PROFITABILITY EXPECTATIONS AND UNCERTAINTY IN THE PHOTOVOLTAIC DIFFUSION PROCESS IN GERMANY AND SPAIN, 2004-2013.

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Overview

Photovoltaic (PV) technology presents the greatest potential towards the decarbonisation of electricity generation, both in terms of physical and technological potential (WBGU, 2011) and cost efficiency (IEA, 2014). That is why PV has expanded exponentially in last decade (REN21, 2015), helped by favourable regulations and financial incentives set up by governments worldwide. However, the diffusion process of PV has been uneven, due to the uncertainty created by the sudden regulation changes and the rapidly evolving PV market.

Our hypothesis is that expected profitability is the main determinant of PV diffusion, so regulation, by determining profitability through financial incentives (mainly Feed-in Tariffs (FiTs), but also investment subsidies and soft loans), indirectly determines the diffusion of the technology. Although profitability can be accurately estimated for PV when FiTs are in place (because the main cost is the initial investment and the revenues are guaranteed by the government), the changing environment regarding the evolution of the subsidies and the technology, have created wrong expectations in investors and uncertainty, which finally determined the diffusion of the technology. We study this hypothesis for two cases: Spain, where both subsidies and costs have considerably fluctuated during the last decade, and Germany, where the determinants of profitability evolved more smoothly, between 2004-2013.

Methods

The methodology used to assess the profitability of different types of installations is the Internal Rate of Return (IRR), which is the most widely used indicator in finance to determine the profitability of any kind of investment. The IRR is simply the discount rate at which the net present value of the investment equals zero. In other words, the relative (percentage) annual return investors get for each euro invested. We assume that the investment is 80% externally financed (as indicated by the Spanish PV industry association and Fraunhofer Institute) at the average market interest rates for the last decade. Our calculations are differentiated by the type of installation/investor. Therefore, larger scale installations (utility segment) enjoy lower costs and interest rates, and small scale (residential segment) will experience higher costs and interest rates (that is why governments set up several FiT levels depending on the scale of the installations, to compensate for the different economic conditions of different investing segments).

Results

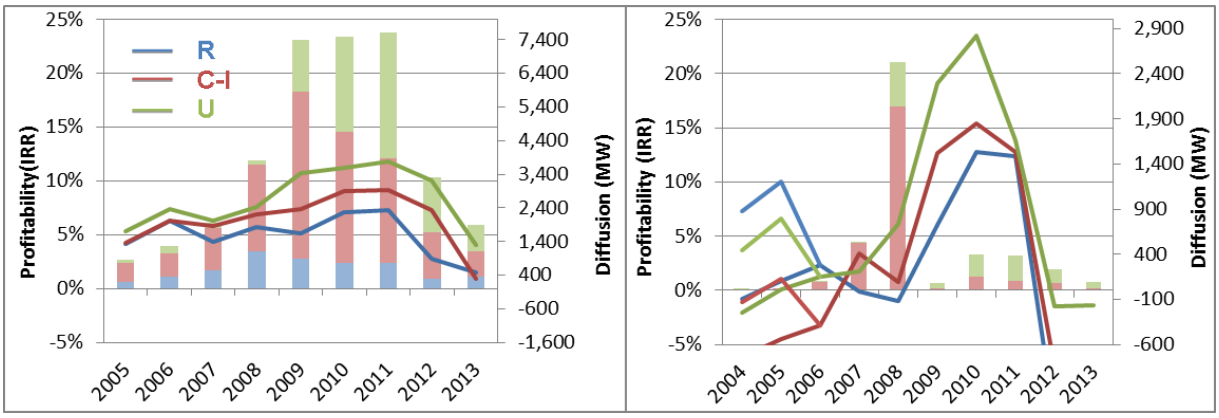
Spain experienced a profitability bubble, which was surprisingly subsequent to the diffusion bubble it also experienced. That is, Spain experienced an investment boom in 2008 (half of the current installed capacity was deployed that year), and a profitability boom between 2009-2011, paradoxically just when the government decreased FiTs to PV (suddenly in 2009, and through a degression rate between 2009-2011), because costs fell faster than FiTs. But since the government also established a quota on new installations elligible for FiTs, the diffusion of the technology was capped and therefore a correlation between profitability and diffusion cannot be seen. On January 1st, 2012, the government cut all incentives for renewable energies, so profitability fell below zero and the diffusion process was paralyzed. In Spain, therefore, the correlation between profitability and diffusion cannot be seen due to, mainly, three causes: (i) the external shock caused by the financial and real estate crash, which caused a capital flight from construction sector to PV investments, considered safe in a context of high uncertainty. (ii) The distortionary effect *solar orchad* owning structure, through which small investors came together building large scale (and therefore low cost) installations and getting high FiTs (since each investor owned less than 100kW power capacity), thus obtaining much higher profitability (up to 13%) than that for which the FiT had been designed. (iii) Regulatory changes and quota establishment, which dilute the relationship between profitability and diffusion.

In Germany, however, both PV system prices and financial incentives evolved more smoothly, making profitability more stable and predictable. Consequently, a clear correlation can be observed between profitability and diffusion levels. Moreover, when we observe profitability in dynamic terms (not only level, but also evolution), and compare it with the evolution of the profit rate of the economy as a whole (net returns on net capital stock), we find an even clearer correlation between profitability and diffusion, which is higher for the

larger installation/investor types (i.e. the link is stronger for utility companies than for residential investors). That is reasonable because an increase in the profit rate of the economy entails a higher opportunity cost of capital, which could be invested in other sectors of the economy.

Figure 1. Profitability (Internal Rate of Return, left axis, lines) and diffusion (annual installed capacity, right axis, bars) for Residential (R), Commercial-Industrial (C-I) and Utility (U) segments.. Note that the left axes (profitability) are in the same scale, so both figures are visually comparable, whereas the right axes (diffusion) are in different scales.

A) Germany, 2005-2013 *B) Spain, 2004-2013*



Note: In Spain there were regulation changes in June 2007 and September 2008. The profitability values for those two years reflect the situation after the reform. Therefore, the profitability levels associated with the diffusion bubble of June 2007-September2008 are those of 2007. Sources: Profitability: own calculations. Diffusion: Fraunhofer, PSE AG and CNMC.

Conclusions

In a market caracterized by stability and certainty as Germany, we can clearly identify a correlation between expected profitability and diffusion. This correlation is stronger the larger the type of installation/investor. However, not only the level of profitability matters, but also its dynamic evolution and comparison to the profit rate of the economy as a whole. In a context caracterized by changing regulations and uncertain environment, however, even if the incentives are well designed, profitability/diffusion bubbles can happen due to external shocks, "innovative" owning structures and sudden costs drops. Therefore, expectations (economically quantified though the IRR), and certainty, are the pillars upon which investment decisions, and therefore diffusion of innovative technologies, are based.

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