluster c for research in structural unit j is the number of firms that expose demand n_j^c multiplied by the average value that is generated through R&D in that

field I_j^c. As we differentiate firms according to their size, we need to consider the sum over all three categories $s = 1..3$, where 1 represents micro firms (less than 10 full-time equivalent employees), 2 stands for small firms (10-50 full-time equivalent employees) and 3 represents middle and large firms (> 50 full-time equivalent employees).

Summarize the product of firm number and average demand for each size category yields $n_j^{c1} \cdot I_j^{c1} + n_j^{c2} \cdot I_j^{c2} + n_j^{c3} \cdot I_j^{c3}$. To account for the fact that a high demand of large firms might involve greater spill-over we multiply the demand in each size category with the average number of full-time equivalent employees e^c of firms belonging to the corresponding category. We denote the demand of cluster c for structural unit j as d_j^c with: $d_j^c = n_j^{c1} \cdot I_j^{c1} \cdot e^{c1} + n_j^{c2} \cdot I_j^{c2} \cdot e^{c2} + n_j^{c3} \cdot I_j^{c3} \cdot e^{c3}$. The overall demand for structural unit j then is the sum of clusters` individual demand over all considered clusters y. However, this would imply that all clusters have an equal weight. We control for structural differences and propose to take both the number of firms in a cluster N^c as well as their total number of employees e^c into consideration. We receive the following function that characterizes the demand for a certain field of research aggregated over all relevant clusters:

$$D_j = \frac{1}{\sum_{c=1}^{y} N^c \cdot \sum_{c=1}^{y} e^c} \cdot \sum_{cl=1}^{y} d_j^c \ , \qquad \text{with } D_j \in [0;100].$$

Obviously, if there is no demand for cooperation with structural unit j the resulting value is 0 whereas if all firms in all clusters state the highest possible demand we receive a value of 100. As we control for the number of firms and employees the resulting demand values will be rather small. This has no effect on the implications we derive since we are interested in the relative demand for each structural unit of regional research institutions. Nevertheless, as it is relevant for the matching of demand and supply we discuss this aspect in section 5. Our demand function directly applies if decision makers are able to state precise information. In case they provide intervals to account for uncertainty we could compare structural units based on two values (a demand value for the upper and the lower boundaries). Alternatively, one could calculate the arithmetic or geometric mean of the

given demand intervals. This number is appropriate for a comparison if there are no structural differences in demand uncertainties between all research fields.

In summary our recommended demand measure accounts for existing informational uncertainties and controls for differences in firm size. The introduced value function assumes that all elements are additively separable analogous to the standard microeconomic demand function. As we see no indication for structural dependencies among demand of different clusters, this assumption should be basically fulfilled. Section 4 presents an empirical investigation for Saxony-Anhalt to test our proposed methodology before section 5 contrasts supply and demand on the basis of an empirical analysis of research supply at the Otto von Guericke University Magdeburg (Bühnemann and Burchhardt 2013).

4. Empirical Investigation

For the region of Saxony-Anhalt, a federal state in Mid-East Germany, a recent cluster potential analysis (Hausberg et al. 2008) identified key industries of which eleven are currently represented by state-funded clusters. Saxony-Anhalt`s cluster structure analysis delivers broad industry information but does not specify their approach to determine profitable clusters. For a scientific methodology to set-up a regional cluster strategy see e.g. Feser and Bergman (2000).

We started our investigation with a pretest of our questionnaire - an in-depth expert interview with a cluster manager to check whether our target group fully understands all questions and is able to provide information with the intended level of detail. The valuable feedback was integrated in the questionnaire design. For our survey we then approached all knowledge-intensive industries with existing network structures. Cluster **MAHREG** Automotive, Cluster Chemie/Kunststoffe Mitteldeutschland (**CHEM**), Polykum e.V. (**POLY**), Cluster Biotechnologie in Sachsen-Anhalt (**BioTech**), Netzwerk Ernährungswirtschaft Sachsen-Anhalt (**NE**), Cluster Sondermaschinen und Anlagenbau in Sachsen-Anhalt (**SMAB**), Cluster für erneuerbare Energien in Sachsen-Anhalt (**CEESA**), Cluster **IT** Mitteldeutschland, Cluster Kreislauf- und Ressourcenwirtschaft (**KRW**), Cluster **BioEconomy**, Cluster Solarvalley Mitteldeutschland (**SOLAR**). We thereby build on the existing cluster structure. This limits the explanatory power of our survey as some

promising industries might not be represented. Ten out of eleven participated, which is a remarkable response rate. Only the cluster "Chemie/Kunststoffe Mitteldeutschland" did not follow our request. Hence, one has to bear in mind that our results take not into consideration the chemical industry although it is one of the most influential. Nevertheless, all in all, the ten covered clusters are politically legitimated and represent a large proportion of the knowledge-intensive economy (Hausberg et al. 2008).

Figure 1 characterizes clusters on the basis of size and multidisciplinarity. The cluster BioEconomy is not illustrated because of missing values. The vertical axis shows the number of firms each cluster represents and the horizontal axis illustrates the total number of full-time equivalent employees in these firms. Therefore, the position of each of the nine clusters indicates their economic influence on the considered region. The further to the north-east the higher is the expected impact. It is also possible to gain insights on differing firm structures. Whereas cluster IT represents a small number of large firms cluster SMAB provides services for many rather small companies. Note that we controlled for different regional foci of some clusters. CHEM, IT, POLY, SOLAR and BioEconomy cover Central Germany, a considerably larger area than Saxony-Anhalt. Thus, cluster manager were advised to refer their answers exclusively to our region of interest. Nevertheless, it is only a rough indicator for the share of regional GDP as it ignores e.g., the personnel costs/total output ratio. Simultaneously, it indicates why it is necessary to control for both dimensions, as they have obviously significant differences in their economic importance. For instance, as the economic impact of cluster MAHREG in Saxony-Anhalt seems to be significantly higher than of cluster SOLAR the overall demand must account for this. Instead to use the number of employees one could also take statistics on industries` contribution to regional GDP as proxy, if available. As there is a missing value of cluster BioEconomy figure 1 only displays nine clusters.

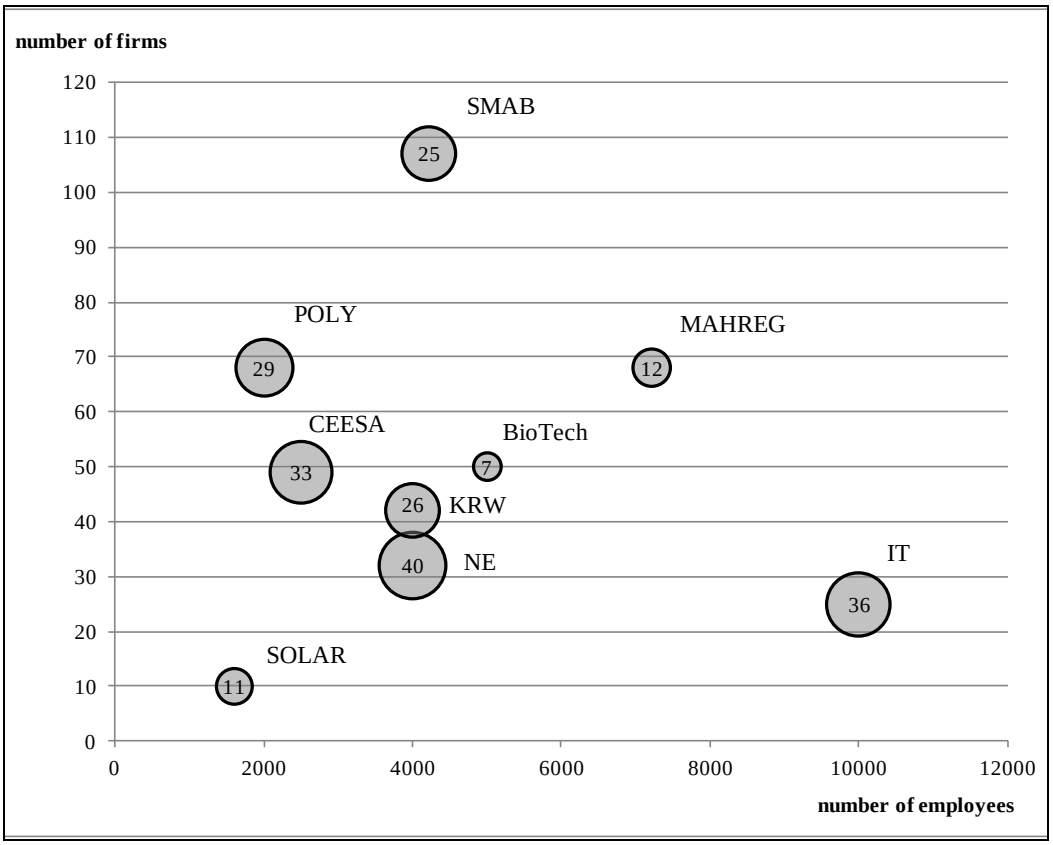

Figure 1: Cluster Comparison

In addition to differences in size Figure 1 also provides rough information on clusters` demand. The size of each circle represents the number of structural units each cluster stated a demand for. Independent of the demand intensity it is an indicator for the R&D multidisciplinarity of clusters. As virtually no cluster expressed demand for one of the 50 structural units belonging to the medicine faculty we have taken these out of our analysis. Hence, the maximum number of linkages would be 63. This gives reason to conjecture that the IT industry, the food industry and the industry for renewable energies exhibit a high demand and thus provide high innovation potential to realize synergies. This number, though, does not account for the qualitative demand dimension. It rather indicates that some clusters see cooperation potential breadthways. It might be of considerable importance to support networking of these clusters as they require research input from various fields and partners. Whether MAHREG, BioTech and SOLAR have only a low demand for scientific knowledge or they need intense linkages to a small number of partners can be analyzed with Table 1.

faculty	**FWW**		**FIN**		**FMA**		**FMB**		**FVST**		**FEIT**		**FNW**	
cluster	#	/ intensity	#	/ int.	#	/ int.	#	/ int.	#	/ int.	#	/ int.	#	/ int.
BioTech	1	0,6	0	0	0	0	0	0	5	6,8	2	2,8	2	6,5
SMAB	2	4,8	4	3,2	1	1	76	32,6	20	14,8	12	24,8	0	0
MAHREG	0	0	0	0	0	0	38	47,9	18	21	15	15	0	0
SOLAR	3	0,3	1	0	0	0	3	9,6	2	3,5	2	6,6	1	0
POLY	2	2,4	5	6,4	3	0	7	10,6	11	15	6	10	2	1,8
NE	10	16,8	4	7,6	1	1,8	2	4,6	5	9,5	2	3,4	1	1,3
IT	3	4,7	21	94,2	16	61,8	6	28,9	3	12	13	51,6	3	12,5
BioEcon	0	0	0	0	0	0	0	0	6	13,8	0	0	0	0
CEESA	2	2,8	4	43,4	4	26	17	59,3	10	67	15	74,2	2	8,3
KRW	2	4,4	2	3,6	1	1,3	4	8,3	6	15	1	1,2	0	0

Table 1: Quantitative and Qualitative Demand on the Faculty Level

This table shows the quantitative and qualitative demand of all clusters on the faculty level: **FWW** (Faculty of Economics and Management); **FIN** (Faculty of Computer Science); **FMA** (Faculty of Mathematics); **FMB** (Faculty of Mechanical Engineering); **FVST** (Faculty of Process and Systems Engineering), **FEIT** (Faculty of Electrical Engineering and Information Technology) and **FNW** (Faculty of Natural Sciences). The Faculty of Medicine as well as Humanities, Social Sciences and Education (**FHW**) is left out since we observe almost no demand for their structural units. The first value in each column is the rounded average number of firms that perceive a general relevance of a faculty`s fields of research. The second value is the average influence of faculty specific R&D on the business of all firms that articulate demand within a given cluster. This illustration allows us to gain some general insights on the innovation potential of research cooperation between faculties and industries in Saxony-Anhalt. The BioEconomy cluster has only stated a low level of research relevance of the Faculty of Process and Systems Engineering. Some clusters like IT and CEESA confirm a high relevance and intensity over several

faculties whereas e.g., the photovoltaic and biotechnology industries see only a low relevance over all faculties. We also find industries with a high demand for research foci of a single faculty and quite low demand for all others. This specialization can be observed e.g., for the automobile industry (MAHREG). From the perspective of faculties we receive some with a high demand distributed over several industries like FMB and FEIT while some others attract demand almost exclusively from a single industry (Faculty of Mathematics). Yet others are broadly confronted with a low demand, quantitatively and qualitatively, like FWW and FNW.

Of course, it will be difficult to analyze demand if we provide that discussion on the level of single structural units. Therefore, we use the methodology presented in section 3 to combine both dimensions and control for the size of firms. We applied a preliminary version of the survey design that uses the same logic of the value function to aggregate the qualitative as well as the quantitative dimension. Our questionnaire did not offer the opportunity to state demand in intervals and our estimation of the demand does not differentiate between proposed size categories. Prior to an application we need to check whether basic assumptions hold. First, we found no incidences that individual clusters` demand depend on each other. Hence, we are able to aggregate industries demand with an additive separable value function. Second, we need to check whether the existing clusters cover the most important industries and therefore represent Saxony-Anhalt`s innovative capacity in large part. Due to a lack of transparent evaluation systems of regional economy on the industry level we cannot perfectly validate the established cluster structure. Nevertheless, we did not find any further economically relevant research-intensive industry and, thus, argue that our eleven clusters reasonably embody the demand for scientific knowledge. Third, the share of firms in each industry affiliated in the government promoted clusters is high, especially if we account for their size. Although there is no comparable source of information on the number of firms and employees per industry available for this region, cluster manager claim to represent a large proportion of their industry. Thus, we conclude that our measure should provide a good estimate of industrial demand. Table 2 gives an overview of the ten structural units facing the highest aggregated demand.

Rank	**Faculty**	**Unit**	**Demand**	**∅ Trend**
1	FMB	Material and Joining Engineering	3,99	increase
2	FMB	Manufacturing Engineering & Quality Management	3,54	slight increase
3	FMB	Mobile Systems	3,43	increase
4	FEIT	Automation Engineering	3,36	slight increase
5	FEIT	Electronics and Signal Processing	3,17	increase
6	FMB	Mechanics	2,79	constant
7	FVST	Process Engineering	2,74	constant
8	FMB	Industrial Science & Factory Automation	2,70	constant
9	FMB	Logistics and Material Handling Engineering	2,63	constant
10	FMB	Machine Design	2,45	constant

Table 2: Top Ten Units in Aggregate Demand

Even among the top ten units that predominantly belong to the Faculty of Mechanical Engineering we observe significant differences in industrial demand. Although we need to carefully interpret the absolute demand value, in relation to the maximum value of 100 it indicates a rather moderate expected relevance of scientific knowledge for regional firms` businesses. On contrary, the relative demand has a high explanatory power. The ranking shows the current attractiveness of all units. A detailed analysis of the demand origin can then deliver more concrete information on the realization of that potential, e.g., whom to contact or which transfer channel to use. As we search for ways to improve the future exploitation of possible synergies and as it takes time to adapt competences and capacities we need to consider future expectations too. To enhance the predictive power we therefore include a question on the expected development of a cluster's demand within the next two years on a five point Likert scale. The right column of Table 2 contains an indicator for the future development of industries` demand. The underlying measure accounts for the

differing impact of industries on research areas. We weight the trend value for each structural unit with the individual demand of a cluster. Policy recommendations should take the current demand as well as future expectations into consideration. Among the top ten there are clear differences in the predicted trend. Whereas the top five even have a positive outlook the remaining can expect at least a constant demand within the next two years. As demand for specific knowledge has short time windows we recommend implementing an online survey on a regular basis, twice or four times a year. Within a couple of years the resulting panel data enriched by the collection of realized cooperation results enables to derive cluster profiles and to evaluate the quality of cluster managers' predictions. Simultaneously, it might allow concluding on the effectiveness of taken measures. We hypothesize that deepening the cooperation paths and gaining further positive experiences of knowledge transfer will stepwise reduce the informational gap between both market sides. This in turn will lead to an increasing demand over time.

In the following section we build on the demand data presented in section 4 and the supply data from the study of Bühnemann and Burchhardt (2013). We provide a possible illustration to contrast both market sides and derive implications for research institutes as well as policy recommendations for local government.

5. Contrasting Supply and Demand

Figure 2 shows 63 structural units with demand on the vertical axis and supply on the horizontal axis. The supply crucially depends on the weighting model for the indicators of total commercialization potential. Our comparison in Figure 2 is based on the average of all expert opinions (model 1 of Bühnemann and Burchhardt 2013). Units from the medical faculty were left out as we did not observe any industrial demand for their research. Graphically these units would congest the horizontal axis, as competences are present but regionally not demanded. Both market sides have diverging dimensions. Despite two different methodological approaches to determine a single measure for the demand and supply of scientific knowledge, we are able to provide an illustration that combines both dimensions. For a relative comparison we normalize demand and supply values. The structural unit with the highest (lowest) score receives 100 (0) and all others are evaluated proportionally in between. The absolute performance can therefore not be interpreted in

Figure 2. However, a qualitative matching allows us to derive specific policy recommendations for each segment.

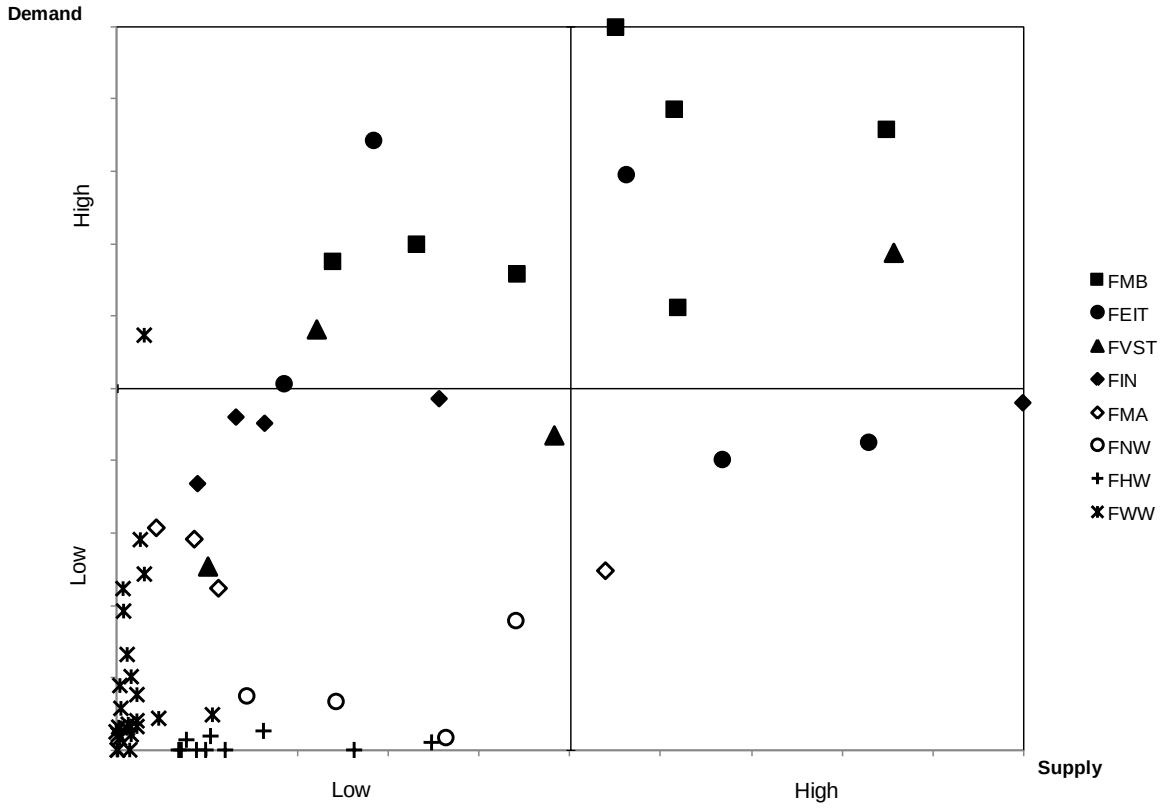

Figure 2: Contrasting Supply and Demand

Figure 2 divides the market for academic knowledge into four segments. The lower-left segment represents structural units where research institutions perform relatively poor and current regional demand is relatively low. From the governmental perspective research in these fields should not be promoted as they will be less likely to positively influence the regional development of Saxony-Anhalt. Nevertheless, structural units with a positive forecast among them might be interesting in the future. From the perspective of universities it should be investigated whether there might be a national or international demand. As international university-industry linkages exist almost exclusively between large firms and top-level institutions and as for a poor current performance it is unlikely to become internationally competitive it directly implies that transfer funds in structural units of this segment should rather be cut back. The legend of Figure 2 shows the affiliation of

units to one of the eight considered faculties. Almost all units belonging to the Faculty of Humanities, Social Sciences and Education (FHW as cross) and the Faculty of Economics and Management (FWW as star) are located in the lower-left segment. Research in these fields is simply not transfer-affine. It is also not surprising that a majority of structural units with an emphasis on basic research are within this segment.

The lower-right segment shows structural units with a comparatively good performance while industrial demand is rather moderate. Here, at least a national transfer campaign should be initiated as the necessary competences seem to exist. Especially if that demand forecast is poor as well policy makers might prefer to disinvest because a contribution to the regional development is unlikely. Nevertheless, a crucial aspect might also be whether research output and national cooperation have an expected positive effect on a region`s reputation. In general policy recommendations should not be strictly based on categories but rather the relative location and individual influences. For example two units from the Faculty of Electrical Engineering and Information Technology (FEIT as circle), electric energy systems as well as micro- and sensor systems, are among the top 5 in aggregate commercialization potential and attract medium demand. It is worth to analyze their matching potential in detail.

The upper-left segment indicates research areas where regional demand is relatively high, but the university has rather low commercialization potential. This segment corresponds to the question marks of the BCG-matrix (Hedley, 1977). Whether promoting structural units in this segment or not (especially in case of promising demand forecasts) depends on the likelihood to develop a competitive offer within a short period of time. This requires a comprehensive in-depth analysis of competences and competitors. This decision under uncertainty must be based on a profound cost-benefit analysis. The choice among cooperation opportunities is rather selective. E.g., production and logistics (FWW) attract demand from various industries, few firms with high relevance and simultaneously a medium intensity from a multitude of firms. The rather low supply value results from no invention notifications and no public third party funds in the sample period. This must not constitute a low transfer potential, but it indicates that they might use other transfer channels and do not fully exploit their existing potential so far.

Finally, the upper-right segment indicates a high transfer potential as current demand matches existing research foci. Here, it is important to examine the variety of existing

cooperation. Local government would be interested in building bridges between university representatives of these high-demand research areas and firms. The demand structure has direct implications for the choice of transfer channels policy makers might support. For example all structural units from the Faculty of Computer Science (FIN as diamond) exclusively attract demand from the IT industry whereas research units from the Faculty of Process and Systems Engineering (FVST as triangle) have a broad demand base. This is one reason for a differentiation of governmental support measures. For universities with the transformation to a transfer-affine research institution ahead a concentration on the upper-right segment is especially valuable. It creates trust and can generate common value that might finance subsequent university-industry collaboration.

Our investigation of the market for scientific knowledge identified hidden potential to sustainably strengthen the economic power of a region. Saxony-Anhalt is lagging behind most other regions in Germany as statistics like the average per capita GDP and per capita income confirm. One reason might be the low level of total R&D expenditures which represent only 1 percent of Germany`s investments to R&D (BMBF 2012, p.415). In order to close the economic gap the local ministry of economics and science plans a change in strategy from supporting numerous small short-term projects to fostering a transfer unit that is able to sustainably strengthen the knowledge spillover to industry. Consequently, one of the central tasks of a transfer unit is building bridges to industry and thereby closing informational gaps. Our main contribution is a proposal of a methodology to improve transparency by determining local supply and demand. The identification of UIKT potential is just the first step. To realize this potential local government need to stimulate both market sides and promote establishing a variety of transfer channels. The literature on knowledge transfer provides many insights into the effectiveness of different transfer channels for various contexts.

There are several limitations to our empirical study that need to be mentioned. First, there is a short time lag between demand and supply data. Whereas our demand survey is up-to-date, the commercialization potential survey is based on the period 2007 to 2011. Second, our study exclusively focused on the OvGU. Although it is one of the major research institutions in that area it would be of great value to include all other research institutions into analysis. Transparency among all relevant players and an alignment of all activities would best stimulate knowledge transfer as the study by Geuna and Muscio (2009)

underpins. They indicate a need for regional offices rather than small offices in individual universities to reach a critical size for a network to be effective. Third, our analysis only focuses on transfer activities. A general decision on the strategic orientation of universities must consider a balance of all targets. Policy recommendations for the region of Saxony-Anhalt should account for this aspect. Fourth, with the chemical industry the second most important industry for Saxony-Anhalt`s innovativeness did not participate. Their inclusion might have a significant impact on outcomes. Fifth, of minor importance is a possible distortion of firms with a broad value chain that might be affiliated to more than one cluster. If several representatives account for their demand this could lead to an overestimation of total demand.

6. Conclusion

This research study strengthens the importance and public perception of university-industry knowledge transfer for regional development. It shows that transfer strategies need to be based on both, the industry and science perspective. We investigated the demand for scientific knowledge and proposed an inquiry of cluster manager as intermediates to reduce the informational gap. Using the example of Saxony-Anhalt we demonstrated the applicability of our methodology and provided a possible illustration of the demand and supply matching. On this basis we derived clear policy recommendations to support the knowledge transfer from universities to industry. First, depending on the multidisciplinarity of industries we recommend the use of different transfer channels. Second, the identification and promotion of flagship cooperation areas will create trust and foster the mutual exchange of information. Third, if all research institutions of a region are evaluated the expected economic value of knowledge transfer might be one basis for governmental support. Decision makers within the research institutions might use our matching grid as decision tool for future transfer strategies. Simultaneously, economy profits from enhanced transparency as it facilitates to find suitable partners and indicates interesting arenas for future research.

The specified methodology is an important basis for the development of a transparent platform for all players on the market for scientific knowledge. In recent years politics

demands and promotes more transparency in technology transfer. This paper constitutes a first step towards the EU-requested evaluation system.

For future research it might be interesting to contrast the results of our study with a direct survey among existing firms. This could strengthen or disprove the eligibility of cluster manager as source of information. Additionally, our study has explored indicators for cluster politics as avenue for further research. The establishment of clusters on the basis of objective criteria is an important prerequisite for the validation of our approach but still unsatisfactorily covered.

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Appendix - Structure of the „Cluster Manager"-questionnaire

First page:

Dear Cluster Manager,
the project „Pro-Active Science Transfer" aims to strengthen the link between economy and science in Saxony-Anhalt. In the first step the current transfer potential of all structural units of the Otto von Guericke University Magdeburg (OvGU) was analyzed. For a successful knowledge- and technology transfer we now need to investigate the demand of the regional economy. Therefore, we ask you as a representative for a certain economic branch to evaluate the relevance of the research foci for each structural unit we identified at the OvGU.

To contrast supply and demand of scientific output enables to develop strategic measures for an improved transfer at the OvGU. Thank you very much for your support!

page 2:

Which cluster do you represent? [please choose one]

Cluster Biotechnology Saxony-Anhalt
Cluster chemistry/synthetics Central Germany
Cluster for renewable energies Saxony-Anhalt (CEESA)
Cluster IT Central Germany
Cluster recycling and resources management
Cluster automotive (MAHREG)
Cluster special machines and plant construction Saxony-Anhalt (SMAB)
Food industry network Saxony-Anhalt
Excellence cluster BioEconomy
Excellence cluster solar valley Central Germany
"Polykum e.V." polymeric development and plastics engineering Central Germany

page 3:

How many firms currently belong to your cluster, subdivided into three categories according to their size, and what is their average annual revenue?

Micro-firms (<10 employees)	*[number]*	*[revenue in €]*
Small firms (10-50 employees)	*[number]*	*[revenue in €]*
Middle & large firms (>50 employees)	*[number]*	*[revenue in €]*

How many individuals are currently on aggregate employed in all firms that belong to your cluster?
[number]

What are the average annual expenditures for external R&D of the firms your cluster represents subdivided into the three categories?

Micro-firms (<10 employees)	*[expenditures in €]*
Small firms (10-50 employees)	*[expenditures in €]*
Middle & large firms (>50 employees)	*[expenditures in €]*

up to 113 inquiries with the following pattern:

Faculty for mechanical engineering of the OvGU

Research foci of structural unit: Mechanics ***(****Prof. Dr.-Ing. Albrecht Bertram)*
crystal and composite material
texture development for mechanical deformation processes
modeling of disruption, deterioration and fatigue
visco-plasticity of high temperature alloy
vibration engineering, supervision and adaptive vibration disruption
automatic balancing of inflexible rotors
modeling, calculation and optimization of adaptive mechanic systems
high performance computing, accurateness and reliability of numerical methods
creeping and deterioration mechanics, micro-polar continuum
mechanically blown foam, functionally graded ceramic, sandwiches, laminate
adaptive structural systems
multifunctional construction material systems
vibroacoustics

For how many firms in your cluster are the research foci above of structural unit "Mechanics" relevant?
[Interval evaluation from 0 to max]

How large is the average influence of research in the special field described above on the value created in the firms you are representing (e.g. revenue increase through product innovation or cost reduction through process innovation)?
[Choose the level in the interval between 0 (no influence) to 100 (very high influence) for each firm category]

Micro-firms (<10 employees)	*[scroll bar 0% to 100%, 100 steps]*
Small firms (10-50 employees)	*[scroll bar 0% to 100%, 100 steps]*
Middle & large firms (>50 employees)	*[scroll bar 0% to 100%, 100 steps]*

How will the research demand of the firms your cluster is representing develop within the next two years? [Please choose one]
strongly decreases
decreases
constant
increases
strongly increases

last page:

Is there a demand for research areas and foci that are not covered by the OvGU so far? If so, describe them in detail and evaluate their relevance analogous to the prior structural units?
[open answer box in combination with the question block above]

Thank you very much for your support!

IV. REVEALING THE PREFERENCES OF SOCIAL FINANCIERS

Revealing the Preferences of Social Financiers

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Abstract

Financiers of social entrepreneurs are typically characterized as having some form of pro-social or CSR related objective. While in some studies such objectives have been formulated on an analytically inconvenient level, other contributions are limited only to charity finance. In this paper we identify Fehr and Schmidt's inequality aversion as an analytically tractable and most basic motivation of social financiers in general. Specifically, we show that the financiers' decision structures and their observable behavior coincide with the experimental findings of Fehr and Schmidt (1999). Moreover, we derive behavioral implications for social entrepreneurs. Paradoxically, given that financiers do not prefer a self-consumption of the social service, they contribute more if the entrepreneur provides them nevertheless.

Keywords: inequality aversion, social entrepreneurship, financier, public good, social service

JEL classification: D03, D31, L26, L31

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1. Introduction

Social entrepreneurs solve societal problems by creating goods or services that meet the needs of specific disadvantaged individuals. Their operations are financed through diverse sources. Some entrepreneurs generate earned income by charging user fees or member dues while other organizations sell mission-unrelated goods or services on for-profit markets. Despite such activities, social entrepreneurs often rely heavily on external funds. As an indication, the US SIF Foundation (2012) reports that individuals, institutions, investment companies, or money managers held $3.74 trillion of socially responsible investment assets in 2012 in the United States. For the same year, Giving USA (2013) highlights that US charitable contributions totaled $316.23 billion.

As external finance is apparently important for a social venture's success, it is essential to understand how social entrepreneurs can optimally attract such funds. In this paper we seek to identify, in a first instance, a simple common motivation by which social financiers are guided. This motivation allows us, in a next step, to derive several important implications for the optimal design of entrepreneurial ventures.

The management literature has long assumed that investors pursue only financial returns. This perspective has been challenged quite recently as it lacks to explain why social ventures are usually able to attract funds even though they cannot offer investors a market-adequate repayment. In this line, some approaches suggest that, in addition to financial returns, socially responsible investors usually seek to fulfill some social as well as personal objectives.[1] Hence, they are willing to sacrifice a part of their profits in expectation of some non-monetary value. Other observations reveal that profit-oriented firms often implement corporate-social-responsibility strategies in hope of satisfying stakeholder needs. In this respect, they build partnerships with social entrepreneurs and support them financially.[2] Obviously, the outlined motivations are able to explain why social entrepreneurs receive external funds despite their limited repayment ability. However, these general preferences are less applicable to predict the funding behavior of

[1] Compare, for example, Bollen (2007), Buttle (2007), Derwall et al. (2011), Pérez-Gladish et al. (2012), and Schueth (2003).
[2] Compare, for example, Nelson and Jenkins (2006), Prieto-Cárron et al. (2006), Zahra et al. (2008).

investors in response to the social entrepreneur's operational decisions such as the choice of the target group or the quality of the social good or service.

In contrast, analytically convenient preferences can be found in the public-economics literature. Among others, such preferences include altruism[3], warm glow[4], prestige[5], or inequality aversion[6]. The corresponding studies as well as related works focus exclusively on donations to charitable causes and provide several insights of how charities can increase their fundraising success. For example, Harbaugh (1998) finds that nonprofit organizations can increase contributions by publicizing donations in dollar categories rather than by reporting the exact amount. Or, Andreoni (2006) shows that the announcement of initial gifts has a positive influence on the subsequent fundraising success.

This paper attempts to identify an analytically tractable and most basic motivation of a wide class of social-financier types, not only contributors to charities. As a plausible restriction, however, we just consider private individuals or institutions, as the motivation of public decision makers may be dominated by political goals (Kickul and Lyons, 2012). We start our analysis by revealing typical decision structures of social financiers and find that the structures are almost identical to two experimental settings analyzed in the literature on public economics, viz., the dictator and the public-good game. Most prominently, Fehr and Schmidt (1999)[7] (henceforth F&S) found that in such experiments individuals are governed by inequality aversion. By contrasting empirically observable behavior of financiers and participants of such experiments, we follow F&S and argue that this preference specification is also a promising candidate to explain the behavior of social financiers in general.

With the F&S specification of inequality aversion at hand, we derive several implications concerning the optimal design of the entrepreneurial venture. For example, we find that the entrepreneur should provide the service only to individuals who are poorer than his social financiers. Likewise, the service quality should be limited. Moreover, we show that financiers dislike costless own direct benefits, e.g., through consuming the

[3] See Bergstrom et al. (1986).
[4] See Andreoni (1989).
[5] See Harbaugh (1998).
[6] See Fehr and Schmidt (1999) or Bolton and Ockenfels (2000).
[7] Until Dec, 2013 the paper received over 6000 Google-Scholar citations, which is unique among all publications in the field of social preferences.

entrepreneur's service, if they perceive a strong disutility from being better off than other individuals. Paradoxically, though, the entrepreneur should nevertheless enable such direct benefits as they will increase the financiers' total contributions.

The paper is organized as follows. In the next section we analyze typical decision structures and behavior of social-venture financiers and contrast our findings with existing experimental results. In the third section we briefly introduce a technical characterization of F&S-inequality aversion and adjust it to the social entrepreneurship context. In the fourth section some basic propositions concerning the behavior of social financiers are derived. We then indicate further important behavioral issues whose analysis would also benefit from an application of the F&S-preference function. Finally, we conclude this paper with implications for further research.

2. Decision structures and financier behavior in social-venture funding

The identification of a financier's decision structure in social-venture financing requires, first of all, a closer look on the fields of activities of social entrepreneurs. In principle, entrepreneurs create social value by solving social problems through innovative processes and ideas. There is rich evidence that poverty[8] or the non-provision of public goods through commercial markets or the government[9] are central to a large part of social problems. Poverty or, more specifically, the inability of people to pay for goods and services traded on markets often entails that basic human needs cannot be satisfied. In this respect, social entrepreneurs provide subsidized or free-of-charge private goods or services (henceforth social services) to needy individuals. Typically, social services are designed to meet urgent consumption needs directly (e.g., food, shelter, clothing, health care) or to empower individuals to self-improve their life-situation (e.g., micro-loans, education and training, advocacy, access to networks).

For example, Aidchild mainly aims at satisfying basic human needs of HIV-infected orphans in Uganda who do not receive support from extended family members. Founded in 2000, the organization runs multiple centers and serves more than 3,000 children and

[8] Compare Dees (1998), Seelos and Mair (2005), Austin et al. (2006), and Starke (2012).
[9] Compare Bilodeau and Slivinski (1998), Austin et al. (2006), and Nicholls (2009).

adults with numerous services such as shelter, food, medical care, and education.[10] In contrast, the nonprofit organization KIVA alleviates poverty by empowering needy individuals to self-improve their living standard. KIVA runs an internet platform which seeks to match micro-loan investors in the industrialized world with loan applicants in developing countries. Given a successful matching, the investors' funds are forwarded by the organization to a local microfinance institution which grants the loan to the beneficiary and monitors its repayment. Basically, KIVA pays no interests to the investor, however, in order to cover operating costs the local finance partner charges a fee which lies below market prices.[11]

Beside poverty alleviation through social services, entrepreneurs also engage in the provision of public goods where governments fail to do so. Here, entrepreneurs often provide environmental, cultural, political or infrastructural projects. In general, a public good is characterized by the non-exclusion and non-rivalry properties. Specifically, once the good is provided, no individual can be excluded from its consumption and the own consumption is not affected by other individuals' behavior. For example, an improved infrastructure benefits all individuals in the corresponding geographic region. All people can use the good and the individual benefit is, in principle, not affected by the others' use of the infrastructure.

The encyclopedia Wikipedia is one of the most prominent examples for public goods. Founded in 2003 the non-profit US-American foundation Wikimedia Inc. provides and administers a general internet knowledge infrastructure in 285 languages which is free to everybody and of course non-rival in consumption. The encyclopedia is supported by volunteers who write and edit pages as well as donors who cover the majority of administration and development costs.[12]

In order to cover the costs of supplying social services or public goods, entrepreneurs, typically, apply for funds with a variety of financiers such as private donors, sponsors, or social investors. During the application process, the financiers expect the entrepreneur to provide detailed information about the project, which enables them to assess the impact of

[10] Compare Aidchild (2013).
[11] Compare Kiva (2013).
[12] Compare Wikipedia (2013).

their funding. Specifically, financiers demand information concerning the social problem, the involved and targeted individuals, and the costs and benefits of providing the good or service. In general, social entrepreneurs document such details in their business plans, in advertisements, or on their internet platforms. For example, Aidchild publishes nutrition lists which detail the weekly menu supplied in its care centers and KIVA specifies the purpose of a granted loan. Wikipedia informs in length where and with what desired effect money is spent or new projects are launched.

With the detailed project information at hand, financiers consider the amount and conditions of funding (e.g., interest rate, repayment, duration). In this respect, it can often be observed that, in contrast to supporting profit-oriented projects, social financiers voluntarily agree on funding conditions that imply a below-market return on investment. This sacrifice of return is important for social entrepreneurs as the peculiarities of the social problem often preclude them from designing the good or service in a profitable manner. For example, Aidchild cannot charge orphans the local market prices for food or housing as their payment ability is insufficient. A similar problem occurs with public goods. Due to the non-exclusion property, prices cannot be charged for such goods and, therefore, their provision must be financed by voluntary contributions. The limited opportunity to generate financial returns prevents social entrepreneurs from applying for funds at usual capital markets. Instead, as Emerson (2003) points out, social financiers are willing to support entrepreneurs with non-repayable funds or repayable capital with below market returns on investment. These funding instruments have in common that financiers give up own monetary payoff in comparison to investments in commercial markets. In the following, we refer to this foregone payoff as a donation.

As indicated above, in most cases, the entrepreneur not only forwards donations to people in need, as can be observed with KIVA, but transforms it into a social service or public good. This is an important feature of the financier's decision structure as the transformation, in turn, is likely to influence his willingness to donate. Specifically, the recipient's benefit level from consumption (valued in monetary terms) can be higher or lower as the monetary donation. For example, the consumption benefit of a service tends to be lower if the entrepreneur has to cover administration costs, or the recipient's preference for the supplied service is not as intense as for other services offered at markets. In

contrast, it tends to be higher if the financier's contribution is intended for self help, e.g., high-quality education helps the beneficiary realize a much higher future income. The benefit of the entrepreneur's service is also higher if the service implies a need satisfaction for the recipient that cannot be reached by forwarding the donations directly. This is the case, for example, if, with the transferred money at hand, the recipient is not able to buy a similar good or service at a market price that includes a significant profit margin.

Up to this point, we identified three important features of a financier's decision structure which are common for social services and public goods. First, the financier basically decides on the level of donations which he transfers to the social entrepreneur. Second, the entrepreneur works as an intermediary who transforms the donation into a social service or public good and provides it to the target group. Third, the financier knows (at least partially) the entrepreneur's target group, and he is also capable to develop an idea of how recipients benefit from the good or service.

However, a relevant distinction between both decision structures is given by the consumption properties rivalry and exclusion. Accordingly, a financier who contributes a Dollar to a public good creates an unrestricted benefit to all consumers who wish to consume the good. A further, yet unconsidered, typical difference in comparison to social services is that the financier can also consume the public good. For example, any individual who donates to Wikipedia is also free to use its internet service. As a consequence, the benefit from self-consumption increases the user's contribution willingness. In the extreme case, the personal consumption benefit exceeds the contribution level and, hence, it pays for the financier to fund the public good completely on his own. However, in many cases the consumption benefit is relatively low such that a one-Dollar contribution increases utility by a value below one Dollar.

From a theoretical perspective, the analyzed features of the two decision structures suggest an unambiguous prediction of a financier's behavior. Independent of whether a social service or a public good is considered, a selfish and rational decision maker will not wish to donate as the contribution implies a net reduction of the own payoff. Moreover, a decision maker concerned with financing a public good even increases his payoff by free-riding on the others' contributions. Although it can be observed that many individuals do not donate to social organizations, there exists a large body of evidence that does not

comply with the theoretical prediction. For example, as GfK (2011) reports, about 35 percent of European households donate annually to charitable causes. In addition, KIVA reports that $111,078,600 have been granted in 2012[13] and Aidchild states that 30 percent of the annual budget is covered by donations[14]. Finally, for Wikipedia almost all revenues stem from voluntary contributions.[15]

Over the last decades, such contradictions have led economists to search for other motives than egoism which are able to explain the empirical findings. A seminal approach in this vain has been put forward by F&S who looked for a simple common principle that was able to explain the social behavior of individuals in various experiments. They concluded that individuals are basically guided by inequality aversion, which "means that people resist inequitable outcomes; i.e., they are willing to give up some material payoff to move in the direction of more equitable outcomes" (F&S, p. 819). In this paper we argue that inequality aversion is a promising candidate for explaining the behavior of private social-venture financiers. In the remainder of this section, we give two reasons which support our hypothesis. First, the decision structures analyzed in this section are basically equivalent to two investigated experimental settings in the F&S study, viz., the dictator and the public-good game without punishment. Second, the behavior of social-venture financiers is almost identical to the behavior of participants in the F&S experiments.

We begin our argumentation by contrasting the experimental settings with the financier's decision structures in Figure 1. We use ovals to symbolize individuals and hexagons for the sets of public information. In addition, the rectangle in the public-good game represents an automatic process. The characterizations of the financier's decision structures on the left-hand side account for the previously highlighted features. Specifically, prior to the financier's decision on the donation level, he receives information about the entrepreneur's planned allocation or public-good characteristics, i.e., at what costs are donations transformed into a good or service, which individuals are targeted and how do they benefit. The figure also shows that, in contrast to social services, public goods are non-excludable and non-rival. Therefore, each individual benefits from the financier's contribution.

[13] See Kiva (2013).
[14] See Aidchild (2013).
[15] See Wikipedia (2013).

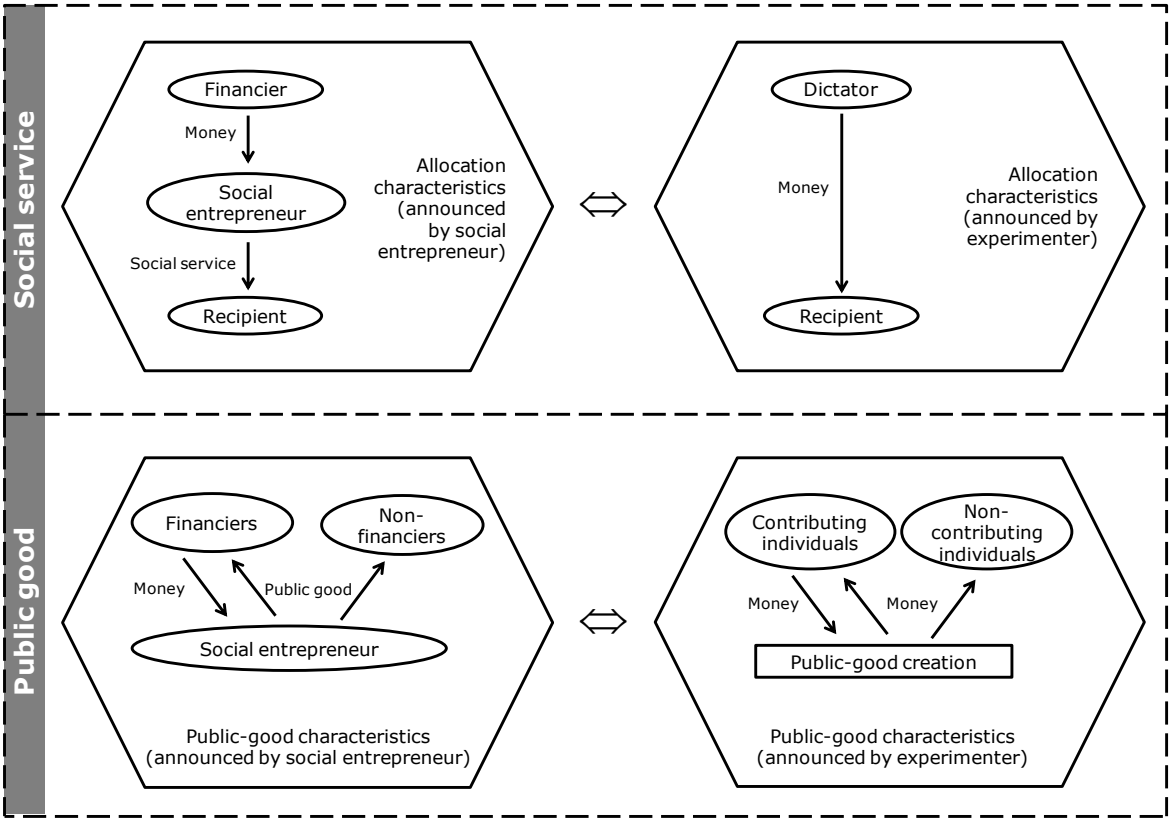


Figure 1: Contrasting the financiers' decision structures with experimental settings

The corresponding experimental settings are characterized on the right-hand side of Figure 1. Accordingly, in the dictator game the decision maker knows the specific allocation rule, previously announced by the experimenter,[16] and decides how much of his own money should be spent to benefit another (other) individual(s). He is free to offer any share of his money and the other individuals must accept this decision, specifically, they cannot influence the dictator's payoff. In other words, if the dictator offers nothing, he keeps the complete amount of money, and the other individuals receive nothing. If he offers a positive share, he keeps the residuum and the other individuals benefit from his contribution. The lower panel of Figure 1 considers the public-good game where each individual decides on a contribution to the provision of the good. Initially, a payment reduces the payoff of the contributor. But, once the good is provided, a specific surplus is added to the payoff of all individuals. As an important feature, the contribution creates an

[16] In standard dictator experiments, the rule simply states that each given Dollar reaches the recipient without any (efficiency) loss.

individual pay-off surplus below the contribution value but, on the other hand, also implies an aggregated surplus over all consumers, which exceeds the contribution level.

In principle, the experimental games and the financier's decision structures differ only in one element: The transformation of money into a consumption good or service. As argued above, the entrepreneurial transformation may change the decision outcomes quantitatively or, from the financier's view, may cause, a deviation of the recipients' benefit from the donation value. This deviation incites the financier to donate a lower or higher amount compared to the direct distribution of money. However, from a qualitative perspective, there is no difference between the decision situations of financiers and experimental dictators since the crucial property is included in both settings: The financier decides on the reduction of his own monetary payoff and, simultaneously, as the flip side of this decision, on how much the recipient's utility will be increased. We, therefore, propose that the two experimental settings are conceptually equivalent to both financier's decision contexts and well-suited to analyze the motives which incite social financiers to give up own wealth.

The theoretical predictions of the individuals' behavior in the dictator and public-good experiments are identical compared to the social-financier case. Specifically, selfish dictators will not wish to donate own monetary payoff to other individuals. Likewise, egoistic participants maximize their own utility by not contributing to the public good and, hence, by playing a free-rider strategy. However, F&S present experimental data which show that these predictions are only partly correct. For example, they cite two studies which found that in two-player-dictator games 60 to 80 percent of the dictators donated up to 50 percent of their own payoff to individuals with lower payoffs. Similar results were presented for 12 studies of repeated public-good games. F&S examined only the final period of these experiments and found that on average 73 percent of the participants did not contribute in this period. Consequently, the selected studies show that the behavior of individuals in both experimental settings is quite mixed, a result that is also indicated above for social-venture financing in practice.

We complete this section by emphasizing that the characterized experimental settings are not appropriate to analyze the behavior of for-profit social entrepreneurs. In this case, the social entrepreneur acts not simply as a channel for the financier's donations but,

instead, decides on how much of the donated share will be applied to the transformation process and how much will be self-consumed. This decision structure departs significantly from the dictator or public-good game. Only if the entrepreneur announces the own profit share in advance and, hence, decides prior to the financier, the decision structures are retained from the financier's perspective.

3. F&S inequality aversion and its application to social financing

F&S model the preferences of distributors in experiments as self-centered inequality aversion, meaning that a decision maker experiences a disutility if his own payoff exceeds or falls short of the payoff of $n-1$ other individuals to whom he compares himself. F&S use the following specification to characterize inequality aversion:

(1) $U_i(x_i) = x_i - \frac{1}{n-1}\alpha_i \sum_{j \neq i} max\{x_j - x_i, 0\} - \frac{1}{n-1}\beta_i \sum_{j \neq i} max\{x_i - x_j, 0\}.$

According to the first term of Equation (1), the decision maker i perceives a direct utility from the own payoff x_i. This utility is reduced by the other two terms which represent the disutility from monetary inequality. Specifically, the middle term shows that the decision maker dislikes being worse off than others. The payoff difference toward each wealthier individual is weighted by $\alpha_i/(n-1)$. In contrast, the third term represents the disutility from having a higher payoff than others and the term's impact is determined by $\beta_i/(n-1)$. Due to this specification, the F&S preference function accounts for different degrees of inequality aversion. A purely egoistic individual is characterized by $\alpha_i = \beta_i = 0$ and maximizes utility by keeping the whole payoff for own consumption. An identical behavior results for subjects with $\alpha_i > 0$ and $\beta_i = 0$. Such individuals envy wealthier people but they do not care for the poor. Only for a sufficiently large β_i, the disutility from advantageous inequality (i.e., the payoff difference toward poorer individuals) is predominant for the decision maker, and he is willing to share his payoff with others in order to reduce this inequality.

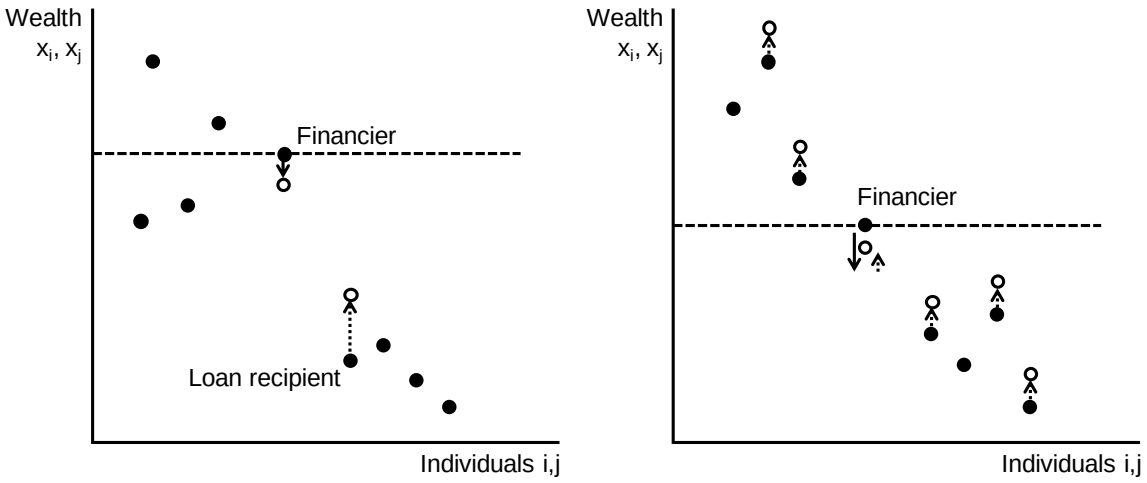
As previously argued, inequality aversion seems to be well suited to explain the behavior of social financiers. The F&S specification, as given by Equation (1), assumes that, in a first step, the financier compares himself to a group of specific individuals. A non-exhaustive list of such individuals may include relatives, friends, neighbors,

colleagues, celebrities, and target groups of social entrepreneurs. In the following we will subsume such individuals under the term circle of concern. The financier compares himself to individuals in the circle of concern on the basis of specific 'payoffs'. According to the social entrepreneurship context characterized in the second section, two categories of measures appear to be relevant: First, financiers may compare consumption levels. Suchlike evaluations could include a specific category (e.g., only food consumption) or a consumption average over all goods and services of concern. Second, financiers may consider income levels whose comparison can be carried out on a micro or a macro scale. For example, other individuals may be valued by the available budget to purchase a specific good or service or they may be compared in terms of total monetary wealth.

The necessary information to determine such measures is available from different sources. Specifically, the income and consumption levels of other individuals can be approximated by direct observations (e.g., job, consumption behavior, residence etc.), interviews, income publications (e.g., Forbes 500 list, published wage categories for public servants), news information, or income and poverty reports on country or regional basis. Moreover, entrepreneurs often report further wealth-relevant information concerning their target group, especially in the case of poverty alleviation. For example, KIVA publishes income relevant data about loan applicants to a potential financier, e.g., type of their business, number of children, and regional economic statistics. Beside the financier's assessment of individual incomes or consumption endowments, the decision on his donation also requires him to determine how his contribution will affect the recipients' endowments after the entrepreneurial transformation process. If consumption levels are compared, financiers can use information provided by entrepreneurs or other sources about who is served and with what intensity. For example, Aidchild publishes nutrition lists which detail the weekly menu supplied in its care centers and KIVA specifies the purpose a loan is used for. If financiers compare income levels, they may estimate the monetary value of the entrepreneur's good or service by involving its market value or average costs. Moreover, recognizing also intertemporal effects, financiers could estimate how the future income or consumption level of recipients is impacted. For instance, in the case of KIVA financiers may approximate how a microloan will increase the living standard of the loan recipient. Independent of which measures financiers use in practice to compare their

personal wealth to that of others, in the following, we will only refer to the term wealth to keep terminology as simple as possible. Consequently, in Equation (1) x_i denotes the wealth level of the financier and x_j the wealth of an individual in his circle of concern.

Figure 2 illustrates two exemplary decision frameworks. In Panel A the financier considers contributing to a social-service provision (viz. KIVA) whereas Panel B characterizes a public-good-decision situation (viz. Wikipedia). In both panels each black point represents a specific individual in the financier's circle of concern and indicates the respective wealth level before the financier's contribution is made. The financier's endowment is marked by the dashed line. In contrast, the white points indicate the resulting wealth levels after the financier's contribution has been transformed and allocated to the beneficiary.
Additionally, the black arrows symbolize the exact amount of the donation and the dotted arrows characterize the financier's perceived improvement of the recipients' wealth due to the entrepreneur's provision.



Panel A – social service

Panel B – public good

Figure 2: The financier's decision framework in the case of KIVA (Panel A) and Wikipedia (Panel B).

As can be observed with Panel A the micro loan initiated by KIVA reduces the wealth of the private financier by a relatively small amount as he foregoes only the payment of interest. However, the benefit of the recipient is probably much larger. The individual usually uses the loan for productive purposes such as launching an own business or buying

agricultural equipment, which may increase the future wealth level significantly. In Panel B the financier contributes to Wikipedia which uses the money, for example, to improve its service. Typically, the improvement will be relatively small and, hence, many Wikipedia users in the financier's circle of concern will perceive only a marginal increase of their consumption benefits. The panel also accounts for the fact that consumption is voluntary: The financier uses the web service whereas some others refuse it. Consequently, they do not benefit from the financier's contribution.

Given the characterized decision framework, the financier chooses the level of donations that maximizes his utility U_i. In order to simplify the analytical determination of this optimum, we rewrite Equation (1) without loss of generality as follows:

(2) $$U_i(g_i) = (x_i - (1-a_i)g_i) - \frac{\alpha_i}{n-1}\sum_{j\neq i} max\{(x_j + a_j g_i) - (x_i - (1-a_i)g_i), 0\} - \frac{\beta_i}{n-1}\sum_{j\neq i} max\{(x_i - (1-a_i)g_i) - (x_j + a_j g_i), 0\}.$$

Equation (2) includes two further specifications. First, we extend Equation (1) by the decision variable g_i which denotes the financier's donation level. In Figure 2 g_i corresponds exactly to the length of the black arrow. Second, to account explicitly for the recipients' consumption benefits, we introduce the parameter $a_j \geq 0$ which characterizes individual j's constant marginal consumption benefit if the financier increases his donation. In Figure 2, consequently, $a_j g_i$ equals the length of the dotted arrow for individual j which may differ from the length of the black arrow. For example, a KIVA loan implies $a_j > 1$ because the recipient's productive use of the financier's contribution leads to a relatively high future wealth improvement. Hence, the recipient's benefit is larger than the financier's foregone interest. In the Wikipedia case, however, recipients benefit only marginally from a given contribution, i.e., we have $a_j < 1$.

Equation (2) implies the following marginal utility of donating:

(3) $$\frac{dU_i(g_i)}{dg_i} = -(1-a_i) - \frac{\alpha_i}{n-1}(1-a_i)w_i + \frac{\beta_i}{n-1}(1-a_i)\bar{w}_i + \frac{1}{n-1}\left(\beta_i \sum_{j\in \bar{W}_i} a_j - \alpha_i \sum_{j\in W_i} a_j\right).$$

In Equation (3), W_i denotes the group of individuals who are at least as wealthy as the financier, and $\bar{W}_i$ characterizes the group of poorer individuals. Furthermore, w_i and $\bar{w}_i$

denote the numbers of individuals belonging to the respective groups. As highlighted with Equation (3), the marginal utility of donating is composed of four effects:

A negative consumption effect: The financier's contribution reduces his own consumption level (in Figure 2: reduction from the black to the white point) and, thus, his utility. This effect is the smaller, the higher a_i is, i.e., the own consumption benefit of the entrepreneur's good or service.

A negative disadvantage effect: Due to the reduction of the financier's wealth, the disadvantageous inequality toward all wealthier individuals increases. In Figure 2 such individuals are above the dashed wealth line, and the financier's donation increases the distance towards these individuals, which he dislikes.

A positive advantage effect: In contrast, the financier's utility increases as a lower own wealth reduces the advantageous inequality toward all poorer individuals below the dashed line.

A recipient effect: The algebraic sign of this effect is indeterminate. The entrepreneur forwards the financier's donation to one or more beneficiaries, which increases their wealth. Given that a recipient is wealthier than the financier, the disadvantageous inequality increases and, hence, the financier's utility is reduced. If the recipient is poorer, the advantageous inequality decreases, which implies a utility increase. This second case is characterized in Figure 2, panel A. The relative wealthy investor grants a zero-interest rate loan to the poor applicant in the developing country. The beneficiary uses the loan for a business investment that generates a higher future wealth (white point). However, as indicated previously, the entrepreneur may choose more than one beneficiary. In this case, the recipient effect is a weighted accumulation of the respective inequality variations. The extreme case is given for public goods where the effect includes all individuals in the financier's circle of concern who wish to consume the good. This case is depicted in Figure 2, panel B.

4. Implications for social-venture financing

Having identified inequality aversion as a candidate for the motivation of private social-venture financiers, we can now characterize their funding behavior and predict their

reactions to situational changes. Below, we highlight some basic behavioral patterns in form of propositions, each proved by pointing to the responsible marginal-utility effects in Equation (3). Subsequently, we discuss selected implications of the propositions for social entrepreneurs who are interested in attracting a maximum level of funds.

As a first issue, consider the entrepreneurial distribution policy. Basically, the social entrepreneur can choose between two allocation strategies. Either he supports an individual who is at least as wealthy as the financier or he serves an individual who is strictly poorer. The first strategy increases inequality because the recipient's consumption benefit enlarges the wealth difference toward the financier whereas the second strategy reduces inequality. Consequently, as the financier perceives an aversion toward inequality, he will prefer entrepreneurs serving poorer individuals. We capture this basic result in Proposition 1.

Proposition 1. The financier's willingness to donate is higher for poorer than for wealthier recipients.

The validity of Proposition 1 can be shown by simply analyzing the recipient effect in Equation (3). Accordingly, a marginal increase of a beneficiary's wealth increases utility if the recipient is worse off than the financier. However, utility decreases if beneficiaries are better or equally well off. Thus, the marginal utility of donating is larger for poorer than for wealthier recipients.

Proposition 1 contributes to several results from experimental social psychology which found a positive relationship between an individual's need for help and the likelihood that others will offer this help. This positive correlation is confirmed for various settings, e.g., Levitt and Kornhaber (1977) compared donations of randomly approached pedestrians, whereas Cheung and Chan (2000) conducted a general telephone survey in Hong-Kong analyzing the giving intent. The positive relationship between the need for help and the incentive to offer help also holds for different conceptions of an individual's neediness. In this respect, Levitt and Kornhaber (1977) compared donations to solicitors who exhibited different handicaps, and Berkowitz (1968) conducted controlled field experiments among male students where neediness was characterized by the affiliation to different social classes. Nevertheless, most studies do not specify a concrete social motive to explain the observed behavior, with a few exceptions, e.g., Berkowitz (1968) who analyzed the

explanatory value of reciprocity in such settings. In this line, Proposition 1 complements the literature as it shows that inequality aversion may well explain the observed behavior of contributors.

Proposition 1 enables us to identify two behavioral implications for entrepreneurs supplying social services. First, the entrepreneur maximizes fundraising success by serving the poorest individuals. Specifically, a switch from a wealthier to a poorer target group implies that some individuals who were worse off than the recipients are now better off than the new service beneficiaries. Their marginal utility of donating, thus, increases through the change of recipients. Given that this increase is sufficiently large, i.e., the sign of Equation (3) turns positive, the entrepreneur indeed receives more donations.

Second, social entrepreneurs should make sure that the benefit of their social service or, closely related, the service quality, is not too high. This recommendation emanates from the fact that financiers dislike services which make recipients better off than themselves. As long as the wealth of a recipient is sufficiently low, a further donation of the financier is accompanied by a positive recipient effect. However, once the financier's and the recipient's wealth levels are equally large, the effect becomes negative as further contributions now increase the disadvantageous inequality between both. In this case, the financier may stop contributing or, given the decision is on a non-variable funding amount, he may not give at all. This implication is especially relevant for entrepreneurs who give needy individuals the opportunity to self-improve their life situation. For example, funding high-quality education or granting loans to highly profitable business ideas of yet poor people typically lead to a significantly higher future wealth of recipients. In this case inequality-averse financiers may remain reluctant if they expect that their own future wealth level could be exceeded.

Beside the entrepreneurial distribution policy considered in Proposition 1, the financier's willingness to donate is also influenced by his wealth rank among the individuals of concern. For an intuitive explanation, consider Figure 2, panel A. By shifting the financier's wealth level from the black to the white point, he approaches the wealth level of six individuals below the dashed line, which decreases inequality and, hence, increases his utility. However, he simultaneously diverges from the two wealthier individuals, which he dislikes. If, all other things being equal, the share of poorer

individuals is now increased from 6/8 to 7/8 (e.g., through a sufficiently large reduction of the wealth level of a better-off individual), the financier's donation willingness increases. The contribution now reduces inequality toward seven individuals (instead of six) and increases inequality toward only one individual (instead of two). This finding is specified by Proposition 2.

Proposition 2. The financier's willingness to donate increases with his wealth rank among the individuals to whom he compares himself.

For a technical explanation consider Equation (3). Here, the positive advantage effect increases with the number of individuals being poorer $(\overline{w}_i)$ whereas the negative disadvantage effect decreases with the number of individuals being at least equally wealthy (w_i) than the financier. As a higher wealth rank increases $\overline{w}_i$ and reduces w_i, both the advantage and the disadvantage effect increase. Consequently, the financier perceives a higher willingness to donate.

Proposition 2 contributes to the prominent discussion on the effects of leadership giving. Accordingly, it has been observed that capital fund drives often start by announcing a significant initial contribution by a single wealthy donor, and it is hypothesized that this contribution affects the behavior of many other donors (Andreoni, 2006). Support for this hypothesis is provided by, for example, List and Lucking-Reiley (2002) or Shang and Croson (2009). They show in laboratory and field experiments that the information about past contributions increases the contributions of new donors. Yet, alternative explanations of such observations include, among others, the conformity to social norms (Shang and Croson, 2009), the existence of fixed costs (Andreoni, 1998), and that leadership gifts serve as a signal of the social venture's imperfectly observable quality (Andreoni, 2006; Vesterlund, 2003). By applying inequality aversion to the context of social venture financing, we add a new explanation to this discussion: Proposition 2 shows that, given a sufficiently large contribution, the lead donor becomes poorer than another individual whose marginal utility of donating increases. Therefore, the higher the leadership gift is and, hence, the more the wealth rank of the lead donor decreases, the more people perceive a higher willingness to donate.

It is important to emphasize that a leadership gift can only be effective if all relevant details of this contribution are accessible for any other potential financier, for instance, the identity of previous contributors, their initial wealth, and the size of their donations. Clearly, for social entrepreneurs the publication of such details is not necessary if all potential financiers can perfectly observe them. In this case, contributions directly increase the willingness to donate of such individuals who become wealthier than the lead donors. In contrast, given that at least one of the three characterized contribution details cannot be observed, the behavior of others may remain unaffected. Then, the entrepreneur's fundraising success can only be maximized if the missing information is reported to all potential financiers.

A second implication of Proposition 2 concerns the entrepreneur's communication with individuals who do not care for his target group. Typically, such individuals remain reluctant, as, from their perspective, a contribution to the social venture represents a waste of funds.[17] However, the attitude toward donating will change if the entrepreneur is able to design an appropriate information strategy, i.e., apply communication methods that shift the circle of concern of reluctant financiers from wealthier individuals (e.g., celebrities or rich neighbors) to the target group. Under the assumption that people have a constant perception capacity[18] and, hence, compare themselves to a constant number of individuals, their willingness to donate will change as predicted by Proposition 2. In practice, an appropriate communication strategy brings potential financiers and (poorer) target-group individuals together as close as possible, e.g., through detailed reporting of personal backgrounds surrounded by pictures and movies or, even more extreme, through personal contact (e.g., letters, visits).[19] For example, Aidchild seems to apply such a matching-strategy in Uganda where their local shops and restaurants not only generate direct revenues for the care centers but also intend to create emotional awareness for the social problem.

The joint consideration of Propositions 1 and 2 yields a further implication: Social entrepreneurs should focus their fundraising efforts on sufficiently wealthy people as they

[17] In Equation (3) the recipient effect is zero.
[18] This assumption is supported by various psychologists, e.g., Sweller (1988).
[19] The argumentation is supported by Simon (1997) who found that a higher allocation of media coverage to foreign earthquakes increases aggregate donations from U.S. citizens.

are most likely to give. Intuitively, if we assume that individuals are equally inequality averse, i.e., for all people we have identical α- and β-values, wealthier individuals tend to show a higher contribution willingness. For such individuals the negative disadvantage, the positive advantage, and the recipient effect are relatively high. Specifically, the wealthier a financier is, the higher (lower) is the share of individuals being poorer (wealthier). By making a donation, the financier, thus, approaches (departs from) the wealth level of more (less) individuals, which implies a higher advantage (disadvantage) effect. Even the recipient effect is larger because the entrepreneur's good or service reaches more individuals that are poorer than the financier.

The final behavioral issue which will be analyzed in this section relates to the desirability of the financier's own consumption. In principle, when planning for social-value creation, the entrepreneur has the opportunity to design the good or service from scratch. Thereby, he can choose to supply also the financier with costless direct consumption benefits. For example, activities like reporting donations or naming tangible assets after the donor (e.g., buildings, institutions, or initiatives) create a good image and, thus, a benefit for the financier. Additionally, the entrepreneur's choice of the legal status may allow donors to receive tax exempts. Entrepreneurs could also provide direct consumption benefits to financiers if they design their good or service as a public good. Consider, for example the healthcare context. Medical treatments or micro-health insurances at subsidized prices are social services which are typically not offered to the social organization's funders. However, the change of general healthcare conditions, e.g., through a public demonstration of health-conscious consumption or through reducing a health-threatening environmental pollution, would be a public good, which also reaches the financier. Public-good design alternatives for entrepreneurs can also be found in the education sector: Exclusive university courses for needy people are private services whereas Massive Open Online Courses (MOOCs) feature elements of a public good and are usually accessible for financiers.

Clearly, the entrepreneur's decision on the financiers' own consumption benefits should have an effect on their contribution willingness. One could expect, at a first glance, that financiers would always prefer a costless own consumption. However, the argumentation does not hold for financiers with a sufficiently high aversion toward being

better off. In principle, financiers donate because they wish to reduce inequality toward poorer individuals. If they now receive own consumption benefits, the reduction of the advantageous inequality is counteracted. Since this negative effect dominates the benefits associated with the own consumption, if the financier perceives a high aversion toward advantageous inequality, he will, in a first instance, dislike own direct benefits. We formulate this result as follows:

Proposition 3. The financier dislikes own consumption benefits, if the aversion toward advantageous inequality is sufficiently high.

For a technical explanation of the result consider the marginal utility of donating, given by Equation (3). We find that an own consumption benefit ($a_i > 0$) implies a lower marginal utility if β_i is sufficiently high, i.e., $\beta_i > (n - 1 + a_i w_i)/\bar{w}_i$.[20]

Paradoxically, the dislike of costless own consumption benefits does not imply that financiers contribute less. To the contrary, the contribution will increase, if it benefits poorer individuals at least as much as wealthier people, i.e., the recipient effect is non-negative. Two effects explain this reaction: First, by donating to the social organization, the financier wishes to reduce inequality toward poorer individuals. However, the own consumption benefit increases the wealth of the financier and, simultaneously, the advantageous inequality. The financier anticipates this wealth increase and counteracts by donating more. Second, as the achievement of a given wealth level now requires higher donations there is also a higher total benefit for recipients, which, additionally, increases the financier's willingness to donate. We capture our result in Proposition 4.

Proposition 4. Given a non-negative recipient effect, the financier contributes more if he receives own consumption benefits.

The financier contributes to the social enterprise until the marginal utility of donating, as characterized by Equation (3), turns negative. The sign of the marginal utility in

[20] The argumentation shows that the own consumption is more attractive to a financier if $\beta_i < (n - 1 + a_i w_i)/\bar{w}_i$. However this result does not imply that the financier donates at all. A contribution would demand a positive marginal utility of donating, which, in turn, requires a sufficiently high $\beta_i \beta_i$. It can be shown, that there is an interval for β_i that implies both a positive marginal utility of donating and a desirability for own consumption if the entrepreneur's allocation causes a positive recipient effect for the financier.

Equation (3), thereby, depends on the number of individuals in the financier's circle of concern who are at least as wealthy as the financier (w_i). If we set Equation (3) equal to zero, employ $\bar{w}_i = (n-1-w_i)$,[21] and solve for w_i, we obtain its optimal size $w_i^* = [(n-1)/(\alpha_i+\beta_i)]\{\beta_i - 1 + [R/(1-\alpha_i)]\}$ with R as the recipient effect as defined by Equation (3). Now consider the derivative of w_i^* with respect to the financier's own consumption benefit α_i. Given that the recipient effect is non-negative, an increase in α_i implies a constant or higher w_i^*. The realization of w_i^*, thus, requires the financier to donate more to the social enterprise in order to offset the own consumption benefits.

The implications of Propositions 3 and 4 for social entrepreneurs are obvious. If the entrepreneur solicits for relatively small donations per financier, e.g., in order to diversify funding sources, he should give financiers the opportunity to decide on their own consumption level. The entrepreneur thereby maximizes total funds, as contributors with relatively high aversion toward advantageous inequality will wish not to consume, whereas others prefer own consumption. In contrast, if the entrepreneur does not offer this consumption choice, a disadvantaged financier may choose to fund a competing organization. In practice, self-consumption decisions are indeed implemented for financiers by some social ventures. For example, Wikipedia or MOOCs are offered costless via the internet and financiers can but do not need to use the service.

However, the situation is different if the entrepreneur wishes to maximize individual donations. As Proposition 4 suggests, in this case financiers should receive a direct consumption benefit independent of its desirability. For example, the entrepreneur could announce to publicly report every donation or to name buildings, institutions, or initiatives after the donor, irrespective of whether or not the contributor prefers this. The financier is also not able to refuse own consumption benefits, if public goods are provided, such as environmental protection, the change of a legal system, or the preservation of security. Specifically, the effects of an entrepreneur's environmental initiative usually reach all individuals in a given region, even contributors.

The presented four propositions indicate the large variety of behavioral issues whose analyses benefit from a postulation of the F&S-preference function. New insights will also

[21] Note that all individuals in the circle of concern $n-1$ are either included in $\bar{w}_i$ or in w_i.

emerge if the preference form is applied to further important research questions. One of those issues, for example, concerns the effects of the social organization's legal status on the financier's contribution willingness. Seminal work in this field has been done by Hansmann (1980) who emphasizes the importance of the non-distribution constraint in attracting donations to a social organization. Accordingly, donors dislike for-profit ventures as a fraction of their funds could be extracted by the owners. The application of F&S preferences sheds a new light on this discussion: The financier's willingness to contribute depends crucially on the comparison of his own wealth with that of the entrepreneur. If, for example, the financier cares for the entrepreneur and is wealthier, his choice of the contribution level does not depend on the entrepreneur's legal status. Both a profit extraction and a transfer of the contribution to poorer individuals imply equally high recipient effects and, thus, account for the financier's indifference.

As a second promising research direction we suggest a consideration of the relationship between an organization's efficiency and a financier's willingness to provide funds. In industries with several competing entrepreneurs the efficiency level is one of the key indicators for social investors. Specifically, the higher the efficiency is, the more attractive a social venture is as an investment opportunity. In this respect, the empirical literature on charitable giving shows that the willingness to donate increases with the share of donations that is used for the social purpose (Posnett and Sandler, 1989; Okten and Weisbrod, 2000). The F&S-preference function offers several features that allow for a differentiated analysis of the efficiency issue. Specifically, the efficiency of the social organization is, on the one hand, embedded in the transformation coefficient a_j (compare Equation (2)) which represents the consumption impact for an individual j. A low efficiency due to high administration costs, for example, would result in a relatively low consumption outcome for the recipient. On the other hand, as indicated previously, financiers consider organizations that serve the "wrong" individuals as inefficient. In this respect, serving too wealthy people or individuals that the financier does not care for constitutes a "waste of money". Such different forms of inefficiency should have different effects on the relative attractiveness of social organizations which compete against each other for social funding.

5. Conclusion

This paper identifies inequality aversion as an analytically tractable and most basic motivation of social financiers. We show that the decision structures of such financiers are typically equivalent to the well-known experimental settings of the dictator and the public-good game. In their seminal work F&S discover that inequality aversion best explains individual behavior in experiments. By contrasting the behavior of social financiers, we find that the F&S-preference specification is also a promising candidate to characterize the financier's motivation.

We then use inequality aversion to derive general propositions concerning the financier's behavior and identify several important implications for social entrepreneurs. Most paradoxically, we show that financiers dislike a direct own consumption benefit (e.g. through consuming the entrepreneur's good or service) if they are sufficiently averse toward being better off. Nevertheless, social entrepreneurs should provide funders with such benefits as this will maximize individual contributions. Specifically, the financiers will increase giving to compensate the disliked own benefits.

The identification of inequality aversion as the driving motive of social financiers should be especially useful for social entrepreneurs, policy makers, and researchers. As we indicated within our analysis, knowing the basic motivation of financiers helps the entrepreneur develop a best practice to attract a maximum of funds. In addition, policy makers benefit as the knowledge of the financier's objective enables them to predict their reactions to different political settings which could include tax regimes or governmental co-funding. Finally, the application of inequality aversion should also help researchers explain further empirical evidence on the behavior of social financiers.

Our analysis indicates general directions for future empirical research. Yet, relatively little is known about the main determinants of the circle of concern. Why does an individual compare himself to some people and not to others? Do individuals typically compare consumption levels, budgets to satisfy specific needs, or, more generally, total incomes? A further research issue could challenge the explanatory power of inequality aversion in experiments that account for the entrepreneurial transformation process. How do giving patterns change if recipients do not obtain money from the experimenter but real goods such as cafeteria or fuel vouchers? Related to this issue is also the question whether

inequality aversion explains well the financiers giving behavior to for-profit social entrepreneurs. Put differently, how does the behavior of contributors in experiments change if an intermediate distributor can keep an unknown share of the money for own consumption?

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V. TARGET-GROUP AND QUALITY DECISIONS OF INEQUITY-AVERSE ENTREPRENEURS

Target-Group and Quality Decisions of Inequity-Averse Entrepreneurs

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Abstract

Limited donations force nonprofit entrepreneurs to ration needy individuals by deciding on who is served at what quality level. We propose a positive model of this allocation for applicants with differing incomes under the assumption of perfect user-fee discrimination. By following recent experimental economic research on social preferences, we assume that entrepreneurs behave inequity averse, i.e. they care about the relative consumption possibilities of others. We find that less inequity-averse entrepreneurs prefer to serve wealthier individuals at high reference quality. In contrast, more inequity-averse entrepreneurs care for the poorest individuals but offer minimum quality. Furthermore, as input costs increase, entrepreneurs with low inequity aversion change the target group, while entrepreneurs with high aversion do not.

Keywords: inequity aversion, nonprofit, quality, rationing, social entrepreneur, user fees

JEL Classification: L31, H41, D45

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1. Introduction

The quality with which nonprofit organizations provide needy individuals with goods and services is subject to large variations, even within the same branches of the same region: The provision of shelter ranges from a low-quality emergency stay to a long-term accommodation at market standard; food is supplied on a nonprofit basis by soup kitchens as well as higher quality university cafeterias. The choice of quality level follows a specific pattern related to the income of the target group. In cases where only the ability to pay defines the neediness of individuals, the good or service provided to the poorest is frequently of significantly lower quality than comparable market offers. According to the World Bank (2003), in low- and middle-income countries services for poor people are often of low quality characterized by inadequately skilled workers, lacking resources, facilities in disrepair etc. More specifically, for micro-insurance schemes addressing the poor in developing countries a survey by McCord (2001) shows that these insurances' coverage of health risks is very limited.[1] Similar findings are reported for food assistance programs, which often supply low-quality food.[2] From these observations one may question why nonprofits do not alternatively use their income from donations to lift the service quality to market level at the cost of a lower number of recipients. Our interest in this paper is to provide a theoretical foundation to explain how nonprofits generally choose the quality/quantity mix of social goods and services.

Existing explanations for the low quality of services to the very poor are limited to the role of governmental provision. For example, Glazer and Niskanen (1997) highlight the importance of a poor majority in a public choice setting while Besley and Coate (1991) study governmental measures for redistributing income from the rich to the poor. However, due to the inability of raising taxes and an underlying voting mechanism, these approaches cannot be adapted to private nonprofit organizations.

A survey of the corresponding literature reveals three different patterns to implement service quality and quantity into the objective function of private nonprofit decision makers. Newhouse (1970), Feldstein (1977), and Rose-Ackerman (1987) follow the established convention that indifference curves between service quality and quantity have the "usual" convex shape. Along a second line, Dor and Farley (1996) as well as Friesner

[1] The study pinpoints major exclusions and limitations in the coverage of micro-insurance schemes. Moreover, most of the schemes operate with reimbursement limitations.

[2] Food for Survival (2000) studied 971 New York soup kitchens and food pantries and found that the majority of offered food consists of cheap non-perishable goods (rice, pasta, beans, powdered milk, canned foods etc.) while the supply of fresh food is relatively rare.

and Rosenman (2004) argue in favor of service intensity-adjusted output, where quality (characterized by service intensity) and quantity are multiplicably dependent within the nonprofit's utility function. A third specification is given by Blau and Mocan (2002) and Lakdawalla and Philipson (2006). They apply an objective function that features a profit (determined by quantity) and a "profit-deviating" preference for quality. However, all approaches lack a profound motivation for the specific interaction of quality and quantity within the decision maker's utility function. Specifically, the intuition of the assumed dependency between the marginal utility of service quality and the absolute level of provided quantity remains unclear.

The present paper fills this gap by assuming that nonprofits are *inequity averse* in making their decisions. We thereby implement one of the major insights of recent experimental economic research on social preferences obtained from distribution games.[3] Accordingly, in our theoretical model we assume that the decision maker cares about the relative payoff of others and experiences a disutility if the consumption possibilities of an individual deviate negatively from a social reference level. We show that this characterization provides a clear understanding of how nonprofits benefit from service quality, quantity, and the composition of recipients with regard to their initial consumption endowment.[4] Moreover, we show within our theoretical framework that allocations which correspond to the empirical observations mentioned above can be explained. We find the following patterns: Weakly inequity-averse entrepreneurs choose to serve the least needy individuals at (maximum) social reference quality. In contrast, highly inequity-averse entrepreneurs provide the poorest individuals at minimum quality. Allocations between both extremes occur only for entrepreneurs with moderate aversion.

The organization and main results of the paper are given as follows. Section 2 introduces a model of the entrepreneur's allocation problem accounting for applicants with differing incomes and exogenously given donations. Additionally, we allow the entrepreneur to charge perfectly discriminated user fees, which goes in line with common nonprofit practices.[5] Section 3 analyzes how a variation in donations and input costs impacts the rationing behavior of nonprofits. We show first that an increase in donations leads to an extension of the target group for all entrepreneurs and additionally to an improvement of service quality for highly inequity-averse entrepreneurs. Second, an

[3] Seminal work in this field has been done by Fehr and Schmidt (1999).

[4] Starke (2012) also discusses a nonprofit objective function that includes service quantity and the composition of recipients with regard to their income. However, the function does not account for different quality levels of the good or service.

[5] A discussion of instruments enabling user-fee discrimination is given by Steinberg and Weisbrod (1998).

increase in input costs incites decision makers with less inequity aversion to serve even wealthier individuals at constant (social reference) quality. More averse entrepreneurs leave the target group unchanged but decrease service quality. We conclude in section 4 with a discussion of these results.

2. The Model

We consider a continuum of individuals $\mathcal{N} = [n_{min}, n_{max}] \subseteq R_+^*$ seeking to satisfy a basic human need. Examples of such needs are food, shelter, clothing, health, etc. Each individual $n \in \mathcal{N}$ purchases one unit of a need-specific good from perfectly competitive markets where firms face zero profits. The firms offer different product qualities and the price of the good increases with its quality level. Each individual in $\mathcal{N}$ spends the budget $b(n)$ on satisfying the specific need, with $db(n)/dn < 0$ and $b(n_{max}) = 0$. However, individuals are poor, such that $b(n)$ enables them to achieve only an insufficient level of need satisfaction. Therefore, $b(n)$ can be termed the payment ability of individual n. Consequently, n_{max} characterizes the poorest and n_{min} the wealthiest individual. Furthermore, as the good satisfies a basic human need, we assume that all individuals show identical preferences for quality, and their marginal utility of quality is positive. As an illustrative example, consider food consumption. Given that budgets are insufficient to eliminate hunger, we can expect all individuals to show relatively equal preferences for higher qualitative nutrition.

Suppose a social entrepreneur is able to perfectly observe individual budgets. This assumption is supported by nonprofit practices, implying that it is quite common to differentiate the financial situation of needy people either through income verification sheets or through appropriate indicators.[6] The social entrepreneur compares the individual budgets with a subjective social reference level b_{sr}, which might be equal to her own consumption budget or might be deduced from scientific or regulatory guidelines.[7] This

[6] Steinberg and Weisbrod (1998) provide a general discussion of these indicators. More specifically, FAO (2001) surveys and discusses the application of indicators of several nutrition programs in developing countries (e.g. socio-economic status, education level, age, household size, number of children etc.). Although such practices are supposed to cause so-called targeting costs, we simplify by ignoring them for the following reason: These costs mainly arise due to the identification of suitable income indicators and the screening of individuals. However, since the social entrepreneur must screen all applicants to detect the targeted individuals, targeting costs are independent of the number and composition of recipients. Hence, they are fixed costs that simply reduce the amount of donations. A variation in donations is analyzed in section 3.

[7] For example, the UK government (School Food Trust 2007) defined a minimum quality for school food by pinpointing items that have to be offered within a specific period.

reference level determines the individuals the entrepreneur considers needy. For reasons of simplicity, we assume that all n individuals own a budget endowment equal or below this level, i.e. $b_{sr} = b(n_{min})$. Consequently, the social entrepreneur observes a budgetary inequity of $q_{ea}(n) := b_{sr} - b(n) \geq 0$ for the *n*th individual, which will be referred to in the following as *ex-ante inequity*.

In order to mitigate the ex-ante inequity, the nonprofit entrepreneur offers any preselected individual one unit of a need-specific good which features two characteristics. It is a purely private good for the recipients and a public good for other individuals (e.g., donors) who perceive an altruistic benefit. In the following, we use the label *social good* to account for this composite character.

The entrepreneur's selection of recipients is based on two related decisions: Which product quality should be offered and which needy subgroup should be targeted? We make four assumptions about the quality of the social good. First, the good is provided to all recipients at uniform quality, i.e., we do not consider quality discrimination.[8] Second, the marginal costs of producing an additional unit of the social good $c \in R_+^*$ are independent of the supplied quantity but positively correlated to the product's quality level.[9] In the following, we do not distinguish between quality and marginal production costs and denote quality equivalently by c. Third, for reasons of simplicity, it is assumed that the quality of the social good is produced with the same technology as the market good. Fourth, given an identical quality, the market and the social good are perfectly substitutable in consumers' utility.

In order to illustrate the setting we have in mind, consider the following application to food-consumption. Here, the good is viewed as a bundle of staple foods of specific quantity and quality. Any change in the composition of the bundle that increases need satisfaction is modeled as an increase in the good's quality. Hence, an increase in the number and scope of meals through additional food as well as an increase in the quality of a single item enhances the overall quality.

[8] There exists empirical evidence that supports our assumption. For example, Rosenman et al. (2005) find that community clinics in California do not practice quality discrimination. Additionally, the results of Grabowski et al. (2008) indicate that US nursing homes do not quality discriminate between privately paying and Medicaid patients.

[9] A different approach is taken by Rose-Ackerman (1987), who argues that the marginal costs of quality for the provision of social goods are zero. Although sharing the opinion that there exist some factors improving quality without additional costs, e.g., changing school teaching from frontal to interactive mode, we account for the majority of dimensions where improvements in quality are costly.

The second decision of the social entrepreneur concerns the composition and size of the target group. As will be argued by the following assumptions, this decision solely requires the choice of the marginally poorest recipient $\bar{n} \in \mathcal{N}$. First, we define $\underline{n} \in [n_{min}, \bar{n})$ as the marginally wealthiest recipient and we assume that the group of served individuals lies in the closed interval $[\underline{n}, \bar{n}]$, with the number of recipients given by $\bar{n} - \underline{n}$. Furthermore, we allow the entrepreneur to perfectly discriminate prices. The differentiation of user fees according to payment ability, which is often observed in practice, is a basic assumption in models of nonprofit firms.[10] In this regard, Steinberg and Weisbrod (1998) provide numerous examples of nonprofit industries frequently charging sliding-scale fees for different users.

In our model, the social entrepreneur charges the *n*th individual a user fee that exactly corresponds to the budget endowment $b(n)$. Since this fee is identical to the price imposed by market firms, the individual's choice of the preferred supplier is only governed by the product's quality. Due to zero profits in perfectly competitive markets, for-profit firms produce at price equals marginal costs and, equivalently, a quality that equals $b(n)$.[11] In contrast, using the identical production technology as market firms, the social entrepreneur offers the good at product quality c. The targeted individual is indifferent between both offers if $c = b(n)$ and strictly prefers the entrepreneur's offer if $c > b(n)$. Consequently, given that $c \geq b(n)$ for all $n \in [\underline{n}, \bar{n}]$, the entrepreneur's total user-fee revenues F are given by

$$(1) \quad F = \int_{\underline{n}}^{\bar{n}} b(n)\, dn .$$

In addition to these revenues, the entrepreneur receives an exogenously given level of donations $D \in (0, D_{max})$, with

$$D_{max} = [(n_{max} - n_{min}) \cdot b_{sr}] - \int_{n_{min}}^{n_{max}} b(n)\, dn$$

[10] Theoretical aspects of price discrimination by nonprofits are studied in Le Grand (1975) and Steinberg and Weisbrod (2005).

[11] Note that marginal production costs and quality are assumed to be equivalent in this paper.

as the maximum level at which all individuals are served at social reference quality.[12] In line with the organization's nonprofit status user-fee revenues and donations have to be spent completely on financing the allocation of the social good to needy individuals, i.e.

(2) $F + D = c \cdot (\bar{n} - \underline{n})$.

The *nonprofit-condition* (2) shows that for given levels of donations D and individual budgets $b(n)$, the entrepreneur's choice of the good's quality c and the marginally poorest recipient $\bar{n}$ determines the marginally wealthiest recipient $\underline{n} = \underline{n}(c, \bar{n})$ and, likewise, the size of the target group $\bar{n} - \underline{n}(c, \bar{n})$. These dependencies are depicted in figure 1.

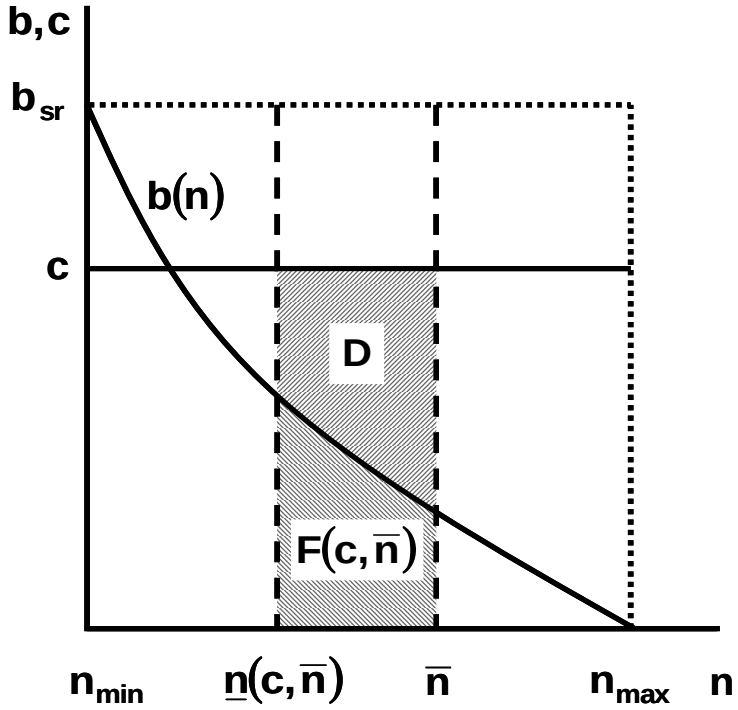


Figure 1: Allocation effects of the choice of quality and target group.

Given the individual endowments $b(n)$, the social entrepreneur is confronted with the status-quo budgetary inequity $q_{ea}(n) = b_{sr} - b(n)$. With donations D at hand, she decides on the quality level c of the social good and determines the specific target group by choice of the poorest recipient $\bar{n}$. Due to the nonprofit-condition, she completely spends donations to cover the difference between marginal costs c and individual contributions. Starting with the poorest recipient the funds suffice to subsidize $\bar{n} - \underline{n}(c, \bar{n})$ individuals.

[12] This exogeneity assumption implies that donors have no preferences concerning the entrepreneur's pricing decision. Specifically, their giving behavior is invariant to changes in total user-fee revenues.

Since recipients have to pay a user fee equal to their payment abilities, total user-fee revenues amount to $F(c,\bar{n})$. Subsequent to the allocation of the social good, there remains an inequity with served individuals amounting to $q_{ep}(c) := b_{sr} - c$, which will be referred to as *ex-post inequity* in the following. With the choice of her allocation the entrepreneur simultaneously shows two types of rationing. First, by choosing the target group she completely rations all individuals $n \notin [\underline{n}(c,\bar{n}),\bar{n}]$. Second, her determination of a quality level partially rations all recipients since they do not receive the social reference level.

It is important to emphasize that our assumption of a monopolistic distribution of the social good allows us to focus exclusively on the rationing decisions characterized in figure 1. Nevertheless, the model also applies to situations of imperfect competition for needy individuals between nonprofits, i.e., (some) individuals are already served by other nonprofits, but the entrepreneur still observes a specific level of inequity. Given that third-party funds are insufficient to eliminate the entire inequity, the entrepreneur then has to ration individuals either completely or partially.

As indicated in the introduction, we characterize the social entrepreneur as an inequity-averse decision maker. Specifically, she perceives negative utility from a deviation of an individual's consumption possibilities $b(n)$ from the social reference level. By providing needy individuals with the social good she reduces the inequity and, hence, her own disutility. We thereby build on recent experimental economic research which investigates general social preferences by means of simple distribution games, e.g. dictator and ultimatum games, where one individual decides on the distribution of an exogenously given amount of money between herself and other players. In their seminal work Fehr and Schmidt (1999) analyze the results of several experiments and conclude that the inequity-aversion motive is able to explain the observed behavior. Fehr and Schmidt (1999) thereby use the following definition: "Inequity aversion means that people resist inequitable outcomes; i.e., they are willing to give up some material payoff to move in the direction of more equitable outcomes."

We apply this motive to our model for two reasons. First, the analyzed distribution games are closely related to the decision context of the social entrepreneur in that an exogenously given amount of third-party funds has to be allocated between different

individuals.[13] Second, given that the principle of inequity aversion constitutes a building block in understanding the general fairness preferences of individuals, we can expect it to characterize the motivation of social entrepreneurs, in particular these, whose raison d'être lies in the mitigation of existing inequitable allocations. However, Fehr and Schmidt (1999) model the preferences of the distributor as self-centered inequity aversion, meaning that she cares about her own payoff relative to the payoff of others. In contrast, we do not restrict the reference outcome (in our paper: the social reference level b_{sr}) to be the entrepreneurs own budget endowment but also allow for alternative reference levels, e.g., societal standards. As a second difference to Fehr and Schmidt (1999), we do not differentiate between aversion towards advantageous (individuals dislike being better off) and disadvantageous inequity (individuals dislike being worse off). Since the entrepreneur compares the budget endowments $b(n)$ of all individuals with the social reference level b_{sr}, where, by assumption, $b_{sr} \geq b(n)$ for all $n \in \mathcal{N}$, the entrepreneur is confronted only with advantageous inequity.

The inequity-aversion motive is introduced into our model through the parameter $\alpha \in R_+$. It determines the social entrepreneur's disutility from inequity by exponentially weighting $q_{ea}(n)$ and $q_{ep}(c)$, respectively. The functional form of her disutility can be written as

(3) $v(q) = q^{\alpha}$, with $q \in \{q_{ea}(n), q_{ep}(c)\}$.

The parameter α thereby determines the level of the constant elasticity of marginal disutility $\varepsilon = \alpha - 1$ and is likewise a measure for the curvature of value function (3).[14] Additionally, as with the class of Cobb-Douglas utility functions, α characterizes the entrepreneur's intensity of disutility. Marginal disutility is decreasing with $\alpha \in (0,1)$, constant with $\alpha = 1$, and increasing with $\alpha \in (1,\infty)$.[15] More specifically, an entrepreneur with $\alpha = 0$ does not care about differences in budgetary inequity between individuals and values $q_{ea}(n)$ and $q_{ep}(c)$ identically. In contrast, for any positive α the entrepreneur perceives increased disutility from individuals being subject to higher inequity. This

[13] Although we do not account for efficiency concerns in our model, the distribution game closest to our model specification is analyzed as *treatment R* in Engelmann and Strobel (2004). Here, the decision maker is the wealthiest individual and is likewise not able to extract any rents for herself.

[14] The elasticity of marginal disutility is defined as $\varepsilon = [dv'(q)/dq] \cdot [q/v'(q)]$.

[15] With these specifications of marginal disutility we broaden the scope of Fehr and Schmidt (1999), who integrate α multiplicatively into the utility function and, hence, restrict their analysis to *linear* inequity aversion, i.e. constant marginal disutility. However, they also observe "a nonnegligible fraction of people who exhibit nonlinear inequality aversion" in dictator experiments (p. 823).

increase in disutility is the larger the higher the value of α is, and it becomes infinite with $\alpha \to \infty$.[16] As will be shown later, entrepreneurs with extreme inequity aversion care only for the poorest target group individuals.

Based on the introduced disutility concept, we now characterize the social entrepreneur's utility from allocating one unit of the social good to a target group individual by the following functional form:

(4) $u(c,n) = v(q_{ea}(n)) - v(q_{ep}(c)) = [b_{sr} - b(n)]^{\alpha} - (b_{sr} - c)^{\alpha}$.

Her utility equals the difference between the weighted ex-ante and ex-post inequity, i.e. the reduction of disutility through provision of the social good. As intuitive result, a non-inequity-averse entrepreneur $(\alpha = 0)$ receives no utility from allocating the good independent of the type of recipient. Hence, she does not engage in the social-good provision.

As previously argued, by simultaneously choosing the quality level c of the social good and the poorest recipient $\bar{n}$, the entrepreneur, due to nonprofit condition (2), indirectly determines the wealthiest recipient $\underline{n}(c,\bar{n})$ and, hence, also the number of served individuals, $\bar{n} - \underline{n}(c,\bar{n})$. Aggregating the utility values of equation (4) for each recipient then yields the following total utility level:

(5) $U(c,\bar{n},\underline{n}(c,\bar{n})) = \int_{\underline{n}(c,\bar{n})}^{\bar{n}} \left[[b_{sr} - b(n)]^{\alpha} - (b_{sr} - c)^{\alpha} \right] dn$.

For reasons of tractability, the notation of utility function (5) includes the entrepreneur's decision variables c and $\bar{n}$ as well as their influence on the value of the wealthiest recipient $\underline{n}(c,\bar{n})$. We thereby allow for a precise characterization of the entrepreneur's scope of alternatives: Under consideration of nonprofit-condition (2), the entrepreneur can (directly or indirectly) vary two of the variables with the third kept constant. The maximization problem of the entrepreneur is given by

(6)
$$\max_{c,\bar{n}} \; U(c,\bar{n},\underline{n}(c,\bar{n}))$$
$$\text{s.t. } D - \int_{\underline{n}}^{\bar{n}} [c - b(n)]\, dn = 0 .^{17}$$

[16] Note that the case $\alpha = \infty$ corresponds to maximin-preferences.

[17] Employing equation (1) into nonprofit-condition (2) and rearranging it with respect to D yields $D = \int_{\underline{n}}^{\bar{n}} [c - b(n)] dn$.

In the following, we prove the existence of corner and interior solutions to maximization problem (6).[18]

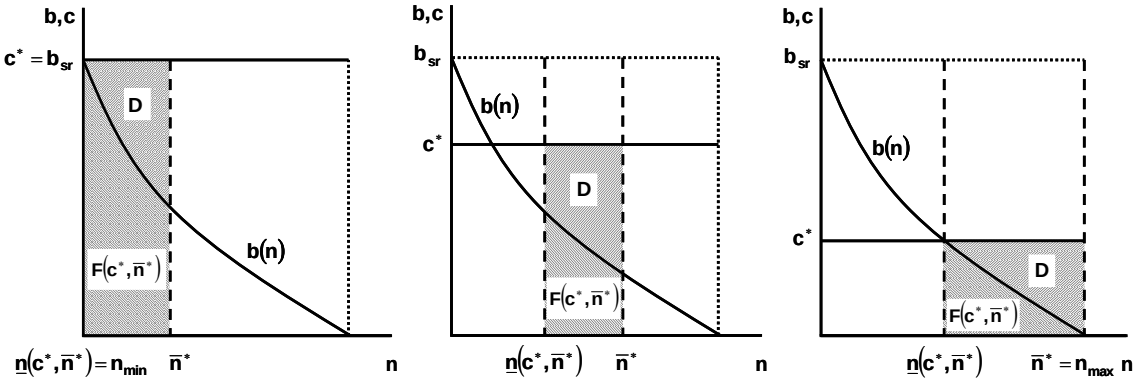
***Proposition 1*:** Weakly inequity-averse entrepreneurs $(\alpha \in (0,1))$ choose the maximum quality $\left(c^* = b_{sr}\right)$ and provide only the wealthiest individuals $\left(\underline{n}(c^*, \bar{n}^*) = n_{min}\right)$. On the other hand, highly inequity-averse entrepreneurs $(\alpha \in (1,\infty))$ serve only the poorest applicants $\left(\bar{n}^* = n_{max}\right)$ at the lowest feasible quality $\left(c^* = b(\underline{n}(c^*, n_{max}))\right)$. Finally, interior optima $\left(c^* \leq b_{sr} \text{ and } \bar{n}^* \leq n_{max}\right)$ only exist if $\alpha = 1$.

***Proof*:** See Appendix.

With limited donations at hand, the social entrepreneur chooses the allocation that maximizes her utility from reduced inequity. The utility maximum can be identified by comparing the marginal utilities of quality, of serving the wealthiest, and of serving the poorest individuals for all feasible combinations of social-good quality and target groups that fulfill nonprofit-condition (2). Note that, due to these comparisons across all possible allocations, the entrepreneur's choice also accounts for the opportunity costs of not serving some individuals.

As proposition 1 shows, a first maximum is given for weakly inequity-averse entrepreneurs $(\alpha \in (0,1))$. Their marginal utility of serving the next poorer recipient is always lower than both their marginal utility of an improvement in quality (given a constant wealthiest recipient) and their marginal utility of serving the next wealthier recipient (given a constant quality). Consequently, the entrepreneur maximizes the social-good quality $\left(c^* = b_{sr}\right)$ and serves only the wealthiest recipients $\left(\underline{n}(c^*, \bar{n}^*) = n_{min}\right)$. Intuitively, weakly inequity-averse entrepreneurs show the highest marginal disutility of inequity for marginal deviations of individual budgets from the social reference level. Hence, the first unit of donations is used to completely eliminate the inequity of the wealthiest needy individual $(n \to n_{min})$ which requires the entrepreneur to choose the maximum quality for the good. Until the entire donations are spent, individuals are successively supplied according to the next higher inequity. The characterized corner solution is depicted in figure 2, panel (a).

[18] Utility function (5) is similar to the normative poverty measure put forward by Foster et al. (1984). Applying this measure Bourguignon and Fields (1990) analyze optimal governmental subsidies to individuals. Their findings resemble the results of proposition 1.



(a) (b) (c)

Figure 2: Corner allocations and an arbitrary interior solution.

Second, interior optima $\left(c^* \leq b_{sr} \text{ and } \bar{n}^* \leq n_{max}\right)$ exist for moderately inequity-averse entrepreneurs $(\alpha = 1)$. Their marginal utility of a change in each of the three variables is equally large, which allows for any values that satisfy nonprofit-condition (2). Entrepreneurs in this category show a constant marginal disutility of inequity and, thus, do not care for which applicants and to what level inequity is reduced. An arbitrary interior solution is characterized in figure 2, panel (b). Throughout the rest of the paper the case of $\alpha = 1$ will no longer be analyzed. Independent of the subsequently considered parameter variations it can be shown that the marginal utilities of quality, of the wealthiest, and of the poorest recipient remain equally large. Consequently, any allocation satisfying nonprofit-condition (2) is optimal and, therefore, $\alpha = 1$ has no further explanatory value.

Third, the marginal utility of highly inequity-averse entrepreneurs $(\alpha \in (1,\infty))$ is lower for an improvement in quality than for a provision of both the next poorer and the next wealthier recipient. The resulting allocation is depicted in figure 2, panel (c). Here, only the poorest recipients $\left(\bar{n}^* = n_{max}\right)$ are served at the minimum quality $\left(c^* = b(\underline{n}(c^*, \bar{n}^*))\right)$.[19] The intuition runs contrary to that of panel (a). Since the marginal disutility from inequity is largest for the highest inequity level, utility is maximized, if donations are transferred to the poorest individuals $\left(n_{max} - \underline{n}(c^*, \bar{n}^*)\right)$, such that the ex-post inequity is equal across recipients but highest across all needy individuals. This procedure determines the low quality level of the social good.[20]

[19] Interestingly, this is also the optimal allocation under maximin-preferences.

[20] If we allow entrepreneurs to choose discontinuous target groups, the results of proposition 1 do not change for $\alpha \in (0,\infty) \setminus \{1\}$. Such entrepreneurs perceive a strictly decreasing (respectively increasing)

There exists evidence from the child care sector that supports our model's predictions. For example, Cleveland and Krashinsky (2009) survey 232 Canadian nonprofit centers and find quality differences among them. Morris and Helburn (2000) find such differences among 200 nonprofit child-care centers in the US states of California, Colorado, Connecticut, and North Carolina. Specifically, they show that centers operated by community agencies and churches offer services of lower quality at significantly lower user fees than other nonprofits, which indicates that may be targeting low-income families. On the other hand, independent nonprofit centers are found to choose relatively high quality and prices on average.[21]

In addition to these findings, figure 2 (panel (c)) indicates that highly inequity-averse entrepreneurs choose to serve the largest number of needy individuals $\left(\bar{n}^* - \underline{n}\left(c^*, \bar{n}^*\right)\right)$. However, this result only holds if the function of budget endowments $b(n)$ is convex. More specifically, differences in the chosen target-group quantity depend on both the social entrepreneurs' inequity aversion and the curvature of the $b(n)$-function, as we show formally with the following proposition.

***Proposition 2*:** Highly inequity-averse entrepreneurs $(\alpha \in (1,\infty))$ serve the maximum number of individuals $\bar{n}^* - \underline{n}\left(c^*, \bar{n}^*\right)$, if the $b(n)$-curve is convex. In contrast, if $b(n)$ is concave, then the number of recipients is largest for weakly inequity-averse entrepreneurs $(\alpha \in (0,1))$. However, both types of entrepreneurs choose the same and likewise maximum number of recipients if $b(n)$ is a linear function.

***Proof*:** See Appendix.

Intuitively, the maximum number of individuals is served if the required average subsidy margin, i.e. the average difference between constant marginal production costs c and the perfectly discriminated user fee $b(n)$, is lowest. There are two requirements to a minimal average subsidy. First, since marginal production costs are assumed to be equal across individuals, and $b(n)$ is a decreasing function in n, any target group is served with the lowest possible amount of donations, if the wealthiest recipient receives no subsidy.

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marginal disutility of inequity and, as indicated above, would therefore supply the continuous target groups characterized in figure 2, panel (a) and (c). However, discontinuous intervals of recipients might be chosen by entrepreneurs with $\alpha = 1$ as their marginal disutility is invariant to the inequity level. Hence, they are indifferent between all combinations of quality and (discontinuous) target groups that satisfy nonprofit-condition (2).

[21] Empirical evidence on target-group and quality differences between nonprofit organizations in a specific industry is relatively sparse. Although there is much empirical investigation in the hospital sector, work in this field mainly concentrates on quality differences between for-profit and nonprofit hospitals with mixed results. See, for example, Chou (2002) and Milcent (2005).

Otherwise, any positive subsidy to this individual would have to be likewise granted to each other recipient, implying increased spending of donations. Second, a minimum average subsidy margin arises among those recipients whose budgets are most uniformly distributed. For those individuals the gap between costs and user fee $c - b(n)$ is smallest on average.

Following proposition 1, the first requirement is met for all entrepreneurs with $\alpha \in (0,\infty) \setminus \{1\}$. However, the fulfillment of the second requirement depends on the curvature of the function of budget endowments $b(n)$. Given that $b(n)$ is convex, individual budgets vary least among the poorest individuals, such that highly inequity-averse entrepreneurs $(\alpha \in (1,\infty))$ serve the maximum number of recipients. In contrast, given a concave $b(n)$-function, budgets are most uniformly distributed among the wealthiest individuals which are supplied by weakly inequity-averse entrepreneurs $(\alpha \in (0,1))$. Consequently, they serve the maximum number of recipients. Finally, there exist no such differences in the distribution of individual budgets, if the $b(n)$-curve is linear, which implies an equal and maximum target-group quantity for all entrepreneurs with $\alpha \in (0,\infty) \setminus \{1\}$.

The results of proposition 2 have implications for the relationship between nonprofit organizations and their stakeholders. Typically, donors and governments monitor quality and quantity measures to ensure that funds are spent according to the mission. However, the quality of the social good is a multidimensional construct, which sometimes complicates its observation. Hence, third parties might rely on the number of served individuals as a major screening device. In addition, Steinberg (1986) notes that governments may prefer nonprofits affecting the highest number of individuals to gain maximal political leverage. In such cases highly inequity-averse entrepreneurs might be more successful in attracting third-party funds if the majority of needy individuals is relatively poor (suggesting a convex budget-function in the model).

3. Variations in Donations and Input Costs

As argued in section 2, the determinants of the social entrepreneur's allocation decision include available third-party funds and production costs. These financial conditions are likely to change during the lifetime of a social business. A donor might withdraw or extend announced funds or might simply terminate a long-term relationship. Input costs might vary due to periodic shortages or shocks on resource markets. In this section, we

analyze the impact of those variations on the entrepreneur's choice of target group and social-good quality.

In principle, the social entrepreneur can alternatively use additional donations to serve more or different individuals, or to improve the quality of the social good. The next proposition shows that, on the one hand, entrepreneurs react differently on variations in donations but, on the other hand, the classification of corner and interior solutions by level of inequity aversion remains unaffected.[22]

***Proposition 3*:** Given an increase in donations, entrepreneurs with $\alpha \in (0,\infty)\setminus\{1\}$ enlarge the number of served individuals $\left(\bar{n}^{D*} - \underline{n}\left(c^{D*},\bar{n}^{D*}\right) > \bar{n}^{*} - \underline{n}\left(c^{*},\bar{n}^{*}\right)\right)$. In particular, weakly inequity-averse entrepreneurs $(\alpha \in (0,1))$ keep serving the wealthiest individuals $\left(\underline{n}\left(c^{D*},\bar{n}^{D*}\right) = \underline{n}\left(c^{*},\bar{n}^{*}\right) = n_{min}\right)$ at the social reference level $\left(c^{D*} = c^{*} = b_{sr}\right)$ and expand their target group toward the next poorer individuals $\left(\bar{n}^{D*} > \bar{n}^{*}\right)$. In contrast, highly inequity-averse entrepreneurs $(\alpha \in (1,\infty))$ still focus on the most needy individuals $\left(\bar{n}^{D*} = \bar{n}^{*} = n_{max}\right)$, improve the social-good quality $\left(c_D^{*} > c^{*}\right)$ and serve the next wealthier applicants $\left(\underline{n}\left(c^{D*},\bar{n}^{D*}\right) < \underline{n}\left(c^{*},\bar{n}^{*}\right)\right)$.

***Proof*:** See Appendix.

Intuitively, an increase in donations does not affect the entrepreneur's marginal disutility of ex-ante inequity as obtained from equation (3). Hence, there is no effect on her decision on how to reduce this inequity optimally, i.e. the order of her marginal utilities of quality c, marginally poorest recipient $\bar{n}$, and marginally wealthiest beneficiary $\underline{n}(c,\bar{n})$ remains unchanged. Consequently, entrepreneurs with $\alpha \in (0,1)$ still have the highest marginal disutility for the lowest levels of inequity which incites them to serve the wealthiest individuals $\left(\underline{n}\left(c^{D*},\bar{n}^{D*}\right) = \underline{n}\left(c^{*},\bar{n}^{*}\right) = n_{min}\right)$ at social reference quality $\left(c^{D*} = c^{*} = b_{sr}\right)$. These recipients now comprise the ex-ante target group and, additionally, the next poorer applicants $\left(\bar{n}^{D*} > \bar{n}^{*}\right)$.

Entrepreneurs with $\alpha \in (1,\infty)$, on the other hand, eliminate the maximum disutility of inequity, if they keep on serving the poorest individuals $\left(\bar{n}^{D*} = \bar{n}^{*} = n_{max}\right)$ at minimum quality. Additional donations are spent on serving the next wealthier applicants. However, these individuals are only willing to purchase the social good, if its quality is at least

[22] In the following the entrepreneur's decision variables are superscripted by D to account for the state of increased donations.

equal to their budget endowment. Hence, the entrepreneur, likewise, improves quality unless the wealthiest recipient is indifferent between the market and the social good $\left(c^{D*} = b\left(\underline{n}\left(c^{D*}, \bar{n}^{D*}\right)\right)\right)$. Consequently, the model predicts an increase in both the number of recipients and the social-good quality as a reaction to an increase in third-party funds. This relationship between quality and third-party funds is consistent with the empirical findings of Dranove and White (1998). They analyze price discriminating (Medicaid-dependent) hospitals in California between 1983 and 1992 and find that they responded to Medicaid reimbursement cutbacks with a reduction of the service level (i.e., quality level) for both private and Medicaid patients.

Furthermore, our model predicts that an increase in donations increases the number of served individuals and, therefore, leads to higher user-fee revenues $F\left(c^*, \bar{n}^*\right)$ for all entrepreneurs with $\alpha \in (0,\infty)\setminus\{1\}$. Evidence for this result is provided by Khanna and Sandler (2000), who show a positive relationship between voluntary contributions and autonomous income (including user fees) for social-welfare charities. Additionally, Andreoni and Payne (2011) also find a positive correlation between donations and program service revenues for other charity subsectors.

As a second variation, consider a general increase in input costs (in the following indexed by superscript I). Note that in section 2 we assumed perfectly competitive for-profit markets and identical quality-production technologies of for- and nonprofit firms. These assumptions imply that, for a constant quality, the increase in input costs equally increases the price of the market good. Additionally, it still holds that any individual owning a budget equal or below the quality level c^I applies for the social good and individuals with $b(n) > c^I$ demand the market good. The increase in input costs is reflected by a change of two parameters. First, the social reference budget increases $\left(b_{sr}^I > b_{sr}\right)$ because higher expenditures are required to purchase the corresponding consumption quality. Second, we assume that the total number of needy individuals enlarges by those people who are no longer able to afford the social reference consumption. As a result, the set of needy individuals is now characterized by $\mathcal{N}^I = \left[n_{min}^I, n_{max}\right] \subseteq R_+^*$ with $n_{min}^I < n_{min}$ and $b_{sr}^I = b\left(n_{min}^I\right)$.

Given that the social entrepreneur does not change marginal production costs $\left(c^I = c\right)$, she is restricted to use qualitatively lower or less inputs per unit of the social good, which deteriorates its quality. Alternatively, she could increase c^I to keep the

quality constant, but this, according to nonprofit-condition (2), would imply a decrease in the number of served individuals. As proposition 4 shows, an increase in input costs leads to contrary reactions of social entrepreneurs depending on their level of inequity aversion.

***Proposition 4*:** For weakly inequity-averse entrepreneurs $(\alpha \in (0,1))$ an increase in input costs leads to a provision of wealthier individuals $\left(\underline{n}\left(c^{I*},\bar{n}^{I*}\right)=n_{min}^{I}\right)$ at (unchanged) social reference quality $\left(c^{I*}=b_{sr}^{I}\right)$. In contrast, highly inequity-averse entrepreneurs $(\alpha \in (1,\infty))$ keep serving the status-quo target group $\left(\bar{n}^{I*}=\bar{n}^{*}=n_{max}\right.$ and $\left.\underline{n}\left(c^{I*},\bar{n}^{I*}\right)=\underline{n}\left(c^{*},\bar{n}^{*}\right)\right)$ at constant marginal costs $\left(c^{I*}=c^{*}=b\left(\underline{n}\left(c^{*},n_{max}\right)\right)\right)$, i.e. lower quality.

***Proof*:** See Appendix.

Weakly inequity-averse entrepreneurs $(\alpha \in (0,1))$ show the highest marginal disutility of ex-ante inequity for marginal deviations of individual budgets $b(n)$ from the social reference level. An increased budget b_{sr}^{I} required to consume the social-reference quality and a simultaneously enlarged number of needy individuals $\left(n_{max}-n_{min}^{I}>n_{max}-n_{min}\right)$, thus, renders the initial choices of marginal costs $\left(c^{*}=b_{sr}\right)$ and target group $\left(\underline{n}\left(b_{sr},\bar{n}^{*}\right)=n_{min}\right)$ suboptimal. The entrepreneur reacts by increasing marginal costs to b_{sr}^{I} and shifting the target group toward the 'new' wealthiest applicants $\left(\underline{n}\left(b_{sr}^{I},\bar{n}^{I*}\right)=n_{min}^{I}\right)$. This way, she eliminates the fraction of inequity with the highest disutility.

As figure 3 indicates, a complete shift in the target group occurs, if b_{sr}^{I} is such that donations are insufficient to allocate the good to more than the "new" applicants at social reference quality, i.e.

$$D \leq \int_{n_{min}^{I}}^{n_{min}} \left[b_{sr}^{I}-b(n)\right]dn .$$

No initially served individual is further considered by the entrepreneur. In contrast, the marginal disutility of highly inequity-averse entrepreneurs $(\alpha \in (1,\infty))$ increases with the inequity level. As shown in section 2, they choose to serve the poorest individuals $\left(\bar{n}^{*}=n_{max}\right)$ at minimum quality $\left(c^{*}=b\left(\underline{n}\left(c^{*},n_{max}\right)\right)\right)$. Since an increase in input costs exerts no effect on the relative poverty of individuals, i.e. the individuals within the set

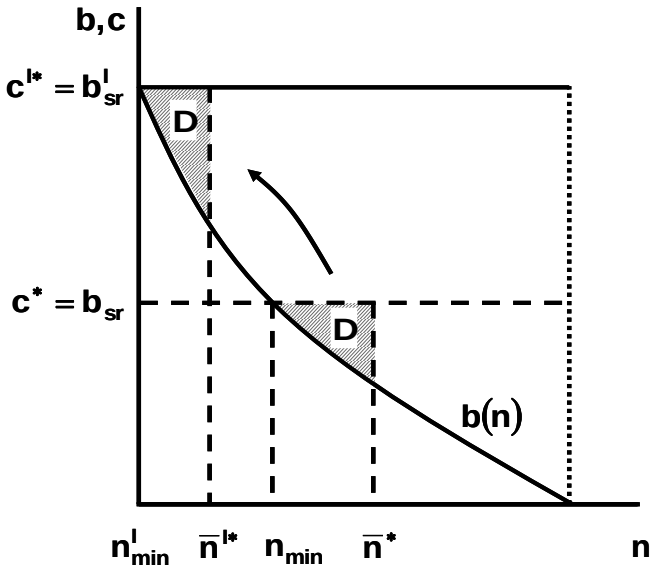

Figure 3: A complete shift of the target group as a weakly inequity-averse reaction on an increase in input costs.

$\left[\underline{n}\left(c^*, n_{max}\right), n_{max}\right]$ are still poorest, the entrepreneur neither changes the target group $\left(\bar{n}^{I*} = \bar{n}^* = n_{max}\right.$ and $\left.\underline{n}\left(c^{I*}, \bar{n}^{I*}\right) = \underline{n}\left(c^*, \bar{n}^*\right)\right)$ nor the marginal production costs $\left(c^{I*} = c^* = b\left(\underline{n}\left(c^*, n_{max}\right)\right)\right)$. However, quality necessarily drops due to increased input costs.

Additionally, figure 3 indicates that a weakly inequity-averse social entrepreneur not only changes the composition of recipients but also their number. The next proposition shows that this change unambiguously depends on the curvature of the budget function $b(n)$.

***Proposition 5*:** Given a concave (convex) function of budget endowments $b(n)$, weakly inequity-averse entrepreneurs $(\alpha \in (0,1))$ increase (decrease) the number of served individuals, i.e. $\bar{n}^{I*} - \underline{n}\left(c^{I*}, \bar{n}^{I*}\right) > \bar{n}^* - \underline{n}\left(c^*, \bar{n}^*\right)$ $\left(\bar{n}^{I*} - \underline{n}\left(c^{I*}, \bar{n}^{I*}\right) < \bar{n}^* - \underline{n}\left(c^*, \bar{n}^*\right)\right)$, as a reaction to an increase in input costs. Given a linear budget function, they do not change the number of recipients.

***Proof*:** See Appendix.

From proposition 2, we know that the number of recipients is negatively correlated with the average subsidy margin required to serve the targeted individuals. Since the wealthiest recipient receives no subsidy independent of the input costs, this margin is only conditional on the distribution of individual budget endowments, i.e. the curvature of the $b(n)$-function. The average subsidy is thereby the smaller the more uniformly budgets are

distributed. Given that $b(n)$ is concave, the dispersion is lowest among the highest budgets. Consequently, the target group is larger after input costs increased, because recipients are wealthier on average. However, the ex-post quantity is smaller if $b(n)$ is convex, which is depicted in figure 3. Here, individual budgets are least uniformly distributed among the wealthiest applicants. Finally, due to the same reasoning, no differences occur if $b(n)$ is linear.

4. Conclusion

Our objective in this paper was to develop a positive model of a nonprofit entrepreneur's allocation decision, which includes the selection of the target group and the quality of the social good, in the light of limited third-party funds. By assuming that a social entrepreneur`s decision is characterized by inequity aversion, we follow recent results of experimental economic research on social preferences. We demonstrate how this preference assumption conveys a better understanding of how the good's quality, the number of recipients as well as their income distribution interact within the objective function of private nonprofit decision makers. Specifically, an improvement of service quality increases the consumption level of beneficiaries and, hence, reduces inequity. In contrast, an enlargement of the target group reduces the inequity for additional recipients. In both cases the entrepreneur benefits through a reduction of her disutility from inequity. Finally, the composition of recipients enters the decision calculus through the marginal disutility of inequity. With increasing (decreasing) marginal disutility the entrepreneur prefers to reduce a given amount of inequity of a poorer (wealthier) individual.

We find that weakly inequity-averse entrepreneurs choose to provide wealthier individuals at high social reference quality. In contrast, highly inequity-averse entrepreneurs care for the poorest individuals but offer minimum quality. These results allow for two explanations of the low quality of services to the very poor. First, the goods or services considered in these studies were provided by highly inequity-averse entrepreneurs and/or, second, they were supplied by weakly inequity-averse entrepreneurs applying a low subjective reference quality. Whether social entrepreneurs apply subjective reference levels or rather a societally standardized norm remains an empirical question.

As a further result, we show that the number of supplied individuals depends on the curvature of the budget function. Given convexity (concavity), highly (weakly) inequity-

averse entrepreneurs serve the maximum number of needy people. Moreover, we find that entrepreneurs react differently with regard to variations in donations and input costs. Irrespective of the considered variation, entrepreneurs with low aversion never change the quality of the social good. In contrast, entrepreneurs with high aversion improve quality if additional funds are available, and they lower quality when inputs used for production become more expensive. Common to both types of decision makers is the provision of more individuals if donations increase. However, given a sufficiently high increase in input costs, highly inequity-averse entrepreneurs do not change the target group while weakly inequity-averse entrepreneurs serve a completely different (viz. wealthier) group.

Our results yield implications for stakeholders of nonprofit organizations whose objectives are related to quality, quantity and the composition of recipients. More specifically, donors or governments aiming at maximizing the number of served individuals with given funds should fund entrepreneurs who focus on the poorest people, if the majority of needy individuals is relatively poor (suggesting a convex budget-function in the model). In contrast, stakeholders generally interested in minimizing the number of needy individuals, through a provision of maximum service quality, should support entrepreneurs serving less poor individuals. Those stakeholders do not even need to change their contribution if input costs increase.

Finally, the framework developed in this paper constitutes a basis for analyzing additional issues of social entrepreneurial behavior. Specifically, it merits further investigation of how the different allocation patterns change if stakeholders exert an influence on the social entrepreneur's decision. Especially, so-called lead donors, typically granting a significant and often the largest part of the initial financial need of nonprofit organizations, might wish to regulate if the entrepreneurial behaviour inadequately reflects their own objectives.

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Appendix: Proof of Propositions 1-5

***Proof of Proposition 1*:** For notational clarity, we temporarily expand the term $U(c,\bar{n},\underline{n}(c,\bar{n}))$ to $U(c,\bar{n},\underline{n}(c,\bar{n});\alpha)$ to emphasize the influence of the entrepreneur's inequity aversion. However, we simplify the explicit notation by use of U.

By inserting user-fee revenues (1) into nonprofit-condition (2) and applying the implicit function theorem, one obtains the partial dependencies $d\bar{n}/dc = -[\bar{n} - \underline{n}(c,\bar{n})]/[c - b(\bar{n})] < 0$, $d\,\underline{n}(c,\bar{n})/dc = [\bar{n} - \underline{n}(c,\bar{n})]/[c - b(\underline{n}(c,\bar{n}))] > 0$ and $d\,\underline{n}(c,\bar{n})/d\bar{n} = [c - b(\bar{n})]/[c - b(\underline{n}(c,\bar{n}))] > 1$. Given that $\underline{n}(c,\bar{n})$ is constant, the social entrepreneur increases c at the cost of $\bar{n}$, or vice versa, if her total utility level is increased. She leaves both decision variables unchanged if the utility maximum is reached. Equivalent considerations apply for the pairwise variations of c and $\underline{n}(c,\bar{n})$, while keeping $\bar{n}$ constant, as well as $\bar{n}$ and $\underline{n}(c,\bar{n})$, with c constant.

Consider the variation of c and $\bar{n}$ for a constant $\underline{n}(c,\bar{n})$. The corresponding condition for marginal utilities can be written as

$$\text{(A1)} \quad \frac{\partial U}{\partial c} \gtreqless \left| \frac{\partial U}{\partial \bar{n}} \cdot \frac{d\bar{n}}{dc} \right|.$$

Specifically, the entrepreneur increases (decreases) c and likewise decreases (increases) $\bar{n}$ if (A1) holds with > (<). Both variables are left unchanged if (A1) holds with equality. Inserting the partial derivatives into condition (A1) and rearranging it yields

$$\text{(A2)} \quad \alpha \gtreqless \frac{[b_{sr} - b(\bar{n})] \cdot [(b_{sr} - b(\bar{n}))/(b_{sr} - c)]^{\alpha - 1} - (b_{sr} - c)}{[b_{sr} - b(\bar{n})] - (b_{sr} - c)}.$$

As a first result, condition (A2) holds with equality for $\alpha = 0$ and $\alpha = 1$. Since any entrepreneur with $\alpha = 0$ perceives no utility from and, hence, does not engage in the allocation of the social good, an interior utility maximum is solely given for $\alpha = 1$. Furthermore, the right term of condition (A2) is convexly increasing in α. Combining the two results gives $\partial U/\partial c > |(\partial U/\partial \bar{n}) \cdot (d\bar{n}/dc)|$, if $\alpha \in (0,1)$, $\partial U/\partial c = |(\partial U/\partial \bar{n}) \cdot (d\bar{n}/dc)|$, if $\alpha = 1$, and $\partial U/\partial c < |[\partial U/\partial \bar{n}] \cdot (d\bar{n}/dc)|$, if $\alpha \in (1,\infty)$.

The same reasoning applies to the pairwise variation of c and $\underline{n}(c,\bar{n})$ for a constant $\bar{n}$. Formulating the condition on marginal utilities yields

$$\text{(A3)} \quad \frac{\partial U}{\partial c} \gtreqless \left| \frac{\partial U}{\partial \underline{n}(c,\bar{n})} \cdot \frac{d\,\underline{n}(c,\bar{n})}{dc} \right|.$$

Its rearrangement gives a similar expression as shown in condition (A2):

$$\text{(A4)}\quad \alpha \underset{<}{\overset{>}{=}} \frac{[b_{sr} - b(\underline{n}(c,\bar{n}))]\cdot[(b_{sr} - b(\underline{n}(c,\bar{n})))/(b_{sr} - c)]^{\alpha-1} - (b_{sr} - c)}{[b_{sr} - b(\underline{n}(c,\bar{n}))] - (b_{sr} - c)}.$$

Again, condition (A4) holds with equality for $\alpha = 0$ and $\alpha = 1$ and its right term is convexly increasing in α. Hence, $\partial U/\partial c > |[\partial U/\partial \underline{n}(c,\bar{n})]\cdot[d\underline{n}(c,\bar{n})/dc]|$ if $\alpha \in (0,1)$, $\partial U/\partial c = |[\partial U/\partial \underline{n}(c,\bar{n})]\cdot[d\underline{n}(c,\bar{n})/dc]|$ if $\alpha = 1$, and $\partial U/\partial c < |[\partial U/\partial \underline{n}(c,\bar{n})]\cdot[d\underline{n}(c,\bar{n})/dc]|$ if $\alpha \in (1,\infty)$.

Finally, consider the pairwise variation of $\bar{n}$ and $\underline{n}(c,\bar{n})$ for a constant c. Here, the condition on marginal utilities is written as

$$\text{(A5)}\quad \frac{\partial U}{\partial \bar{n}} \underset{<}{\overset{>}{=}} \left|\frac{\partial U}{\partial \underline{n}(c,\bar{n})}\cdot\frac{d\underline{n}(c,\bar{n})}{d\bar{n}}\right|,$$

or, equivalently,

$$\text{(A6)}\quad x(\varphi,\alpha) := \frac{[b_{sr} - b(\underline{n}(c,\bar{n})) + \varphi]^{\alpha} - (b_{sr} - c)^{\alpha}}{c - b(\underline{n}(c,\bar{n})) + \varphi} \underset{<}{\overset{>}{=}} \frac{\left[(b_{sr} - b(\underline{n}(c,\bar{n})))^{\alpha} - (b_{sr} - c)^{\alpha}\right]}{c - b(\underline{n}(c,\bar{n}))},$$

with $\varphi := b(\underline{n}(c,\bar{n})) - b(\bar{n}) > 0$ and

$$\frac{\partial x(\varphi,\alpha)}{\partial \varphi} = \frac{[b_{sr} - b(\underline{n}(c,\bar{n})) + \varphi]^{\alpha-1}}{(c - b(\underline{n}(c,\bar{n})) + \varphi)^2}\cdot \hat{x}(\alpha) \underset{<}{\overset{>}{=}} 0,$$

with

$$\hat{x}(\alpha) := \alpha\cdot[c - b(\underline{n}(c,\bar{n})) + \varphi] - [b_{sr} - b(\underline{n}(c,\bar{n})) + \varphi] + (b_{sr} - c)\cdot\left(\frac{b_{sr} - c}{b_{sr} - b(\underline{n}(c,\bar{n})) + \varphi}\right)^{\alpha-1}.$$

For $\alpha = 0$ and $\alpha = 1$, condition (A6) holds with equality and $\hat{x}(\alpha) = 0$ and, hence, $\partial x(\varphi,\alpha)/\partial\varphi = 0$. For $\alpha \neq \{0,1\}$, $\partial x(\varphi,\alpha)/\partial\varphi$ and $d\hat{x}(\alpha)/d\alpha$ are indeterminate. However, since $d^2\hat{x}(\alpha)/d\alpha^2 > 0$, it follows that $\partial x(\varphi,\alpha)/\partial\varphi < 0$ and, hence, $\partial U/\partial\bar{n} < |[\partial U/\partial \underline{n}(c,\bar{n})]\cdot(d\underline{n}(c,\bar{n})/d\bar{n})|$ if $\alpha \in (0,1)$. $\partial U/\partial\bar{n} = |[\partial U/\partial \underline{n}(c,\bar{n})]\cdot(d\underline{n}(c,\bar{n})/d\bar{n})|$ if $\alpha = 1$. Finally, $\partial x(\varphi,\alpha)/\partial\varphi > 0$ and $\partial U/\partial\bar{n} > |[\partial U/\partial \underline{n}(c,\bar{n})]\cdot(d\underline{n}(c,\bar{n})/d\bar{n})|$ if $\alpha \in (1,\infty)$.

The results of the pairwise comparisons show that, for any given α, the ordering of marginal utilities is independent of the levels of c, $\bar{n}$, and $\underline{n}(c,\bar{n})$. Hence, with exception of the special case $\alpha = 1$, the social entrepreneur directly or indirectly chooses the extreme levels of those two variables that show the highest marginal utility. Thus, combining the previous results, one obtains

$$\frac{\partial U}{\partial c} > \left|\frac{\partial U}{\partial \bar{n}} \cdot \frac{d\bar{n}}{dc}\right| \text{ and } \frac{\partial U}{\partial \bar{n}} < \left|\frac{\partial U}{\partial \underline{n}(c,\bar{n})} \cdot \frac{d\,\underline{n}(c,\bar{n})}{d\bar{n}}\right| \text{ if } \alpha \in (0,1),$$

$$\frac{\partial U}{\partial c} = \left|\frac{\partial U}{\partial \bar{n}} \cdot \frac{d\bar{n}}{dc}\right| = \left|\frac{\partial U}{\partial \underline{n}(c,\bar{n})} \cdot \frac{d\,\underline{n}(c,\bar{n})}{dc}\right| \text{ if } \alpha = 1, \text{ and}$$

$$\frac{\partial U}{\partial \bar{n}} > \left|\frac{\partial U}{\partial \underline{n}(c,\bar{n})} \cdot \frac{d\,\underline{n}(c,\bar{n})}{d\bar{n}}\right| \text{ and } \frac{\partial U}{\partial c} < \left|\frac{\partial U}{\partial \underline{n}(c,\bar{n})} \cdot \frac{d\,\underline{n}(c,\bar{n})}{dc}\right| \text{ if } \alpha \in (1,\infty).$$

Consequently, $c^* = b_{sr}$ and $\underline{n}(c^*,\bar{n}^*) = n_{min}$ if $\alpha \in (0,1)$, c^* and $\bar{n}^*$ can adopt any values that satisfy nonprofit-condition (2) if $\alpha = 1$, and $c^* = b(\underline{n}(c^*,\bar{n}^*))$ and $\bar{n}^* = n_{max}$ if $\alpha \in (1,\infty)$. **Q.e.d.**

***Proof of Proposition 2*:** Let l index the optimal choices for $\alpha \in (0,1)$ and h for $\alpha \in (1,\infty)$. The maximum number of recipients is given if the average subsidy margin to served individuals, $c - \int_{\underline{n}(c,\bar{n})}^{\bar{n}} b(n)dn \Big/ [\bar{n} - \underline{n}(c,\bar{n})]$, is minimal. Since $db(n)/dn < 0$ and c^* is constant for all $n \in [\underline{n}(c^*,\bar{n}^*),\bar{n}^*]$, a minimum average margin implies non-subsidization of the marginally wealthiest recipient, i.e.

(A7) $c^* - b(\underline{n}(c^*,\bar{n}^*)) = 0$,

which is, following the proof of proposition 1, fulfilled for $\alpha \neq 1$. Furthermore, for any two pairs c_i^*, $\bar{n}_i^*$ and c_j^*, $\bar{n}_j^*$ fulfilling (A7) and with $c_i^* > c_j^*$ and for all $\mu \in (0, n_{max} - \underline{n}(c_j^*,\bar{n}_j^*)]$, it holds that

(A8) $c_i^* - b(\underline{n}(c_i^*,\bar{n}_i^*) + \mu) \gtreqless c_j^* - b(\underline{n}(c_j^*,\bar{n}_j^*) + \mu)$ if $d^2b(n)/dn^2 \gtreqless 0$.

Consequently, if $d^2b(n)/dn^2 > 0$, then the average individual subsidy margin is minimal for the choices c_h^* and $\bar{n}_h^*(= n_{max})$ which implies the maximum number of served individuals $n_{max} - \underline{n}(c_h^*, n_{max})$. In contrast, if $d^2b(n)/dn^2 < 0$ then the choices $c_l^*(= b_{sr})$ and $\bar{n}_l^*$ imply the maximum number of recipients $\bar{n}_l^* - \underline{n}(b_{sr},\bar{n}_l^*)$. Finally, if $d^2b(n)/dn^2 = 0$, then we have $n_{max} - \underline{n}(c_h^*, n_{max}) = \bar{n}_l^* - \underline{n}(b_{sr},\bar{n}_l^*)$. **Q.e.d.**

***Proof of Proposition 3*:** From the proof of proposition 1, the order of the marginal utilities of c, $\bar{n}$, and $\underline{n}(c,\bar{n})$, as given in (A2), (A4), and (A6), is uniquely determined by α, and consequently independent of D. Thus, for $\alpha \in (0,1)$ an increase in D leads to

$c^{D*} = c^* = b_{sr}$ and $\underline{n}(c^{D*}, \bar{n}^{D*}) = \underline{n}(c^*, \bar{n}^*) = n_{min}$. Given these values, nonprofit-condition (2) is fulfilled if $\bar{n}^{D*} > \bar{n}^*$ which implies $\bar{n}^{D*} - \underline{n}(c^{D*}, \bar{n}^{D*}) > \bar{n}^* - \underline{n}(c^*, \bar{n}^*)$. In contrast, for $\alpha \in (1,\infty)$ the entrepreneur chooses $\bar{n}^{D*} = \bar{n}^* = n_{max}$ and $c^{D*} = b(\underline{n}(c^{D*}, \bar{n}^{D*}))$ which implies $c^{D*} > c^*$ and $\underline{n}(c^{D*}, \bar{n}^{D*}) < \underline{n}(c^*, \bar{n}^*)$ and, hence, $\bar{n}^{D*} - \underline{n}(c^{D*}, \bar{n}^{D*}) > \bar{n}^* - \underline{n}(c^*, \bar{n}^*)$. **Q.e.d.**

***Proof of Proposition 4*:** In the proof of proposition 1 we showed that the order of the marginal utilities of c, $\bar{n}$, and $\underline{n}(c,\bar{n})$, as given in equations (A2), (A4), and (A6), is uniquely determined by α, and hence independent of b_{sr}. Thus, for $\alpha \in (0,1)$ an increase in input costs, i.e. an increase in b_{sr}, leads to $c^{I*} = b_{sr}^I$ and $\underline{n}(c^{I*}, \bar{n}^{I*}) = n_{min}^I$. In contrast, for $\alpha \in (1,\infty)$ we obtain $\bar{n}^{I*} = n_{max}$ and $c^{I*} = c^*$, which implies a decrease in social-good quality. **Q.e.d.**

***Proof of Proposition 5*:** The proof of proposition 2 shows that the number of recipients is negatively correlated to the average subsidy margin $c - \int_{\underline{n}(c,\bar{n})}^{\bar{n}} b(n)dn \Big/ [\bar{n} - \underline{n}(c,\bar{n})]$ to served individuals. Since, according to proposition 4, condition (A7) is still fulfilled after input costs rise, i.e. $c^{I*} - b(\underline{n}(c^{I*}, \bar{n}^{I*})) = 0$, differences in the average subsidy margin between the two states are uniquely determined by the sign of $d^2b(n)/dn^2$. With $c_i^* = c^{I*}$, $\bar{n}_i^* = \bar{n}^{I*}$, $c_j^* = c^*$, and $\bar{n}_j^* = \bar{n}^*$ and, hence, $\mu \in (0, n_{max} - \underline{n}(c^*, \bar{n}^*)]$, it follows by condition (A8) that if $d^2b(n)/dn^2 < 0$ then the average individual subsidy margin is smaller for the choices c^{I*} and $\bar{n}^{I*}$ which implies $\bar{n}^{I*} - \underline{n}(c^{I*}, \bar{n}^{I*}) > \bar{n}^* - \underline{n}(c^*, \bar{n}^*)$. In contrast, if $d^2b(n)/dn^2 > 0$ then $\bar{n}^{I*} - \underline{n}(c^{I*}, \bar{n}^{I*}) < \bar{n}^* - \underline{n}(c^*, \bar{n}^*)$. Finally, if $d^2b(n)/dn^2 = 0$ then we have $\bar{n}^{I*} - \underline{n}(c^{I*}, \bar{n}^{I*}) = \bar{n}^* - \underline{n}(c^*, \bar{n}^*)$. **Q.e.d.**