Some ideas for practical application of stochastic subsidy models to EAM 6 March 2015

Originally the EAMM (EAM) case is based on the position of Sonia in June 2014 contemplating acquiring 31 PV solar plants in Italy for some EUR 114 m. Expected Q production is 44 GWhrs per annum, with a gross revenue of 16.3 EUR, 85% from supposedly permanent FIT, guaranteed by the Italian government. An appropriate analysis is based on either a permanent subsidy for 16 years, or perhaps a retractable subsidy, both models from Adkins and Paxson (2015) The Manchester School (journal). That is the basic case.

But Groups 3 &4 are now aware from [www.eamsolar.no](http://www.eamsolar.no) that two weeks after the acquisition of most of these plants, the Italian government decided that most of these FIT subsidies should be withdrawn, due to misrepresentations, fraud, or other reasons, so eventually by 4Q 2015 EAM decided to write down the accounting value of these assets by a very large amount. Whether these FITs will be restored is perhaps to be decided by a court case in April 2016 (or later perhaps due to the complexity of the case).

So this has turned the problem into modeling a permanent subsidy that might suddenly appear, or Model RIII on page 27 of Subsidies Uncertainty, which requires also calculating the value of a permanent subsidy Model I on page 26. Some of those equations are repeated below. Now the “effective acquisition” price is no longer EUR 114m, but instead what a current investor in the EAM shares would effectively pay to acquire these facilities with maybe a permanent subsidy. Given Ding’s limited knowledge of Italian politics and law, one approach is to assume some probability  of a permanent subsidy being restored, and then inferring what current R would justify making an immediate investment in EAM shares.

Consider a perpetual opportunity to construct an electricity generating facility producing Q GWhrs/pa, using solar power, at a fixed investment cost . This investment cost is treated as irreversible or irrecoverable once incurred. The value of this investment opportunity, denoted by ROV, depends on the amount of output Q, and the price per unit of output, denoted by , P\*Q=R, revenue. R is assumed to be stochastic and to follow a geometric Brownian motion process:

 (1)

where  denotes the instantaneous risk neutral drift parameter (equals  the asset yield),  the instantaneous volatility, and  the standard Wiener process. The differential equation representing the value to invest for an inactive investor with an appropriate investment opportunity (based perhaps on approval for the facility or a concession for infrastructure) is:

 (2)

where  is the risk-free rate. Adkins and Paxson (2014) show that the solution to (2) is:

. (3)

 is the power parameter for this option value function. Since there is an incentive to invest when R is sufficiently high but a disincentive when sufficiently low, the power parameter value is positive. Also, the power parameter is determined using the characteristic root equation (which is the positive root of a simple quadratic equation) found by substituting (3) in (2):

. (4)

After the investment, the solar plant generates revenue equaling (1+)\*R, where  is the permanent subsidy proportional to the revenue sold (=0 indicates no possible subsidy). So from (2), the valuation relationship for the operational state is:

 (5)

After the investment (K), the solution to (5) is:

. (6)

## Model 1

The subsidy is set to equal zero in Model 1. If the threshold revenue signaling an optimal investment is denoted by , then: . (7)

The value for the investment opportunity is defined by:

 (8)

where: . (9)

**Model 2**

For a positive proportional permanent subsidy , the corresponding results are:

, (10)

 (11)

 (12)

**Model 3B**

The probability of a sudden unexpected introduction of a permanent subsidy is denoted by . If the revenue threshold signaling an optimal investment is denoted by , then its solution is found implicitly from:  (16)

where  is from (12). The value for the investment opportunity is specified by:  (17)

where: . (18)

For , when there is no likelihood of an unexpected introduction of a permanent proportional subsidy, Model 3B simplifies to the Model 1 solution.

Now what are the appropriate inputs for these models? Not all companies disclose all the information required (although the EAM chief real options manager would have some of that internal data), so some reasonable assumptions are necessary. Here is one set of assumptions, with the disclosed input in blue.



The precise amounts of RIP (average market price of electricity) and FIT (feed-in-tariff, now withdrawn) are not apparently disclosed (although estimates by plant were given in the June 2014 prospectus). If these are permanent subsidies, R\*<R so this investment appears to be too good to be true, since as well the NPV=V-K=404. But the drifts and R volatilities are just assumed.



But if there is only a  chance of this permanent subsidy, use Model 3B.



What if an investor has a perpetual opportunity to acquire all of these facilities at the current EAM share price (times the shares outstanding) on the OSLO Stock Exchange? A hypothetical share price of 20 EUR per share results in the following equivalent investment price.



So inputting that investment requirement instead of K into the Model 1 and 3B spreadsheets will indicate whether the current revenue justifies an immediate investment, or if not what equivalent K would.

As with all models there are some assumptions which may not be appropriate. One is the R drift, which it appears must be positive to avoid 3=1. These investments are considered perpetual, for a perpetual facility (relaxed to be finite in some of the spreadsheets), and at a constant investment price. But if a subsidy suddenly appears, due to a favorable court decision for EAM, surely the share price would increase. What other assumptions have you found that are problematical?