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From the Host to the Home Country, the International Upgradation of EMNEs in Sustainability Industries—The Case of a Chinese PV Company

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Abstract: With the internationalization of firms from emerging-markets, the upgradation along the global value chain of emerging-market multinational enterprises (EMNEs) has attracted the attention of academics and industries. However, the role of upgradation of EMNEs in a host country to the transition of EMNEs in the home country is ignored. This study explored how EMNEs from emerging-markets could upgrade their operations in their home countries driven by the transformation of subsidiaries in host countries. An in-depth analysis of Company S was conducted to elaborate on the resources and trigger time a firm needs to transform the function of a subsidiary in the host country, and the upgradation of the firm in the home country during the internationalization process. Research on the internationalization of Company S suggested that with the complementary capabilities and markets as the fundamental basic resources, the industrial crisis triggers the firm's upgrading in the host country. In addition, the intrafirm (internal) market mechanism makes it possible to sustain the upgrading process without conflicts between subsidiaries. Moreover, synergies will develop through interactions with subsidiaries, owing to complementary capabilities and the internal market. The synergetic development promotes the transition of firms in the home country and emphasizes the complementarity of the manufacturing and engineering service. Finally, this study demonstrates the two-stage international upgrading process, in which the international upgrading of firms in the home country is driven by the development and transition of the subsidiary in the host country, which provides contributions to the internationalization upgrading strategy and process of firms from emerging-markets.

Keywords: photovoltaic; upgrading; internationalization; global value chain; China

1. Introduction

A growing number of researchers have recognized the importance of technological improvements in the global value chain (GVC) [1]. In addition, the GVC approach has an important impact on the technological upgrading and catch-up of firms [2–6]. However, transformation and upgrading with GVC is still under exploration. Some studies suggest that the export-oriented technological upgrading of Chinese firms contributes to the success of Chinese firms in foreign markets [2]. Nevertheless, it is not easy for many Chinese export manufacturers to upgrade because they provide components to foreign firms and foreign markets. How, then, can a firm from an emerging-market, like China, upgrade along the global value chain? This is a question that requires further research. In addition, the role of upgradation emerging multinational enterprises (EMNEs) in a host country in relation to their

transition in the home country is ignored. In other words, it is the question considering the process of international upgradation of an EMNE from an emerging-market in and out of its home country which needs further research.

Since the end of the 20th century, new energy sources, such as solar energy, have been thought of as a solution to the challenges stemming from the shortage of traditional fuel, given their property of environmental friendliness [7,8]. The solar photovoltaic (PV) industry has become the priority in many countries, like China. As an industry advocating low-carbon transition, the Chinese solar PV industry has grown to provide the largest capacity of PV products in the world since the 1990s, following rapid growth in the 1990s and 2000s [9]. However, Chinese PV firms were adversely affected by international trade conflicts, including antidumping and anti-subsidy investigations of Chinese photovoltaic products by the United States (US) and the European Union (EU) at the end of 2011 [10,11]. We assume that the crisis faced by Chinese PV firms is mainly due to the low position of Chinese firms in the global industrial value chain. With the industry facing such a crisis, the existing research began to try to solve the problem through the correct use of policy and technology development. The industrial transformation and upgrading will be one method to address this crisis. Although many Chinese PV firms have moved their attention to the Chinese market, the export of PV components still play a critical role in many Chinese PV firms. Thus, how Chinese PV firms could transform with internationalization would provide examples to the research on international upgradation along the GVC.

Therefore, we selected Company S, a firm in the PV industry, as the case study to pursue answers to the research question of "how a firm from emerging-market could achieve international upgradation in the home and host countries." The results of our research will contribute to both the theory and practice of industrial upgrading and internationalization for companies from emerging countries in the global value chain.

The paper is organized in six sections. Following the introduction, Section 2 reviews the literature on the internationalization, upgrading, resource-based view, the global value chain, and the solar industry and PV firms. Section 3 proposes a research framework and discusses the research methodology used in the study. Section 4 describes the development and internationalization of Company S. Section 5 analyzes and discusses the fundamental resources and capabilities of Company S, the approaches to upgrading along the global value chain followed by Company S, and the evolution of Company S and its subsidiary during the international upgrading process. The paper closes with conclusions and suggestions regarding upgrading strategies.

2. Literature Review

2.1. Internationalization Strategy and International Process

With EMNEs rising at an ever-accelerating speed, the evolution of EMNEs and what drives the internationalization of EMNEs has attracted more attention [12].

Internationalization strategy is the development strategy of a firm's products and services outside the country. The internationalization strategy of a firm will affect the process of internationalization of the firm to a great extent. From another perspective, an approach to internationalization strategy should be based on strategic reasoning [13]. Internationalization strategy can be divided into three major pillars [14]: Targeting market selection; the mode of market entry or cultivation; and the timing strategy to enter a foreign market, and the market entry sequence across various countries [15]. The generic internationalization strategies pursued by Chinese EMNEs include being the local optimizer, the low-cost supplier, the advanced-market seeker, and the global consolidator, respectively, depending on its strategic direction, such as target countries with multinational preference, the movement value chain, brand, and entry mode [16].

In the context of emerging economies, the possible internationalization process of EMNEs seems to be the Uppsala process model—incremental internationalization model [17], and the mergers and acquisitions of brands and production operations other than greenfield investment. In addition, after

emerging international multinationals enter and integrate into the international market, most of them do not have a core competence but have a strong entrepreneurial orientation. Moreover, the existing advantages they have formed and established in their home market will be challenged, because the environment for such advantages has changed fundamentally. Based on this, the linkage, leverage, and learning (3L) analysis models [18] are commonly used for scholars to observe the transnational corporations from emerging countries who seeking complementary strategic assets and achieving their endogenous advantages. Those can be seen in the internationalization case of Haier's overseas factory investment: Huawei's own brand exports and Lenovo's mergers and acquisitions to gain market and technology. Furthermore, Lund (2009) proposes a typical production and market growth strategy for new energy technologies from the local to the global market and from local to global production [19].

Emerging economies, such as China, have generated lot of multinational enterprises in recent decades, in which many firms are very small [20]. Further, those main forces of internationalization wave face the problem of a lack of resources and international experience, and being limited to the Chinese scene. However, with the popularity of the global supply/value chain and competition of the global market, small firms from China have to change to integrate to an international background, so as to not be left behind; some firms are EMNEs concentrated in traditional industries [21]. In addition, the internationalization of small firms is forced by the imperfection of the domestic market, which means they need the business and social network of the host country [22].

The internationalization strategy adopted by EMNEs is different from those used in MNEs in advanced economies; the internationalization of Chinese firms has the characteristic that it can be directed towards other emerging economies and towards advanced economies, and that they consider both lower end industries, and higher-value adding activities [20]. The internationalization strategy of EMNEs depends on three aspects: several firm-specific characteristics, stage of evolution as an MNE, and the concerned industry [16]. In addition, with their knowledge of foreign markets and accumulated prior experience with foreign business operations in the process of internationalization, individuals with international experience who are involved on more strategic levels will influence firms' internationalization practices [17,23]. The solid social network and international competencies are especially needed in the process of internationalization [24].

When narrowing down on EMNEs in the renewable energy industry, research on Chinese firms at an international level in those industries depends on the strategies of firms and industries [25] and a smart use of energy resources [26]. After experiencing the crisis of the market in the PV industry, how can one take the road to internationalization? How can Chinese PV firms explore a suitable internationalization strategy to be competitive in the EU market? In addition, how can those firms obtain competitive resources and capabilities to realize the development of the firm itself? All of these answers still need to be studied and found.

2.2. The Resource-Based View, the Global Value Chain, and Upgrading

The resource-based-view (RBV) was commonly used to "select a strategy which best exploits the firm's resources and capabilities relative to external opportunities" [27]. It is a common theory that is used to explain the performance difference between firms by regarding one firm as a set of resources and capabilities [28]. A firm can obtain its competitive advantage when the resources and capability of the firm are valuable and rare, costly to imitate, and non-substitutable [29].

The RBV is prevalent in research on international business [30,31] and commonly used as a theoretical basis for research on EMNEs [32] and diversification [33]. In the research on innovation and dynamic capabilities, the RBV is also used to emphasize the importance of knowledge and combinative capabilities as a resource [34], dynamic capabilities as a competitive advantage in sustaining the development of firms [35], innovation capabilities positively related to innovation performance [36], and so on. Thus, the RBV is among the theoretical perspectives employed in this analysis.

With the constant progress of globalization and internationalization, China is currently experiencing a period of transition from being primarily a center of low-cost export manufacturing

toward being a large and rapidly growing domestic market [37]. At present, the study of catching up mainly focuses on the early stages (how to acquire enough knowledge to access the market (e.g., [38]), while for the later stages, the process of transition is still in its infancy, with poor and relatively discrete related literature [39].

The global value chain has already become a promising topic. The distribution of the value chain provides opportunities for the development of firms and industries in emerging economies [40]. Thus, the GVC is seen as a key means for firms from emerging economies to improve their learning and innovation [41,42]. The interfirm linkages in the GVC can play a significant role in transferring technological knowledge, promoting innovation and technological development [4,5,43], and upgrading the technological capabilities of firms [2]. Regarding latecomer firms, research on the GVC suggests that domestic and export markets can be used to test their products [44], while strong customer relationships [45] and regional cooperation and learning [46] can be used to realize breakthroughs in the GVC. Moreover, some important events will function as a chance to push a firm to find a new development trajectory, such as the intellectual property-rights litigation and the dumping of Sunstar (Incheon, South Korea) in the research of Lee and his colleagues [6], which could be seen as the trigger of the transformation along the GVC. However, upgrading along the global value chain by latecomers has not been fully explored. What is more, literature in the GVC area focuses on how firms in emerging economies develop by integrating into the value chain of global industries, often ignoring that once these local enterprises grow, they will transcend national boundaries [47].

The development of the PV industry is also closely related to its global supply/value chain [48,49]. In addition, to maintain sustainable development, the need for technological improvement and cost reduction along the value chain is urgent [1]. Nevertheless, how to shift from the low value-added stage to the high value-added stage is a hard task for Chinese PV firms and a question still being studied.

3. Research Methods and Framework

3.1. Analytical Framework

According to the importance of resources, capabilities, and trigger/time in the transformation of firms in the GVC in the theories of the RBV and transformation [6], this paper proposes a framework (Figure 1) focusing on the resources/capabilities and trigger/time factors on the process of upgrading along the global value chain. In this framework, we think that resources and capabilities are the source of an enterprise's core competitive advantage and the key to a sustainable competitive advantage, including intangible and tangible resources [50]. Trigger refers to a factor caused (or aided) by the environment to make something happen very quickly and suddenly [51]. In addition, the decision making, and innovation policies created by an enterprise based on its own conditions and environment is referred to as the "approach" in our research model. This "approach" can take a variety of forms, such as entering a higher unit value market niche or new sector, or taking on new production (or service) functions. Through the appropriate "approach," the firm can make full use of its own resources/capabilities and external trigger/time stimuli to achieve its own upgrading. Adopting the theories on catch-up along the GVC (e.g., [6]), upgrading in this framework refers to innovation to increase value-added, while firms leveraging value within the value chain means moving up to the high value-added stage. Successful upgrading along the GVC in this case can enable firms to obtain dynamic competitiveness and realize international upgrading (from an exporter to a global player).

Based on the framework in Figure 1, we answer the research question from three aspects: (1) What resources and trigger/time factors does a firm need to upgrade along the global value chain? (2) What approach should a firm take when seeking to upgrade along the global value chain? (3) What is the international upgradation process of a firm from emerging-markets in and out of its home country?

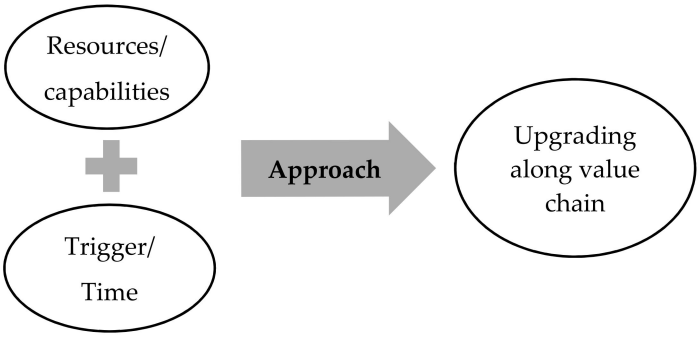

Figure 1. Analytical framework of international upgradation along the global value chain.

3.2. Research Methods

The case study method can be used to answer the research questions of studies based on the principles of engagement with practice [52], and build new theories in a more accurate and robust way [53]. In addition, the case study method and other qualitative research methods are critical to capturing phenomena; explaining the uniqueness of management; exploring comprehensive insights; and developing context-specific theories of emerging-markets [54], such as China, owing to the variety of philosophies, theories, and approaches in business and management between emerging and developed markets [55]. Therefore, the present study adopted the case study method to better understand and explore the mechanism and strategies involved in upgrading along the global value chain for business to business (B2B) manufacturing firms in an emerging industry and from an emerging-market.

A longitudinal case study can provide a more comprehensive understanding of the background of a given case and reveal how the study object changes over time. A single case study can be used to explore the typical case in a representative sense, with the conclusions helping to deepen our understanding of similar events or things [52].

As noted in the literature review section, the PV industry is a typical B2B industry, occupying a clear stage in the value chain. In addition, the internationalization process of the PV industry in China has certain distinguishing characteristics. However, as that topic is under research, we chose a firm in the Chinese PV industry, Company S, for our case study to analyze the approach that a B2B manufacturing firm takes to upgrading along the global value chain.

We chose Company S as our case mainly because of its typicality. Firstly, Company S already has a history of more than 16 years in the PV industry. Its product covers the generation from wafer to electricity. Company S exports a large percentage of its products to international markets. The development of Company S was strong both before and after the industrial crisis of 2012. Secondly, Company S has undergone a notable upgrade to the high-end of the value chain during its history. When facing the Chinese PV manufacturing crisis, Company S established an engineering firm in Germany to build and operate electricity generation stations (solar energy power stations), completing the high value-added stages of the value chain of PV industry. Thirdly, most purchasers of PV products are not individuals but representatives of the PV industry, as is typical in the B2B industry. Thus, the developmental trajectory of Company S is an ideal example that can be used to illustrate strategies and approaches to firms from emerging countries upgrading along the global value chain. Our study, thereby, contributes to research on the internationalization of firms from developing countries. Company S is an example of a firm that has an engineering company in Germany (Company S—Germany) and a factory in China (Company S—Shaoxing). The Company S Group owns Company S in the PV industry and other firms in the chemical fiber industry.

Semi-structured interviews (key questions can be found in the Appendix A) and field visits were used to collect data for this research. In addition, second-hand data and company data were collected. We conducted two formal interviews with several senior management team members of Company S—Shaoxing, the Company S Group, and Company S—Germany in 2014 and 2015. In the summer

of 2014, we visited Company S and interviewed three persons, the board secretary (Ms. W) and the co-founder of the Company S Group (Mr. Y), as well as the general manager of Company S—Shaoxing (Mr. Z). Each interview lasted more than 1.5 h. To collect first-hand information about Company S—Germany, one of the authors visited the electricity generation (solar energy power) station in Lolland, Denmark with all the members of Company S—Germany in December 2015. During the one-and-a-half-day field trip, we interviewed nine members of Company S—Germany, including the CEO (the founder of Company S—Germany, Ms. M), key engineers, financial personnel, and staff in charge of purchasing and logistics. Information provided by Ms. M was verified by information from staff members, and vice versa. Ms. M was interviewed several times. In addition, we interviewed an investment firm in Denmark that is one of the investors in the solar energy project in Lolland and a long-term partner of Company S—Germany—an interview that lasted approximately 2 h. Information obtained from this investment firm was used to corroborate information obtained from Company S—Germany regarding the complicated process of carrying out a PV electricity generation project. In total, we interviewed 13 persons.

Moreover, several informal communications with Ms. W, the board secretary of the Company S Group, took place in 2016 and 2017 to corroborate the information obtained from Company S—Germany about the running of the company and cooperation between the two subsidiaries. Additionally, through these communications, we updated our information about the co-development of the two subsidiaries in 2016 and 2017, following our earlier interviews. Public information from websites and companies' introductory documents were also used as background information and to triangulate the data. Due to the research purpose on the upgrading process, the collected data were recorded and analyzed according to our research framework (Figure 1). The resources and capabilities in Figure 1 were analyzed in terms of two variables, referring to the available competences and the resources/knowledge. The trigger factor was measured from the business environment. The approach to upgrading was analyzed from the perspectives of the technology transfer or collaboration in the firm. The upgrading along the value chain in Figure 1 was measured by the change of market and productivity. All of these variables were examined following the internationalization process of Company S.

4. Case Description

The market development of Chinese PV firms shows a significant difference from other industries. With big support from the government, in the period from 2004 to early 2011, the dominant market for Chinese PV products was not the home market (the Chinese market) but the foreign market, because of the relatively low barriers to entry on global markets [56]. However, things changed with the occurrence of international trade conflicts. Company S is a typical PV company with such a background.

Founded in Shaoxing in the Zhejiang Province of China in 2005, Company S has rapidly expanded its production and gained a considerable market share by producing silicon chips, solar cells, crystalline PV-modules, and photovoltaic constructions. Company S's factory, with more than 1500 highly qualified employees, is based in Shaoxing and is called Company S—Shaoxing, as mentioned above. Mr. Z, the general manager of Company S—Shaoxing, has approximately 20 years of work and research experience in the PV industry. As with other Chinese PV manufacturers, Company S produced and exported safe silicon products to foreign markets before 2013. Foreign markets, especially the European market, have contributed heavily to the revenue of Company S, providing 70% to 100% of company's revenue before 2013. With the growth of PV electricity generation in Europe, Company S has become one of the largest photovoltaic manufacturers in China. In 2010, Company S went public in Shenzhen.

However, the European market was turbulent. Company S faced international trade conflicts related to antidumping with America and Europe at the end of 2011. Company S—Shaoxing suffered severe losses in 2012, as did other Chinese PV companies, because of the crisis in the international market and the immaturity of the domestic Chinese market.

Company S was planning to establish a firm in Europe focused on PV electricity generation projects that use PV components produced by Company S—Shaoxing. However, in Europe, completing a PV electricity generation project from project planning to PV electricity generation operations is an extremely complicated process. For those unfamiliar with the regulations and rules applied to PV electricity generation projects in Europe, the Company S Group had to find partners with strong industrial knowledge and capabilities. Therefore, in 2011, Company S partnered with a Chinese expert and her colleagues in the PV industry in Germany, inviting her to set up its sole-invested firm in Germany (Company S—Germany) as an engineering firm that performs all operations related to PV electricity generation, from design to operations and the maintenance of PV electricity generation, using products provided by Company S—Shaoxing. The CEO of Company S—Germany, Ms. M, is a friend of the president of Company S and a previous German customer of Company S. Company S—Germany is independent of the sales office of Company S in Europe.

Since then, Company S—Germany and Company S—Shaoxing have cooperated to expand their business in the European market for PV electricity generation and sustain the production and exports of Company S—Shaoxing. Thus, through cooperation with foreign partners in Europe and based on the industrial expertise of employees and the manufacturing base of Company S—Shaoxing, Company S—Germany has grown in the European market. Company S—Germany has now completed PV plant projects in Germany, Italy, Spain, Romania, and Denmark. Most importantly, Company S has recovered from the industrial crisis. Company S—Shaoxing has not only improved its production capacity but also developed its engineering capacity based on domestic projects and cooperation with Company S—Germany.

5. Case Analysis and Discussion

As discussed above, the development of the PV industry follows the value chain of the PV industry [48], from the low value-added stage (wafers in Figure 2) to the high value-added stage of the value chain (electricity generation in Figure 2) [48]. In short, the design, building, and operation of PV electricity generation conducted by Company S—Germany is a high value-added activity in the value chain, while the production of PV components by Company S—Shaoxing is a low value-added activity in the value chain. For example, Ms. M emphasizes that "We [Company S–Germany] work for the design, installment, and sometimes of operation of the PV generation stations in Germany, Denmark, and other countries. Company S—Shaoxing provides PV components for our engineering projects." Thus, we assume that the establishment and management of Company S—Germany, with the Company S Group as the sole investor, displays the implementation of an upgrading strategy as well as an internationalization process, as shown in Figure 2.

Hence, in accordance with the framework (Figure 1) proposed and derived from the RBV and the value chain in the PV industry (Figure 2), this section analyzes the case of Company S in terms of five aspects: (1) the internationalization process of Company S; (2) the basic conditions of upgrading along the GVC—the resources and capabilities that Company S could utilize in upgrading along the global value chain; (3) the factors that triggered upgradation in this case—the reasons why Company S implemented its strategic upgrading process; (4) approaches to the implementation of the upgrading strategy—the mechanisms that Company S employed to ensure the success of its upgrading process; and (5) the international upgradation process of Company S.

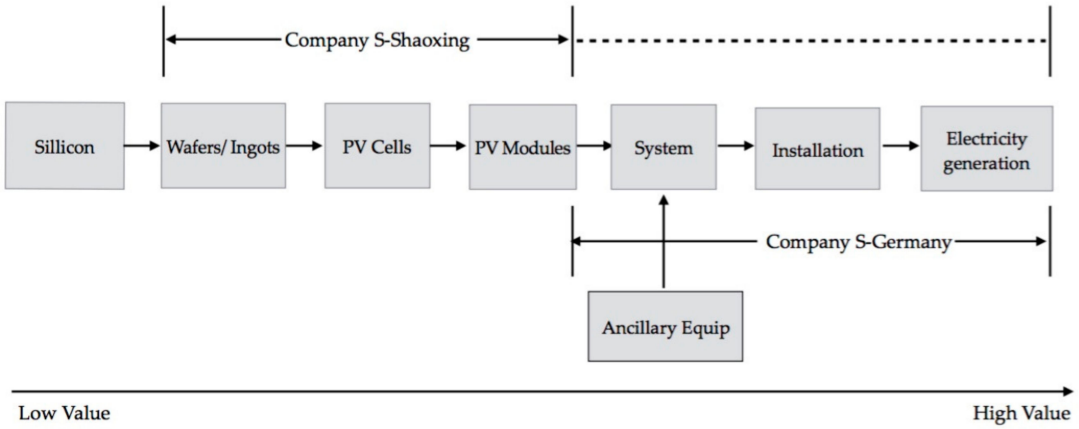

Figure 2. The value chain in the PV industry and development of Company S along the global value chain (GVC). The value chain of the PV industry was adapted from the work of De La Tour, Glachant and Ménière [48].

5.1. The Internationalization Process

The information in the Section 4 suggests that, based on the key activities and location, internationalization along the global value chain of Company S (including Company S—Shaoxing and Company S—Germany) can be divided into three stages, as shown in Figure 3. The available competences, resources/knowledge, business environment, learning/technology transfer, and the market locations of Company S in each stage are summarized in Table 1.

Table 1. Key elements in each stage of the internationalization process of Company S.

Key Elements	Stages of Internationalization Process		
	Stage 1	**Stage 2**	**Stage 3**
Available Competences	Production capabilities, operation management capabilities of PV panels from Japanese partners and expertise	PV electricity generation project management and operation capabilities of Company S—Germany, production capabilities of Company S—Shaoxing	Production capabilities of PV components, project management capabilities of PV electricity generations, and others of Company S
Resources	Capitals, factory, etc.	Talents in Europe, network in Europe and China, capitals, etc.	Talents, capitals, factories, network, etc.
Business environment	Increasing international market	Anti-dumping from EU and US, growing Chinese market	Increasing global PV market
Learning/Technology Transfer (TT)	Learn through collaboration projects	TT and learn between subsidiaries	TT and learn between subsidiaries
Market	European market, Japanese market	European market, Japanese market, increasing Chinese domestic market	International market, Chinese domestic market

In the first stage, the same as that of other Chinese PV firms, Company S—Shaoxing produced PV components mainly for the foreign market, with its ability to produce low-value added products, as described by Mr. Z: "During the period from 2005 to 2010, the company enjoyed good profits and rapid technological innovation, mainly exporting to the European market, under the pressure of competition with Japanese and European companies." That description was confirmed by Mr. Y, and Ms. W, and the news about Chinese PV exports during that time. In that stage, Company S increased its production capabilities and operation management capabilities through the learning by project collaboration with Japanese partners and the brain gain policy, as shown in Table 1. For instance, Mr. Z was recruited as an expert with education and work experience relating to photoelectric technology. "We focus on the process engineers; [. . .] the production quality was improved, and the cost was reduced after my

joining," said Mr. Z. "We learnt the operations management, project management, and so on, from our Japanese experts, who visited our firm as technical advisors several times per month in the years of 2006 to 2008. We generated our technical team through this kind of cooperation. [. . .] Some of technical personnel moved to other PV firms. We contributed to the technical improvement of the Chinese PV industry," Mr. Y mentioned.

In the second stage, Company S—Shaoxing provided PV products to domestic and foreign markets, while Company S—Germany worked in foreign markets to develop PV electricity generation, as shown in Figure 3 and Table 1. In this stage, through the cooperation of two subsidiaries, Company S—Germany finished more than 10 PV electricity generation projects in Germany, Italy, Romania, Denmark, and so on. "Most of the [PV electricity generation] projects in Europe were sold after construction. Some are operated by ourselves," said Ms. M, and confirmed by Mr. Y and Ms. W. As mentioned in the Section 4, the purpose of establishing Company S—Germany in 2011 was to conduct engineering projects to build and operate PV electricity generation facilities in the European market rather than sales of PV components in the European market. Therefore, we define this as the second stage of internationalization to the global high value-added value chain.

The third stage was a phase in which, Company S—Shaoxing and Company S—Germany together, worked in global markets and the Chinese domestic market as providers of PV products, and builders and operators of PV electricity generation facilities, with the abilities of both engineering and producing PV products, following their co-evolution with the expansion of electricity generation projects through the interaction between Company S—Germany and Company S—Shaoxing. As discussed in the Section 4, they worked together for the projects in South Asia. "On the basis of the existing foundation, the company S focuses on market development. In 2013, 80% of its focus was on foreign markets. In following years, the domestic market has risen, and half of the market is already in China," confirmed Mr. Z, Mr. Y, and Ms.W.

In summary, these three stages make up the internationalization process, leading to the high value-added stage of the value chain: the first stage—export; the second stage—international upgradation; and the third stage—global expansion.

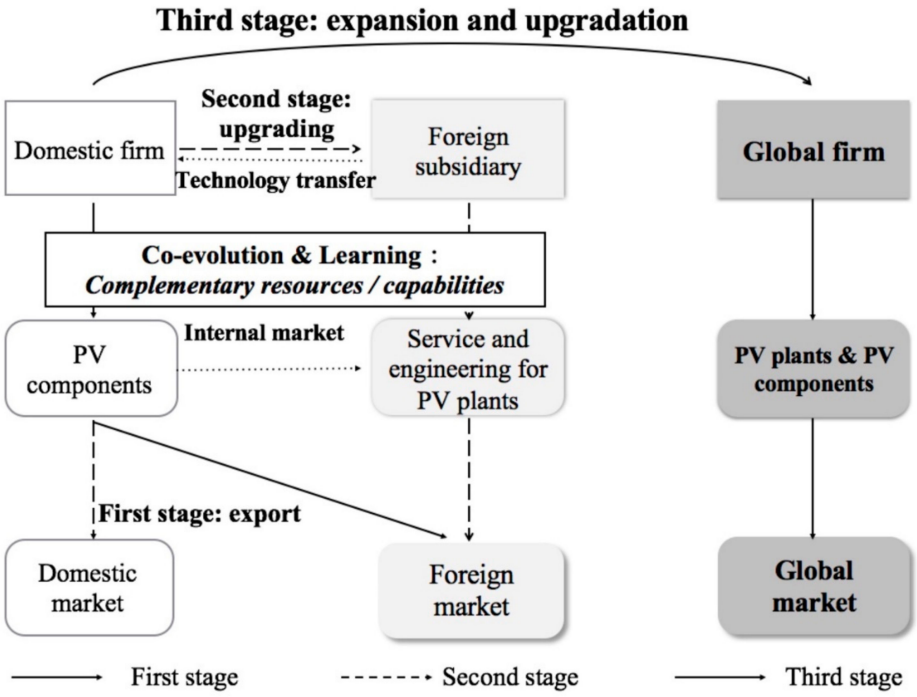

Figure 3. Three-stage internationalization process of Company S.

5.2. The Complementary Capabilities of Upgrading and Co-Development

Based on the RBV, we suggest that complementary capabilities of Company S—Shaoxing and Company S—Germany comprise the basic condition for the implementation of upgradation along the global value chain. Without the respective capabilities of Company S—Shaoxing and Company S—Germany, the international upgradation strategy would have been unwarranted.

Complementary capabilities between Company S—Shaoxing and Company S—Germany appear to exist in two respects. One is the complementary capabilities of the two subsidiaries of Company S. The other is the international social network of the president of Company S, which contributed to building of Company S—Germany and the interaction between Company S—Germany and Company S—Shaoxing.

As described in the case, Company S had a plan to do business on PV projects in Europe but had no capabilities and experience in the area before 2012. "It is a complex and long-term process to manage a PV electricity generation station from design, to installment, to the operation. It is a process including the land leasing, environmental evaluation, a public announcement, and the approval of the villages in the land, the connection to the grid, etc.," mentioned by Ms. M and operations manager of Company S—Germany. Ms. M and her colleagues in the PV industry have extensive knowledge and capabilities with respect to the complicated process of PV electricity generation and are familiar with the regulations and incentive policies regarding the PV industry in different European countries. For example, "I have worked in this industry for 11 years. All of them [her colleagues] have worked in this [PV] industry for many years. The engineers are my former colleagues from a German Company," said Ms. M. On the other hand, the financial requirement to set up a firm in the PV industry and the wish of Ms. M to be a professional manager could be resolved by the president of Company S. Thus, the expert and her friends, the key members of Company S—Germany, cooperated with the Company S Group to set up Company S—Germany for the European PV market. The establishment of Company S—Germany was a marriage of technology and capital.

Of course, the social network of the firm's leaders in the home and host countries contributes to the establishments and functions of the subsidiaries, which leads to the upgradation of firm in the home and host countries. In this case, the president of Company S played a bridging role. The president of the Company S Group had met Ms. M before they collaborated to establish Company S—Germany. They knew each other well and had good cooperative experiences in business deals, which was confirmed by Mr. Y, Mr. Z, and Ms. M. It was, therefore, possible for the president of Company S to invite Ms. M to do business together, confirming the role of international networks in the internationalization by emerging economy firms [57].

After the establishment of Company S—Germany, the production capability of Company S—Shaoxing and the project management capability of Company S—Germany were mutually supported by each other in a process of co-development. "They [customers] think we [Company S – Germany] are a German firm when we negotiate projects with customers because most of engineers are German and all of us speak German fluently. When we bid on the project, we have the cost advantage as a subsidiary of a Chinese firm." said Ms. M. All German employees have never thought of Company S–Germany as a Chinese firm. On the one hand, Company S—Germany cannot leave product support to Company S—Shaoxing. Firstly, for the PV-modules, cells, and wafers needed for the project, Company S—Germany has its own source of PV components, helping it to improve its ability to control the cost of solar power station projects to compete with other European firms that have a very strong price advantage. "The PV electricity generation station in Europe has stable and high revenue; the company S combines components' sales with building power stations, and sells power stations as products." The development of Company S—Germany confirms that the cost advantage is important in sustaining development in the PV industry [19]. Second, Company S—Germany can design products of a special size and scale, given the production capabilities of Company S—Shaoxing. Third, in the detailed implementation of the project overseas, the financial part and supply chain management of Company S—Germany also requires communication and cooperation with Company S—Shaoxing.

Therefore, the development and operations of Company S—Germany cannot leave the production capabilities to Company S—Shaoxing.

On the other hand, with the development of a PV electricity station project by Company S—Germany, Company S—Shaoxing maintains its production and exports and improves its production capabilities to provide PV components to Company S—Germany. For example, in 2014, Company S—Shaoxing provided Company—S Germany with more than 7 million silicon wafers, an intrafirm PV market of Company S—Shaoxing. Hence, the operations of Company S—Germany have created a new market for Company S—Shaoxing. Most importantly, the expertise of Company S—Germany, with extensive industrial experience in PV technology and PV projects, provides Company S—Shaoxing with sustained and sufficient technical support for PV projects in China and other countries. For instance, "We [Company S—Germany] have helped them [Company S—Shaoxing] win in international PV project bidding, including with standard, international PV bidding document-preparation." said Ms. M. In other words, the mature experience of carrying forward overseas projects by Company S—Germany and the development of communication and technology transfer between the two subsidiaries help Company S—Shaoxing to improve its ability to run PV electricity generation projects and increase its knowledge of policy and institutional situations in foreign markets, as concluded in Table 1. For instance, Company S—Shaoxing has already carried out ground engineering in the Hainan province in China, with an installed capacity of 20 M, and, "We are planning to build distributed power stations in Zhejiang Province and western China," said Mr. Y. Additionally, "we cooperated on the project bid in South Asia," said Ms. M. Hence, Company S—Shaoxing has not only improved its ability to produce PV-modular components and others, but also upgraded to the high value-added stage of the PV value chain [48] (the dashed line stage in Figure 2), which is the ability to build solar power stations, with technical support from Company S—Shaoxing.

Through coordinated progress and the mutual support of subsidiaries, the Company S Group has expanded its overseas market from Europe to South America and Africa. Furthermore, engineering projects carried out by Company S—Shaoxing in China and other countries, and the development of its overseas manufacturing bases entail the transition and upgradation of Company S—Shaoxing along the global value chain, in accordance with theories of GVC. This confirms previous research on the transition and GVC [58]. In conclusion, the case of Company S indicates that the pursuit of complementary capabilities is basic to the processes of internationalization [34], upgrading along the global value chain, and expansion in the international market.

5.3. The Trigger Factor of Upgrading

The crisis pushed firms to create a new trajectory of the global value chain [6]. Although the present case hints that Company S created a new trajectory of the global value chain in the PV industry, the reason for and timing of the establishment of Company S—Germany implies that the fierce double-antidumping in the European market forced the president of Company S to engage in an upgrading initiative. Based on the complementary resources and capabilities of Company S—Shaoxing and the potential Company S—Germany, the president of Company S wielded his social network in Europe to set up the engineering firm, Company S—Germany, to focus on the business of PV electricity generation as an innovative tactic to address the crisis. Pressure creates motivation. In an effort to survive the international trade crisis, Company S had to upgrade along the global value chain. The establishment of Company S—Germany benefited Company S—Shaoxing in dealing with the crisis on PV from the EU. "In the past two years, the domestic market environment was not good; the pressure of the price war was high, and the profitability was poor. In 2012, the foreign export market of Chinese PV components plummeted. But we did not have a serious financial problem [after the anti-dumping policies of the EU] because we had a company in Germany focusing on the engineering projects, not sales," said Ms. W, the board secretary.

Although, like other Chinese PV firms, the Company S—Shaoxing invested in the Chinese PV electricity generation stations with the encouragement of Chinese policies, Company S—Shaoxing

concentrated on setting up the company in Germany. It was a decision after a comparison of the European PV market and Chinese market. It was because the Chinese PV market in 2012 was in its infancy; the capacity and voltage stability of the PV grid-connected system in China was weak, and the financial tools to support the PV electricity generation in Europe were much better than those in China. For instance, Mr. Y said, "The debt interest-rates in Europe were quite low. The competition in Europe is based on the quality rather than the price."

"We [Company S—Germany] can find the investors when we start our project [in Europe]. We have never worried about the sales of electricity no matter how much electricity will be generated from our stations [in Europe], which was not ensured in China." said Ms. M.

"We recognized the PV electricity generation project, like the project of Ms. M, as a financial investment project with stable annual return," said the Danish investor.

Thus, the crisis of the Chinese PV industry from the international market was a triggering factor, incentivizing Company S to combine complementary resources and capabilities to follow a strategy of upgrading along the global value chain. Following on the footsteps of Company S, some Chinese PV firms employed foreign engineering projects in overseas markets. Therefore, we suppose that the crisis of antidumping worked as a window of opportunity during the evolution of the PV industry, which confirms the findings previous empirical studies in the literature (e.g., [59]).

5.4. The Approach to Upgrading

The intrafirm market (referred to as the internal market hereafter) relationship between Company S—Germany and Company S—Shaoxing based on their complementary capabilities and resources available (as concluded in Table 1) suggests that the establishment of an internal market can be a mechanism for firms to upgrade along the global value chain. For instance, Ms. M mentioned, "We (her company) could be seen as a customer of Company S—Shaoxing. We purchased components from Company S—Shaoxing." That was confirmed by the financier and purchaser of Company S—Germany. Nevertheless, as an independent firm, Company S—Germany can acquire PV components at a lower price. "It [the low price of components] gives us competitiveness when we competed with others for the PV station project," said Ms. M. Trade with Company S—Germany also means exports for Company S—Shaoxing and enables Company S to remain an exporter of PV components. Thus, we suppose that, through intrafirm linkage, the internal market enables each partner to easily cooperate with other partners on PV electricity generation projects and engage in vertical business along the value chain under a relatively fair-trade method, providing benefits to all partners. This verifies views about the role of intrafirm linkages in the development of firms in the GVC [4,5,43]. In other words, it is not necessary for a firm to give up its low value manufacturing base if it can achieve an industrial transition or upgrade that involves the formation of an internal market.

In addition, communication and cooperation between Company S—Germany and Company S—Shaoxing can be seen as a mechanism of technology transfer and learning that improves the capabilities and competitiveness of both partners. For example, Company S—Germany helped Company S—Shaoxing to develop new products meeting the market requirements, which enhanced the R&D capability of Company S—Shaoxing. The knowledge management, such as the documentary management system of Company S, contributes to the improvement the design and management capabilities of electricity generation station projects of Company S—Shaoxing. "We submit all files to China," said the employee from the supply chain of Company S—Germany. "They learn from us," said Ms. M. It confirms the finding that the role of the vertical integration of value chains is important in technology transfer in the Chinese PV industry [60].

Hence, the key elements and factors in the international upgrading process of Company S can be summarized in Figure 4 below, based on the analytical framework of Figure 1.

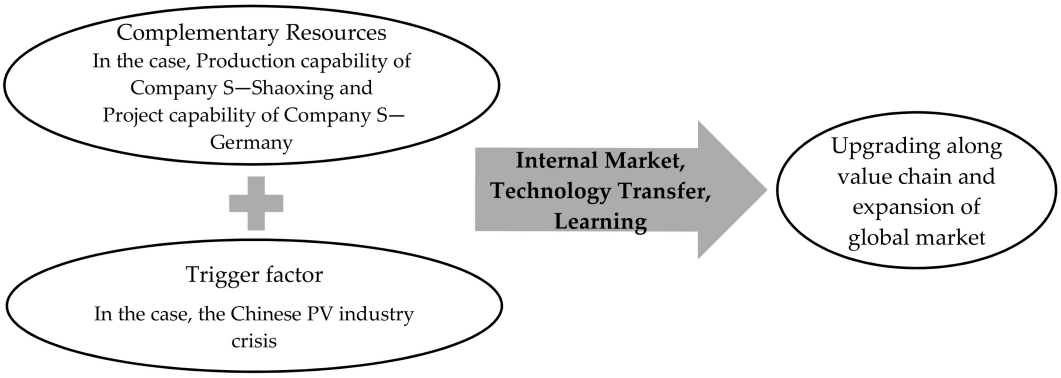

Figure 4. Key elements in the international upgrading process: the case of Company S.

5.5. The International Upgradation Process

This internationalization process of company S was specific: it set up a service company in a foreign country, not an acquisition, nor a sale, as shown in Figure 3, thus differing from the traditional internationalization process of Chinese firms, which involves moving from domestic markets to foreign markets, and from production in China to production in China and in foreign countries, as Lund mentioned [19]. Although some Chinese firms have subsidiaries that provide engineering services and conduct engineering projects in Europe and other regions for their customers, these are still not as same as those of Company S. The subsidiary of Company S in Germany is not only a customer of Company S in Shaoxing, but the owner of the PV electricity generation projects, not just a contractor for those projects.

Compared with the internationalization process proposed by Lund [19], the internationalization process (Figure 3) emphasizes the establishment of an internal market in stage 2 and businesses in the upstream part of the value chain rather than production in a foreign market. As presented in this case, the Company S Group established a production base overseas to engage in foreign production and then later achieved global production in stage 3 rather than stage 2. We assume one of the main reasons for the difference from Lund's model is because Chinese PV firms, like Company S in the case, were export-oriented before the antidumping and other trade conflicts. They set up a Chinese market (domestic market) later than the foreign market. The second reason is because Company S—Germany was established neither for the localized production nor for local sale in the foreign market, which then led to the transformation of Company S—Shaoxing, as well as the whole group.

In other words, we assume that the internationalization process of Company S in Figure 3 demonstrates a new international upgradation process (as shown in Figure 5), which is different from the previous research of Lee and his colleagues, although the international upgradation of Company S confirms that firms from emerging economies can achieve transition and upgradation in the global value chain. It is an international upgrading process in which the international upgrading of firms in the home country is driven by the development and transition of the subsidiary in the host country.

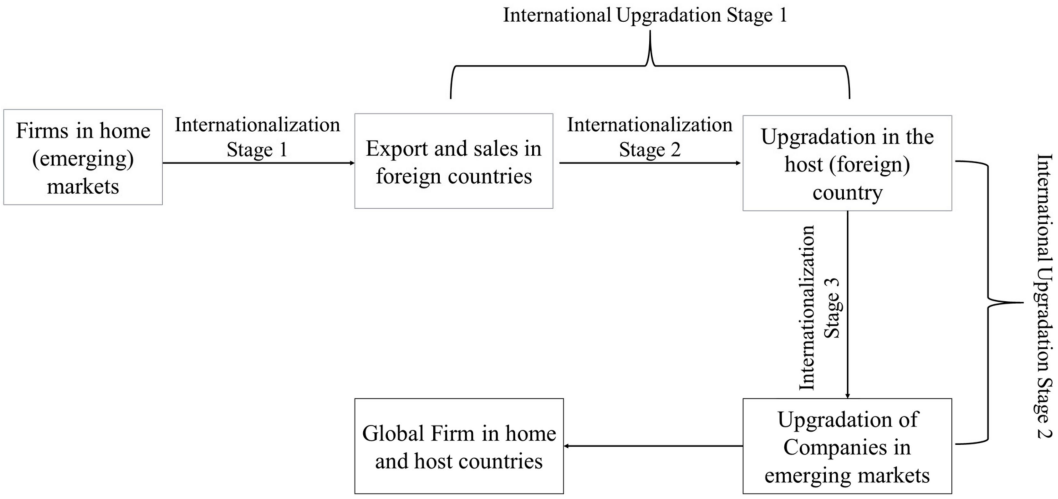

Figure 5. The international upgradation process of firms in emerging economies.

This international upgradation process in Figure 5 includes two stages. At first, the firm exporting components to the foreign countries is promoted to be a firm whose subsidiary is offering the engineering projects, operations, and services in the host countries and other foreign countries. It could be recognized as the international upgradation stage 1 in Figure 5: from the exporting of components from the firm in the home country (such as the first stage in Figure 3) to the exporting of also providing the complete package of components, engineering services, and the operation of the final product (such as PV plants at the second stage in Figure 3). Then, the development of the subsidiary in the host country advances the transition of firm in the home country (such as the third stage in Figure 3), as shown in the international upgradation stage 2 in Figure 5. The international upgradation stage 2 in Figure 5 emphasizes the process of internal product markets and technology transfer, which are approaches to upgrading and interaction between partners. The success of internationalization depends on the complementation of resources and capabilities of partners (subsidiaries of firms). It emphasized co-creation in the market and tech improvement in the process.

From the case of Company S, we can see clearly that the role of GVC upgrading in the process of internationalization from exporter to global firm (internationalization upgrading) is significant, and the interplay between the GVC upgrading process and the internationalization process is not negligible. The activity in internationalization stage 1 provides the possible resources and capabilities for Company S's GVC upgrading. The establishment and operation of Company S—Germany means upgrading to high-value activities, also meaning that Company S has taken a big step towards its global corporate goals. The good progress of Company S—Germany's European project means successful upgrading of the GVC of Company S, which also brought about the acquisition of new competences and development of their own product, which paved the way for the companies to become more global (corresponding to international upgrading, stage 2 in Figure 5).

6. Conclusions

The above in-depth analysis of the development of Company S in the PV industry after 2011 revealed a two-stage international upgradation process—a possible approach to upgradation and the resources needed for upgradation in the PV industry in specific, and manufacturing firms in general, from the perspective of the global value chain. Based on this case, this research proposes an international upgradation process for firms in the PV industry, as shown in Figure 5. It is a process that includes three stages of internationalization and two stages of international upgradation. The three internationalization stages are: stage 1—export; stage 2—international upgradation; and stage 3—global expansion and upgradation. In this process, firms can upgrade along the global value chain without becoming involved in price wars, establishing local factories overseas, or engaging in

overseas R&D. Furthermore, this paper contributes the idea that firms should set up new strategies for market expansion, not just the same as those of their competitors (Chinese PV for Chinese markets and, later, markets in developing countries), and achieve the first mover advantage (other PV companies had a similar strategy later).

The co-evolutionary development of the subsidiaries of Company S in Shaoxing and Germany and the international upgrading process indicate the importance of the complementary resources and capabilities of the two subsidiaries as the basic conditions for the implementation of an upgrading strategy, which is consistent with findings [61] that a stimulating linkage between an EMNEs' home-country partners and host-country firms is a key condition for progress towards achieving sustainable development goals. In addition, the internal market is a useful and effective means of enhancing interaction and cooperation between international subsidiaries of firms. Without complementary resources and capabilities—the production capabilities to provide high-quality wafers and other products of Company S—Shaoxing and the engineering and marketing capabilities to build and operate PV solar electricity generation facilities of Company S—Germany—it would be impossible to set up the internal linkage and internal market between the low value-added activities, and the high value-added activities in the global value chain to complete the internationalization of a firm. This is consistent with previous research that capability-building of the domestic industry has an important influence on the foreign direct investment (FDI) of EMNEs [25]. On the other hand, the co-evolution of Company S—Shaoxing and Company S—Germany suggests that Chinese firms should not give up manufacturing capabilities and advantages, even those at the low end of the value chain, as they provide solid support to high-end value activities, enhancing their comparative advantages.

The development of Company S reveals that a crisis could become a trigger to upgrade and transition when the firm can access or owns complementary capabilities. For instance, the challenge faced by the Chinese PV industry at the end of 2011 drove Company S to upgrade in the global value chain and engage in its transition. It confirms the finding of Lee and his colleagues regarding the time to employ the transition strategy [6].

Not taking into account the expansion of the production base overseas as a strategy to maintain a certain position in foreign markets, such as PV modelers, the case of Company S also illustrates the advantages of establishing a subsidiary at the high value-added stage of the value chain as a capability and market complement. Thus, the specific international upgradation process of firms proposed in this research emphasizes upgrading and improvements in synergy between high and low value-added stages of the global value chain, which differs from the typical international production and market growth strategy for new energy technologies [19]. At the same time, by focusing on the specific internationalization process of establishing a subsidiary corporation in a target market—which is not a low-cost strategy; the establishment of an overseas factory; mergers and acquisitions; and overseas R&D, Company S grew and achieved industrial upgrading.

The findings indicate that government and policies should guide enterprises to attach importance to value chain upgrading and actively encourage enterprises to emphasize high value activities after accumulating advantages. What is more, the government should pay attention to the cultivation and development of the domestic market.

With them being a sustainable energy source, research on Chinese solar energy enterprises will not only help Chinese solar energy enterprises to overcome the development crisis and achieve sustainable development, but also provide ideas for the further development of the solar energy industry. Furthermore, it provides a basis for energy infrastructure upgrading.

The international strategies and the unique internationalization patterns of emerging, MNEs like Company S, and the open innovation strategies in those processes, require further research in other fields in the future. Further, this research is based on one case of PV in China, which limits the generalizability of this research. Therefore, further research in more companies, other regions, and using other research methods (such as quantitative research) will be needed to explore the findings proposed in the paper.

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Appendix A Main Interviews Questions

1. At the Company S—Shaoxing:

    a) When was the company founded? What is the number of employees? What is the revenue of the company in the current year? What are the key products and markets of company? What are the advantages and disadvantages of the company? What are the production capacity and technological capabilities of the PV product?
    b) What was the influence of EU market crisis on you? How did you deal with the crisis? What was the exportation and revenue of your company after the crisis?
    c) Why and how did your company set up the subsidiary in Germany? What are benefits to your company from the subsidiary in Germany? What changes happened in your company after the establishment of subsidiary in Germany?

2. At the Company S—Germany:

    a) What is your education and work experience? What is your function in the German company? Did you know Ms. M before?
    b) When was the German company established? Are you the co-founder of the German company? How did you recruit your employees? Why did you cooperate with Company S to set up the German company? How did you know the president of Company S?
    c) What is the function or role of the German company? What is the relationship with the company in China and the sales representative in Europe?
    d) How many projects did you finish? Which market did you work in? How do you operate your projects? What are profits of your company?
    e) How do you compete with other PV project companies in Europe? How and what business do you conduct in Europe?
    f) What are main problems you meet when your company operates in Europe?
    g) How do you find the enough financial support, given the heavy capital requirement of PV projects?
    h) What are competitive capabilities of your company? What is the operation of your company?
    i) What benefits do you get from Company S in China? What do you contribute to the Company S in China?
    j) What do you think about the future of German company and Company S, and the PV market?

3. At the Danish investment company

    a) What are your key businesses? Why do you invest in PV project as a fund company?
    b) How do you know Ms. M? Why do you cooperate with Ms. M? Why did you invest in the project of Ms. M when they started the infrastructure project? What is the cooperation with the German company?
    c) How do you evaluate the project in the island?

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