ON ENERGY CONSUMPTION, DEMAND UNCERTAINTY AND PRIORITY OF DISPATCH: A MODIGLIANI-MILLER EFFECT ON CONVENTIONAL ELECTRICITY PRODUCERS?

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Extended Abstract

Introduction

Among developed countries, the European Union is a strong proponent of a clean environment. For this reason it has promoted research and development in clean energy projects, has implemented policies for emission control and established a viable emission trading system. EU countries were among the first to ratify the Kyoto Protocol, while recently there are on-going discussions in the European Council about the 2030 energy and climate framework. The new framework sets more ambitious targets compared to the 2020 strategy, including the reduction of emissions by 40%, the increase of renewable sources and energy efficiency by 27%, respectively.[1]

In achieving these ambitious targets and especially the deployment of RES, EU countries have adapted various policy levers, including generous support schemes for RES production in order to stimulate investment in this sector. Overall, these support schemes, despite some observed weaknesses, have contributed to the substantial growth observed lately in the RES sector. According to Eurostat data, the total share of RES from 8.7% in 2005 grew to 14.1% in 2012.[2]

In addition to the support schemes, EU policies have offered priority in the dispatch schedule to RES in order to keep RES investment growth on track. Although such a policy is supportive of the target set by the RES EU Directive, and in the right direction for a cleaner environment, it also changes the risk/return characteristics for the non-RES companies.

Our study investigates the impact of the RES priority rule in the dispatch schedule on the conventional power producers and particularly in their operation, profitability and their prospects in the overall EU electricity markets.

We develop a model where electricity market faces a given demand uncertainty that is satisfied by both the conventional and RES electricity producers. In line to the existing EU policy, since RES production is taken first into the system, RES production does not

[1] The 20% target of final energy consumption from RES by 2020 is an average target. Individual countries may have different targets ranging from 10% in Malta to 49% in Sweden.

[2] See European Commission in http://ec.europa.eu/energy/en/topics/renewable-energy

face any demand uncertainty. In fact, the higher the RES electricity supply over time leads to a higher concentration of demand risk on the non-RES electricity companies. Such concentration of the demand uncertainty should be captured by the volatility of conventional power generation..

This concentration of risk on conventional power producers is equivalent to the Modigliani-Miller effect of leverage whereby the cost of equity increases with the increase in leverage despite the fact that the overall risk of the company does not change.

As RES investments grow through time to meet at least the binding target 20% in 2020, more and more electricity demand is satisfied by the RES companies. This fact is likely to reduce the share of electricity produced by non-RES, but also increase the volatility of non-RES profitability.

These empirical arguments are tested with data from the EU electricity markets. In particular we will utilize monthly electricity production figures by energy source, balance sheet and income statement figures and stock prices of a sufficient dataset of EU non-RES electric companies to estimate the cost of equity over time, controlling for changes in financial leverage of these companies.

The model

Demand uncertainty in energy consumption is normally expressed as daily and intra-day variation in prices and quantities. If we suppose that total demand is given by a random variable X (μ,σ) then the variability faced by each supplier is initially based on her share of the market s: her share of demand is:

$$Q = sX(\mu,\sigma) \qquad (1)$$

The random characteristics of Q are $(s\mu, s\sigma)$. In effect, however, the coefficient of variation of her portion of demand is the same as that of total demand (σ/μ) and independent of her share s. We could therefore say that suppliers share total uncertainty in a proportional manner.

Let us now suppose that by policy decision a portion of total demand is preferentially allocated to a distinct class of producers such as RES who are enabled to satisfy this demand first. This policy is intended to stabilize the market for this distinct class alone. Let us therefore suppose that they fulfill demand to the amount of Z, where $Z<X$. Therefore if

the scale of Z is small enough as compared to X so that it represents an amount of orders to buy that is always available, then the policy violates the proportional sharing of demand uncertainty. It offers an assured market to a preferred distinct class and an uncertain market to the others. What is then the uncertainty born by the non-preferred class?

The total demand they confront is:

$$X(\mu,\sigma) - Z \qquad (2)$$

And if market shares remain unchanged, each producer in this category is now confronted with demand, Q':

$$Q' = s(X(\mu,\sigma) - Z) \qquad (3)$$

Now the mean of demand confronted by each of these producers is $s(\mu - Z)$. The standard deviation confronted by each is the same as before since Z is a constant (non-random), i.e. $(s\sigma)$. Now however, the coefficient of variation is increased from the previous level of (σ/μ): It becomes $(\sigma/(\mu - Z))$. Hence, per unit of mean, the variability increases.

In words this means that if you carve out of a random variable a non-variable portion and allocate the remainder to a class of producers, that class will end up bearing more than proportionally the risk associated with general demand uncertainty.

This effect is in fact a Modigliani-Miller effect. In their classic case of leverage, it was assumed that a firm has random earnings which go to shareholders. When the firm assumes leverage and carves out of random earnings a fixed amount for debt service, shareholders receive the remainder, and this remainder is characterized by higher risk than when the firm was an all-equity entity. MM's famous theorem II shows algebraically how the risk allocation changes: as leverage expands the residual risk undertaken by shareholders also increase and imposes a higher rate of return in compensation.

An analogous argument can be made here. The carve-out of a fixed portion of demand in favor of RES (who are given priority of dispatch) is analogous to the offer of a fixed return to bondholders out of a firm's risky total earnings. The higher risk that this implies for shareholders, in the MM case, is homologous to higher demand risk faced by conventional producers. The final result is that investment in conventional production will end up requiring a higher rate of return.

These theoretical arguments will be tested empirically using data from the electricity market and applying an appropriate methodology.

Data and Methodology

Since the paper focuses on the EU policy regarding the electricity market, our data are drawn from the European market. Our sample is made up of European electricity companies that produce electricity from combustible fuels and nuclear. For each company we construct a series of electricity production and stock price data as well as income statement (sales and net income) and balance sheet (capital structure) items for the last 10 years. In addition, we have access to monthly data on electricity production by source of energy fuel for each country.

Our main hypothesis is to test whether the steady growth of RES electricity production, taking into account that it is given priority of dispatch to enter the electricity grid over non-RES produced electricity, destabilizes the operations of non-RES electric companies and causes three significant effects:

a) Increases the volatility of non-RES sales,

b) Affects the profitability of non-RES companies and

c) Increases the cost of equity.

If these three effects occur, this suggests that EU policy has created conditions of risk concentration on non-RES companies. This may not only be the known risk of the electricity market due to conventional carbon sources but also the increased risks that RES are associated with (i.e., wind capacity, sun presence).

Referring to a) above and in line with our theoretical arguments, we test the hypothesis that as the share of RES in the overall electricity production increases, the volatility of non-RES production also increases. We can use a regression model of the following form for the empirical tests:

$$Y = \alpha + \beta s + \varepsilon \quad (4)$$

Where, Y is the volatility of the electricity production of non-RES electric companies. For each company in our sample, as an estimate of the volatility we will use the annual standard deviation of electricity production of each company using monthly observations over a 10-year period. s is the percentage share of RES electricity production over the total produced as an annual average of monthly figures. ε is the regression error. The regression model in (4) is estimated using a panel methodology. We expect the coefficient β to be positive and statistically significant.

Referring to b) above, we will utilize the annual net income data of each company and we will perform a time series analysis to test whether non-RES company profitability has deteriorated over time.

Referring to c) above, we will use daily stock prices for each company and estimate the cost of equity for each year via the Capital Asset Pricing Model. Our argument in a) suggests that the cost of equity (k) increases as RES production increases and we can test this relationship in the regression model (5):

$$k = \alpha + \beta s + \varepsilon \qquad (5)$$

Where k is the estimated cost of equity, s and ε as above. Coefficient β is expected to be positive and statistically significant providing that the capital structure of the company remained stable over the years. For this reason we will examine the capital structure data to exclude the possibility that the increase in the cost of equity is due to the increase in leverage.

Policy implications

If empirical tests support our hypotheses, there is a significant policy implication about the current preference to promote RES investments in Europe. Such promotion is not without cost and the cost should not be borne by the established non-RES electricity companies. These companies have made large investments in capital assets which are less utilized than originally thought thus reducing the required returns. This change of rules jeopardizes the viability of the non-RES companies and in essence prevents investments in reliable energy sources and such a situation will present problems in the energy security in the medium term.

Our paper aims to contribute towards the need of the EU to reform its policy so that it provides incentives for the continuation of investments in reliable energy sources for base load electricity and cost allocation either to the overall budget or to a market-wide environment that is spread over various industries.

In developing our paper we will attempt to answer a number of questions to understand the way the EU policy operates. Below are some of the questions within the sphere of our study.

(a) How is preference for RES actually implemented in everyday markets? How does their priority of dispatch work in non-peak markets?

(b) What happens to RES supply at peak times? Is all peak demand directed to conventional producers?

(c) What about risk that comes not from demand but from the technology. We know some RES producers are exposed to weather risk whereas conventional producers are not.

(d) Is the riskiness of technology in RES correlated to demand risk in some way?

(e) Does EU policy involve a general preference or are there quantitative limits as to how much the RES producers can supply with priority of diapatch?

(f) If there are limits as per question (e), are they a function of national specifics or are they general European parameters?

(g) Does the allocation of demand uncertainty depend on specific national factors which act over and above European policies?

(h) One recognizable national variation is that in some countries the actual capacity of RES may be too small, and their preferential treatment makes no real difference to the allocation of risk.

REFERENCES

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