

Research on the impact of subsidy on photovoltaic industry

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Abstract. The photovoltaic industry has a good development prospect and is one of the important objects of national policy support. Based on this background, this paper analyzes the reasons why the state provides subsidy policies, the relevant impact of the policies, and the future direction of the measures.

Keywords: Macroeconomic effect, subsidy, photovoltaic industry, forecast analysis.

1. Introduction

The photovoltaic industry has become an important part of innovation-driven development in China, which can well solve the problems of excessive carbon dioxide emissions (Sun, et al., 2014). According to Mankiw (2015, p.203), one of the ten principles of economics is that government action can sometimes improve market outcomes. To support the development of photovoltaic industry, the Chinese government has brought a series of subsidy policy into force since 2009. This essay will explain the reasons and effects of using subsidy policy and discuss whether it is effective in the future.

2. Reasons of Chinese government providing subsidies for photovoltaic industry

2.1 The photovoltaic industry provides positive externality to the society

According to Mankiw (2015, p.203), externality is the uncompensated effect of actions of a person on the welfare of bystanders. If the effect on bystanders is beneficial, it is called a positive externality (Mankiw, 2015, p.211). Ulteriorly, one potential type of positive externality is technology spillovers, and economists believe that governments should encourage those industries with the greatest spillovers of output (Mankiw, 2015, p.217). From a business point of view, historical data shows that solar photovoltaic capacity reached 104.1 gigawatts in 2018, which proves that solar power is one of the most promising renewable energy sources (Ren, 2020). Additionally, China has the natural advantage of abundant solar energy resources (Ren, 2020). In other words, the PV industry has great commercial prospect and resource potential, which can generate large output spillovers (Zhao et al., 2011). From the perspective of improving life, the development of its photovoltaic industry has contributed greatly to the reduction of carbon dioxide emissions (Ren, 2020). These all show that the photovoltaic industry belongs to the research of new technologies, not only has great excellent industry prospects, but also bringing more environmentally friendly electricity, provides positive externality to the society.

2.2 Government subsidies can solve the problems triggered by positive externalities.

Positive externality will affect the market produce less than the socially desirable quantity (Mankiw, 2015, p.215). To solve this problem, the government can internalize externality by subsidizing externality (Mankiw, 2015, p.215). Figure 1 shows under the condition of positive externalities, the market equilibrium (Q_m) will move to the social optimal (Q_{best}) through subsidies.

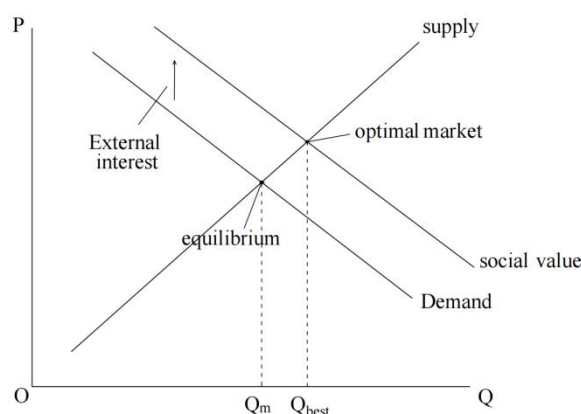


Figure 1: Optimal market

When positive externalities exist, the social value of goods is greater than the private value (demand). If the government subsidizes the goods, the demand curve will shift approach to the social value curve, thus result in the equilibrium point shift approach to optimal market. This confirms that applying subsidy policy can effectively promote the development of the photovoltaic industry in China.

3. The economic impacts of this subsidy in China

3.1 Effect on consumers and producers' market

Based on the principle that people respond to incentives, the effects of subsidies on the economy can be divided into the economic effects on consumers and the economic effects on producers by group to discuss. Figure 2 and Figure 3 show the effects of government subsidies on consumers and producers market outcomes, respectively.

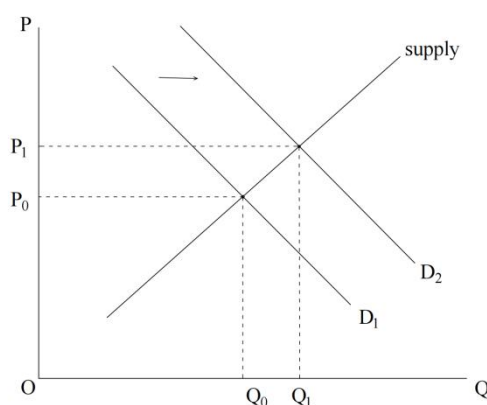


Figure 2: Government subsidy to consumers

The economic effect of government subsidy to consumers is that the demand increase. When government subsidy happened to stimulate the market, the demand of goods will increase, with the demand curve shifting from D_1 to D_2 .

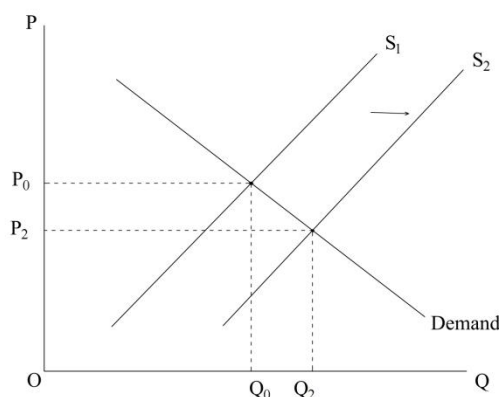


Figure 3: Government subsidy to producers

The economic effect of government subsidy to producers is that the supply increase. When government subsidy happened to stimulate the market, the supply of goods will increase, with the supply curve shifting from S_1 to S_2 .

3.2 Effect on consumers

According to the law of demand, suppose other conditions being equal, if the price of a good decreases, consumer demand for those good increases (Mankiw, 2015, p.73). Government subsidies reduce the cost of photovoltaic industry and thus lower the price of photovoltaic power for consumers. With lower price, consumers are more willing to use the cleaner photovoltaic power thus result in the increase of the demand. Additionally, utility measures the satisfaction people derive from consumption (Frank et al., 2017, p.70). Government subsidies indirectly provide the opportunity for consumers to buy goods in a cheaper price, which accordingly raise up the utility of consumers. In other words, under the influence of government subsidies, consumers will have a higher level of acceptance and enthusiasm for photovoltaic products.

3.3 Effect on producers

According to the conception of Economies of scale, if the cost per unit of output falls as the scale of production increases, the firm experiences economies of scale (Mankiw, 2015, p.291). In other words, if a firm receives increasing returns to scale from its factors of production, then as it produces more, it will use less and less of the number of factors per unit of output, which lower the costs. In long-term sight, as the production scale increases, enterprises will also experience economies of scale. In addition, the application of subsidies can not only reduce operating costs, but also impose restrictions on their harmful impact on the natural environment (Gołębiewski and Galant-Gołębiewska, 2021). Therefore, enterprises will also bring positive efforts to protect the environment at the moral level.

3.4 Effect on other relative impacts

Relevant goods being affected as well. Substitutes are two items in which an increase in the price of one commodity trigger an increase in the demand for another (Mankiw, 2015, p.76). Under the influence of government subsidies, consumers will use more photovoltaic power, which will reduce the demand for other sources of electricity. On the one hand, consumers can use PV products at more favorable prices after the support of government subsidies, which means lower prices for consumers. On the other hand, conventional power generation is relatively expensive and environmentally damaging. For instance, coal-fired power generation produces a lot of carbon dioxide and requires more costs for carbon capture (Al-Hamed, 2022). As a result, coal-fired power costs will be higher than government-subsidized photovoltaic power, and consumers will prefer clean and cheap photovoltaic power. In other words, it will be detrimental to the development of thermal power generation. Therefore, the use of government subsidies to support the Photovoltaic industry will contain the traditional power generation to develop.

4. Welfare impacts of photovoltaic subsidy in China

4.1 Concept of Welfare economics

Welfare economics is a study of how resource allocation affects economic welfare (Mankiw, 2015, p.143). In addition, one possible model for measuring the economic well-being of a society is the sum of consumer and producer surpluses (Mankiw, 2015, p.150).

4.2 Impact of subsidy with diagram analysis

Figure 4 illustrates the change of consumer surplus under the influence of government subsidies.

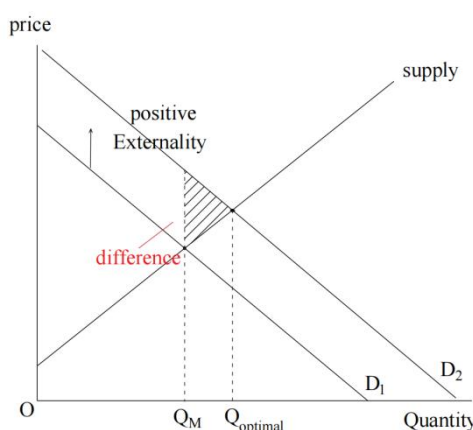


Figure 4: The impact of subsidy on welfare

When there is positive externality in the market, government apply subsidies can increase the sum of consumer surplus and producer surplus. Without giving subsidies, there is a difference between Q_M (market quantity) and $Q_{optimal}$ (social optimal quantity). Assume the supply is constant, under the impact of government subsidy policy, the demand will increase, with the demand curve shifting from D_1 to D_2 . The shaded part of the figure represents the increase in the

total surplus of both consumers and producers after the effect of government subsidies. This shows that the welfare economy will increase under the influence of government subsidy policies.

5. Future direction of the measures

Should the subsidy maintain the original level in the future?

The government should gradually reduce the scale of subsidies in the future. Although government subsidies can promote the development of the industry by stimulating production and increasing consumption, it may lead to uneven phenomenon when more suppliers enter the market. For example, companies with immature technologies are not as well positioned for exploitative learning as companies with more mature technologies. (Hoppmann, 2013). Thus, overweight subsidies will lead to less mature technologies entering the market, leaving good and bad in the market. Additionally, a study of A-share listed photovoltaic companies from 1999 to 2019 in China shows that government subsidies have two sides to the progress of photovoltaic technology. It illustrates that tax filing have a positive effect, while fiscal subsidies have a negative mitigating effect (Cai, 2022). These all show that the government should reduce financial subsidies in time to promote the technological progress of China's photovoltaic industry.

6. Conclusion

Generally, I think government subsidies are necessary for photovoltaic industry in China, as this industry has good development prospects and can slow down the pressure of carbon dioxide emissions and contribute to the environment. However, the level of subsidies should be gradually reduced in the future. Appropriate subsidies in the early stage can stimulate consumption to stimulate production and encourage more market participants to enter the market, thus promoting the development of the photovoltaic industry. Accordingly, continuous subsidies will lead to adverse effects, such as immature production technology of some players will enter in the market (Hoppmann, 2013). Therefore, the government should reduce financial subsidies in time in the future to provide better development of the photovoltaic industry.

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