ECONOMETRIC STUDY ON THE PRICING MECHANISM OF GLOBAL SOLAR PV PANEL

Peck Yean GAN

The Institute of Energy Economics, Japan, Inui Bldg., Kachidoki 13-1, Kachidoki 1-chome, Chuo-ku, Tokyo 104-0054 Japan, Telephone: +81-3-5547-0231, Fax: +81-3-5547-0227

E-mail: pyean@tky.ieej.or.jp

LI ZhiDong

Dept. of Management and Information System Science, Nagaoka University of Technology

Overview

The global solar PV industry has experienced unprecedented growth over the last decade with an average annual growth rate of 50%. In 2011, global solar PV market has reached a cumulative installed capacity of close to 70GW, up from 1.8GW in 2000 (EPIA, 2012), providing 0.1% of total global electricity. While still a dwarf compared with fossil fuels, the PV industry is expanding very rapidly due to dramatic cost reductions in the past decades. Long-term scenario studies projected an increasing role of PV in global electricity generation and positioned solar energy as one of the realistic options for future's energy mix. Though PV is still economically uncompetitive compared with conventional sources such as gas, coal, and even with other renewable sources, technology improvements, innovation, adequate incentives and support policies, such as the FiT will bring further cost reductions for electricity from PV.

Methodology and Data

In this study, we analyzed the pricing mechanism of global solar PV panel using learning curve (LR) as the tool to identify contributing factors to cost reduction of PV panel from 1988 till 2006. We then utilized the estimated LR results to project future module cost reduction pathways based on a range of solar deployment scenarios by IEA and EPIA.

In the estimation of LR, we utilized world average PV module cost per watt as the performance measure instead of using prices as a proxy for a more accurate estimation of LR. In addition to cumulative global solar PV production, the following potential explanatory factors (1) silicon prices; (2) demand and supply gap of world PV market; and (3) Chinese share in world PV production were also tested to analyze their contributions to cost reductions in the production of PV module from 1988 till 2006.

Firstly, we estimated the LR of PV for 1988 till 2006 as a whole and then we divided the review period into three periods namely (1) 1988-1996: Preparation for take off; (2) 1997-2001: Early commercial; and (3) 2002-2006: Commercialization, and repeated the estimation to examine changes in LR as technologies mature. Where applicable, we also repeated the estimation using both nominal and real prices for comparison.

In term of data, module costs, silicon prices, global annual and cumulative solar production data, and etc were assembled from Annual Trade Statistics of Japan by Ministry of Finance, statistics of European Photovoltaic Industry Association and Earth Policy Institute (MOFJ, EPIA 2008 and 2012).

Results

Our estimations indicated that:

- LR estimated with only cumulative production indicated possible missing explanatory factor in the estimation.

- Silicon prices should be considered in estimating LR of solar PV.
- Data in real prices is preferred in order to account for inflation.
- It is meaningful to examine LR of energy technologies according to stages of industry (technology) development.

In the sensitivity analysis of module cost reductions to a range of solar deployment scenarios, our estimations indicated that overall, module cost reduction is projected to be in the range of 19% to 35% in 2030 against 2011 level for the three solar deployment scenarios analyzed.

Conclusion

We assembled historical PV data from 1988-2006 to estimate and analyze its LR. Our analysis indicated that estimated LR using only cumulative production denoted possible missing explanatory factor in the estimation, and that other important explanatory factors such as silicon prices should also be considered. Real prices data is preferred for the estimation to account for inflation where applicable. Additionally, LR of energy technologies should be examined according to stages of development to reflect changes in LR as industry/technologies mature. With consideration to the above findings, we estimated that LR was 12% for 1988-1996, dropped to 10.7% for 1997-2001 and slowed to 10.2% for 2002-2006. This conformed to theory where young technologies learn faster from market experience than old technologies with the same progress ratios. The same absolute increase in cumulative production will have more dramatic effect at the beginning of a technology's deployment than it will later on.

In sensitivity analysis of PV module cost projections using a range of solar deployment scenarios, results indicated that module costs in real prices will drop from $3.8/W in 2006 to $2.01/W in 2020 and $1.68/W in 2030 for the most accelerated solar deployment scenario. Overall, module cost reduction is projected to be in the range of 19% to 35% in 2030 against 2011 level for the three scenarios analyzed. Nonetheless, these projections should be regarded as indicative of possible pathway of cost reductions as technology breakthrough and further expansion of less costly PV modules may drive faster cost reductions than indicated.

References

[1] EPIA. 2012. Global market outlook for PV until 2016.

[2] Ministry of Finance Japan (MOFJ). Trade Statistics of Japan.

[3] European Photovoltaic Industry Association (EPIA). 2008. Solar generation V 2008. pp.25. Available at http://www.photovoltaique.info/IMG/pdf/EPIA_SG_V_ENGLISH_FULL_Sept2008.pdf [accessed 8 Dec 2009].