**Assessing the Economies of Scope from Vertical Integration: Empirical Evidence from European Electricity Utilities**

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## Overview

In the classical fashion, vertical integration of upstream and downstream operations was the predominant organizational form of an electricity utility, to benefit from scope economies of vertical integration. A fully vertically integrated electricity company would encompass all stages from electricity generation, over high-voltage transmission, to local distribution. It seems natural that vertical integration exhibits cost savings through coordination advantages, sharing of information, use of common inputs, among other factors.

In recent decades, the unbundling of the transmission grid has been put into practice in the European Union. This regulatory measure has the aim to isolate some segments of the electricity sector, which do not exhibit the usual properties of a natural monopoly (e.g. generation, retail), for the sake of eliminating anti-competitive forces and lowering the electricity price for end-consumers through increased competition. The remaining segments – the transmission grid and the distribution lines – feature typical network characteristics associated with a natural monopoly and, thus, need to be regulated.

However, a controversial debate has arisen whether the benefits of increased competition may be offset by potentially increased costs of utilities from unbundling. The policy discussion by and large neglects the fact that the regulatory measure of vertical disintegration comes at a cost, namely the destruction of vertical cost savings. Against this background, it is relevant to assess if and how large these vertical economies may be. Most of all, it is important to take these potential costs of unbundling into consideration.

While the empirical literature in general finds considerable cost savings from vertical economies for U.S. electricity utilities, limited empirical literature on single-country studies points toward modest cost savings in Europe. In brief, empirical evidence questions the effectiveness of the divestiture of integrated utilities in the electricity industry, whereby evidence from Europe is scarce and not as distinctive as from the U.S. Moreover, the predominant share of the literature concentrates on the estimation of scope economies from the stages of generation and distribution, for which data seem to be easier available. Contrary, there is hardly evidence on cost savings from integrating the stages of generation and transmission. Since the EU explicitly requires the unbundling of the transmission grid, such information would be of utmost relevance and promotes one decisive feature of this study.

We, therefore, concentrate on the efficiency and effectiveness of vertical disintegration between the stages of generation and transmission of European electricity utilities. To achieve this goal, we derive vertical scope economies based on the estimation of a multistage quadratic cost function. If these vertical economies are found to be large, it is an indication that the regulatory measure of ownership unbundling of the transmission grid may come at substantial costs.

## Data and Methodology

We utilize novel firm-level data on 22 European electricity utilities from 16 European countries for the period 2000–2010. Data are collected from annual reports and combined with various sources (Worldscope, Amadeus, OECD, PLATTS). Hence, the paper provides the first empirical European cross-country analysis of economies of scope from vertical integration in the electricity sector. A key benefit of this study is its focus on generation versus transmission, while most of the remainder literature has focused on generation versus distribution. The data allow for exploiting vertical economies through mixed company structures, since the sample represent pure generators, pure transmitters, and utilities having both generation and transmission.

This study incorporates the quadratic specification of the cost function, which has been widely applied for estimating scope economies in electricity markets. This quadratic specification has several advantages over other functional specifications, since it readily handles the problem of zero values and results obtained allow for a comparison with other studies. The following specification is applied:

$$C\_{it}=α\_{0}+α\_{G}+α\_{T}+β\_{1}Y\_{G}\_{it}+β\_{2}Y\_{T}\_{it}+0.5β\_{3}Y\_{G}\_{it}^{2}+0.5β\_{4}Y\_{T}\_{it}^{2}+0.5β\_{5}Y\_{G}Y\_{T}\_{it}+$$

$γ\_{1}Y\_{G}w\_{L}\_{it}+γ\_{2}Y\_{G}w\_{C}\_{it}+γ\_{3}Y\_{G}w\_{F}\_{it}+γ\_{4}Y\_{T}w\_{L}\_{it}+γ\_{5}Y\_{T}w\_{C}\_{it}+ρ'Z\_{it}+ε\_{it}$ (1)

where where subscripts *i* and *t* stand for the utility and year respectively. We include two outputs for the two supply stages of generation and transmission, denoted $Y\_{G}$ and $Y\_{T}$ respectively, and the three input prices of labor ($w\_{L}$), capital ($w\_{C}$) and fossil fuel ($w\_{F}$). Moreover, control variables are included in $Z$. Equation (1) is estimated both by pooled OLS and seemingly unrelated regression (SUR).

The concept of economies of scope roots from the multiproduct production theory, based on the idea that there may be potential cost savings from jointly producing two outputs in contrast to separate production. For electricity utilities, integrating the upstream stage of electricity generation and the downstream stage of electricity transmission into one production process may be cost efficient compared to specializing in only one of the two stages. Hence, vertical scope economies exist if $C\left(Y\_{G},Y\_{T}\right)<C\left(Y\_{G},0\right)+C\left(0,Y\_{T}\right)$. The magnitude of economies of vertical integration (EVI) can be estimated as the cost savings of jointly serving both stages relative to stand-alone generation and stand-alone transmission:

$EVI=\left[C\left(Y\_{G},0\right)+C\left(0,Y\_{T}\right)-C\left(Y\_{G},Y\_{T}\right)\right]/[C\left(Y\_{G},0\right)+C\left(0,Y\_{T}\right)]$ (2)

## Results

The regression results of estimating Equation (1) are in line with economic intuition and robust to different specifications. The most important finding for the estimation of vertical economies is the negative and significant coefficient estimate on the interaction term between the two outputs ($0.5Y\_{G}Y\_{T}$) of -0.028 (std.err. =0.009). It implies cost complementarity. The quantification of vertical economies follows Equation (2) and is based on estimates from the cost function. Economies of vertical integration reflect the cost savings of joint operation of electricity generation and transmission versus stand-alone operation.

Both OLS and SUR come to similar findings. Economies of vertical integration tend to increase with greater output combinations. Overall, from the median output levels of 50,480 Gigawatt hours of generation and 4,630 kilometers of transmission to larger output combinations, vertical economies turn statistically significant. Below this threshold, vertical synergies cannot be verified statistically. Substantial vertical synergies arise at the European electricity market. The median electricity utility in our sample obtains cost savings from vertical integration of generation and transmission of 16 to 17 percent relative to stand-alone operations. For larger utilities, cost savings increase further. Yet for very large output combinations at the 90th percentile or higher, cost savings seem unrealistically high and should be viewed with caution. In general, this analysis shows that the regulatory principle of transmission unbundling comes at substantial costs due to lost vertical synergies. This finding holds especially true for large electricity utilities which may obtain cost advantages of 20 percent and higher. In contrast, our findings for utilities having smaller output combinations than the medium utility are in the range of 11 to 17 percent, yet statistically insignificant.

## Conclusions

This analysis is, to the best of our knowledge, the first to show European cross-country results on the costs of disintegration of the transmission stage, and adds depth to the discussion on the benefits and costs of vertical divestiture. This is of particular concern since the EU has recently introduced the measure of transmission unbundling from other stages of electricity supply. The reason behind is the hope to promote competitive pressure in the electricity industry. Cost savings from vertical integration of generation and transmission are likely to arise from various effects, such as the common usage of inputs, sharing of information and risk and coordination advantages. Hence, unbundling of transmission may result in significantly higher costs for utilities in Europe. The findings confirm the existance of substantial vertical economies of scope between the stages of upstream generation and downstream transmission. In more detail, small utilities are found to have less potential for vertical synergies, while large operators exhibit vertical economies of beyond 20 percent.

This analysis has a rather static focus because the data at hand do not allow for a proficient analysis of dynamic effects. Over time, cost increases may be partly compensated by positive dynamic effects of unbundling. Besides, the estimated additional costs of unbundling through lost vertical synergies cannot be easily compared with the benefits of increased competition and anti-monopolistic forces. This analysis is, however, important as it provides evidence that vertical unbundling comes at a cost, which has to be addressed in the policy debate.