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Government subsidies for the Chinese photovoltaic industry

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ABSTRACT

Since 2009, the subsidy for large-scale photovoltaic (PV) power plants had been launched, which effectively promoted the development of PV industry. At the same time, negative effects, like serious oversupply of PV industry, were brought about by these large scale governmental subsidies. Although governmental subsidy strongly supports the China PV companies, few of them have competitiveness in the global market. This dramatically conflictive phenomenon attracted many researchers' attentions in recent years. However, investigations on the best entry and exit occasions of governmental subsidies for the PV industry were rarely reported in previous studies. Therefore, based on the existing division method of enterprise development model, classification of 72 PV companies listed in Shanghai and Shenzhen Stock Exchanges in China was firstly carried out in this paper. This is followed by studying the influence of governmental subsidies on the indexes of different stages of enterprise development. Finally, a conclusion was drawn that the governmental subsidies at Early Exploratory Stage can maximize the social and economic effects, suggesting the best entry occasion, and subsidies at Intermediate Stage and Mature Stage have little effects on its turnover and aggravate the overcapacity of PV supply, suggesting a suitable exit occasion.

1. Introduction

As the worldwide electricity demand and price growing, environmental aspects represent a large concern and heavily influence the global energy policy, such as global warming, ozone layer depletion and high-levels of pollution, especially the PM 2.5 air pollution in Beijing in China. It is necessary to emphasize the use of emerging and well-known renewable energy, and different energy conservation approaches (Song et al., 2016). The abundant and widely available solar power resource makes it to be one of the major renewable energy sources that have the great development potential (Zhao et al., 2013; Peng and Lu, 2013). Solar photovoltaic (PV), which converts the sunlight directly into electricity by means of silicon-based material, is an important utilization technology of solar power. Solar PV power generation is clean, safe, convenient, and with high efficiency. As global energy shortages and environmental pollution have become increasingly prominent, solar PV power has received worldwide attentions (Zhang and He, 2013; Low and Abrahamson, 1997). From 2002 to 2012, the global PV industry had nearly an average annual growth rate of 50%. In China, PV industry grew even faster. Its growth rate even exceeded 100% in some years after 2002. Since 2009, its production has ranked the first in the world in the following consecutive four years. And in 2012, its production accounted for 60% of the world production, as shown in Fig. 1 (Yuan et al., 2014). With such a large share of the global PV industry, China's PV industry has great impact on global PV market (Zhang and He, 2013). As shown in Fig. 1, China is the only one country that can cover its own growing market with 320% more production than its need (Yuan et al., 2014).

On the other hand, positive governmental policy is an extraordinarily effective method to boost the growth of PV industry because this industry needs a long-term development period. Low and Abrahamson (1997). As the same as Europe (EU), the United States of America (USA) and Japan, China launched a national solar subsidy program in June 2009, named Golden Sun Program, which subsidized 50% of investment for solar power plants, with a total amount of 10 billion RMB (1.6 billion USD). Owing to the incentives of the large amount of subsidy, the PV industrial scale undergoes a rapid increase with compound annual growth rate (CAGR) of 285%. As shown in Fig. 2, the annual newly-added PV installed capacity in China was raised from 200 MW in 2009 to12.5 GW in 2013. Accordingly, the share of China's cumulative PV installed capacity in the world's cumulative installed capacity increased from 5% in 2009 to 20% in 2014 (Michaela, 2013).

Abbreviations: B, net profit of the following year; CAGR, compound annual growth rate; EES, Early Exploratory Stage; EU, Europe; IS, Intermediate Stage; MS, Mature Stage; PV, photovoltaic; R & D, research and development; RI, Revenue Increase; ROE, return on equity; SPSS, Statistical Product and Service Solutions; T-S, total tax of the following year; UK, the United Kingdom; USA, the United States of America

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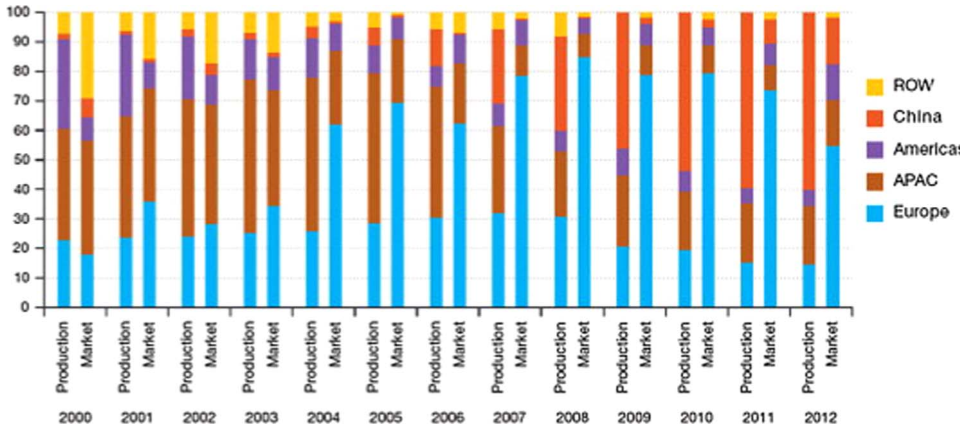

Fig. 1. Historical PV market vs. production by region (%).

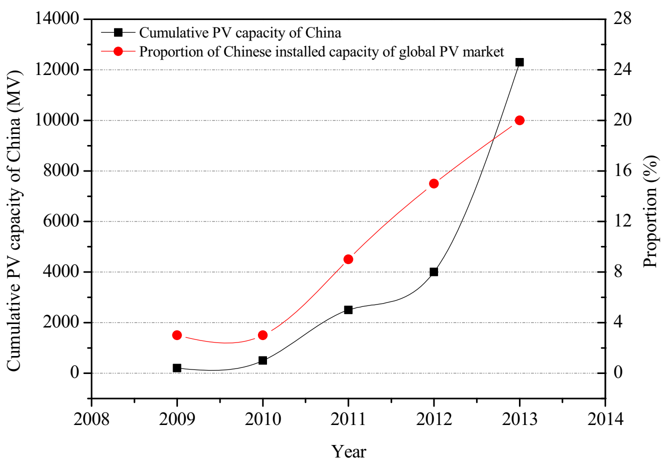

Fig. 2. Cumulative installed PV capacity of China and proportion of Chinese installed capacity of global PV market (Michaela, 2013).

However, negative effects were also brought about by the large scale governmental subsidy. In 2008, the global financial crisis emerged and then resulted in a rapidly shrinking foreign PV market. Chinese PV companies faced a tough period due to their entirely dependences on foreign orders at that time. A large number of enterprises have ceased production and even closed down. Then in 2009, European debt crisis happened. Demands in the market for PV products continued to be weakened. Moreover, anti-subsidy investigations were conducted by EU and USA in 2012, because of accusing that China dumped polysilicon to USA, Germany and Korea at a price below the cost (Zhao et al., 2015). Therefore, serious oversupply was resulted in by low domestic demands and sharply decreased foreign demands. Furthermore, to obtain more governmental subsidy, many factories expand their production, which makes the situation of oversupply on PV module production more serious (Zhang and He, 2013; Wang et al., 2014).

Although there is governmental subsidy supporting these China PV companies, few of them have competitiveness in the global market. Take a company in Jiangsu Province of China as an example, it received a total subsidy up to 450 million RMB (71 million USD) from the national, provincial and municipal levels of government in 2012. However, there was still an operating-profit loss of 530 million RMB (85.5 million USD) even considering the subsidy of 450 million RMB (71 million USD). Moreover, with the subsidy decreasing, the profit was significantly reduced. In 2013, the received subsidy was decreased to 41.71 million RMB (6.58 million USD), 10% less than that in 2012, with the operating-profit loss up to 130 million RMB (20.5 million USD). It is obvious that these China PV companies will nearly have no competitiveness in the global market but for any governmental subsidies (Wang et al., 2014). Therefore, PV industry and related governmental subsidy policy attract more and more attentions from researchers all over the world in recent years, as summarized in Table 1 (Song et al., 2016; Peng and Lu, 2013; Yuan et al., 2014; Michaela, 2013; Zhao et al., 2015; Wang et al., 2014; Heras-Saizarbitoria et al., 2011; Pablo and Pere, 2012; Sahoo and Shrimali, 2013; Verhees et al., 2013; Zhang et al., 2013, 2014; Veldhuis and Reinders, 2013; Chowdhury et al., 2014; Jung and Tyner, 2014; Chen et al., 2014; Lin et al., 2014; Kim and Kim, 2015; Watts et al., 2015; Shen and Luo, 2015; Gao et al., 2015; Sahu, 2015; Hansen et al., 2015; Chaianong and Pharino, 2015).

Particularly, in 2012, Pablo and Pere (Pablo and Pere, 2012) reported an overview of the trends of the Spanish solar PV feed-in tariff and its design elements, identifying some implications for the effective and cost-efficient deployment of solar PV in Spain, with some lessons which might be useful for the implementation of support for solar PV elsewhere. Thereafter, Sahoo and Shrimali (Sahoo and Shrimali, 2013) investigated the effectiveness of domestic criteria in India's Solar Mission in 2013. Their analysis revealed a comparison with the Chinese innovation system indicating shortcomings in the Indian innovation system of research and development (R & D) capabilities, coordination of resource provision and complementary industrial strengths. Finally, a suggestion was given that the solar PV domestic content requirement should be removed from the National Solar Mission by policymakers (Sahoo and Shrimali, 2013). At the same time, in Netherlands, the United Kingdom (UK), China, Hong Kong and Indonesia, many researchers gave their reports on solar PV industry development and related policy in different fields, including development and policy of solar PV power, potential and cost-effectiveness of grid-connected solar PV, development potential of rooftop PV system and its environmental benefits, etc. (Peng and Lu, 2013; Sahoo and Shrimali, 2013; Verhees et al., 2013; Zhang et al., 2013; Veldhuis and Reinders 2013). From 2014 to 2015, as listed in Table 1, more researchers coming from different countries and regions reported their findings about PV industry, especially the governmental policy (Yuan et al., 2014; Michaela, 2013; Zhao et al., 2011, 2015, 2016; Wang et al., 2014; Verhees et al., 2013; Zhang et al., 2013, 2014; Veldhuis and Reinders, 2013; Chowdhury et al., 2014; Jung and Tyner, 2014; Chen et al., 2014; Lin et al., 2014; Kim and Kim, 2015; Watts et al., 2015; Shen and Luo, 2015; Gao et al., 2015; Sahu, 2015; Hansen et al., 2015; Chaianong and Pharino, 2015; Ouyang and Lin, 2014). For example, Wang et al. Wang et al. (2014) concluded the reason of overcapacity in China's PV industry in its early growth stage. Kim and Kim (2015) studied the role of policy in innovation and international trade of solar PV technology, by modeling study on unbalanced panel data, obtained between 1991 and 2008, from 16 countries using solar PV. Gao et al. (2015) overviewed the historical development of feed-in