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Consumer loss in Czech photovoltaic power plants in 2010–2011

Jan Průša [a,*], Andrea Klimešová [a], Karel Janda [a,b]

[a] Institute of Economic Studies, Faculty of Social Sciences, Charles University in Prague, Opletalova 26, 11000 Prague, Czech Republic
[b] Department of Banking and Insurance, Faculty of Finance and Accounting, University of Economics (VSE), Naměstí Winstona Churchilla 4, 13067 Prague, Czech Republic

HIGHLIGHTS

- We calculate economic losses generated by Czech photovoltaic power plants.
- Without subsidies estimated loss is CZK 12.6 billion in 2012 (8% of invested assets).
- 43% is the dead weight loss due to high technology costs.
- 57% is the profit redistributed out of subsidies as interest payments to banks.
- Only a 7-fold change in parameters of the model would make PV plants profitable.

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ABSTRACT

This paper provides a financial survey of a small sample of Czech photovoltaic (PV) plants. To evaluate the extent of market losses, we calculate the shadow market price of solar electricity. From the profit and loss accounts of the PV plants and the shadow market price we estimate the total economic loss generated by PV electricity sector in the Czech Republic. The presented microeconomic approach has two main advantages: firstly, we work with real observed data, which offsets the drawback of a limited sample. Secondly, the profit accounting calculation enables sensitivity analysis with respect to key variables of the plants. We show that money invested in PV plants would generate an annual loss of 8%. Given the estimated solar assets of CZK 165.6 billion (EUR 6.6 billion) as of December 2011, this translates in at least CZK 12.6 billion lost in the Czech solar sector in 2012. About 43% of this loss is due to high technology costs and corresponds to pure dead weight loss, while the remaining 57% constitute the redistributive profit component of subsidies. Finally, we calculate that unless electricity prices increase or technology costs decrease approximately sevenfold, PV plants will remain loss making.

1. Introduction

Concerns about anthropogenic global warming (also referred to as climate change) and carbon emissions led governments around the world to adopt various energy policy measures with significant financial impact on public budgets. The most widespread measures include subsidies of renewable sources of energy, especially photovoltaic (PV) electricity generation.

While some authors (Pearce, 2002) emphasize the positive contribution of photovoltaic energy to limiting carbon emissions, several affairs of the PV sector recently caught negative attention in the media: (1) generation of subsidized green electricity at night using diesel aggregates in Spain. This particular case received extensive international coverage (Bloomberg, 2010). (2) Bankruptcies of several large PV companies, including PV panel producers Evergreen Solar and Solyndra. Solyndra even received $535 million of US federal government guaranteed debt to finance its expansion. The company reported assets of $859 million and debt of $749 million (Bloomberg, 2011d). When Evergreen Solar filed for bankruptcy, it owed its creditors $485.6 million while listing assets of $424.5 million (Bloomberg, 2011a). German PV panel producer Solon SE filed for insolvency in December 2011, with debt of EUR 570m and assets of EUR 466m as of September 2011 (Bloomberg, 2011b). (3) Rapidly increasing electricity price for Czech customers due to PV energy subsidies. The surcharge for renewable sources paid by consumers amounted to 166.34 CZK/MWh or 6.7 EUR/MWh in 2010 (ERÚ, 2009) and jumped to 419.22 CZK/MWh or 16.8 EUR/MWh in 2012, an increase of 152% (ERÚ, 2011). (Note that throughout this text we use the exchange rate of 25 CZK/EUR.)

This study concentrates on the last case. We provide a survey of PV plants in the Czech Republic, where we focus on large greenfield projects. We analyze their profitability and decompose their

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* Corresponding author. Tel.: +420 222 112 330.
E-mail address: jan.prusa@ies-prague.org (J. Průša).

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cost structure. We calculate alternative revenue scenario based on market prices, which allows us to calculate the real revenue gap needed to be covered by subsidies. This follows the approach of Borenstein (2008), who employs this procedure to determine the market value and cost of PV electricity in the U.S.

Dusonchet and Telaretti (2010a, Table 11) show that Czech Republic, along with Slovakia and Bulgaria, are among the three Central and Eastern EU member states with the most generous PV subsidy programmes. However most western EU countries have still more profitable PV subsidies, as documented in Dusonchet and Telaretti (2010b, Table 20). Šúri et al. (2007, p. 1298) name Czech Republic along with Germany as an example where “policy has stimulated PV growth even in regions with moderate solar energy resource”. Thus Czech Republic is a very clear example of a Central and Eastern European country which joined rich western EU countries in their generous PV support.

This calls for a detailed analysis of impacts of the supportive PV policy. Hitherto evaluations of Czech PV subsidies (including Dusonchet and Telaretti, c.f.) are typically based on a top-down approach calculating merely with the value of feed in tariffs (hereninafter FIT, defined in the next section), without taking into account the detailed cost structure of these plants. One of the exceptions is Lewandowski et al. (2006, Table 9) who present detailed cost projections for production of electricity from biomass in the Czech Republic. Our approach has the benefit that we look at the single plant level to build a comprehensive view of their microeconomics and how efficiently these plants turn the subsidies into profits. Above all we look at depreciation schedules and financing costs. When compared with estimated market value of PV generated electricity, as a result we provide a thorough estimation of the dead weight loss which was caused by Czech PV subsidies.

There is a growing amount of literature devoted to economic analysis of PV plants. The U.S. market was analyzed in great detail e.g. by Wiser et al. (2009) and Borenstein (2007). The former paper tracks the cost of PV plants in terms of assets that were built, while the latter models the move away from cross-subsidization by means of time-of-use rates. The Czech case was most recently described by Smrčka (2011), who argues against the efficiency of PV subsidies in terms of theoretical political economy. To the best of our knowledge our microeconomic survey is completely novel in the field.

The rest of the paper is organized as follows: in Section 2 we introduce general theoretical considerations on PV subsidies along with the legislation background. In Section 3 we present the core microeconomic survey of selected PV plants. Figures from this survey enter our calculation of dead weight loss in Section 4. Section 6 concludes.

2. Theoretical considerations

2.1. Understanding PV costs

It goes without saying that without subsidies PV plants would generate losses, otherwise subsidies would not be needed in the first place. These losses stem above all from significant requirements for capital investment into plant equipment. Not only are solar panels produced by expensive technology. The panels also use costly materials and are relatively fragile, which shortens their expected lifetime.

The situation was made worse by the subsidies themselves, because the governments in fact generated a perfect PV bubble. Polysilicon, the major component of solar panels, illustrates the case:

> Polysilicon has been used as a semiconductor in computer microchips for decades. Supplies only became scarce from 2004, when European nations began introducing subsidies for clean energy. The price soared to $475 [per kilo] in March 2008 from about $30 in 2003. New capacity began to come on stream in 2008. (Bloomberg, 2011c)

As of 2011 year-end the price has fallen back to $33 due to massive jump in capacity and fall in demand. At this price however, some producers are making big losses and will have to close down. On this example we see the size of the shock that is imposed on the economy because of one simple policy.

In the Czech Republic we will evaluate the size of this shock in more detail. We will analyze the case of feed-in tariffs, which is a common way to subsidize electricity from PV plants. An excellent overview of other options to support PV plants is provided by Timilsina et al. (2011, Section 5).

FIT are defined as a scheme in which producers of PV electricity are paid for each unit certain guaranteed fixed price above market price. Such subsidies of course do not lower costs of PV electricity at the outset, although it can be argued that by encouraging installations they help the technology to reach economies of scale and consequent cost reductions (Sandén, 2005). For example, Barbose et al. (2012, Fig. 7) document the decreasing unit price of new installations in the United States for the period 1998–2011.

As long as the cost of technology remains high however, customers are charged more for electricity than their original willingness to pay. In the Czech case it was the regional electricity distribution companies who were required by law in 2010–2011 to pay artificially high price to PV producers. Distribution companies were then allowed to pass this additional cost onto end consumers. This PV surcharge was spread over all units of electricity sold, so that end customers ended up paying higher average electricity price.

The subsidized price can be decomposed into three parts. The first part of the price p_{01} covers the average cost of electricity in the grid produced by standard plants. Price p_{01} approximately corresponds to the market price at which electricity is traded on the commodity exchange. To the extent that average cost of PV plants is higher than average cost of the remaining sources, there is *dead weight loss* in the economy induced by the subsidies. The difference between PV average cost and p_{01} is the second subsidized price component p_{02}, which we call the pure DWL component. Finally the third component p_{03} is the amount above PV average cost which constitutes profits of PV plant owners. As we shall see below a significant part of the subsidies goes to this profit component.

This decomposition is shown in Fig. 1. While in reality the electricity market is affected by many factors such as availability of the specific sources, the figure schematically captures long-term average costs and the way how subsidies in the form of FIT shift PV power from not economically feasible to a utilized source. The shaded rectangles indicate various sources of electricity, typically these would be nuclear, lignite/coal and natural gas plants, as well as variable renewable resources such as hydropower. Note that the costs depicted here include the interest accrued to creditors and shareholders. PV plants are initially at the right end because their cost is above market cost. The figure on the right shows how the situation changes after PV subsidies are introduced. The supply curve is distorted, as suddenly PV plants are shifted to the left. A green tax is introduced which is paid by all consumers, driving the price above the natural market price. The proceeds are distributed to PV plants to cover their excessive costs (p_{02}) and any additional profits made by PV plant operators (p_{03}). Hence the two dotted (orange) rectangles have an equal area.

In reality the subsidies can be financed from other sources than just a tax-driven price increase. In the Czech Republic, for example, the sum of subsidies granted to PV operators was covered by three sources: (1) the green tax on electricity price, (2) the proceeds

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