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Exploring the micro-foundations of Public-Private Interactions for the diffusion of new technologies - the case of wind power in emerging markets

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Abstract

One of the key challenges of designing renewable energy policies is to measure and predict the effects of regulation on investment flows. When designing these policies, public authorities aim at attracting domestic and foreign companies along the value chain while minimizing overall costs of the energy infrastructure. However, even with originally good intentions, these efforts can lead to power projects that are not commercially viable. This paper builds a bridge between private sector actors and public authorities by revealing the preferences of the former for different, uncertain regulatory framework conditions. More specifically, we investigate decisions by project developers in wind energy investments in emerging economy contexts. By applying a simple, jet effective method for our questionnaire as well as qualitative

measures this study makes several contributions: Theoretically, this study provides empirical insights regarding public private interactions. Methodologically, it applies successfully Maximum-Difference-Scaling in the field of energy policies. Empirically, our findings show that a Feed-In-Tariff and a guaranteed grid access are by fare the most attractive measures; moreover, several non financial aspects such as transparency in and duration of the approval process are ranked second before other purely financial aspects.

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1 Introduction

The diffusion of new technologies faces several obstacles before reaching a broad-based market penetration. One of the key stages relates to early adopters without whom ensuring hurdles would not be even faced (Metcalfe, 1988; Geroski, 2000). While in many industries this diffusion is left entirely to market forces, there are at least two scenarios where policy makers are key stakeholders exercising their regulative powers adding to technological uncertainty (Weber et al., 2009): industries that are relevant for a nation's self-reliance, particularly with regard to energy supplies, hence new technologies that can help secure this supply (Vasudeva, 2009); emerging economies, where regulation is often a remnant from post-colonial eras in order to protect (nascent) domestic industries from global competition (Henisz, 2002).

In these political environments technology diffusion cannot be understood without investigating the role of the state and its interaction with private decision makers (Nemet, 2009; Leitner et al., 2010; Huberty and Zysman, 2010). An interesting context is one of technologies that are proven to be technologically (and economically) viable in industrialized countries and their diffusion in emerging markets. Thereby, on can abstract from technological uncertainty and study the interaction of public and private actors in a quasi-experimental setting.

Against the extant literature, our research questions is: Which factors influence the early adopters of an established technology in a highly regulated nascent market? The context of energy infrastructure investments assures a focus on highly regulated market. More specifically, we have chosen wind energy as a technology focus. Wind energy is one of the cheapest renewable energy tech-

nologies (IEA, 2008) and depending on the policy framework manufacturing could possibly be done within emerging countries (Lewis and Wiser, 2007). Beyond these points the technology is well established for 2 decades and more in many industrial countries such as Denmark, Spain, Germany. However, while large countries such as China and India are currently very active to adopt the technology small emerging markets are still in a nascent stage. Therefore the latter countries offer a suitable framework for our study. In this context our research analyzes the relation of the public and the private sector by investigating at the micro foundations of public-private interaction at the early adoption stage.

The rest of the paper is structured as follows: First, we analyze theoretical concepts and approaches as well as the context of energy policies (2). This forms the basis for the research design in the following section (3). Then, the implications based on the qualitative foundation of our research are discussed (4) followed by an overview of the quantitative approach and the sample that we have chosen (5). The findings of both, the qualitative and the quantitative data that we gathered during the process, are discussed in great detail in chapter 6. The paper concludes with implications for both academics and practitioners (7).

2 Theoretical background

2.1 The diffusion of technological innovation

Rogers (1995) defined diffusion as "the process by which an innovation is communicated through certain channels over time among members of a social

system". The innovation my be a process, idea, concept, product or set of these which is newly available to potential adopters. In our case the innovation, energy infrastructure, is new not because of technology innovation but because they are applied in a new region with little or no previous application of the technology. The social system as it is defined by Rogers (1995) or more specific the institutional framework (Porter, 1990; Vasudeva, 2009) interacts with the adopters of a technology. This will be the focus of our study.

A similar approach was also chosen by Weber et al. (2009) who closely linked the process of diffusion with the adoption of policies in emerging countries by local decision makers. Also Taylor et al. (2003) and Hall and Khan (2003) analyzed the relation of government decisions and innovation and found that government regulation lead inventive activities. These findings were further detailed by Leitner et al. (2010) who identified various diffusion pathways that are triggered by the main three drivers of innovation namely government (regulation), market (competition and cost) and technology. In line with previous researchers he concluded that regulations that incentives rather than force organizations to comply with regulation lead to higher diffusion rates. However, the question which regulatory incentives lead to higher diffusion rates remains open. By analyzing how regulation and other factors are perceived by adopters of innovations this paper contributes to the ongoing discussion.

Long term diffusion studies in the field of infrastructure investment such as Henisz (2002) and Nemet (2009) demonstrate that political environments that limit the feasibility of policy change are an important determinant. However, in emerging markets uncertainty for investments is in general higher than in industrialized countries. How do companies deal with this type of uncertainty? In the field of climate change measures scholars have analyzed the strategic re-

sponse of established industries (Kolk and Pinkse, 2005; Engau and Hoffmann, 2009; Okereke and Russel, 2010). While this research is a valuable contribution with partly surprising results, it does not offer any insights how early adopters react and decide when facing uncertainty. This paper is an attempt to close this gap.

Based on the work of Metcalfe (1988) the diffusion literature can be divided in two dominant streams: First, those characterizing the mechanisms and patterns of diffusion. This approach manly looks at the rate and total amount of adoption in a given population in a time period. Second, those seeking to understand and characterize the decision making structure and process regarding product adoption. This approach focusses on the individual decision-making based on rational choice. Sarkar (1998) and Geroski (2000) further elaborated on the issue.

The first type of aggregated analysis of the diffusion of energy infrastructure was very useful to gain a general understanding about the policy mechanisms behind the deployment of the the major renewable energy markets. One key observation is the high dependence of the diffusion curves on changes within the social system (Lipp, 2007; Mallon, 2006). Another key observation is that aggregated market analysis was mostly used for analyzing which policy mechanism would best support market deployment. However, as shown in the following section, the support mechanism alone is a rather narrow conceptualization that is not able to fully explain the deployment. These findings suggest, that a broader understanding in the field of public private interactions regarding energy infrastructure is useful which seems to be true especially in the case of emerging markets.

The second type of diffusion analysis based on Metcalfe (1988) intends to

explore why and when the adoption might occur. Here models and approaches available include a wider array of factors that arguably influence the decision to adopt. In the field of energy infrastructure there are only few studies in this field. Butler and Neuhoff (2008) asked 23 project developers for wind energy about investment barriers and competition in Germany and UK. Two other studies applied conjoint analysis in order to identify the part worth utilities of relevant aspects that influence the decision process of adopters. Lüthi and Prässler (2010) compared the preferences of project developers in the US and Europe (late adopters) while IWOe (2010) focusses on the investor in energy infrastructure in emerging countries.

A similar distinction is made in the field of strategic management. Any phenomena in strategic management can either be explained on two different levels: the micro level that consists of individual choices and the macro level that consists of collective choices (Danserau et al., 1999; Felin and Hesterly, 2007). Researchers found that in different fields of strategic management such as value appropriation (Coff, 1999) , resource value (Lippman and Rumelt, 2003), inertia (Kaplan, 2005), firm-level heterogeneity (Gavetti, 2005) or capabilities (Abell et al., 2008) explanatory mechanisms at the the level of individual action offers important insights than could not be generated at the macro level. While the concepts at the macro level still offer important insights, the micro foundation potentially results in a deeper understanding of patterns.

2.2 The rational of energy policies

Current and past research in the field of renewable energy polices focuses often on analyzing the deployment of markets and then drawing conclusions about success factors of support mechanisms. In general researchers analyze and compare one or several countries or renewable energy technologies (Haas et al., 2004; Jacobsson and Bergek, 2004; Buen, 2006; Mallon, 2006; Jacobsson and Lauber, 2006; Ringel, 2006; Gan et al., 2007; Lipp, 2007; Valle Costa et al., 2008; Kristinsson and Rao, 2008; Mendonca et al., 2009; Mostafaeipour, 2009). Among other factors there are three important conclusions that can be drawn based on these papers:

(1) The policy framework should be transparent and predictable in the long run in order stimulate the market.
(2) Incentives should decrease over time in order to make renewable energies more competitive in the long run.
(3) A technology specific level of support based on the degree of technology maturity should be applied with the aim to locally develop not only the cheapest renewable energy technology but a portfolio of different technologies

This type of aggregated market analysis was mostly used for analyzing which policy mechanism would best support markets deployment. However, the focus on support mechanisms as main drivers for renewable energy is a rather narrow conceptualization that is not able to fully explain that deployment:

First, the success of the Spanish market was initially attributed to the implementation of a Feed-In-Tariff (Meyer, 2003; Munoz et al., 2007; Ringel, 2006;

Söderholm, 2008). Dinica (2008) revealed that this success was not based on the Feed-In-Tariff but on the emergence of strong Public-Private-Partnerships between local politicians, project developers and investors. In addition one key success factor of the Spanish market in contrast to Germany and the UK was that the utilities in Spain proactively drove the diffusion of wind power (Stenzel and Frenzel, 2008).

Second, it is remarkable that the main reasoning for a quota system with tradable certificates compared to a Feed-In-Tariff is to archive a defined renewable energy targets at minimal costs (Haas et al., 2004). Reality has shown that the opposite is true (Lipp, 2007; Bergek and Jacobsson, 2010; IEA, 2008). It turned out that investors required a higher return if a quota system is in place due to their exposure to price volatility.

Third, a fundamental assumption of the analysis of the comparison of aggregated market data and the policy mechanism was that the results could easily be applied in other countries. This assumption holds not in all cases as aggregated market data are only available in industrialized countries and in large emerging countries such as China and India. Is the situation in smaller emerging countries like Romania, Egypt or Uruguay the same? This question cannot be answered sufficiently as these markets are still in a nascent stage.

In order to go beyond the discussion which support mechanism is best and to identify the possibilities for smaller emerging markets to attract investors for their renewable energy projects it is necessary to ask the investors or the project developers directly. This approach was proposed by Wiser and Pickle (1998) who highlighted that many policies are not effective in terms of market growth as they do not meet the needs of investors. This conclusion was supported by Langniss (1996) and Enzensberger et al. (2002) who both classified

the broad term investors on a conceptional level. The investment risk and the related financing costs were identified as a key factor that effects the market deployment and extended the view of renewable energy policies (Gross et al., 2009; Lüthi and Prässler, 2010). It became clear that non financial barriers have a great impact on the deployment of renewable energy especially but not only in emerging countries (IEA, 2008). The IEA Implementing Agreement on Renewable Energy Technology Deployment (de Jager and Rathmann, 2008) conducted cash flow simulations under different policy framework conditions based on the current major renewable energy markets with the result that suitable policy framework conditions can reduce the overall generation costs for renewable energy by 10 - 30 per cent.

3 Research Design

In order to explore how public policies and other factors affect the investment decision of early adopters we have chosen a three step approach that includes qualitative as well as qualitative measures.

(1) In order to gain an in depth understanding of the topic we conducted 11 interviews with private decision makers and other experts for public policy and finance in the field of wind energy in emerging markets.

(2) Based on the theoretical and practical findings of the first step we conducted a quantitative survey using Maximum Difference Scaling.

(3) In order to gain even further insights, the findings of both the interviews and the survey where discussed during a one day workshop with 13 experts. The participants of the workshop had a background in finance and assurance (3), project development (2), manufacturing (1) and consult-

ing (4). In addition 3 national and international wind energy industry associations were present.

4 Qualitative Approach: Identifying the key decision factors

In order to identify the key decision factors first interviews were conducted with 4 german project developers that are active in wind power projects in different emerging countries. The key questions were: Which challenges do you face with your current wind energy projects in emerging countries? How do you choose which emerging market to enter next? Based on these interviews we developed a preliminary list of items that matter for project developers. This list was further discussed and refined during several semi structured interviews with 7 international experts in the field of renewable energy policy and finance. All interviews were conducted face to face or via telephone and took between 30 and 90 minutes each. The aim of the interviews was twofold: on one hand it was important for the research team to understand the rational of the decision process of project developers and on the other hand we were identifying two types of items: a) items that are absolutely required in order to conduct business in an emerging country and b) items that are not critical but important enough to have a significant influence on the investment decision.

We identified four factors that are absolutely required for all project developers: First, the availability of wind resources. Second, political stability which means that the government including all its bodies is stable in a foreseeable future. Third, the financial viability of the project which means either a financial support mechanism for wind power or sufficiently high and stable electricity tariffs that assure an income for the investor. For simplification we decided to

leave out the factor electricity tariff and focus on the financial support mechanism. Fourth, it is fundamental for a wind power project to get access to the grid. If one of these four items is not given in an emerging country the wind market will stay at a nascent stage no matter how good the other items are. Based on these results of the interviews we defined a decision scenario for project developers:

Imagine you should decide weather your company develops a 30MW wind park in an emerging country or not. The following conditions are given:

- *The political stability is acceptable.*
- *So far only few wind parks got connected to the grid.*
- *Government authorities have agreed on ambitious long term targets and financial support for wind energy.*
- *First estimations regarding the internal rate of return (IRR) are promising.*

Based on the interviews a second set of items was identified. These items have a significant impact on the attractiveness of an emerging market and belong to either the support mechanisms, financial and non-financial aspects or relate to the grid connection of the power plant. The full list of items is presented and further explained in the Appendix.

5 Quantitative Approach: Evaluating the key decision factors

5.1 Maximum Difference Scaling

Maximum Difference Scaling which was first developed by Finn and Louviere (1992) turned out to be the most suitable method for our research.

This method is an extension of the paired comparison method that offers a more efficient questioning structure (Cohen and Orme, 2004). Respondents are asked to choose the most attractive feature (best) and the least attractive (worst) feature from a set of 3 to 7 items. Due to its simple questioning structure the method does not allow for scale use bias that could be an issue with other types of questions such as ranking questions (Couch and Keniston, 1960; Bachman and O'Malley, 1984; Finn and Louviere, 1992; Baumgartner and Steenkamp, 2001; Cohen and Neira, 2003; Butler and Neuhoff, 2008). This factor is especially relevant in our case, as decision makers with various cultural backgrounds are involved in the study. Also the results that are generated by the method have a high degree of discrimination which allows to easily identify the true preferences of the respondents (Finn and Louviere, 1992; Hein et al., 2008).

However, the results of Maximum Difference Scaling questions give less information compared to rating questions. The reasons is, that the results indicate which item is most or least attractive without giving any information to the level of preference. This limitation can be overcome as the respondent is answering several questions with different groups of items which allows hierarchical bayes estimation to extract the relative preference of the respondent regarding all items (Rossi and Allenby, 2003; Gelman et al., 2004).

The quality of the statistical analysis increases with a higher number of questions (Orme, 2005). In addition the time a respondent requires for answering one question increases with the number of items per question. Therefore Chrzan and Patterson (2006) recommends to use 4 or 5 items per question. In order to minimize the number of questions within the survey we decided to use 5 items per question. Each item was shown three times to the respondent

in order to assure stable results of the hierachical bayes estimation (Orme, 2005).

In order to avoid any bias in the survey design and to assure that the results can be statistically analyzed it is crucial to assure assure (Orme, 2006): a) frequency balance which means that each item is shown an equal number of times during the whole survey, b) orthogonality which means that each item is paired with each other an equal number of times, c) connectivity which means that the set of items can not be divided in two groups with no overlap and d) positional balance which means that each item appears an equal number of times in each row.

So far, Maximum Difference Scaling has been successfully applied in the field of consumer preferences for wine (Casini and Corsi, 2009; Cohen, 2009) and food (Finn and Louviere, 1992; Jaeger et al., 2008) as well as consumer preferences for health care (Flynn et al., 2007). This study presents a new application of the method in the field of early adopters preferences and energy infrastructure.

5.2 Sample selection and sample characteristics

In order to identify the decision makers that have the experience to rank the list of items we followed a two step process. First, we identified companies that act as a project developer for wind energy in emerging countries. After conducting a comprehensive web research and checking the membership directory of international and national wind industry associations such as the European Wind Energy Association (EWEA) 88 companies were found. Second, we identified a maximum of 3 employees in each company that already gained personal experience with wind energy in emerging countries. In total

158 persons were identified.

The administration of the survey took place between June and August 2010. Before launching the survey, a pre-test with a limited number of experts in the field was conducted in order to validate the measurement and refine the survey. Then, people we previously identified were contacted individually by email or social networks such as Xing and LinkedIn. People who did not reply within 4 weeks were contacted again. As we intended to optimize the accuracy of responses and to limit the impact of self-assessment we guaranteed that all information would remain completely confidential, we promised to share the final results of the study with respondents and we agreed to distribute a personalized feedback document (Huber and Power, 1985). This process allowed us to gather 41 completed questionnaires by persons from 36 different companies, corresponding to an effective return rate of 25 per cent.

Regarding the personal background the respondents gained work experience in a large number of emerging markets (Figure 1). Please note that countries that were named only once or twice are summed up per continent.

Almost half the respondents (19) are working in top management. Around one quarter of the respondents work in business development (12) and project management (9). Only one respondent is working exclusively in finance. Regarding professional experience in the wind energy sector two different groups were identified. One the one hand there are 6 respondents that worked in wind energy from the very beginning with work experience of 15 years up to 28 years. One the other hand there are 35 respondents with up to 10 years professional experience.

To further describe the sample there are relevant information regarding the

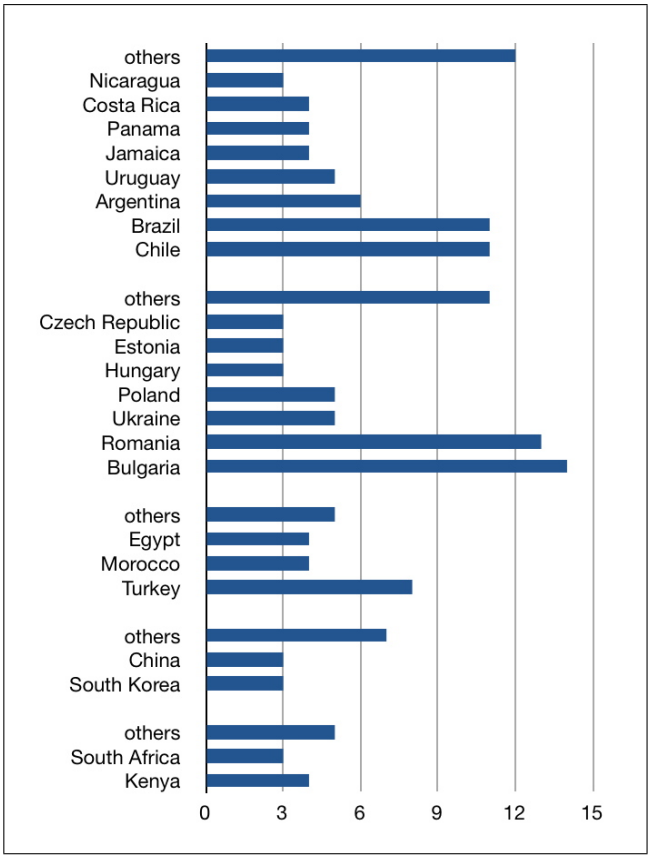

Figure 1. Countries where the study participants gained professional experience

companies where the respondents work. One third of the companies have their headquarter in Germany (14), one third in other European countries (15) and one third in non European countries (12). Regarding the current regional strategy of the companies it is important to know, that two thirds are focussing on established markets in Europe and the US. BRIC countries and small emerging countries are of high or very high strategic priority for around half the companies. Please note that all companies are active in emerging markets as this was a selection criteria for participating in this study. The value chain of project developers in wind energy consists of 6 elements: Acquisition of land, technical feasibility, approval process, finance, construction and operation. Almost half the companies cover up to 4 elements of the value chain while the other half covers 5 or 6 elements of the value chain. The large majority of companies is doing acquisition of land, technical feasibility and approval process.

6 Findings and Discussion

The preference that were calculated by the hierarchical bayes algorithms based on 41 completed surveys is shown in Figure 2. The results are rescaled in a way that they sum up to 100 per cent. An item with 10 per cent is twice as attractive as an item with 5 per cent. For further interpretation it is important to have two things in mind: First, all items are identified to be important for a project developer. Therefore in some cases it might happen that even an item of low importance becomes critical for the success of the project. Second, the validity of the results is limited to the given scenario. Using the data for much smaller or larger wind parks as well as for other renewable energy technologies is only possible to a limited extend.

We present our findings focussing on four main elements, support mechanism (1), financial aspects (2), non-financial aspects (3) and grid connection (4). In addition all findings from qualitative data, i.e. interviews and workshop are included in this section.

6.1 Support Mechanisms

By looking at the results (Figure 2) it becomes very clear that Feed-In-Tariffs are rated very positive while all other support mechanisms were rated to be less attractive. Thereby this study provides empirical evidence of the work of Sovacool (2010), who did qualitative research in this field with a special focus on asian countries. In the following text we discuss each support mechanism and include also all statements from the interviews and the workshop:

Regarding the Feed-In-Tariff it became clear during the interviews that many

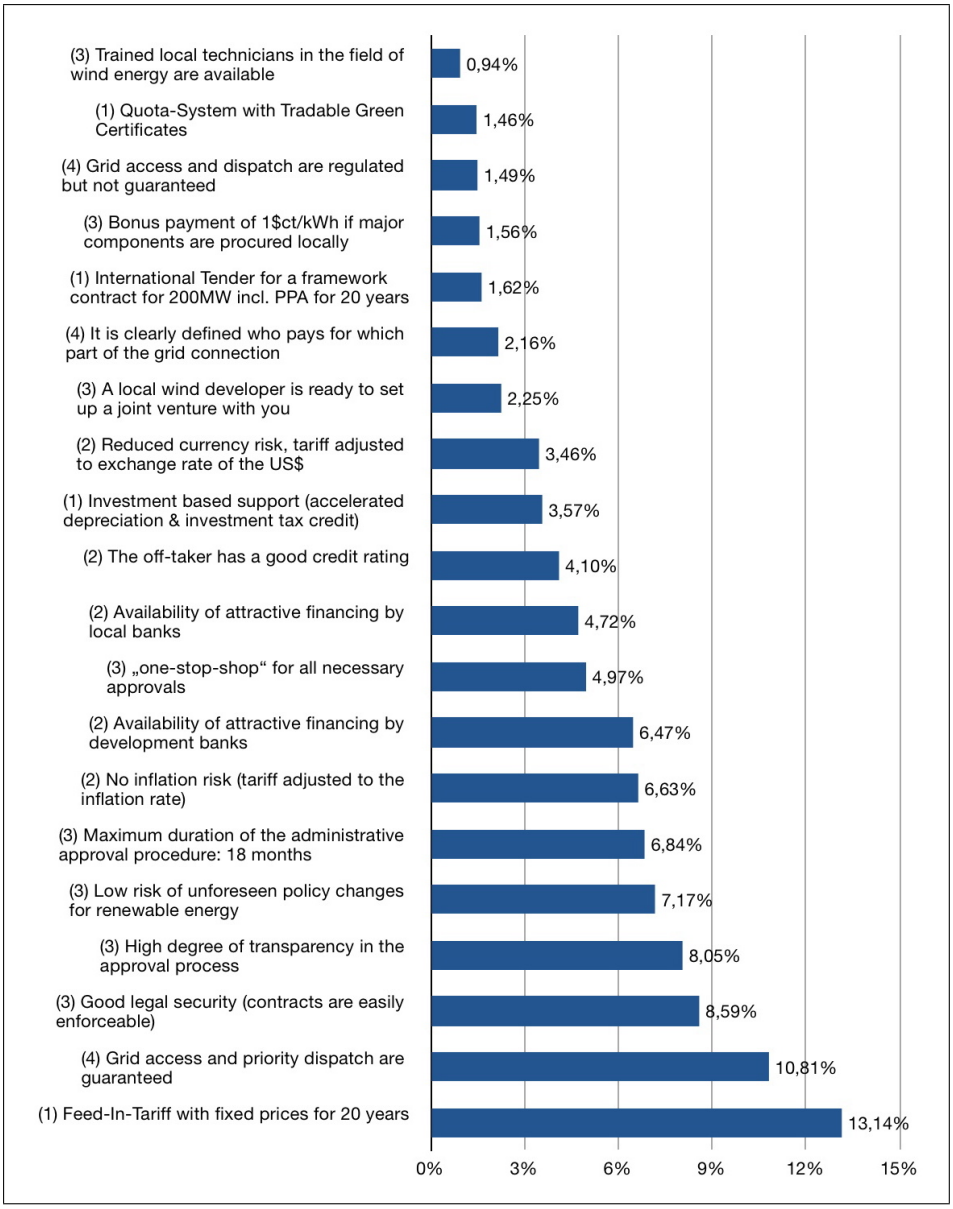

Figure 2. Preferences of the project developers for wind energy in emerging markets

project developers gained very positive experience. A fixed price per kWh that is guaranteed by the government reduces the risk for the investor and creates a stable income. This low risk helps early stage project developers to go through the initial phase of the project and it reduces the costs for debt and equity at a later stage of the project development. This very positive evaluation is supported by our empirical study and also by the opinion of the workshop participants. They added, that the details of the Feed-In-Tariff

matter a lot as they can potentially have a huge impact on the risk-return perception of investors. A well defined Feed-In-Tariff is a suitable possibility to attract international project developers and investors.

During the interviews two types of investment based support were highlighted: First, the investment can be supported by an accelerated depreciation of the investment. Large companies can thereby reduce their tax burden. Small companies or companies that are not profitable are not directly able to benefit from this support. Second, the investment can be supported by an investment grant. However, often the grant is payed only after the commissioning of the wind park. This means that the project developer is bearing an additional risk during the construction phase as the grant may not be payed as initially planed by the developer. These reasons can explain why project developers evaluate the support mechanism as little attractive in the survey. The workshop participants share this view.

In case international tenders are applied there are several challenges for project developers according to our interview partners. Due to the complexity and the length of the tendering procedure this mechanism is only applied for large power projects. Often the large size of the project goes beyond the capabilities of small and medium size project developers. In addition, the mechanism does not allow for a continuous market development. In many cases it is not even clear under which conditions and when the government issues a second and a third tender. Based on these reasons it becomes clear why project developers do not rate this mechanism as an attractive framework condition in the survey. During the workshop another risk was mentioned: the tendering process opens the door for corruption or other non transparent actions. Therefore the project developers are rather critical regarding this mechanism.

A fourth relevant support mechanism according to our interview partners is a quota system with tradable green certificates. This mechanism was initially developed in order to increase the price competition and to focus on the most mature technologies at the best sites within the country. Unfortunately the result of the real world application contradict the original good intention of the mechanism. All experts that were contacted during the initial phase of this study underlined that a quota system is in the first place an additional risk regarding the income. This risk requires the financing institutions and the equity investor to ask for an additional premium. If industrialized countries with a Feed-In-Tariff and with a quota system are compared directly one major learning point is the fact, that a quota system is more expensive in the end (Lipp, 2007; Bergek and Jacobsson, 2010; IEA, 2008). The results of the survey underline that project developers find a quota system not attractive and the workshop participants confirmed this view.

In order to double check the stated preference the project developers were asked how many wind projects they finished successfully in emerging and industrialized countries under the four different mechanisms (Tabel 1). A strong correlation between the stated preference and the number of successfully finished projects was found.

Table 1
Preference for the support mechanisms and number of projects that all study participants conducted under the given support mechanisms

Support mechanism	Sum of Projects	Stated preference
Feed-In-Tariff	406	13.14
Investment based support	57	3.57
International Tender	48	1.62
Quota-System	42	1.46

To sum up, the qualitative data from the interviews and the workshop fully

support the results of the survey. The project developers show a very clear preference for the Feed-In-Tariff compared to other mechanisms and compared to other items in the survey. However, the survey offers only very aggregated insights regarding the support mechanisms. At a more detailed level of the support mechanism there are many choice to be made which can potentially have a significant impact on the overall attractiveness of the mechanism (Ringel, 2006; Dinica, 2006; Klein, 2008; Couture and Gagnon, 2010). Based on the opinion of the workshop participants one key recommendation for policy makers is to focus on a suitable balance of risk and return for the investor. A lower risk for the investor always lead to lower financing costs and thereby lower overall costs for the project.

Proposition 1: *The strength of public sector support mechanisms in emerging markets is positively related to adoption rates of new renewable energy technologies by private sector actors.*

6.2 Financial Aspects

Several financial aspects that go beyond the support mechanism were covered in the survey. In general, project developers rated financial aspects as medium or little attractive compared to all other aspects. (Figure 2)

Transferring the inflation risk to the government is according to our interview partners a key aspect for the bankability of a projects. One reasons for this result is that the initial investment for constructing the wind park is often done in Euro or US Dollar while the income that is generated during the operation phase is received in the local currency. If the inflation increases during the operation phase more than initially expected the investor faces a

loss. These reasons explain why this aspect is rated as attractive in the survey. The participants of the workshop confirm this perspective and underline that an inflation adjusted tariff is relevant in some emerging countries. Even if the risk is only partly transfered it has a significant impact on the investment decision. Also the workshop participants discussed why no inflation risk is rated more attractive as no currency risk. It turned out that hedging the currency risk at financial markets is more easy because the initial investment and the repayment of debt is well known at the beginning of the project.

During the interviews at the beginning of the study it became evident that attractive financing conditions from development banks and local banks are relevant aspects for the market entry of an international project developer. The project developers underlined that the involvement of development banks also means a huge amount of administrative work. Regarding local and potentially government owned banks our interview partners highlighted that including them means to have a supporter who is well connected with public authorities. This helps to assure the long term success of the project. In the survey the project developers rated attractive financing conditions by development banks slightly higher than the same conditions by local banks. One potential explanation came up during the workshop: Local banks in emerging markets have in most of the cases little experience with financing wind parks. Therefore, the project developer himself or a development bank has to develop these capacities at the local bank. The workshop participants also highlighted that especially during the first wind projects development banks play an important role. Thereby our findings support the work of George and Prabhu (2003) who focus on developmental financial institutions especially in India.

During the interviews it also became clear that financing a wind park in an

emerging market also depends on the credit rating of the off-taker. If the off-taker is not credit worthy enough other guarantees by the government regarding the Power Purchase Agreement are required. The survey revealed that the project developers do not have a specific preference for this aspect. In the workshop it turned out that this aspect is more relevant in developing countries than in emerging countries.

Another result of the interviews was that project developers are very critical regarding regulations that force them to procure parts of the wind farm locally. However, it was not clear how to deal with a voluntary mechanism that gives a bonus if major components are procured locally. The survey shows clearly that voluntary mechanisms such as bonus payments if major components are procured locally are little attractive for project developers. During the workshop with the industry experts it became very clear, that a local content requirement is challenging especially in nascent markets. As there are only few potential suppliers in a country that just started to use its wind resources, these companies are tempted to charge monopoly prices for their technology. However, there is a clear opportunity for local companies to become involved. According to the workshop participants and Lund (2009) not all parts of a wind turbine require special manufacturing skills. Local companies typically start manufacturing the tower elements and at a later stage potentially extend their contribution to the value chain of wind farms. To sum up, the study shows very clear that local content requirements even in combination with bonus payments are not attractive for international project developers. However, how can public authorities develop a competitive local wind industry? This aspect is further discussed in the last part of this chapter.

In summary the survey reveals that financial aspects are neither the most

attractive nor the least attractive items regarding the full set of 20 items. Transferring the inflation risks was identified as the most attractive financial aspect. The least attractive aspect was a bonus payment if major components are procured locally. The interviews revealed that before putting such a mechanism in place the advantages and disadvantages of local content requirements should be evaluated in great detail by the public authorities.

Proposition 2: *The strength of financial incentives by the public sector in emerging markets has no effect on adoption rates of new renewable energy technologies by private sector actors - beyond the support mechanism (electricity tariff).*

6.3 Non-financial Aspects

The empirical findings show a group of four aspects that were rated to be less attractive than the two top aspects which are a Feed-In-Tariff and a guaranteed grid access but more attractive than all other aspects in the survey (Figure 2). Our qualitative research offers the following explanations:

During the interviews it became clear that a good legal security is a critical aspect for the project success. The project developers see this aspect more as a long term initiative. However, the interview partners see potential for comparably quick changes regarding the proper definition and the transparency of the approval process. Similar statements were made in favor of the maximum duration of the approval process. The result of the interviews with respect to a low risk of unforeseen policy changes for renewable energy are in line with existing literature such as Henisz (2002) who performed a two-century long historical analysis regarding infrastructure investment. Our interview partners

underline the huge potential to increase the attractiveness of an emerging renewable energy market. This standpoint was clearly confirmed by the empirical study and the workshop participants.

During the interviews several experts mentioned that a one-stop-shop for the necessary approvals could potentially be a very attractive measure. They clarified that their statements are based on the analysis of renewable energy projects in industrialized countries. Our empirical findings regarding emerging markets show no clear preference regarding a one-stop-shop. Therefore the aspect was discussed in detail during our workshop. It became clear that this simplification of the approval process bears several risks as for example: less transparency as well as less knowledge of and influence on the approval process. Although this approach is build on good intentions the workshop participants see a high risk, that it could also end up in an additional administrative barrier. To sum up, this study doesn't support the implementation of a one-stop-shop for wind energy projects in emerging countries. However, some participants of the workshop would appreciate it if there is an official government agency that offers advice if a project is stuck in the approval process.

The interviews with project developers revealed that the market access in emerging countries starts usually with the creation of a joint venture with a local company. However, in the empirical study this aspect was rated as little attractive in comparison with all other aspects. The research team found two different reasons for this rating: On the one hand it is possible that this aspect was overrated during the interviews. Therefore the empirical study corrects the first impression. On the other hand it is possible that there are enough potential joint venture partners. Therefore it is not difficult to find a suitable

local partner for an international project developer. It was not possible to finally answer this question during our workshop as the participants underlined that the aspect is very country specific.

To sum up, it became clear that many non financial aspects were rated significantly more attractive as purely financial aspects. Especially the legal security and the transparency of the approval process have a significant influence on the attractiveness of an emerging market in a project developers perspective. This study does not support the creation of a one-stop-shop for all necessary approvals.

Proposition 3: *The strength of (legal) institutions in emerging markets is positively related to adoption rates of new renewable energy technologies by private sector actors.*

6.4 Grid Connection

Regarding the grid access and power dispatch one thing became very clear: A guarantee is one of the most attractive political framework conditions for the industry. A regulated but not guaranteed access is a far less attractive framework condition for an emerging country (Figure 2).

During the interviews at the beginning of the study it turned out that a well defined regulation regarding the grid connection and the power dispatch is far better than no special regulation for renewable energy. However, the difference between a guaranteed grid access and priority dispatch and a well defined regulation was not clear. Therefore the research team decided to include these two aspects in the study. The survey revealed that a guarantee belongs to the

most attractive support mechanisms while a regulation belongs to the least attractive aspects of the study. The issue was discussed during the workshop with the result that further investigations are required. One the one hand combining grid access and power dispatch in one aspect is too much of a simplification. On the other hand, the participants underlined that regulation means first of all that the project developer has to check all the details. We conclude that this study allows to make for two recommendations: First, a guaranteed grid access and priority dispatch is definitively a very attractive measure for an emerging country. Second, further investigations are required regarding a regulated grid access and dispatch.

During the interviews it turned out that often it is not clear who is going to pay for the grid access of the wind farm and potential grid extensions. The survey results don't support this idea. During the workshop the participants underlined that this aspect matters only in some cases depending on the country and the site.

Finally we can conclude that a guarantee regarding the grid access and the power dispatch is a very convincing argument for an international project developer. Based on the explanations of the workshop participants this type of guarantee is a very strong political signal for the implementation of renewable energy projects.

Proposition 4: *The strength of public sector guarantees for grid access in emerging markets is positively related to adoption rates of new renewable energy technologies by private sector actors.*

7 Conclusion

This empirical study on the preferences of project developers regarding wind energy in emerging countries aims to further contribute to the ongoing discussion on effective renewable energy policies for both academics and policy makers. So far only limited knowledge exists regarding the preferences of the private sector for different policy options for renewable energy in emerging countries. Therefore policy makers find it challenging to understand and adapt the regulations to the need of the private sector. In line with the work of Lüthi and Prässler (2010) as well as IWOe (2010) this study is a first attempt to close this gap. There are contributions on three levels: theory, method and practical implications.

Regarding the theoretical approach most existing research analyzes aggregated market data at the macro level and then concludes how effective different framework conditions are. This approach is very effective in existing or more mature markets. However, the individual decisions and preferences of the private sector are measured only indirectly. This study is taking a different approach by focusing on the micro foundation of early adoption. We applied this approach for emerging or premature renewable energy markets.

Regarding the methodological approach we decided to apply an innovative, simple, yet effective method to reveal the preferences of decision makers. With this study Maximum Difference Scaling has proven to be suitable to some extend in the field of investment decisions. The method is especially strong because its simple question structure, the strong discrimination of the results and the possibility to be applied across different cultures. However, limitations exist as the results are limited to the predefined decision scenario and as

only 20 items could be investigated. Although we are aware, that the latter simplification doesn't not represent the full complexity of investment decisions, we believe, that the combination of qualitative and quantitative research allows to draw valid conclusions.

Regarding the practical implications of this study, we could show that a *Feed-In-Tariff with fixed prices for 20 years* and *Grid access and priority dispatch are guaranteed* are by far the most attractive framework conditions for project developers. Non financial aspects are ranked second while all other support mechanisms were ranked very low. Also we could show that even voluntary local content requirements with bonus payments are not attractive for the private sector. Instead our qualitative findings suggest that policy makers should increase the attractiveness of their renewable energy market including capacity building in small but regular steps and thereby allow the growth of a regional industry. In order to gather more specific recommendations we suggest further research with the very same method on a country specific level.

In a highly regulated energy market an effective regulatory framework for developing and investing in renewable energy offers great value for public as well as for private companies. Decision makers from the private sector should participate in the early stages of policy making Santos et al. (2006); Engau and Hoffmann (2009) and in this regard this paper contributes to the ongoing dialogue. By revealing the preferences of early adopters especially in the case of emerging markets our research helps public authorities to better understand arguments of industry associations and investors in the energy sector. In addition, the study provides insights for the ongoing debate on international climate change measures as for example the Green Climate Fund and National Mitigation Action Plans. These international measures can be

used to fully or partly finance for example Feed-In-Tariffs in developing and emerging countries or to provide any other form of guarantee for the private investor.

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8 Appendix

The full list of items that was used for the survey is presented and explained below.

(1) Support Mechanisms

- International Tender for a framework contract for 200MW incl. PPA for 20 years - Several companies offer to build 200MW at one or several sites, the company with the lowest price per kWh over a period of 20 years wins the tender.
- Feed-In-Tariff with fixed prices for 20 years - Each kWh that is generated by the wind turbine is sold at a fixed price that is constant for 20 years and that is known beforehand.
- Quota-System with Tradable Green Certificates - The government decides on the quota of wind energy in the energy mix of their country. The utilities have to prove the use of wind energy through certificates that they are generating with their own wind parks or that they are

buying from other wind farm operators.

- Investment based support (accelerated depreciation and investment tax) - The investor receives a grant based on the capacity of the wind farm and not on the generated power.

(2) Financial Aspects

- Reduced currency risk (tariff adjusted to exchange rate of USD) - In regular intervals the tariff is adjusted to the exchange rate of the local currency to the USD.
- No inflation risk (tariff adjusted to the inflation rate) - In regular intervals the agreed tariff is adjusted by the inflation rate of the country.
- Availability of attractive financing by development banks - Development banks offer loans and other forms of guarantees for the investor that are below the international market price.
- Availability of attractive financing by local banks - Local banks offer loans and other forms of guarantees for the investor that are below the local market price.
- Bonus payment of 1 USct/kWh if major components are procured locally - If the project developer buys for example the tower elements from a local company the investor receives 1 USct/kWh of bonus payment over the lifetime of the wind farm.
- The off-taker has a good credit rating - It is less likely that the off-taker delays or stops paying for the generated power.

(3) Non-financial Aspects

- Maximum duration of the administrative approval procedure: 18 months - Assuming the project developer follows the defined process and delivers all relevant documents in time the government authorities guarantee that they provide all approvals within 18 months.

- one-stop-shop for all necessary approvals - All necessary approvals can be obtained at one single government agency.
- A local wind developer is ready to set up a joint venture with you - It is easily possible to closely work with a local project developer.
- Good legal security (contracts are easily enforceable) - All involved parties can trust that signed contracts are easily enforceable.
- Low risk of unforeseen policy changes for renewable energy - All involved parties can trust at the beginning of the project that the framework conditions will not worsen during the development phase of the wind farm.
- High degree of transparency in the approval process - Each involved party knows at each point of time by which criteria the decisions on the approvals are made.
- Trained local technicians are available - The developer knows at the beginning of the project that local technicians are available for construction and operation of the wind farm.

(4) Grid connection

- Grid access and priority dispatch are guaranteed - The access to the grid is guaranteed by law and the operator of the wind farm can sell each generated kWh at any point of time to the grid.
- Grid access and dispatch are regulated but not guaranteed - Under predefined conditions the access to grid is possible and generated kWh can be sold.
- It is clearly defined who pays for the grid connection - The financing of the cable that connects the wind farm with the existing grid is clearly defined.