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Understanding debt capital providers' preferences is crucial to raising capital and developing adequate financial models for Photovoltaic (PV) projects. This paper elaborates on the relevance of PV project attributes for providing debt capital. Within an explorative research set-up we ask: What kinds of PV projects do debt capital providers prefer to finance? We contribute to this question by reporting from an Adaptive Choice Based Conjoint experiment with German experts in renewable energy project financing (banks, savings banks, consultants, and project developers). Our survey is still online, thus, results are preliminary. We report from a sample size of 447 choice tasks that have been conducted by 11 interviewees as yet. We find that Debt Service Cover Ratio (DSCR), as assumed "hard fact", is of lowest importance. In turn, using premium brand technology rather than low cost technology is of utmost importance. Overall, we find debt capital providers to be risk averse. Their favour of premium brands is only one reference for that. Moreover, they opt for project initiators who provide for disposal of the generated electricity. Hence, they prefer regional and multinational utilities to be involved in projects. Project initiators like service providers, vertical integrated manufacturers, and financial investors even deter debt capital providers. Additionally, they appreciate an all-inclusive maintenance concept (with system inspection and system monitoring). Regarding capacity we learn that project sizes of 1 MWp-5 MWp are most attractive, followed by projects with above 10 MWp capacity. Small projects of 200 kWp-1 MWp and projects between 5 and 10 MWp have negative impact on choices. Our findings on debt capital providers' preferences contribute to project development practice and research with special regard to financing green energy technologies.

Keywords: renewable energy, photovoltaic, business models, project financing

1. Problem

An increasing concern for photovoltaic (PV) projects is a shortage of capital in the medium term (e.g. Jäger-Waldau 2009; Schwabe et al. 2009). PV project financing is an urgent research topic due to a fundamental lack of knowledge about how debt capital providers evaluate this kind of infrastructure projects. Moreover, after recent turbulences on the financial markets it is somehow open how the availability of capital for renewable energy projects will develop (e.g. Böttcher 2009; Schwabe et al. 2009). This leads to new uncertainties and risks for the development of renewable energies in general and PV projects in particular.

Financing models are decisive for medium and large-scale PV projects since each one has an individually optimal ratio of equity and debt capital. Most projects have in common a significant dependency on debt capital ("highly-geared" projects): Practitioners assume debt ratios of up to 80% or even 90%, whereas the optimum varies from case to case (e.g. Johnson 2009; Böttcher 2009). As there is only limited academic research on project attributes and their relevance for raising debt capital, the focus is on debt capital providers' preferences for variant PV project types. This research addresses an important gap: Today, information on the willingness to provide debt capital contingent on single project attributes is missing. Practitioners could use the insights from our research to design projects and raise debt capital more effectively; an approach to mainstreaming investments in green energy technologies.

PV project attributes include a multitude of parameters such as capacity, module and inverter brand, maintenance concept, and different economic indicators. From a lender's perspective Debt Service Cover Ratio (DSCR) is of utmost importance. DSCR and related indicators are decisive economic "hard facts" (e.g. Grosse 1990; Reuter & Wecker 1999). Going beyond commonly discussed attributes and indicators, a hardly discerned aspect is the project initiator's business model. Examples are vertically integrated PV manufacturers, financial investors, service providers, and regional or multinational utilities. The underlying assumption is that if offered alternate PV projects, the initiator's business model can make a difference for lenders' decisions.

Our explorative research approach addresses the following research question: *What kinds of PV projects do debt capital providers prefer to finance?* We seek to answer this question by conducting an Adapted Choice Based Conjoint experiment (ACBC) (Johnson et al. 2003; Johnson & Orme 2007) with German experts in renewable energy project financing (banks, savings banks, consultants, and project developers).

Although Conjoint experiments are widely used in marketing research (e.g. Louviere et al. 2003) and for exploring investment behaviour (e.g. Clark-Murphy & Soutar 2004), scholars in renewable energy investment apply this method lately (e.g. Oschlies 2007). For the first time this paper investigates debt capital providers' preferences and uses ACBC which combines Adaptive Conjoint Analysis and Choice Based Conjoint (Johnson et al. 2003; Johnson & Orme 2007).

We proceed as follows: First, the theory section evolves state-of-the-art knowledge on PV project financing. Second, we discuss ACBC as our chosen data collection method and derive project attributes and levels for the experiment as presented in the theory section. Our survey is still online, thus, results are preliminary. We report from a sample size of 447 choice tasks that have been conducted by 11 interviewees as yet. We find that Debt Service Cover Ratio (DSCR), as assumed "hard fact", is of lowest importance. In turn, using premium brand technology rather than low cost technology is of utmost importance. Overall, we find debt capital providers to be risk averse. Their favour of premium brands is only one reference for that. Moreover, they opt for project initiators who provide for disposal of the generated electricity. Hence, they prefer regional and multinational utilities to be involved in projects. Project initiators like service providers, vertical integrated manufacturers, and financial investors even deter debt capital providers. Additionally, they appreciate an all-inclusive maintenance concept (with system inspection and system monitoring). Regarding capacity we learn that project sizes of 1 MWp-5 MWp are most attractive, followed by projects with above 10 MWp capacity. Small projects of 200 kWp-1 MWp and projects between 5 and 10 MWp have negative impact on choices. These and further aspects are discussed in the last section of this paper where implications for practice and theory are derived.

2. Theory

2.1 Project Financing

Project financing is crucial for renewable energies (dena 2004; Böttcher 2009, 9-11). For two reasons: First, this industry is still determined by small and medium sized enterprises which need debt capital to realize more extensive ventures (Böttcher 2009, 15). Second, for decades project financing is an established method for one-time ventures such as infrastructure projects (e.g. Backhaus et al. 1990; Reuter & Wecker 1999). For the case of Germany, project financing is commonly applied for medium- and large-scale PV (Grell & Lang 2008, 37).

Advantages are e.g. flexible combinations of different financial, personal and material resources, as well as risk sharing among the parties involved. A plurality of project parties is necessary due to multifaceted technical and economical project development tasks. "Projectizing" (Reuter & Wecker 1999, 9) combines challenges like facility development and installation, reliable revenue forecasts, thorough quality assurances, and as well complex project financing tasks.

In contrast to a firm a project is based on a singular and non-cyclical undertaking. It can have a limited lifetime, serves very specific project targets, and has separable financial, personal and material resources brought in by diverse project stakeholders (e.g. Backhaus et al. 1990; Reuter &

Wecker 1990; Nevitt & Fabozzi 2000). These aspects often lead to the foundation of an independent, legally responsible, and creditable project company—the so called "Special Purpose Vehicle" (SPV) (Grell & Lang 2008, 37). SPVs for renewable energies have to cope with technical complexities, political uncertainties, and have to be economically viable at the same time. These challenges have to be accepted under circumstances of project development and project financing.

Three significant characteristics of project financing are often discussed in literature (e.g. Reuter & Wecker 1999; Nevitt & Fabozzi 2000; Böttcher 2009):

- Off-Balance-Financing, i.e. a financing method separated from the individual or corporate books of the financially involved project stakeholders;
- An orientation towards future project Cashflows which are the only source of economic performance and security;
- A complex network of project parties and a mesh of contracts to provide for broad risk sharing and risk reduction.

Off-Balance-Financing implies that financially involved project parties separate the PV project from their books and establish an SPV. Debt capital is brought to the SPV's books and thus does not influence the project parties' accounting and balance sheet indicators directly—also depending on accounting standards (Böttcher 2009, 21-22). Since the SPV does not possess further assets and since there is no track record, debt capital providers have to rely on future performance solely. That is, in any case future project Cashflows have to provide for debt service and returns on equity (*Cashflow Related Lending*) since a financial liquidation of a PV power plant is complicated and unprofitable (Grell & Lang 2008, 37; Böttcher 2009, 22-23). Lenders usually apply indicators such as Debt Service-, Loan Life- or Project Life Cover Ratio (Grosse 1990, 47-48;

Grell & Lang 2008, 70) (see below). In a project constellation different degrees of recourse can be negotiated (Full-, Limited-, Non-Recourse Lending; Böttcher 2009, 34-35), which can lead to higher credit costs and necessitate broad risk sharing among project parties (*Risk Sharing*). Nevertheless, the main purpose of project financing is the acquisition of large shares of debt capital (Böttcher 2009, 19).

When developing a PV project and its financial concept, at least two aspects have to be taken into account. First, renewable energies are politically determined and reliant upon legal and regulatory frameworks as well as political programs (dena 2004). Second, the credit crunch which peaked in late 2008 changed financial markets, their rules, and related policies (e.g. Schwabe et al. 2009; Jäger-Waldau 2009). Böttcher assumes that the impact on renewable energy project financing is twofold (Böttcher 2009, 14-15): On the one hand, this asset class will continue to grow as it is independent from economic trends. Financing costs will increase, but simultaneously other investment costs will decrease due to falling commodity prices. That is, there is change but stability. On the other hand, projects with somehow higher risks will be rescheduled (e.g. technical, legal, and regulatory risks). Moreover, project initiators and financiers will vary due to decreasing activities of pure financial investors and assumingly increasing activities of players like utilities. That is, the structure of project stakeholders will diversify.

Consequently, the task of "projectizing" is to design a PV project in a way that addresses the above mentioned complexities, market and policy changes, and allows for raising debt capital. Moreover, manifold stakeholders have to be integrated into processes of project development and financing. The initiator is the most important stakeholder at first (Grell & Lang 2008).

2.2 Initiators' Business Models

The project initiator comes up with the project idea, identifies further project parties, negotiates, concludes contracts, and thus actively designs the SPV. These activities also determine the value network surrounding the PV project (Frantzis et al. 2008). It can be assumed that the value network layout is directly influenced by the initiator's business model.

To define possible initiators' business models we refer to two recent studies (Frantzis et al. 2008; Schoettl & Lehmann-Ortega 2010). Somehow, both define business models with a conceptual reference to the business logic of "money-making", "profit earning" (Frantzis et al. 2008), and "the mechanisms enabling a firm to create value" (Schoettl & Lehmann-Ortega 2010). Generally, the business model serves practical purposes and helps managers "to capture, understand, communicate, design, analyze, and change the business logic of their firm" (Osterwalder et al. 2005, 19); but it also offers conceptual and theoretical perspectives for scientific analyses (e.g. Amit & Zott 2001; Zott & Amit 2007; 2008). Since the business logic of money-making, respectively value creation, is a widely agreed on aspect of business models, we will follow these approaches and define a business model using a practice oriented definition: "A business model describes the rationale of how an organization creates, delivers, and captures value." (Osterwalder & Pigneur 2009, 14)[1]

Frantzis et al. (2008) discuss PV business models starting from the PV supply chain and value networks. Their analysis leads to models which differ in terms of ownership (facility owner: end-user, third party, utility) and application (application context: residential, commercial, grid-sited).

[1] Without discussing conceptual details in this paper, it has to be added that the business model's essence becomes clear when its constituent elements and differences to other business and management concepts are considered (e.g. Magretta 2002; Afuah 2004; Belz & Bieger 2006). However, according to Osterwalder (2004) or Ballon (2007) every business model is built on constellations of value proposition, customer interface, infrastructure, and cost and revenue streams. These elements are configured according to a firm's dominant business logic. The question here is, which business logic and business model configurations make a difference in the PV project context?

Due to fundamental differences in the regulatory frameworks in the US and Germany (Günnewig et al. 2008, 44-49; Bolinger et al. 2009) their business models cannot be used in this study. Nevertheless, their conceptual work serves as point of orientation. Accordingly, we start from the PV value chain; afterwards we discuss generic models for the German market based on Schoettl & Lehmann-Ortega (2010).

The latter authors deduce six generic PV business models by means of supply chain deconstruction (Schweizer 2005).[2] Similar to Frantzis et al. (2008) these models are defined by ownership and application, whereas ownership is a continuum of pure ownership and pure service, and application is classed with residential, commercial, and ground mounted. Since our survey is limited to financing ground-mounted PV systems we focus on three generic models with direct reference to this system type (Schoettl & Lehmann-Ortega 2010). These models are not exclusive; i.e. a Large PV Facility Operator may also ask services from the other types.

- Value Added Service Provider: "The player offers a value added service such as project development and consulting. He can be either specialized in one step in the value chain or act as an orchestrator, but he doesn't own the facility."
- Construction & Installation Service Provider: "The player offers a service with less added value as the [Value Added Service Provider]. He offers the construction and installation service to final customers or to orchestrators. The main competency is local project management."

[2] The six generic business models are: Hassle Free Project, Complementary Revenue Provider, Value Added Service Provider, Construction and Installation Service Provider, Large PV Facility Operator, Energy Controller. We do not discuss all of these types. We refer to the ones relevant for ground-mounted systems. For further information on generic and more detailed models see Schoettl & Lehmann-Ortega 2010.

- Large PV Facility Operator: “The player owns the large PV facility: he is an energy producer. He has build the facility all himself or acted as an orchestrator. Main competencies are ability to deal with large projects and to raise cash to finance them.”

To get easy to handle and independent attributes for the ACBC experiment we distinguish two basic types being related to ground mounted systems: Service Provider and Large PV Facility Operator; i.e. in a first step we condense the service models and then simply differentiate ownership and non-ownership. Service Providers are non-owners according to their business of providing value added services for projects. Large PV Facility Operators are basically defined as owners since their business is energy production (Schoettl & Lehmann-Ortega 2010). Finally, due to latest discussions we identify four different initiators who can be owners and Large PV Facility Operators now and in the future. As fifth type we add a non-owner type comparable to Service Providers. These five initiator types and their business models possibly make a difference from a debt capital provider’s perspective (Table 1).

Insert Table 1 about here

As discussed above we refer to initiators’ business models. Assumingly, these determine the business logic of how value is created, delivered, and captured with a PV facility. How do initiators’ business models and projects relate? Not PV projects themselves “have” business models. Projects, respectively SPVs, are assets for initiators’ value creating activities which are conducted according to their business models.

3. Further Specifics of Photovoltaic Projects

3.1 Technological Aspects

The generator is the heart of each PV facility. It consists of an amount of PV modules which are made from solar cells based e.g. on crystalline silicon or different kids of thin film materials. This generator produces direct current (DC) which has to be transformed into alternating current (AC) by the DC-to-AC inverter which feeds the electricity into the grid. The third basic component is the mounting system which has to guarantee for stability in cases of stress, e.g. caused by wind or snow. Moreover, the mounting can be used as tracker system to follow the sun's eclipse.

These components' quality is decisive for a PV facility's performance in terms of efficiency, effectiveness, and long-term reliability. Therefore, brands, certificates, producers' references and long-term experiences are indicators for technological quality (Grell & Lang 2008; Böttcher 2009). Thus, for projects we find two generic possibilities. First, one can choose technology (e.g. modules and inverters) of superior quality and pay a price premium for that technology. This option may be operationalized as premium brand. The second option is to save the price premium and integrate low cost technology (accepting the risk of additional costs of inferior quality).

3.2 System Capacity

Capacity is a crucial physical characteristic of PV systems, determining not only investment volume but also efficiencies of scale and thus cost effectiveness. Within this survey we seize on different capacity ranges which should be of relevance for financing ground mounted PV systems in Germany. We therefore refer to Lenardič's classification of PV power plant sizes (Lenardič

2009).[3] For his annual review he defines seven classes: 200 kWp-500 kWp, 500 kWp-1 MWp, 1 MWp-3 MWp, 3 MWp-5 MWp, 5 MWp-10 MWp, 10 MWp-20 MWp, > 20 MWp.

Another clue for ACBC attribute construction might be the German funding scheme according to the Renewable Energy Sources Act 2009 (EEG). The EEG distinguishes installations which are ground mounted (lower tariff[4]) from those being attached to or on top of buildings (higher tariff[5]). For the latter the EEG defines feed-in tariffs depending on system capacity, whereas for ground mounted PV plants a general tariff is applied. That is, the EEG does not incite decisions for special capacities of ground mounted systems.

We follow Lenardič's (2009) classification in a slightly modified way. Our system capacity attribute classes medium- and large-scale ground mounted PV systems with four categories: 200 kWp-1 MWp, 1 MWp-5 MWp, 5 MWp-10 MWp, > 10 MWp.

3.3 Quality Assurance

Following Grell & Lang (2008), an extensive quality assurance is the most important prerequisite for financing PV projects since its end is to assure Cashflows. Elements of quality assurance are revenue forecasts, performance assessments, inspections, monitoring, and operations control.

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[3] pvresources.com lists the 1,000 largest installations, ranging from 1 to 60 MWp capacity. The world's largest installation is the Spanish "Parque Fotovoltaico Olmedilla de Alarcón" (60 MWp, located nearby Olmedilla, Castilla-La Mancha).

[4] EEG 2009 Section 32 (1) defines the tariff as follows: (1) The tariff paid for electricity from installations generating electricity from solar radiation shall amount to 31.94 cents per kilowatt-hour. (Note: All tariffs are subject to the degression rules of section 20. That is, the tariffs mentioned are only valid for installations which are put into operation in 2009.)

[5] EEG 2009 Section 33 (1) structures the tariff as follows: 1. 43.01 cents per kilowatt-hour for the first 30 kilowatts of output, 2. 40.91 cents per kilowatt-hour for output between 30 and 100 kilowatts, 3. 39.58 cents per kilowatt-hour for output between 100 kilowatts and 1 megawatt, and 4. 33.0 cents per kilowatt-hour for output over 1 megawatt.

Revenue forecasts are the core of planning a PV facility technically as well as financially. While technical planning has to develop a system which suites local conditions and thus optimizes relative energy yield (e.g. in terms of size, cell type, inverter concept, mounting), the planning task from a financial point of view is to assure the desired rates of return (for initiators, sponsors, and further equity investors) and coverage ratios (for debt investors). Consequently, revenue forecasts are fundamental to every PV project. A thorough quality assurance concept includes further measures to back this fundament.

Producers refer to Standard Test Conditions (STC) to declare nominal module capacity. Since technical and financial performance of a project is directly linked to the modules' effectiveness and reliability, independent reviewers should assess declarations and variances of actual capacities. Moreover, performance assessments of installed and activated systems are necessary since PV power plants work under empirical circumstances different from STC. Mandatory for inspection purposes is the availability of documentaries and protocols to check planning and real data when the system has been installed. Such inspections can be improved by means like thermal imaging to identify deficiencies such as damaged modules, wrong wiring, or insufficiently calibrated inverters. At least, a quality assurance concept needs permanent monitoring and automated operations control to monitor the actual Performance ratio (PR) and to recognize malfunctions immediately. Thus, aspects of quality assurance (like system inspection and system monitoring) should be considered within a conjoint experiment.

3.4 Economic viability

According to the idea of project financing (Off-Balance-Financing, Cashflow Related Lending, Risk Sharing) credibility depends on the project itself and its Cashflows. That is, with regard to negotiated recourse (Full-, Limited-, Non Recourse) project Cashflows are the main security for debt capital providers. Therefore, to evaluate a project from a lender's perspective special indicators are used to estimate different coverage ratios.

Insert Table 2 about here

Basically, a ratio of 1.0 indicates exact coverage of debt service. If Cashflows are sufficient the ratio exceeds 1.0; if not, it falls below. The coverage ratios mentioned in Table 2 differ in the periods they take into account (Grosse 1990, 47-48; Böttcher 2009, 129-130): LLCR focuses on debt service during the life of loan. PLCR asks for Cashflows during the project's lifetime. DSCR refers to the relation of gross Cashflow and debt service on a yearly basis and thus varies with different project phases. To prevent annual shortages this indicator has to be applied in any case; it is even acceptable to use DSCR alone (Böttcher 2009, 126). For renewable energy projects Böttcher (2004) as well as Grell & Lang (2008) refer to a minimum DSCR of 1.3; i.e. lenders always charge a minimum contingency reserve.

Practical examples of PV project calculations illustrate the range of DSCR from roughly 1.0 to 3.0 and above (Grell & Lang 2008; Böttcher 2009). Therefore, to create a DSCR attribute for the ACBC experiment we apply three average DSCRs to offer different degrees of overall credibility.

4. Method

4.1 Adaptive Choice-Based Conjoint

What kinds of PV projects do debt capital providers prefer to finance? To answer our research question we conduct an online Adapted Choice Based Conjoint experiment with bank managers from Germany who are responsible for providing debt capital for PV projects.

Conjoint experiments have been widely discussed earlier and we refer to corresponding literature for an overview (Louviere et al. 2003; Train 2003). With its roots in marketing research Conjoint experiments are used for exploring investment behaviour as well (Clark-Murphy & Soutar 2004; Oschlies 2007; Riquelme & Rickards 1992; Shepherd & Zacharakis 1999). Recently, scholars in renewable investment start to apply Conjoint experiments for elaborating on renewable energy investors' preferences (e.g. Oschlies 2007). For the first time this paper investigates debt capital providers' preferences and uses the Adaptive Choice Based Conjoint tool from Sawtooth Software to perform choice tasks. Being available lately, ACBC combines advantages of Adaptive Conjoint Analysis (ACA) and Choice Based Conjoint (CBC) methods (Johnson et al. 2003; Johnson & Orme 2007).

Important advantages of ACBC compared to CBC are "a more stimulating experience that will encourage more engagement in the interview than conventional CBC questionnaires, [the possibility] to screen a wide variety of product concepts, but focus on a subset of most interest to the respondent, [and finally the possibility to] provide more information with which to estimate individual partworths than is obtainable from conventional CBC analysis" (Johnson & Orme 2007, 4). An additional benefit from increased information is that ACBC is especially beneficial for small sample sizes (Johnson & Orme 2007, 18) and therefore fits our requirements. We analyse the choice results by calculating Hierarchical Bayesian (HB) Analysis estimation which allows for calculating data on an individual level (Otter 2007).

The basic idea within choice experiments is that survey participants seek to choose the alternative with the highest utility. Each alternative within the experiment is described by attributes and attribute levels which are the sources of utility.

Utility of an alternative a: $Ua = Va + \varepsilon a$[6]

Conjoint experiments display partworths, i.e. values which indicate a distinct attribute's contribution to the total utility of an alternative. In our experimental set-up we ask debt capital providers to consider different PV projects which are comparable but differ in some aspects (these are our attributes and levels). In the *Build Your Own* section we ask to design the PV project the interviewee would be most likely to finance. In the *Screening* section four different projects have to be evaluated as being "A possibility" or "Won't work for me". Finally, in the *Choice Task* section three different projects are presented of which only one can be chosen (see Appendix). Depending on participants' choices we then are able to bring out the partworths debt capital providers allocate to certain PV project attributes and levels.

Based on the specifics of PV project financing as presented in the theory section we derive six attributes and corresponding levels for the ACBC experiment (Table 3). The experiment is restricted to fictitious medium- and large-scale ground mounted PV facilities being subject to the German Renewable Energy Sources Act (EEG). These restrictive assumptions and our clear focus help increase the degree of rigor.

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[6] V_a = systematic utility (function of observable variables), ε_a = Random utility component (not observed influences)

Insert Table 3 about here

4.2 Sample

Our sample consists of institutions from the conventional finance industry, from the field of sustainable finance, free financial advisors, and renewable energy project companies. The intended sample size is about 30 interviewees who attend the experiment via an online questionnaire. We reached out for the participants first by phone and via e-mail. Our survey has just opened and we are in the beginning of data collection. We report from a sample size of 447 choice tasks that have been conducted by 11 interviewees as yet.[7] The sample size is small due to the participants' high scope. Nevertheless, this high scope contributes to consistency and is beneficial for our findings.

Within the last three years 27.3 % of the respondents' companies financed PV projects exceeding € 500 Million total volume. A volume of € 100-500 Million was financed by another 27.3 %. 45.5 % of respondents' companies financed PV projects with a total volume of up to € 100 Million Euros within the last three years. 54.5 % of the companies operate in Europe. 27.3 % operate in Germany, Austria, and Switzerland only; 18.2 % operate within a global context. All companies have their headquarters in Europe. The interviewees work in various positions in renewable energy project financing (e.g. Executive Director Renewable Energies, Head of Project Financing, Project Manager, Structured Finance Specialist). Most respondents show more than 5 years

[7] We target a final sample size from above 1200 tasks performed by over 30 practitioners and expect to reach that sample size and close the survey by January 31, 2010.

of personal experience in renewable energy financing (54.6 %). 36.4 % have 2-4 years, and 9.1 % have less than 2 years of experience.

5. Preliminary Results

The questionaire is still open and the ACBC experiments are conduted presently. Hence, our results are preliminary. We report from a sample size of 447 choice tasks that have been conducted by 11 interviewees as yet. Table 4 displays the main results as average utilities based on HB estimates. The relatively high standard deviation reflects the temporary small sample size.

Insert Table 4 about here

Displaying the results for attributes only (without the single levels' utility) we see that *DSCR,* as assumed "hard fact", is of lowest importance for debt investors' choices. Of primary importance is the *premium brand/low cost* attribute (Figure 1). Zooming in on the values of different attribute levels we learn about details of debt capital providers' preferences for PV projects (Figure 2). Positive values indicate positive utilities and, thus, a positive impact on lenders' choices, whereas negative values point to aversion to attribute levels.

Insert Figure 1 about here

Insert Figure 2 about here

In the following section we elaborate on different project attributes to understand their value with reference to lenders' preferences to provide debt capital for PV projects.

6. Discussion

Displaying the results for attributes only (without the single levels' utilities) we see that DSCR, as assumed "hard fact", is of lowest importance for debt investors' choices. Of primary importance is the premium brand/low cost attribute (Figure 1). Zooming in on the values of different attribute levels we learn about details of debt capital providers' preferences for PV projects (Figure 2). Overall debt capital providers seem to be risk averse. Their favour of premium brand is only one reference for that. Additionally, they appreciate an all-inclusive maintenance concept with system inspection and system monitoring. Moreover, they opt for project initiators who provide for disposal of the generated electricity. Hence, they prefer regional and multinational utilities to be involved in projects. Project initiators like service providers, vertical integrated manufacturers, and financial investors even deter debt capital providers. Regarding capacity we learn that project sizes of 1 MWp-5 MWp are most attractive, followed by projects with above 10 MWp capacity. Small projects of 200 kWp-1 MWp and projects between 5 and 10 MWp have negative impact on choices. Finally, we see an inverted U-curve relationship for the optimal equity ratio peaking between 20 % and 30 %, but being slightly closer to a ratio of 20 % equity (Figure 2).

Several practical conclusions can be drawn even from these preliminary results. On the one hand, realizing photovoltaic based on a "Special Purpose Vehicle" allows for flexibly combining financial, personal and material resources; if risks and financing structures are handled in a smart way, a PV venture can obtain large shares of debt capital. On the other hand, the technical and economical characteristics of photovoltaic along with the task of "projectizing" bear significant challenges. Consequently, the most important one is to simultaneously meet equity investors' and lenders' expectations (e.g. in terms of IRR and DSCR) with a one-shot venture. Therefore, project developers might want to design projects which propose low risk. In particular they could decide to integrate premium brand components rather than using low cost technology. Moreover, based on our findings we encourage project developers to co-operate with regional or multinational utilities already in the project planning stage. We argue that the involvement of utilities improves the likelihood to attract sponsors significantly. In practice we latterly see vertical integrated manufacturers acting as project initiators. Our survey (as yet) does not proof such initiatives to be valuable from a debt capital provider's perspective. Finally, we encourage project developers to "projectize" PV ventures with a capacity that meets lenders' preferences. In this regard there seems to be potential for projects with a capacity between 1 MWp and 5 MWp.

We want to draw special attention to the value of the project initiator's business model. As discussed above, the initiator is the most important stakeholder at first. He comes up with the project idea, identifies further project parties, negotiates terms, concludes contracts, and thus actively designs the SPV. Therefore, these activities determine the value network and the stakeholder constellation surrounding the PV project. Due to current changes in political settings (new German government) and funding schemes (severe reduction of PV tariffs) lender's preferences might shift from costly premium brands to cost-conscious system components. According to the idea of project financing other risk sharing and assurance concepts besides trust in premium brands will have to be developed. A tendency of "trust in utilities" might result. As our findings show, regional as well as well multinational utilities and their business models of energy production and distribution might play a crucial role for PV project financing in the near future.

Our research faces some limitations. Besides the temporarily small sample size which provides some constraints (e.g. impossibility of segmentation analysis on whether project evaluations differ among different project sponsors) we find a main limitation in the experimental set-up. Experiments reduce the real-world complexity drastically. Especially in the context of decision-making this is not unquestioned. We know that various aspects which have not been included might also impact debt capital providers' choices. For instance, important aspects are discussed in behavioural economics and refer e.g. to group-dynamic determinants of decision-making (e.g. herding).

Being aware of these limitations we state some recommendations for future work. Our experiment can be a first step to understand debt capital providers' preferences for renewable energy projects. Future research may build on that and could consider further determinants of decision-making and thus extend our understanding of how lenders decide about project financing. Drawing comparisons between debt capital providers' preferences from different cultural and policy backgrounds could be more than interesting — understanding such determinants could even be decisive in contexts of global project financing. Finally, comparisons of whether and how project sponsors and project managers preferences differ could be exiting (e.g. within a gap analysis). Identifying ways of bridging differences in preferences and therefore facilitating renewable energy project financing could be possible based on such approaches. Consequently, further research on project financing and debt capital provision could significantly contribute to the diffusion of renewable energy.

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APPENDIX

Screenshot 1: Screening section

Here are a few PV projects you might like. For each one, indicate whether it is a possibility or not.

(1 of 6)

Debt Service Cover Ratio (average)	1.2	1.2	1.5	1.5
Capacity	1 MWp-5 MWp	200 kWp-1 MWp	> 10 MWp	1 MWp-5 MWp
Brand	Low Cost solar cells and Low Cost inverter	Low Cost solar cells and Premium Brand inverter	Low Cost solar cells and Low Cost inverter	Premium Brand solar cells and Premium Brand inverter
Initiator's Business Model	Vertical Integrated Manufacturer	Regional Utility	Service Provider	Vertical Integrated Manufacturer
Maintenance Concept	System Inspection and System Monitoring	System Inspection	System Monitoring	System Inspection
Equity	20 %	10 %	10 %	10 %
	A possibility Won't work for me	A possibility Won't work for me	A possibility Won't work for me	A possibility Won't work for me

Next

Screenshot 2: Choice task section

Among these three, which is the best option? (We've grayed out any features that are the same, so you can just focus on the differences.)

(1 of 10)

Debt Service Cover Ratio (average)	1.2	1.2	1.2
Capacity	5 MWp-10 MWp	200 kWp-1 MWp	1 MWp-5 MWp
Brand	Low Cost solar cells and Low Cost inverter	Low Cost solar cells and Premium Brand inverter	Low Cost solar cells and Low Cost inverter
Initiator's Business Model	Service Provider	Multinational Utility	Vertical Integrated Manufacturer
Maintenance Concept	System Inspection	System Inspection and System Monitoring	System Inspection
Equity	10 %	30 %	30 %

Next

TABLE 1

PV Project Initiator's Business Model

Initiator's PV Business Model		Reasoning
Owner	**Regional Utility**	Utilities' roles in renewable energy supply chains (in the PV industry in particular) is one of the most dynamic topics with regard to their future strategies and business models (e.g. AT Kearney 2007; Accenture 2008; Frantzis et al. 2008; PWC 2009; Schoettl & Lehmann-Ortega 2010).
	Multinational Utility	Undoubtedly, with increasing market shares of renewables utilities as market players will more and more influence and shape this green industry. Following Böttcher (2009) utilities will soon be important project stakeholders. Lenders might perceive project credibility differently if the utility is an international "big player".
	Financial Investor	The US market faces significant shifts in equity investments: "In early 2009, approx. four to six traditional investors remain active [of twenty]. The new deals getting financed are the best projects with solid management teams … New investors could emerge." (Schwabe et al. 2009) Böttcher (2009) assumes similar developments for Germany.
	Vertically Integrated PV Manufacturer	Initiators often come from the downstream PV supply chain segments (e.g. project developers), but also from related and other industries like the above mentioned utilities and financial investors. Recently, market players from the upstream segments (e.g. cell or module manufacturers) act as project initiators, respectively sponsors; i.e. they integrate the PV supply chain.
Non-Owner	**Service Provider**	This initiator is not an owner of the finally realized PV power plant. He offers a value added service such as project development, consulting, construction and/or installation. He can either be specialized in one step in the supply chain or act as an orchestrator.

TABLE 2

Coverage Ratios for Project Evaluation from a Lender's Perspective

Indicator		Interpretation
LLCR =	$\frac{\text{NPV of Cashflows of Loan Lifetime}}{\text{Outstanding Debt}}$	• Loan Life Cover Ratio • refers to the ability of debt service *during the life of loan*
PLCR =	$\frac{\text{NPV of Cashflows of Project Lifetime}}{\text{Credit Amount}}$	• Project Life Cover Ratio • refers to the ability of debt service *during the project lifetime*
DSCR =	$\frac{\text{Cashflow of Period + Interest Payment}}{\text{Repayment + Interest Payment of Period}}$	• Debt Service Cover Ratio • refers to the ability of debt service *on an annual basis*

TABLE 3

ACBC Attributes and Levels for Choice Experiments

Attribute	Levels
Debt Service Cover Ratio (Average)	1.2 1.5 1.8
Capacity	200 kWp-1 MWp 1 MWp-5MWp 5 MWp-10 MWp > 10 MWp
Brand	Low Cost Solar Cells and Low Cost inverter Low Cost Solar Cells and Premium Brand inverter Premium Brand Solar Cells and Low Cost inverter Premium Brand Solar Cells and Premium Brand inverter
Initiator's Business Model	Vertical Integrated Manufacturer Regional Utility Multinational Utility Financial Investor Service Provider
Maintenance Concept	System Inspection Constant System Monitoring System Inspection and System Monitoring
Equity	10 % 20 % 30 %

TABLE 4

HB Average Utilities (Zero-Centered Diffs)

Average Utilities (Zero-Centered Diffs)	Average Utilities (HB)	Standard Deviation
1.2	*-14.85*	*19.37*
1.5	*-8.77*	*24.48*
1.8	*23.62*	*10.38*
200 kWp-1 MWp	*-21.16*	*55.24*
1 MWp-5 MWp	*20.30*	*20.75*
5 MWp-10 MWp	*-5.20*	*40.62*
> 10 MWp	*6.06*	*33.63*
Low Cost solar cells and Low Cost inverter	*-100.67*	*23.92*
Low Cost solar cells and Premium Brand inverter	*-29.79*	*20.21*
Premium Brand solar cells and Low Cost inverter	*29.02*	*18.25*
Premium Brand solar cells and Premium Brand inverter	*101.45*	*26.63*
Vertical Integrated Manufacturer	*-10.64*	*19.07*
Regional Utility	*21.13*	*17.62*
Multinational Utility	*25.43*	*23.50*
Financial Investor	*-25.14*	*17.98*
Service Provider	*-10.79*	*20.23*
System Inspection	*-20.73*	*22.68*
System Monitoring	*-20.97*	*26.28*
System Inspection and System Monitoring	*41.70*	*23.78*
10 %	*-60.35*	*20.48*
20 %	*37.76*	*12.24*
30 %	*22.59*	*13.24*

FIGURE 1

Average Utilities (Zero-Centered Diffs)

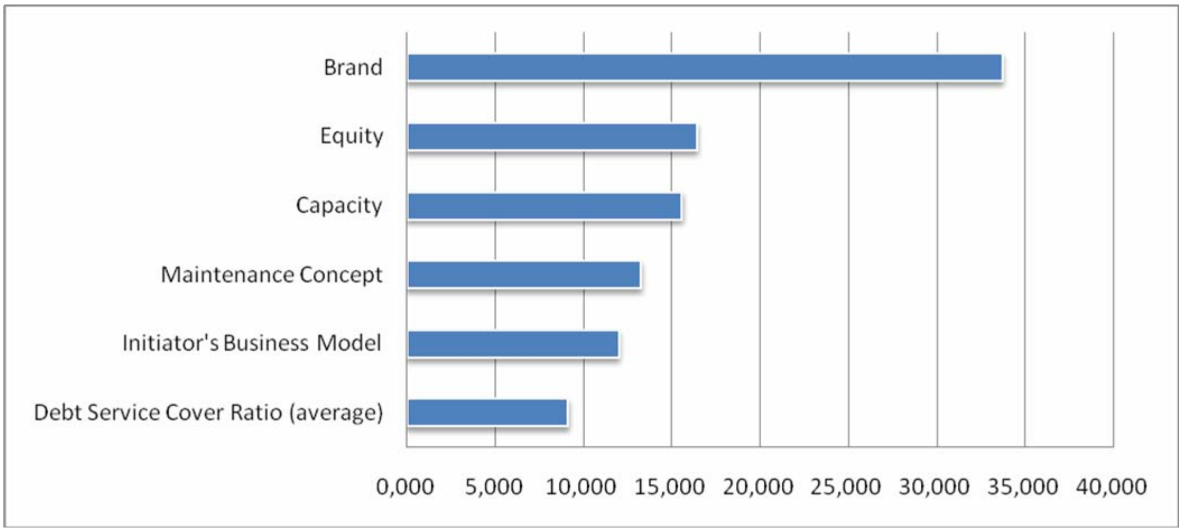

FIGURE 2

Zero-Centered Diffs (Attribute Levels)