

Constrained Divestiture and Ownership Unbundling*

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Abstract

In recent years, the European Union decided on several directives about the unbundling of vertically integrated companies which led to a broad renunciation within the industry concerned. Therefore, we analyze the decision of profit maximizing shareholders on divesting a company division by means of a theoretical model which is also empirically tested afterwards. It is shown that ownership unbundling leaves the investors better off if the company to be divested is a large transmission- or energy distribution operator and earns revenues above 1,000,000 Euro. The opposite is true if the transmission part to be divested is small.

Keywords: Ownership Unbundling, Regulation, Utilities, Energy

JEL classification:

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1 Introduction

In recent years, it was often criticized that regulated utilities are still not sufficiently competitive and transparent in pricing. As a consequence, the European Union decided on several directives concerning the unbundling of vertically integrated companies. Unbundling in general is similar to divesting a certain corporate division and can be distinguished into unbundling of accountants, legal unbundling and ownership unbundling. Unbundling of accountants implies different cost accountings and controlling facilities for each company division whereas under legal unbundling, also management activities throughout the divisions are separated. Ownership unbundling is the most restrictive form and has recently been highly disputed. This concept aims to explain, the separation of ownership and control. In the context of regulated utilities, ownership unbundling implies a sell off of the transmission operators which become independent operators for the operational and commercial grid management as well as maintenance and financial allocation, afterward.

In literature, the consequences of ownership unbundling for the electricity sector are frequently discussed. [Joskow and Tirole \(2000\)](#) for example analyze the dependence between ownership of transmission facilities and market concentration. They show that the existence of vertically integrated companies with ability to exploit monopoly power leads to an increase in profits when transmission capacity is retained. Following this study, [Joskow \(2004\)](#) highlights that these companies are confronted with a distinct incentive to reduce available capacities. More recently, most studies deal with the validation whether ownership unbundling provides an adequate way for reaching regulatory targets. [Bolle and Breitmoser \(2006\)](#) for example show that the basic concept of ownership unbundling will contribute to a higher efficiency but will lead to additional in-transparencies and inefficient transfer prices within the remaining vertically integrated company. By means of a formal model, [Hoeffler and Kranz](#)

(2007) show that the possible improvements of ownership unbundling can also be reached by legal unbundling. Moreover, they argue that under the assumption of competitive prices in downstream markets, the overall welfare with legal unbundling might exceed the reachable sum of consumer and producer rents under ownership unbundling.¹ The most controversial debate concerning ownership unbundling deals with the impact of ownership unbundling on investment decisions and volume. Following Haucap (2007) and Mulder, Shestalova, and Zwart (2007) a positive effect of ownership unbundling can be seen in the resulting unbiased linking of investment decisions and the expected rate of return. Nevertheless, most theoretical analysis does not undermine these positive effects. For example, Brunekreeft and Ehlers (2005) expect that additional parties may enter the investment market while the former integrated companies will reduce its activities. Bolle and Breitmoser (2006) come to the same result.

Overall, most of the current discussion dwells upon this subject from the regulatory economics point of view. Although the positive effects of ownership unbundling on welfare is controversial, its renunciation by the firms concerned is not. Also, the question arises whether the acceptance or rejection of ownership unbundling can be classified as rational choice from a shareholders point of view.

To the author's knowledge, the effect of unbundling from the shareholders perspective has not been discussed in literature yet. Thus, the following article compares the possible methods for divesting or unbundling (in a regulatory background). It turns out that the possibilities to spin off or sell off a certain division are equiva-

¹For a good overview concerning alternative models and their advantages and disadvantages see Buedenbender and Rosin (2007). Most of the studies deal with discrimination of downstream markets and are therefore based on the seminal theories of vertical integration. In this context, Stigler (1951), Porter (1980), Arrow (1975) and Crocker (1983) have to be mentioned. Whilst the first two articles deal with the optimization of inputs and production facilities, the latter focus on the positive effects of available information and transparencies throughout the value chain when vertical integration takes place.

lent to legal or ownership unbundling, respectively. On the one hand, sell offs do not reduce the value of assets under control of the previous management, unless cash is paid to the previous shareholders which converts real assets into liquid assets. On the other hand, spin offs imply a reduction in assets without any cash payments.² In the field of corporate finance and strategic management, empirical evidence concerning divestitures is large. Herein, numerous articles document the positive relationship between divestitures and firm performance as for example [Miles and Rosenfeld \(1983\)](#), [Rosenfeld \(1984\)](#) or [Klein \(1986\)](#) who find cumulative abnormal returns up to 3.5 % assaulting to the remaining stockholders of divesting firms. Consequently, these articles contradict the previously mentioned attitude of the owners concerned.

Bearing this in mind, we start our discussion of the impact of unbundling on shareholder's wealth. In a first step, we derive variables that exert influence on the decision to spin off or sell off certain parts of a company. Moreover, we analyze how rational agents in the utility sector should decide on divestitures, independent from the regulatory background and given the variables derived upfront.

Therefore, the article is organized as follows. Section (2) derives the formal framework for analyzing optimal divestiture decisions. Based on this, the investor's optimal choice is analyzed in section (3). Herein, the results are differentiated with respect to the company's size. Finally, the last section summarizes the findings and draws together the principal conclusions.

²For a deeper insight into the discussion concerning the classifications of spin offs and sell offs see for example [John \(1993\)](#), [Cusatis, Miles, and Woolridge \(1993\)](#) or [Steiner \(1997\)](#).

2 Unbundling as Divestiture

In a first step, we derive the key factors for deciding optimally on divestitures from the viewpoint of rational shareholders. For this, we refer to the optimization approach in [Khan and Mehta \(1996\)](#).

2.1 Optimal Corporate Strategy

As previously mentioned, unbundling can be seen as equivalent to divesting a certain company division. More specifically, legal unbundling can be considered as a spin off decision, whereas ownership unbundling goes in line with divesting in form of a sell off. For expository convenience, the following assumptions have to hold for the model:

- (a) The considered company consists of at least two divisions.
- (b) The costs of the company are composed of unique and joint costs.
- (c) There exists a positive probability of insolvency, such that debt bears a certain risk. Hence, bankruptcy related costs are positive.
- (d) There exists no inventory carry over, i.e. all "produced" units are sold.

Assuming a firm with f divisions, the value maximization function is given by:

$$\begin{aligned} \max V = & \left[\sum_{j=1}^f \frac{1}{k_j} [P_j(Q_j)Q_j - C_j(Q_j)] - \frac{1}{k_a(D, E)} [S(Q_j) + R(D)] \right] (1 - \tau) \\ & - \tau r_d D - \lambda \left[\sum_{j=1}^f I_j(Q_j) - \delta(D, E) \right] \end{aligned} \quad (1)$$

With Q_j as quantity produced and sold, k_j determining the divisional costs, P_j denotes the price for good j and C_j the cost for producing product j . Moreover, k_a

stands for the average cost of capital and depends on the firm's capital structure. $S(Q_j)$ gives the non-financial overhead costs while $R(D)$ measures the indirect cost of debt which are directly linked to bankruptcy when D exceeds a certain critical value. Thus, on the right hand side, the first term in brackets denotes the net operating revenue for each division, minus the overhead costs³. The complete term in brackets gives the operating profit which yields the net profit after taxes (τ) when multiplied with $(1-\tau)$.

As debt is tax deductible, and following [Modigliani and Miller \(1958\)](#), the tax shield ($\tau r_D D$) has to be added. In this context, r_D denotes the interest rate paid for debt and $I_j(Q_j)$ gives the amount of required investments (maintenance of equipment etc.) which can also be regarded as opportunity cost of capital. The third term signals the overall financial resource constraint. Each additional expenditure has to be financed by debt or equity which leads to a change in the capital structure, highlighted by $\delta(D, E)$. The term λ results from the Kuhn Tucker condition.

With respect to equation (1) we are able to maximize shareholder value and decide on the optimal product mix as well as the optimal level of debt simultaneously. The optimal product mix is given by:

$$\frac{\partial V}{\partial Q_j} = \left(\frac{1}{k_j} \left(P_j + (Q_j) \frac{\partial P}{\partial Q_j} - \frac{\partial C_j}{\partial Q_j} \right) - \frac{1}{k_a} \frac{\partial S}{\partial Q_j} \right) (1 - \tau) - \lambda \frac{\partial I_j}{\partial Q_j} = 0 \quad (2)$$

Defining the marginal operating profit for division j with $j = 1, \dots, f$ by $MP_j = P_j + Q_j \frac{\partial P}{\partial Q_j} - \frac{\partial C_j}{\partial Q_j}$ and the divisional marginal overhead costs as $MS_j = \frac{\partial S}{\partial Q_j}$ which have to be discounted with the respective rates (k_j and k_a), and, let MI_j denote the financing costs of marginal investments given by $\frac{\partial I_j}{\partial Q_j}$, equation (2) can be rewritten

³The overhead cost function includes operating and indirect financing costs.

as:

$$\left(\frac{1}{k_j} MP_j - \frac{1}{k_a} MS_j \right) (1 - \tau) - \lambda MI_j = 0 \quad (3)$$

Equation (3) measures the profitability of the considered company. Values exceeding or equal to zero indicate that the considered company operates efficiently. Does the resulting value show a negative sign, the company might be better off by divesting the company division. This can be caused by at least one of the following reasons:⁴

- (1) The operations of a certain company division are not profitable, i.e. $MP_j < 0$.
- (2) The division can cover its unique costs but is not able to cope with the overall burden. This implies $\frac{MP_j}{k_j} < \frac{MS_j}{k_a}$.
- (3) The division is able to cover its own costs and overhead burden but not the opportunity cost of capital, i.e. $\frac{MP_j}{k_j} - \frac{MS_j}{k_a} < \lambda MI_j$.
- (4) The division is able to cover its cost but a divestiture would lead to improvements of the overall company performance.⁵

Intuitively, for the first two items, a sell off decision seems to be more appropriate whereas for the remaining situations, a spin off seems to be more suitable. Accordingly, the company part that produces negative returns will be sold (case one and two). On the other hand, a company division which can possibly generate positive returns when separated from the joint company will leave owners better off when

⁴Recall, in this context, taxes can be neglected as the taxation rate will not change the results.

⁵This point is not taken into account for further analysis because we implement a pre-divestiture test such that possible improvements in operating efficiency or allocative efficiency are not predictable or quantifiable. Following [Khan and Mehta \(1996\)](#) these improvements can be caused by increasing the company's efficiency by divesting a certain division. In this context, the resulting marginal costs (MS'_j) will lie below its pre-divestiture value (MS_j), or capital costs might decrease due to a company split (k_a), or the imminent bankruptcy threats can be lowered (λ) when divesting takes place.

they continue participating in future performances (after divestiture). Nevertheless, with respect to the first order condition, rational investors will decide in favor of a voluntary divestiture if equation (3) is negative. In the context of regulatory economics and especially unbundling, companies are not free to decide on divesting the network segment or not. However, as long as the resulting value shows a negative sign, it has to be concluded that divesting or unbundling will leave shareholders better off.

If equation (3) argues in favor of a divestiture, the owners have to decide about the legal form of the divested division in a second step. In case of voluntary divestitures, this follows conditionally on the decision to divest. Hence, the rejection of divesting a company division would stop the analysis at this point.

For regulatory purpose, this cannot be assigned one to one. In this context, the derivation of the optimal legal choice has to be detached from the previous result. Due to the implementation of unbundling, the regulator forces a company to divest division j , independent from the optimal choice resulting from equation(3). Nevertheless, the question whether shareholders will be better off with a spin off or sell off decision also arises, i.e. with legal or ownership unbundling.⁶

⁶As previously mentioned, the profit maximization function allows further the derivation of the optimal capital structure. This optimization is important after divestiture takes place and is therefore not included in our ex-ante analysis in section (3). For completeness, the derivation is given in Appendix I.

2.2 Optimal Unbundling Choice

In the following, we focus on the differentiation between spin off or sell off decision.⁷ As previously mentioned, this decision is conditionally based on a decision in favor of divestitures (see equation (3)) but it does not necessarily hold for analyzing unbundling decisions. Recall, the capitalization rate for the complete company is denoted by k_a which can lie below or above the individual capitalization rate of a certain company division (k_j).

Suppose, $k_a > k_j$ and the company decides to separate division j . Then, the marginal value of this division prior to divestiture is determined by:

$$\frac{1}{k_j}MP_j - \frac{1}{k_a}MS_j = MV_j \quad (4)$$

After divestiture, this market value changes to:

$$\frac{1}{k_j}MP_j - \frac{1}{k_j}MS'_j = MV'_j, \quad (5)$$

with MS'_j and MV'_j as "new" overhead costs and new market value respectively. After divestiture, production costs are assumed to be at least as high as before, such that $MS'_j \geq MS_j$. Comparing both market values and referring to the fact that the company capitalization rate exceeds the individual capitalization rate implies that the marginal value of the divested division j is even lower than the marginal value of the division as integrated part of the existing entity, such that:

$$\frac{1}{k_j}MP_j - \frac{1}{k_a}MS_j > \frac{1}{k_j}MP_j - \frac{1}{k_j}MS'_j \quad (6)$$

⁷An implicit assumption for the following derivations to hold is that former owners are compensated at fair prices.

Consequently, with $k_a > k_j$, the separation of the company division should take the legal form of a sell off because an independent subsidiary will lead to lower costs⁸.

Suppose now, $k_a < k_j$ when divesting division j . Again, the marginal value of the division prior to divestiture is determined by:

$$\frac{1}{k_j}MP_j - \frac{1}{k_a}MS_j = MV_j \quad (7)$$

After divestiture this value changes to:

$$\frac{1}{k_j}MP_j - \frac{1}{k_j}MS'_j = MV'_j \quad (8)$$

As previously mentioned, the costs are at least as high as prior to divestiture such that $MS'_j \geq MS_j$. In opposite to the previous situation, the marginal value of the divested division (j) is now higher than the market value of the division within the existing entity.

$$\frac{1}{k_j}MP_j - \frac{1}{k_a}MS_j < \frac{1}{k_j}MP_j - \frac{1}{k_j}MS'_j \quad (9)$$

It follows that a divestiture through spin off has to be favored, as the marginal value of division j on a stand alone basis exceeds the value reachable as part of the joint firm. Consequently, if the operational risk of the division divested is larger than the operational risk of the overall firm which goes along with higher possible future returns, the owners of a certain company will not be willing to sell their shares. They will decide in favor of a spin off in order to keep ownership and participate in possible growth.

⁸Recall, lower capitalization rates go along with lower risk. An economic interpretation for favoring sell offs when risk is low is for example given in [Akerlof \(1970\)](#).

In conclusion, the decision on the legal form of divestiture or unbundling depends on the relationship of stand alone market value and integrated market value which is highlighted by equation (6) and equation (9), respectively. As long as the unit to be divested provides a lower market value than the integrated division, one would decide in favor of legal unbundling which is similar to a spin off decision. Obviously, the analysis can be reduced to a comparison of capitalization rates. Therefore, former owners will be better off with legal unbundling if the capitalization rate of a stand alone firm (k_j) exceeds the capitalization rate of the integrated company (k_a) while the opposite is true when deciding in favor of ownership unbundling. Herein, the higher market value of the stand alone division signals revenues that are more stable and less volatile. This goes in line with lower k_j and hence with lower possibility of earning excess returns. In this case, selling the division at fair prices will leave owners better off than keeping ownership and control.

3 Data and Analysis

First, in this empirical section, we analyze whether unbundling in general would be a rational choice for shareholders of energy companies including transmission or distribution facilities. For this, we refer to equation (3) and the adjacent profitability rates. In a second step and detached from the previous part, we derive insights whether legal or ownership unbundling will leave the shareholders better off. This is done with respect to section (2.2). Finally, the last part of this section discusses the shareholder's benefits after unbundling which can be approximated by the return on equity.

For each part, the results for transmission or distribution operators are compared to

the upcoming values of (integrated) energy firms and tested due to significant differences throughout the samples. The accounting data used is provided by Amadeus⁹. The upcoming dataset consists of 624 companies dealing in energy, energy distribution, and energy transmission for the time period between 2003 and 2007. We include 217 distribution companies from Denmark, France, Luxembourg, Sweden and Switzerland, 49 transmission operators from Belgium, Denmark, Finland, France, Germany, Italy, Norway, Sweden, Switzerland and UK and 358 energy companies that do not deal in the transmission or distribution area.¹⁰ Herein, companies from Belgium, Germany, Italy, Norway and the Netherlands are incorporated. With respect to these, three different subsamples - transmission, distribution and energy in general - are distinguished. Although the number of observations is rather large, we do not have the possibility of mapping data covering company divisions into data of the complementary integrated companies. Consequently, we refer to auxiliary-values. In this context, we assume that the profitability (ROA) as well as the capitalization rate (ROC) of the transmission and distribution facilities do not change when a division is divested. This allows for the transmission and distribution firms to serve as proxies for the parameters of integrated distribution and transmission facilities which can then be compared to the values of a non-divested company - given by the reference group of energy firms. The profitability of a company is determined by the return on assets (ROA) which is composed of profit or loss before taxes divided by total assets. For step two, the adequate discount factor is needed. In practice, this is given by the weighted average cost of capital which can be approximated by the return on capital (ROC). It is given as profit or loss before taxes

⁹Amadeus stands for “Analyse major database from European sources”. It covers standardized annual accounts in a consolidated and unconsolidated manner. Moreover, Amadeus provides financial ratios, activities and ownership on approximately 11 million companies throughout Europe and Eastern Europe.

¹⁰Integrated company in this context means that there is no legal unbundling established such that only integrated company data is available.

plus interest paid, divided by shareholder funds and non current liabilities. Return on equity (ROE) is calculated as profit or loss before taxes divided by shareholder funds and serves as proxy for shareholder's benefits from holding a certain asset or share of a company division. For each subsample, average values are cumulated for all years resulting in an average value. In order to shed light on the impact of a company's size, each sector sample is divided into three subsamples for small, medium and large firms. Companies with turnover exceeding 100,000,000 Euro are classified as large company. Companies with turnover larger than 1,000,000 Euro but lower than 100,000,000 Euro are assumed to have medium size and companies with lower turnovers belong to the group of small firms. Similar to the previously mentioned average values, size dependent proxies are derived. The upcoming results in detail are given in Appendix I.

3.1 Return on assets - a proxy for profitability

In a first step, we analyze the profit and the return on assets which is an all-embracing ratio and can be seen as an indicator for a company's profitability. It gives insights whether divestiture or unbundling in general can be a favorable decision for investors.

As stated by equation (3), negative results for the optimal product mix imply that owners will be better off with divesting this company division. From the four mentioned reasons, the situation in which the operations of the certain company division are itself not profitable is the strongest case arguing in favor of divesting. Moreover, for this situation, conclusions on the usefulness of divestitures can be derived independent from the company's vertical structure. For the considered sample, about 45 % of transmission and 60 % of distribution firms show negative profits and hence,

indicate benefits for shareholders when divesting in form of sell offs take place. This is also visualized by the figure (1). Herein, the percentage of firms within the sample providing negative profits is highlighted.

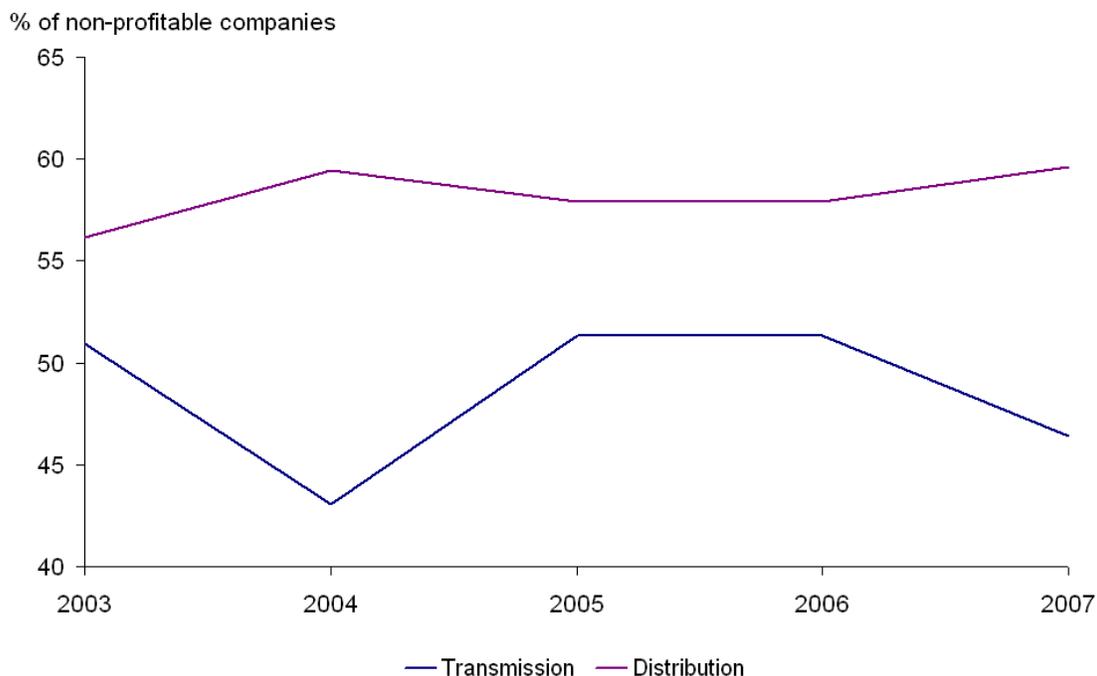


Figure 1: Transmission and distribution facilities with negative profits in percent

In addition to the profit values, the return on asset can serve as a proxy for the firms profitability. Hence, The average values for the time period between 2003 and 2007 are highlighted by figure (3). The aggregation only includes companies with positive profit values. It is shown that the average ROA of energy firms exceeds the returns on equity in the transmission and distribution area, for (nearly) each of the considered years, indicating higher profitability for energy companies. Hence, again, integrated energy companies may increase their (overall) profitability when divesting the transmission and distribution parts, although they provide positive values for the return on assets.

A more detailed picture is given by the following figure. Herein, the return on assets for the considered companies are cumulated with respect to their size.

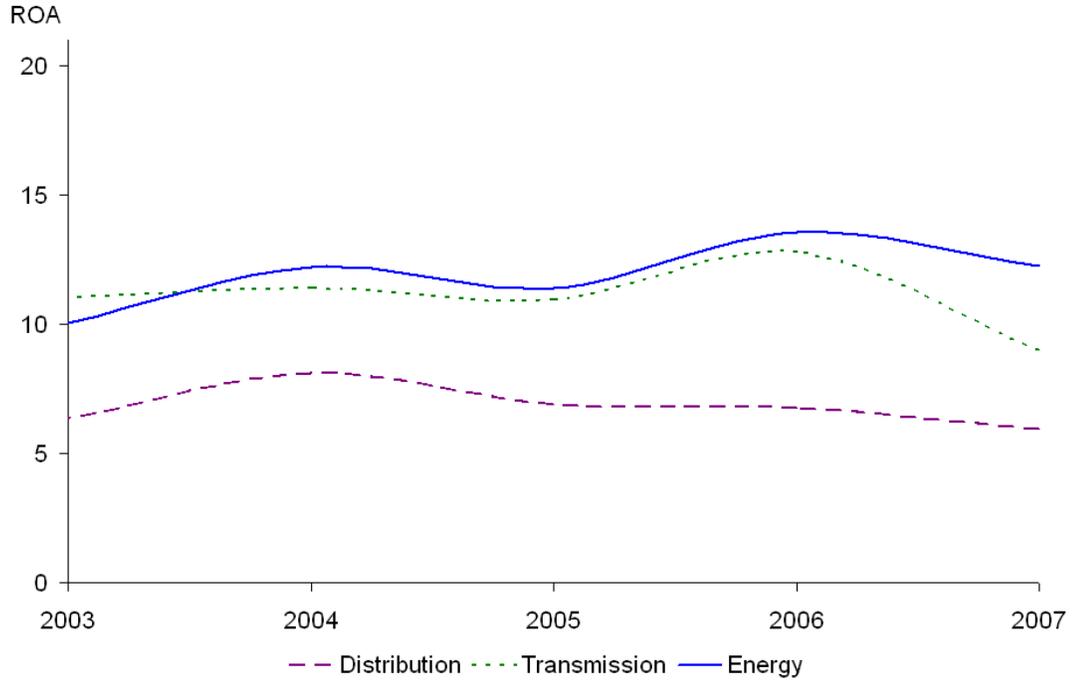


Figure 2: Average return on assets

Due to this illustration, it becomes obvious that a separation of distribution facilities does not increase the average profitability of the divesting firm tremendously (when aggregating over the time period between 2003 to 2007). This finding also holds for large transmission divisions. On the other hand, if the transmission facility to be divested has medium size, the holding company can increase its profitability, while the opposite is true for smaller transmission operators.

In conclusion, on average, the ROA for the transmission and distribution sector are lower than the ROA reachable for firms that operate in other parts of the energy sector. Additionally, cumulating over the complete sample period, leads to a different picture. With respect to enterprise size, the latter observation is mainly driven by medium sized and large transmission companies, while small firms provide rather stable efficiency rates. Overall, with respect to the large amount of non-profitable transmission and distribution facilities it can be concluded that divesting divisions

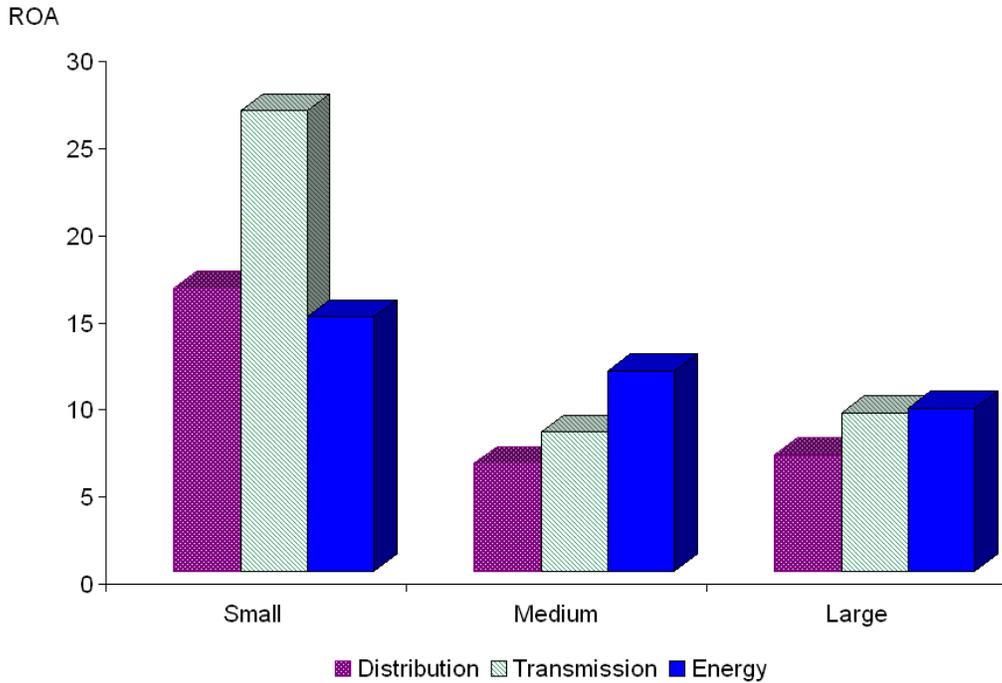


Figure 3: Average return on assets

that deal in transmission will leave investors better off. For distribution facilities, the conclusion is not that unambiguous.

3.2 Return on capital - legal versus ownership unbundling

In a second step, the return on capital is considered.¹¹ It is the modest approximation of an adequate discount factor and encompasses the return on equity as well as the return on debt. Recall, with respect to section (2.2), rational investors will decide in favor of ownership unbundling if k_a , which gives the capitalization rate for energy companies, exceeds the division specific discount factor (k_j). For the considered companies, the average values of the return on capital are calculated and visualized by the following figure.

Obviously, ROC for energy companies, i.e. for integrated companies exceeds the

¹¹Companies with more than one year with negative return on capital exceeding 100 % are excluded from the sample.

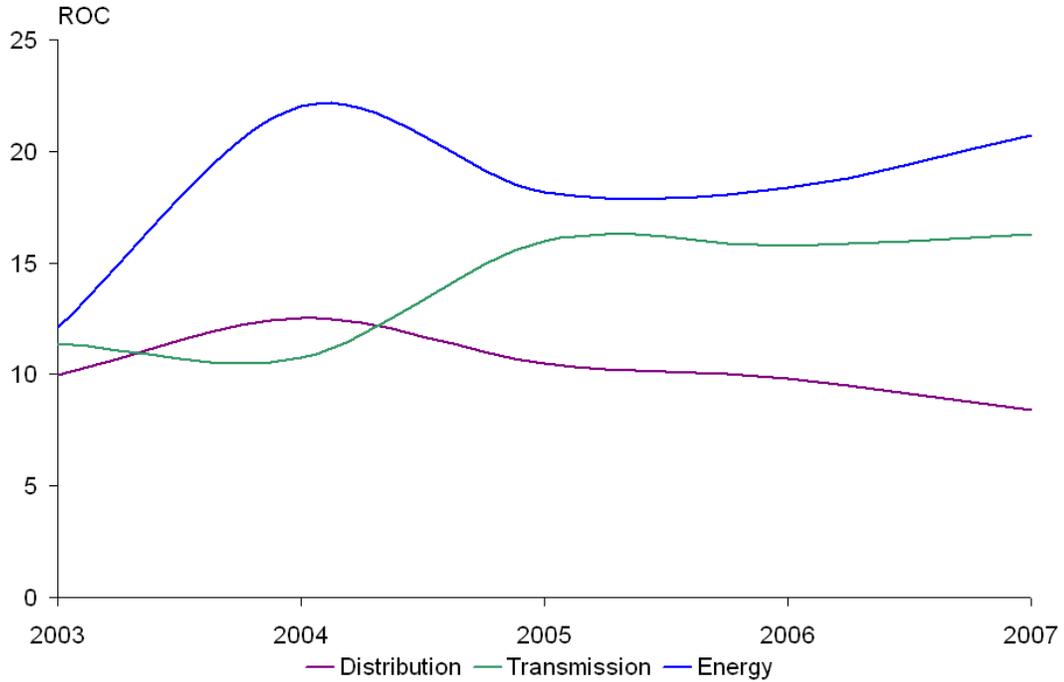


Figure 4: Average return on capital

discount rates for companies dealing in the transmission or distribution area, solely. This observation is also statistically significant at least at the five-percent level as shown in the following table. Moreover, distinguishing the company's size¹², provides a more detailed picture.

| Significant differences | transmission - energy | distribution - energy |
|-------------------------|-----------------------|-----------------------|
| Average | 0.04207 | 0.00430 |
| Small | 0.02020 | 0,03294 |
| Medium | 0.00164 | 0.00043 |
| Large | 0.00365 | 0.00160 |

Table 1: Significant differences in ROC between energy areas

The previous observation on average values also holds for large and medium sized firms dealing in the distribution as well as transmission area. Only small electricity company's provide significantly lower returns on capital than the transmission

¹²For the significance level of the differences in large energy companies compared to transmission or distribution operator's return on capital, we leave aside the outlier in 2003.

operator group.¹³

It can be concluded that ownership unbundling will leave the owners better off if the company to be divested operates in the transmission or energy distribution sector and earns revenues above 1,000,000 Euro. Instead, if the transmission part to be divested is small, investors will be better off by refusing a separation of ownership and control. Hence, considering the return on capital as decision variable implies that a management which rationally controls a company will decide in favor of ownership unbundling the transmission and distribution parts (besides management of small transmission firms). Nevertheless, these findings do not go in line with the recent argumentation of European companies. This induces us, to have a closer look on the return on equity.

3.3 Return on Equity - Owner's Decision Variable

With respect to the evolution of the return on equity which is given in Figure (5), a similar picture arises.¹⁴ The ROE of the energy sector lies inbetween the averaged returns of the transmission or distribution area. The highest returns can be found in the transmission sector which significantly exceed the return on equity of energy firms on average, as well as for small and medium sized firms.

Again, the adjacent significance levels are given in table (2).

Additionally, no significant differences can be found for large transmission firms,¹⁵ i.e. shareholders of transmission facilities earn higher or at least equal returns on equity

¹³The significance for small firms in the transmission area is only calculated with respect to the years 2005 and 2006 as the number of observations for small transmission companies in other years are weak.

¹⁴Recall, we assumed ROA and ROC not to change after divesting, whereas in the context of ROE it is assumed that the values presented represent the return on equity for stand-alone transmission or distribution facilities.

¹⁵Regarding instead only the last three years, the ROE reachable for transmission facility owners exceeds the return on equity for energy firms. In this context, the difference is significant at the ten percent level and given by 0.05548.

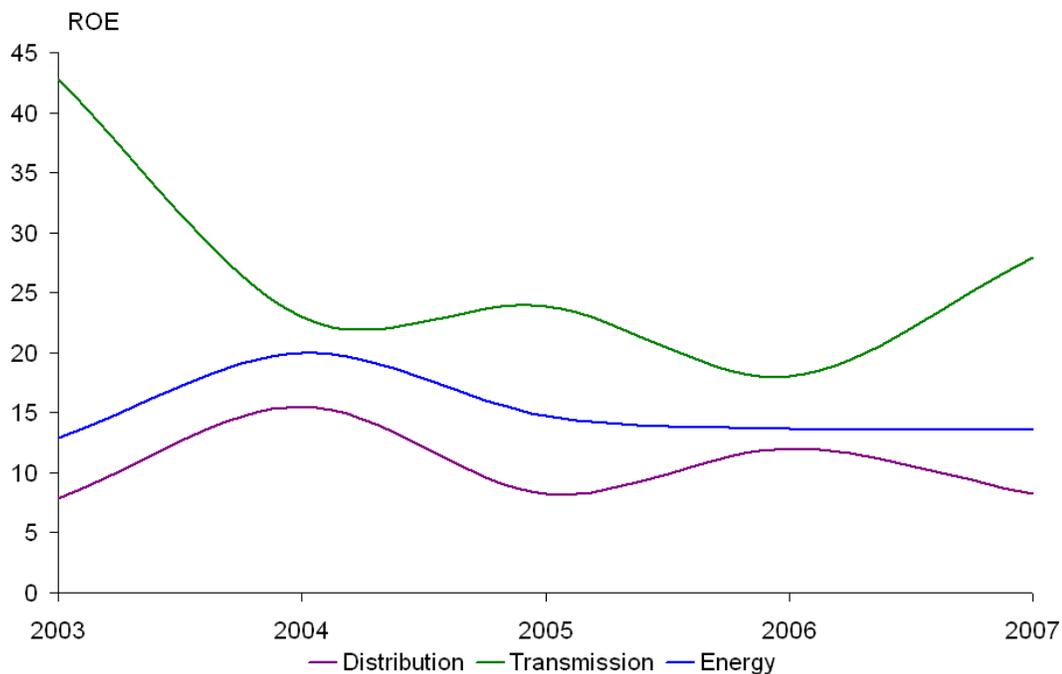


Figure 5: Average return on equity

| Significant differences | transmission - energy | distribution - energy |
|-------------------------|-----------------------|-----------------------|
| Average | 0.03362 | 0.00251 |
| Small | 0.09579 | 0.00548 |
| Medium | 0.08947 | 0.00175 |
| Large | 0.14542 | 0.00358 |

Table 2: Significant differences in ROE between energy areas

as owners of energy companies.¹⁶ For distribution facilities, a different picture arises (besides small distribution firms). Herein, the ROEs of the energy sector exceed the return on equity observable for distribution operators. Hence, as far as the ROE is concerned, equity holders will not be better off with selling the transmission facilities as the expected return on equity is significantly higher than for integrated (energy) companies.

¹⁶Recall, the latter result only holds for large transmission companies if the considered period reduces to the years 2005-2007.

Concluding remarks The empirical analysis showed that about 45 % of transmission and 60 % of distribution firms in 2007 should decide in favor of divesting and hence should appreciate unbundling in general. Moreover, when comparing the decision of legal or ownership unbundling, the presented analysis argues in favor of separating ownership and control for transmission operators as it will leave investors better off. However, we cannot completely confirm the rationality of the recent attitude of European companies from the industry concerned. Only if the return on equity is the crucial decision variable, an argumentation against ownership unbundling of transmission operators seems to be reasonable.

4 Conclusion

In recent years, the European Union decided on several directives concerning the unbundling of vertically integrated companies which can be regarded as involuntary divestitures. In this context, legal unbundling turns out to be equivalent to spin off a company division. Herein, ownership and control stays in the current shareholders' hands, while ownership unbundling goes along with selling off a certain part of a company. With respect to the current discussion and the European companies' argumentation against ownership unbundling, we analyze how investors would decide on legal or ownership unbundling from a rational point of view. Therefore, we refer to the model introduced by [Khan and Mehta \(1996\)](#) and derive the capitalization or more generally, the discount rate as key factor for divestiture decisions.

The empirical analysis provided is based on European data. Herein, we test whether rational agents would decide in favor of unbundling or divesting a company division, detached from the regulatory framework in reality. With respect to the return on as-

sets, it turns out that about 50 % of transmission and distribution operators should see unbundling (legal and ownership unbundling) in a positive manner.

In a second step, the benefits of ownership unbundling and legal unbundling are distinguished. Due to the return on capital which represents the rate of return for equity and debt holders, respectively, it can be shown that ownership unbundling leaves the investors better off if the company to be divested operates in the transmission- or energy distribution sector and earns revenues above 1,000,000 Euro, i.e. is a medium or large firm.

Contrary to this, if the transmission part to be divested is small, investors will be better off by refusing a separation of ownership and control. For transmission operators, the latter finding is also confirmed by the return on equity.

Overall, we do not find univocal evidence that undermines the current argumentation in Europe. Consequently, the determination of additional factors which influence a shareholder's attitude and its characterization whether these are rational and in line with the regulatory constraints is left for further research.

Appendix I

The optimal level of debt can be analyzed by differentiating the maximization function with respect to debt. This leaves us with:

$$\frac{\partial V}{\partial D} = -\frac{1}{k_a} \left(\frac{\partial R}{\partial D} \right) + \frac{\partial k_a}{\partial D} \left(\frac{S(Q_1, Q_2) + R(D)}{k_a^2} \right) - 1 + \lambda = 0 \quad (10)$$

Reshuffling terms and solving for λ yields:

$$\lambda = 1 - \frac{1}{k_a} \left(\frac{S + R}{k_a} \frac{\partial k_a}{\partial D} - \frac{\partial R}{\partial D} \right) \quad (11)$$

in which the second term on the right hand side measures the loss in firm value caused by issuing an additional unit of debt. If there exist no bankruptcy related costs, this term equals zero such that λ will equal 1. The most likely case will induce values above zero, i.e. $\frac{S+R}{k_a} \frac{\partial k_a}{\partial D} > \frac{\partial R}{\partial D}$. The situation which is least probable implies $\lambda > 1$. In this case the partial derivation of costs with respect to debt must exceed the first term in brackets. Economically this implies that costs caused by bankruptcy would be transferred from owners to creditors.

In the context of regulatory unbundling or divestitures, equation (10) can assist the decision making process, as it allows the analysis and ranking of different possible capital structures due to their profitability for the joint firm or the division to be split-up. Assuming for example, a regulatory authority would focus a certain financial structure and given the other parameter values, it can easily be verified whether this ratio leads to an optimum or not. Moreover, it becomes possible to analyze the optimality of the capital structure of the remaining company.

Appendix II

The average values for each ratio and year with respect to the company's size are given in the following tables. Terms in () indicate possible outliers which may have significant impact on further results but cannot be neglected.

| | return on equity | Distribution | Transmission | Energy |
|---------|------------------|--------------|--------------|---------|
| Average | 2007 | 5.9644 | 9.0231 | 12.2631 |
| | 2006 | 6.7729 | 12.7790 | 13.5776 |
| | 2005 | 6.8867 | 10.9593 | 11.3854 |
| | 2004 | 8.0899 | 11.3944 | 12.2289 |
| | 2003 | 6.3366 | 11.0458 | 10.0711 |
| Small | 2007 | 13.9356 | 3.7567 | 12.9322 |
| | 2006 | 12.7814 | 31.7444 | 15.6030 |
| | 2005 | 10.2117 | 30.6088 | 14.6281 |
| | 2004 | 27.1886 | 35.5180 | 15.9170 |
| | 2003 | 16.9914 | 30.5300 | 13.9029 |
| Medium | 2007 | 5.1207 | 8.9657 | 12.1661 |
| | 2006 | 5.7526 | 8.8063 | 12.6612 |
| | 2005 | 6.6601 | 6.5216 | 0.0000 |
| | 2004 | 7.4891 | 6.8727 | 11.3989 |
| | 2003 | 5.8903 | 8.7731 | 9.7300 |
| Large | 2007 | 5.7228 | 10.9256 | 10.5783 |
| | 2006 | 10.0067 | 8.2486 | 12.0867 |
| | 2005 | 6.5514 | 7.4015 | 6.4761 |
| | 2004 | 5.6143 | 9.6325 | 8.7855 |
| | 2003 | 5.4411 | 9.2050 | 8.8206 |

Table 3: Yearly average results for ROA

| | ROC | Distribution | Transmission | Energy |
|---------|------|--------------|--------------|---------|
| Average | 2007 | 8.4241 | 16.2617 | 20.7382 |
| | 2006 | 9.8286 | 15.7439 | 18.3885 |
| | 2005 | 10.4739 | 15.9833 | 18.1409 |
| | 2004 | 12.5140 | 10.7508 | 22.0452 |
| | 2003 | 9.9657 | 11.3850 | 12.0862 |
| Small | 2007 | 22.6360 | | 16.5513 |
| | 2006 | 13.2011 | 24.1475 | 12.3405 |
| | 2005 | 25.6430 | 25.5300 | 12.1204 |
| | 2004 | 59.7875 | (-0.6850) | 22.0820 |
| | 2003 | 32.7133 | | 4.2463 |
| Medium | 2007 | 7.6409 | 13.1542 | 21.4872 |
| | 2006 | 8.76589 | 11.57833 | 19.1124 |
| | 2005 | 9.4583 | 9.4478 | 18.6190 |
| | 2004 | 11.4470 | 7.4619 | 19.6911 |
| | 2003 | 8.9066 | 6.3815 | 23.3559 |
| Large | 2007 | 6.7153 | 22.1660 | 31.1125 |
| | 2006 | 15.8030 | 20.8485 | 30.4096 |
| | 2005 | 10.24000 | 23.4000 | 28.8105 |
| | 2004 | 10.4800 | 21.5357 | 26.9133 |
| | 2003 | 9.9081 | 20.6771 | -3.4223 |

Table 4: Yearly average results for ROC

| | ROE | Distribution | Transmission | Energy |
|---------|------|--------------|--------------|----------|
| Average | 2007 | 8.2617 | 27.9310 | 13.6713 |
| | 2006 | 12.0656 | 18.0027 | 13.6713 |
| | 2005 | 8.2058 | 23.8094 | 14.7570 |
| | 2004 | 15.4807 | 23.0227 | 19.9579 |
| | 2003 | 7.8304 | 42.8058 | 12.9108 |
| Small | 2007 | 21.6811 | 9.8550 | 9.2905 |
| | 2006 | 18.4346 | 29.5438 | 9.2905 |
| | 2005 | 16.0620 | 16.3171 | 13.8166 |
| | 2004 | 24.8193 | 29.6533 | 18.6033 |
| | 2003 | 19.7477 | 86.375 | 8.31 |
| Medium | 2007 | 6.0901 | 29.87132 | 18.2892 |
| | 2006 | 10.8853 | 13.45112 | 18.2892 |
| | 2005 | 6.8055 | 22.8367 | 15.4392 |
| | 2004 | 15.1023 | 23.9759 | 20.02996 |
| | 2003 | 6.4178 | 44.86965 | 12.3279 |
| Large | 2007 | 10.5422 | 29.6925 | 19.898 |
| | 2006 | 14.9935 | 23.5842 | 19.898 |
| | 2005 | 12.5624 | 31.4955 | 15.39025 |
| | 2004 | 12.7574 | 16.2800 | 23.0285 |
| | 2003 | 11.8214 | 20.8380 | 20.0072 |

Table 5: Yearly average results for ROE

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