

# Is the rest of the EU missing out on REITs?

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110

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## Abstract

**Purpose** – The purpose of this paper is to investigate whether real estate investment trusts (REITs) have any significant cost-efficiency advantages over real estate operating companies (REOCs).

**Design/methodology/approach** – The data for listed companies were extracted from the Bloomberg terminal. The authors analyzed financial ratios and conducted a non-parametric data envelope analysis (DEA) for 534 firms in the USA, Canada and some EU member states.

**Findings** – The results suggest that REITs were much more cost-efficient than REOCs by all the parameters in the DEA model during the entire three-year period under consideration. Although the debt-to-equity levels were similar, REOCs were more relying on short-term than long-term maturities, which made them more vulnerable against market corrections or shocks. Being larger in asset size did not necessarily guarantee greater economies of scale. Both – the cases of increasing economies of scale and diseconomies – were detected. The time period 2015–2017 showed the general trend of decreasing efficiency.

**Originality/value** – Very few papers on the topic of REITs have attempted to find out whether a different firm structure displays any differences in efficiency. Because the question of REITs and sustainable growth of the real estate market has become a prominent issue, this research can help EU countries to consider the option of adopting a REIT system. If this system were successfully implemented, the EU member states could benefit from a more sustainable and more rapid growth of their real estate markets.

**Keywords** Efficiency, DEA, REITs, Real estate, REOCs

**Paper type** Research paper

## 1. Introduction

Because real estate investment trusts (REITs) were introduced in the real estate market by President Eisenhower back in the 1960s, nowadays they can hardly be called an innovation. Nevertheless, according to the European Property Research Association (EPRA), in 2018 only 13 out of 28 EU member states had a REIT system implemented in their stock exchange. Although most of Central-Eastern European Countries evidently relied upon a universally accepted firm structure called a real estate operating company (REOC), it should not be overlooked that there exist some significant functional and strategic differences between the two firm types mentioned above. Though both are listed real estate firms, REITs are required to distribute their income to the shareholders, while REOCs can reinvest their earnings. The distribution rates may vary depending on a country. For instance, in 2017 the USA and the UK had the distribution rates amounting to 90 percent of taxable income, while the distribution rate in France amounted to 95 percent (PWC, 2017). In addition, because REITs are required to earn most of their profits from rental activities, their rental income is considered business income and can be deductible. Other intrinsic differences are related to asset formation, listing requirements, investing rules, restrictions imposed on investors and legal provisions imposed on non-residents.



All of these distinctive qualities have made REITs to be the biggest real estate investment vehicle in the USA. According to EPRA (2017) REITs market share by market capitalization amounted to 99.41 percent, while non-REITs (REOCs and other mutual funds that invest in real estate) had only 0.59 percent of the market share. Yet in Europe, REITs market share by market capitalization accounted for only 57.16 percent, while non-REITs occupied 42.84 percent of the market. Strangely enough, even such developed countries as Germany, Spain, Italy and the UK introduced their legislation on REITs not earlier than in 2007, 2009, 2007 and 2007, respectively, whereas Belgian and Luxembourg's parliaments had approved similar legislative acts long before – in 1995 and 1965, respectively.

Despite the fact that REITs development in Europe remains slow, the profound benefits of such systems cannot be denied; they were recognized by researchers decades ago. The first study, carried out by Bers and Springer (1997), argued that REITs displayed economies of scale with regard to assets and revenue, consequentially leading to the bigger housing and commercial supply of usable square feet. Other researchers, like Anderson *et al.* (2002), Linneman and Ambrose (1997), Ambrose *et al.* (2005), Sham *et al.* (2009), Tahir *et al.* (2012), Cotter and Richard (2014) and Topuz and Isik (2017), found that REITs were moderately efficient, but most of them demonstrated economies of scale; larger REITs displayed less systematic risk; upon their entry, new modern REITs outperformed incumbents in their operational efficiency, were more capable in finding the capital necessary to fund their operations, and pursued new opportunities while retaining robust liquidity levels.

At the same time, some contrary evidence on the benefits of REITs can be found. Kawaguchi *et al.* (2012) explained that the high yield on REIT shares endured a high degree of risk, which can make the real estate market unstable. Three different studies, conducted by Miller *et al.* (2007), Vogel (1997) and Ambrose *et al.* (2000), argued that contrary to popular belief, REITs did not exhibit economies of scale (the results were obtained by analyzing different sample sizes for different years). By using a proxy method for interest rates, Brounen *et al.* (2016) stated that REITs were quite sensitive to interest changes because of their extensive leverage. Miller *et al.* (2007) postulated that the fear that national REITs can distort competition when they multiply and merge might be one of the reasons why some European countries have still been resilient to the idea of REITs.

Unfortunately, most of the above-mentioned studies analyzed REITs in standalone, which means that no direct comparison between REITs and other types of firms, like REOCs, can be drawn. This leaves some unanswered questions on whether REITs are performing better than REOCs, whether they have an edge in particular areas, such as efficiency or debt management, or how they affect the stability in the real estate market. Therefore, the purpose of this paper is to conduct the cost-efficiency analysis of REITs and REOCs in order to find out whether any significant differences between the divergent firm structures can be observed.

This paper is structured as follows: Section 2 focuses on existing theoretical and empirical literature addressing REITs; Section 3 provides a thorough guide of the methodological approach, followed to ensure the efficiency of the model; Section 4 presents and discusses the results obtained through application of the data envelope analysis (DEA) model; Section 5 concludes the study, considers its limitations and policy implications, and provides the directions for further research.

## 2. Literature review

Scientific literature on REITs came about mostly in the 1990s, when Scherer (1995) investigated the consolidations and mergers in the USA. The author then stated that because interest rates were increasing and capital availability was decreasing, REITs were unable to expand. This led to creation of mergers and acquisitions, consequently providing economies of scale. Bers and Springer (1997) tested this hypothesis in their empirical study by employing a stochastic frontier model with a translog function for the period 1992–1994.

Having less than 114 USA companies in their model, the authors found that REITs did exhibit economies of scale, but when the companies grew larger, scaling effects disappeared, i.e. the companies had an optimal size to grow. Depending on the complexity of the model, 71–98 percent of the companies had scaling effects. Soon afterwards, Ambrose *et al.* (2000) with a different sample size for the period 1990 to 1997 replicated the same characteristics, concluding that US REITs did have economies of scale, but those economies were mainly observed in smaller companies, while larger companies experienced diseconomies. The methodology used by Ambrose *et al.* (2000) was a comparison of net operating income growth in a shadow portfolio against the selected sample portfolio. Similarly, while analyzing the period 1995 to 1997, Anderson *et al.* (2002) found that US REITs were relatively cost-efficient; most of them faced increasing returns to scale, but this performance was largely attributed to a company's management style and the use of debt. Leaning on their earlier study and employing regression analysis and capital pricing models for the period 1995–2000, Ambrose *et al.* (2005) again discovered that REITs were succeeding at increasing growth prospects by lowering cost, but unlike in the earlier work, scaling efficiencies were observed only for larger REITs. A study of Asian REITs over the period 2001 to 2007, conducted by Sham *et al.* (2009), suggested that in such countries as Japan, Singapore, Hong Kong and Malaysia, scaling characteristics were inherent to all expense categories, except for management fees.

The evidence, contradicting to the positive findings mentioned before, was discovered by McIntosh *et al.* (1991) and McIntosh *et al.* (1995). In their former study, the authors discovered that larger REITs were actually earning poorer returns and were as risky as the firms with a smaller asset size, while the latter study revealed no positive wealth effects for REITs after announcement of a transaction. By employing the method of regression analysis, Ambrose *et al.* (2000) found that economies of scale were driven only by the mergers in the 1990s, but not by superior efficiency parameters. Due to big consolidations, companies were able to buy properties at distressed prices, thus making their after-merger performance excellent. Most of the economies of scale were found to be circumstantial. A study, conducted by Anderson *et al.* (2002), who followed a data envelope approach with a sample size of 157 companies, revealed that REITs had low technical efficiency and failed to operate at a constant return to scale; what is more, many of them experienced diseconomies and poorly used input utilization. Lastly, while researching the period 1997–2003, Miller *et al.* (2007) found little evidence of REITs' economies of scale, but observed some indication of diseconomies. Contrary to previous studies, Miller *et al.*'s (2007) study linked higher leverage to higher efficiency. Similarly, Li (2012) proposed that higher leverage, inflation shocks and the use of short-term debt increased REITs' volatility.

Unfortunately, the above-mentioned studies were mainly focused on US REITs, while the literature addressing European REITs and REOCs, and comparing these two types of structures is still scarce. Ambrose *et al.* (2016) were the first authors who researched European firms in collaboration with the EPRA. By applying the method of stochastic frontier analysis (SFA) with the translog function for 236 companies, the authors found that many listed real estate companies exhibited economies of scale, although diseconomies were also observed. When firms grew larger in their asset size, they tended to incur lower cost. Although the authors analyzed both REITs and REOCs, they did not confirm that a firm's structure might make any difference on its efficiency results. Brounen *et al.* (2013) examined how transition to the REIT regime might affect a firm's performance. They concluded that firms, in general, experienced a decrease in their leverage, a slight jump in their stock turnover level, and faced larger dividend pay-outs. The latest study, conducted by Ascherl and Schaefers (2018), also suggests that REITs, compared to REOCs, provide a significantly lower underpricing at an initial public offering, which means that REITs are more favorably valued by investors. Regrettably, the other studies, which analyzed European listed real estate firms, did not compare REITs to REOCs. Nevertheless, some studies that covered

solely European REITs, for instance, Schacht and Wimschulte's (2008) study on German REITs, Newell *et al.*'s (2013) study on French REITs, Marzuki and Newell's (2018) study on Spanish REITs, and the studies carried out by Brounen *et al.* (2016), Falkenbach and Niskanen (2012), Sin *et al.* (2008) and Connors and Jackman (2000), are worth mentioning. Researchers suggest that REITs, in general, have great opportunities to accumulate capital and facilitate a more integrated development of real estate property (as it was found in the case of Germany); they also give superior risk-adjusted return to bonds, have a  $\beta$  of 0.38, meaning that they are less vulnerable to systemic risk, serve as a great portfolio diversification tool and are less sensitive to interest changes than private firms.

Summarizing the results of previous studies, a lack of theoretical and empirical understanding of how REITs structure compares to REOCs can be observed. In previous works, the efficiencies were either calculated for a single firm structure or as an aggregate value, which left the discrepancies unexplained. The second problem arises from the fact that most studies regarding economies of scale were conducted in the period of the rise of mergers, which might have distorted the data in terms of the intense acquisition of property at distressed prices. In parallel, many researchers admit that the data of the early 1990s might have many inconsistencies with the data reported. At the moment, the existing literature does not provide the answer to the question whether acceptance of a REIT structure for some European countries would lead to obvious benefits brought by the development of the real estate market. This indicates a niche for empirical research.

In this context, this paper aims to contribute to the existing literature by trying to identify cost-efficiency differences observed in the two firm structures. Thus, a proposed hypothesis is formed:

- H1.* On average, a REIT firm structure display significantly better cost-efficiency results than a REOC firm structure.

### 3. Methodology

Data reliability always comes as a first priority, and many authors admit that their data samples are inaccurate because of reporting inconsistencies; this is especially true of the early research pursued in the 1990s. To ensure high data reliability, the Bloomberg terminal database was selected for this research. The total number of observations in the sample size was 531; the research covered the period from 2015 to 2017 and included the following countries: the USA, Canada, the UK, Germany, France, Spain, Italy, the Netherlands, Greece, Finland, Austria and Switzerland. All of the countries under consideration have both REOCs and REITs on their stock exchange; in all of the countries, the priority was given to the largest companies in terms of their market capitalization or assets size. The latter choice was made in order to avoid the sample biases.

If any data were missing, the securities and exchange commission's database or a company's website was visited to extract the missing values from balance sheets or profit statements. Descriptive statistics for the main variables are displayed in Table I.

While reviewing earlier research, two prominent efficiency methodologies – DEA and SFA – were detected. Both of them are considered golden standards for measuring production functions and calculating efficiency frontiers. According to Battese and Coelli (1992) and Henningsen (2014), the main difference between DEA and SFA is that the latter can separate noise in the data and better align with randomness. At the same time, separation might distort the real values because the data are sensitive to changes. Therefore, to represent the values as close to the original values as possible, the DEA method was chosen.

The main concept of the DEA is to calculate how much inputs can be diminished for a given value of outputs so that the production capabilities are technically efficient. The DEA model was formerly created by Charnes *et al.* (1978). Following this method, a firm's technical efficiency is

**Table I.**  
Descriptive statistic  
for main variables

Descriptive statistics	Output Assets	L_Debt	S_Debt	G_A	Inputs Deprec	Int_Exp	Employees
<i>2017</i>							
Mean	23,940	22,467	22,999	19,199	20,191	18,975	83,943
SD	25,709	23,635	25,378	20,030	21,773	20,211	98,193
Max.	17,617	17,332	15,891	91,182	13,508	10,108	21,972
Min.	28,242	25,934	27,967	22,067	24,193	22,660	12,083
<i>2016</i>							
Mean	23,451	22,266	21,407	19,112	19,667	19,029	83,943
SD	24,745	23,241	22,936	19,874	21,096	20,198	98,193
Max.	17,476	15,529	14,690	91,182	13,437	11,850	23,978
Min.	26,977	25,550	25,202	22,067	23,478	22,660	12,083
<i>2015</i>							
Mean	23,325	22,158	21,117	19,004	19,521	18,842	83,942
SD	24,677	23,060	22,594	19,499	21,006	19,608	98,193
Max.	17,657	15,529	14,396	86,482	12,476	10,150	13,862
Min.	26,963	25,304	24,865	21,381	23,497	21,891	12,083

**Note:** All variables are converted to natural logarithms with base of  $e$

defined as the ratio of the sum of its weighted outputs to the sum of its weighted inputs. The DEA creates decision-making units (DMUs) which are benchmarked against the most efficient ones, and by using linear programming equations, it shows how different firm efficiencies are. Companies' technical efficiency scores are represented on the efficiency frontier and expressed in percentage values from 1 to 100 percent, the latter being the most efficient (no firm can be located above the frontier). The formula for technical efficiency calculation is as follows:

$$TE_k = \frac{\sum_{r=1}^s u_r y_{rk}}{\sum_{i=1}^m v_i x_{ik}} \tag{1}$$

where,  $TE_k$  is the technical efficiency of firm  $k$  using  $m$  inputs to produce  $s$  outputs;  $y_{rk}$  the quantity of output  $r$  produced by firm  $k$ ;  $x_{ik}$  the quantity of input  $i$  consumed by firm  $k$ ;  $u_r$  the weight of output  $r$ ;  $v_i$  the weight of input  $i$ ;  $s$  the number of outputs;  $m$  the number of inputs.

The other parameters relating to the model are constant return to scale technical efficiency (CRSTE), variable return to scale (VRSTE) and scale efficiency (SE). The first parameter assumes that most firms operate at an optimal scale and are in a perfectly competitive environment. The second parameter assumes that firms do not operate at an optimal scale and face imperfect competition. Depending on the chosen technical efficiency, mathematical equations have different constraints. The formula for the CRSTE efficiency with input orientation takes the following form:

$$\text{Maximize } \sum_{r=1}^s u_r y_{rk} \tag{2}$$

subject to:

$$\sum_{i=1}^m v_i x_{ij} - \sum_{r=1}^s u_r y_{rj} \geq 0 \quad j = 1, \dots, n, \tag{3}$$

$$\sum_{i=1}^m v_i x_{ik} = 1, \tag{4}$$

$$u_r, v_i > 0 \forall r = 1, \dots, s; i = 1, \dots, m. \tag{5}$$

Under the VRSTE assumption, the additional measure of returns to scale on the variable axis is included as follows:

$$\text{Maximize } \sum_{r=1}^s u_r y_{rk} + c_k, \tag{6}$$

subject to:

$$\sum_{i=1}^m v_i x_{ij} - \sum_{r=1}^s u_r y_{rj} - c_k \geq 0 \quad j = 1, \dots, n, \tag{7}$$

$$\sum_{i=1}^m v_i x_{ik} = 1, \tag{8}$$

$$u_r, v_i > 0 \forall r = 1, \dots, s; i = 1, \dots, m. \tag{9}$$

For the VRSTE parameter, two scale efficiencies emerge: increasing returns to scale (IRS) and decreasing returns to scale (DRS). The first one means that the firms are below the optimum size, and a 1 percent increase in the input will lead to an increase in the output of more than 1 percent, while in the case of diseconomies, a 1 percent increase in the input would lead to an increase in the output of less than 1 percent. Under both the CRSTE and VRSTE parameters, there exists an optimal scale position which is called the most productive scale size (MPSS). The firms that are experiencing diseconomies should reduce their inputs to return to the MPSS point, while the firms that have increasing economies of scale should expand their inputs to the MPSS size.

Because the second parameter has a variable production of scale, the SE parameter can be calculated to show if there exist any economies of scale. In order to find SE, the following equation form is used:

$$SE_k = \frac{TE_{k,CRS}}{TE_{k,VRS}}. \tag{10}$$

SE shows the ratio between VRSTE and CRSTE, meaning that the larger is the ratio, the closer to the MPSS point is the DMU's operation. Also, while conducting research of this type, an input-output orientation has to be assumed. For this particular paper, an input orientation was assumed. This orientation minimizes input for any given level of output. In other words, it indicates to which extent companies are able to decrease their input for any given level of output. Researchers Coelli (1996), Coelli and Perelman (1999) noted that, in many instances, the choice of an input or output orientation has only a minor impact on the technical efficiency scores estimated in the model.

The last important step in the methodology is to determine the correct inputs and outputs for the model. While examining the previous research in which a DEA cost function was constructed, a clear pattern of output selection was found. For estimation of the output variable,

some authors, like Bers and Springer (1997), Anderson *et al.* (2002, 2003), Ambrose *et al.* (2005, 2016), Miller *et al.* (2006, 2007) and Ahmed and Mohamed (2017), employed assets. Many scientists believe that total assets are a reliable choice for the output because it strongly correlates with market capitalization; second, it displays low variance, thus making research results more consistent; lastly, with employment of assets, the outcome shows fewer biases. For the input side, some differences in choices can be observed, although most authors employed a combination of operating expenses, depreciation, general and administrative expenses, and interest expenses. Based on the previous research, the following model was developed:

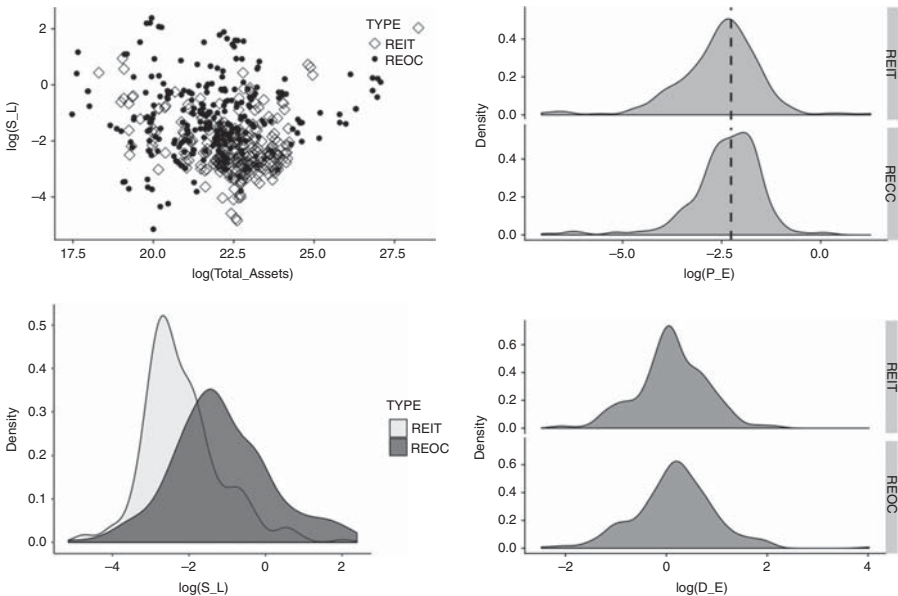
$$TE_k = \frac{\sum_{r=1}^s u_r \text{Assets}_{rk}}{\sum_{i=1}^m v_i G_{A_{ik}} + v_i \text{Int}_{Exp} + v_i \text{Emp} + v_i \text{Depre}} \quad (11)$$

After performing the calculations of the model, REITs and REOCs results were split for comparison, and the additional metrics of descriptive statistics were displayed.

#### 4. Results

In Figure 1, a quick reference of the main indicators, which provide an insight into a firm's efficiency from many different angles, is displayed. At first glance, the debt-to-equity ratio indicates that both structures – REITs and REOCs – were financed at a similar ratio, and the numbers confirm the density plots. In 2017, REITs had their equity-to-debt ratios 3 percent higher than REOCs, while in 2016 and 2015, the latter firms had 14 and 15 percent higher debt-to-equity ratios. It would seem that the amount of financing from debt was similar, but the comparison of the types of maturities disclosed some differences. REOCs were financing themselves with a significantly larger portion of short-term financing maturities. Compared to REITs, REOCs had 34, 25 and 25 percent larger financing coming from short term maturities for the years 2017, 2016 and 2015, respectively.

The differences in financing had always been apparent when comparing private and listed companies. Huynh *et al.* (2018) argued that private companies had higher risk profiles, shorter



**Figure 1.** Density plots of debt-to-equity, short-term-to-long-term-debt, profit-to-equity ratios and scatter plot of assets-to-short-term-to-long-term-debt ratios between REITs and REOCs for all years combined

life cycles and asymmetric information, and a large part of the data for these companies were unavailable or unreliable. For this reason, banks were less eager to offer long-term financing options. However, because both REITs and REOCs are listed companies, the theory of private companies can only be partially applied in this case.

Perhaps the differences emerge due to the fact that REOCs do not have a mandatory income requirement for particular business activity, while REITs have a strict obligation to make 70–90 percent of their income from rental activities. Even in the case of construction, REITs are required to own a newly constructed building for five or more years, which leaves them the only possibility to earn their return on investment from rental activities. In the meantime, because of less strict regulatory provisions, REOCs can operate in a more speculative environment, for instance, make buying and selling transactions in a very short period of time, thus exploiting bubble deviations in the real estate market and having quick financing solutions at hand. This may explain why banks often find it easier to assess the risk and offer better financing options for REITs, and why REOCs have the need for short-term maturities.

Another observation, depicted in Figure 1, corresponds to Bers and Springer’s (1997) and Ambrose *et al.*’s (2016) findings, which proposed that there exists an optimal size, having which REITs and REOCs can operate at their best performance. The optimal asset size, estimated for both REITs and REOCs in this paper, is between \$15 and 22bn. Any size above or below this threshold generates an upsurge in short-debt maturities. REITs are also more similar in size with regard to their assets, and this phenomenon can be explained by the limitations and nature of their activities.

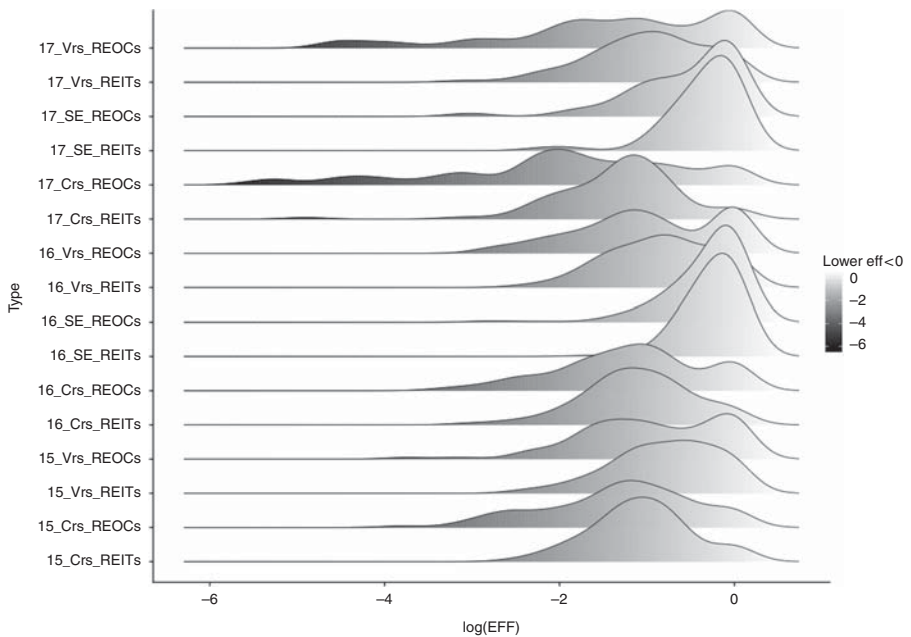
The differences in price-to-earnings ratio were negligible. In 2015 and 2017, REITs managed to surpass REOCs with the profits higher by 12 and 5.5 percent, respectively, while in 2016, REOCs’ profits were by 5 percent higher than REITs’. One could argue that due to the sampling size selection biases, debt-to-equity and profit-to-equity ratios may not reflect any significant differences in the firm structures under consideration; nonetheless, the discrepancies for short-term to long-term maturities that were found to be consistent through the entire period may imply that a firm structure does determine contrasting results.

The results, obtained from the DEA models, are displayed in Table II, and the visuals of the density graphs for better comparison are displayed in Figure 2. Evidently, in all four technical efficiency models, REITs managed to surpass REOCs in efficiency by a slight margin. On a three-year average basis, REITs’ technical efficiency within constant return to

Desc. statistics	REITs			REOCs			IRS	DRS	MPSS
	TE <sub>CRS</sub>	TE <sub>VRS</sub>	SE	TE <sub>CRS</sub>	TE <sub>VRS</sub>	SE			
<i>2017</i>									
Mean	0.33	0.46	0.75	0.28	0.420	0.667	83	80	15
SD	0.22	0.27	0.22	0.306	0.358	0.292			
Max.	1	1	1	1	1	1			
Min.	0.0074	0.041	0.10	0.0038	0.009	0.044			
<i>2016</i>									
Mean	0.40	0.51	0.82	0.398	0.50	0.81	69	89	20
SD	0.23	0.28	0.18	0.307	0.34	0.23			
Max.	1	1	1	1	1	1			
Min.	0.08	0.088	0.30	0.035	0.06	0.053			
<i>2015</i>									
Mean	0.40	0.53	0.78	0.363	0.50	0.742	77	88	13
SD	0.23	0.27	0.19	0.273	0.33	0.244			
Max.	1	1	1	1	1	1			
Min.	0.080	0.087	0.17	0.022	0.023	0.072			

**Table II.**  
DEA efficiency results  
for CRS, VRS, IRS,  
DRS and SE models





**Figure 2.**  
Density plots of DEA  
model efficiencies for  
REITs and REOCs for  
time period of  
2017-2015

scale amounted to 16 percent, their technical efficiency under variable return to scale amounted to 15 percent, and scale efficiencies were 29 percent higher. Hypothesis *H1*, proposing that REIT firm structure on average does have an edge in cost efficiency area, can certainly be accepted.

Although both firm structures have their origin of inefficiency coming from poor management, as it was indicated by the variable return to scale results, it should not be overlooked that scale efficiencies also play a significant role. Regarding the CRS model at the mean value of 0.33 for 2017, REITs were able to become more efficient by expanding their output by up to 67 percent and keeping their input unchanged, while REOCs had an opportunity of a 72 percent expansion. The following expansion logic that applies to all CRS results for the years 2015 and 2016, is depicted in Table II.

The VRS model indicated that the expansion was only a partial solution because many companies were operating above the optimum scale and were experiencing diseconomies. 49, 50 and 44 percent of the firms were operating at diseconomies in 2015, 2016 and 2017, respectively. These firms could increase their efficiency by reducing their size and improving their management. 43, 38 and 46 percent of the firms were experiencing IRS in 2015, 2016 and 2017, respectively. These firms needed an increase in the scale to the MPSS point; they also had to implement better management methods. For the three-year average, only 8.9 percent of the firms were at the MPSS point. Furthermore, the efficiency was steadily declining for both firm structures over the period under consideration, and no obvious trends for scaling effects were detected.

Benchmark frontier locations were detected for both firm structures, which means that both of them can achieve maximum efficiency on the frontier line, yet REOCs have more companies on the frontier and below the lower bound of the frontier, which proposes that REOCs, as a general rule, are less predictable.

Although these findings could not be directly and properly compared with the findings of other authors due to the differences in sample size, input selection, methodological

approach, time period and continental regions, it should be noted that the similar results were presented in the newest Ambrose *et al.*'s (2016) study, where the efficiencies for the period from 2001 to 2015 were found to be declining. In Ambrose *et al.*'s (2016) DEA model, the latest data for 2015 indicated that the average efficiency for REITs and REOCs inclusive amounted to 40 percent, and scaling efficiency amounted to 77 percent, while this paper models the SE of 78 percent, and mean efficiency of 40–50 percent. Despite the differences in the time period, Topuz and Isik (2006) found the efficiencies to be from 11 percent to 55 percent, and scale efficiencies to amount to around 36–86 percent, while Anderson *et al.* (2002) found scale efficiencies to be at around 80 percent, and technical efficiencies to amount to approximately 50 percent. Harris (2012) stated that the efficiencies were at about 33 percent for the CRS, 51 percent for the VRS, and 66 percent for the SE. The prior research also confirmed economies of scale. Anderson *et al.* (2002) claimed that on average 59.8 percent of companies were experiencing an increasing return to scale, Topuz and Isik (2006) discovered that around 33 percent of companies were demonstrating IRS, while Ambrose *et al.* (2016) found that around 36 percent of companies were operating with IRS. Although many factors influence the results of the model, the comparison of the models developed in this paper with the results of previous studies proposes that the constructed DEA values are in a similar value ballpark.

## 5. Conclusions

The European Union member states have always been looking for the ways to innovate and accelerate growth in their real estate markets while keeping the sustainability idea at the forefront. For the last four decades, a promising firm structure named REIT has been overlooked by most CEE members, although a significant amount of research, starting from the early 1990s up to 2016, discovered many positive effects that such firm structure might have on the stock exchange. The positive effects, acknowledged by previous authors, were economies of scale, a considerably smaller amount of leverage, greater opportunities to accumulate capital and less vulnerability to economic shocks. Although some studies provide negative results of REITs' performance, the general literature consensus is positive. It should be noted that no previous study has thus far provided a direct comparison of the REIT structure to another type of firm structure, named REOC. This paper has developed a DEA model to compare the discrepancies in the different structures with different parameters for the period 2015–2017.

The findings in the DEA model indicate that REITs and REOCs have similar debt-to-equity ratios, but their maturity types for debt financing are different. On a three-year average, REOCs had a 28 percent larger short-term debt maturity financing, which indicates that banks are observing REOCs for having a higher risk profile than REITs. During the period under consideration, both firm structures had similar profit-to-equity ratios, and an optimal firm size in terms of assets was estimated to be between \$15 and 22bn. Any deviation from this size resolved in an unnecessary growth of additional debt. Only 8.9 percent of firms managed to remain on the MPSS point of the optimal size; in general, the efficiencies were decreasing for both REITs and REOCs. The number of the companies operating below the optimum scales was also increasing. By the CRSTE, VSRTE and SE parameters, REITs managed to remain by, respectively, 16, 15 and 29 percent more efficient than REOCs. Although a direct comparison with the results of previous research was not plausible, a similar value range has been detected.

The results obtained from the models propose that some EU member states are indeed missing out on REITs capabilities. The policy implications from this research suggest that the EU member states which do not have an existent REIT structure on their stock exchange should facilitate a thorough discussion on whether such system can be beneficial to the development of their real estate markets. If benefits from a REIT system can be achieved, the further discussion should be on what legislation, tax provisions and operational activity

regulations are optimal for particular countries so that REITs could perform at their maximum capability. There exists a cumulative research database that could help find solutions to particular problems related to the topic of REITs. With a successful implementation of REITs, the rest of the EU member states could experience faster, but at the same time more sustainable growth of their real estate markets. Due to greater competition, supply-determined prices for households or companies might grow less rapidly.

Further research should focus on the multilevel, principal component or factor analysis to show how the differences in European countries can affect proper functionality of REIT systems. A deeper analysis with a careful firm profile selection can be carried out to measure efficiencies more accurately, and an inter-continental analysis could preferably become a topic of interest. A wider discussion should be held on whether REIT structures are applicable in all EU member state markets; it should also be discussed what factors could possibly limit the success of REIT implementation.

### References

- Ahmed, A. and Mohamed, A. (2017), "Data envelopment analysis of efficiency of real estate investment trusts in Singapore", *International Journal of Law and Management*, Vol. 59 No. 2, pp. 826-836.
- Ambrose, B., Highfield, M. and Linneman, P. (2005), "Real estate and economies of scale: the case of REITs", *Real Estate Economics*, Vol. 33 No. 2, pp. 323-350.
- Ambrose, B., Ehrlich, R., Hughes, W. and Wachter, M. (2000), "REIT economies of scale: fact or fiction?", *Journal of Real Estate Finance and Economics*, Vol. 20 No. 2, pp. 211-224.
- Ambrose, B., Fuerst, F., Mansley, N. and Wang, Z. (2016), "Assessing size effects and economies of scale in European real estate companies", available at: [www.epra.com/research/academic-research](http://www.epra.com/research/academic-research) (accessed November 14, 2018).
- Anderson, I., Springer, M. and Lewis, D. (2003), "The cost efficiency of real estate investment trusts: an analysis with Bayesian Stochastic frontier model", *Journal of Real Estate Finance and Economics*, Vol. 26 No. 1, pp. 65-80.
- Anderson, I., Springer, W., Webb, J. and Fok, R. (2002), "Technical efficiency and economies of scale: a non-parametric analysis of REIT operating efficiency", *European Journal of Operational Research*, Vol. 139 No. 3, pp. 598-612.
- Ascherl, C. and Schaefers, W. (2018), "REITs and REOCs and their initial stock market performance: a European perspective", *Journal of European Real Estate Research*, Vol. 11 No. 1, pp. 4-27.
- Battese, G.E. and Coelli, T.J. (1992), "Frontier production functions, technical efficiency and panel data: with applications to paddy farmers in India", *The Journal of Productivity Analysis*, Vol. 3 No. 1, pp. 153-169.
- Bers, M. and Springer, M. (1997), "Economies-of-scale for real estate investment trusts", *Journal of Real Estate Research*, Vol. 14 No. 3, pp. 275-291.
- Brounen, D., Ling, D. and Vaessen, H. (2016), "The interest rate sensitivity of public real estate", available at: [www.epra.com/research/academic-research](http://www.epra.com/research/academic-research) (accessed November 9, 2018).
- Brounen, D., Mahieu, R. and Veld, H. (2013), "The effects of shifting tax regimes an international examination of the REIT effects", paper presented at the 2013 Maastricht EPRI REIT Conference, Maastricht, July 20, available at: [www.tias.edu/docs/default-source/Kennisartikelen/the-effects-of-shifting-tax-regimes.pdf?sfvrsn=6](http://www.tias.edu/docs/default-source/Kennisartikelen/the-effects-of-shifting-tax-regimes.pdf?sfvrsn=6)
- Charnes, A.W., Cooper, E. and Rhodes, D. (1978), "Measuring the inefficiency of decision-making units", *European Journal of Operational Research*, Vol. 2 No. 6, pp. 429-444.
- Coelli, T.J. (1996), "A guide to DEAP version 2.1: a data envelopment analysis (Computer) program", working paper, University of Queensland, Brisbane: Centre for Efficiency and Productivity Analysis, Brisbane, August.

- Coelli, T.J. and Perelman, S. (1999), "A comparison of parametric and non-parametric distance functions: with application to European railways", *European Journal of Operational Research*, Vol. 117 No. 2, pp. 326-339.
- Connors, D.N. and Jackman, M.L. (2000), "The cost of equity capital for REITs: an examination of three asset-pricing models", available at: <https://dspace.mit.edu/bitstream/handle/1721.1/32204/48528695-MIT.pdf;sequence=2> (accessed December 12, 2018).
- Cotter, J. and Richard, R. (2014), "A comparative anatomy of residential REITs and private real estate markets: returns, risks and distributional characteristics", *Real Estate Economics*, Vol. 43 No. 3, pp. 209-240.
- EPREA (2017), "Ftse-epra-nareit monthly statistical bulletin September 2017", available at: [http://prodapp.epra.com/media/Monthly\\_Statistical\\_Bulletin\\_September\\_2017\\_1506861911465\\_\(1\)\\_1506952902758.pdf](http://prodapp.epra.com/media/Monthly_Statistical_Bulletin_September_2017_1506861911465_(1)_1506952902758.pdf) (accessed December 18, 2018).
- Falkenbach, H. and Niskanen, J. (2012), "Liquidity of European real estate equities: REITs and REOCs", *International Journal of Strategic Property Management*, Vol. 16 No. 2, pp. 173-187.
- Harris, J.A. (2012), "Real estate investment trust performance, efficiency and internationalization", available at: <http://stars.library.ucf.edu/cgi/viewcontent.cgi?article=3363&context=etd> (accessed November 18).
- Henningsen, A. (2014), "Introduction to Econometric production analysis with R", available at: <https://leanpub.com/ProdEconR> (accessed November 13, 2017).
- Huynh, K.P., Paligorova, T. and Petrunia, R. (2018), "Debt financing in private and public firms", *Ann Finance*, Vol. 14 No. 1, pp. 465-487.
- Kawaguchi, Y., Schilling, J. and Sa-Aady, J. (2012), "REIT stock price volatility during the financial crisis", *European Financial Management*, Vol. 17 No. 1, pp. 1-33.
- Li, L. (2012), "The determinants of REIT volatility", available at: [www.reri.org/research/articlepdf/wp184.pdf](http://www.reri.org/research/articlepdf/wp184.pdf) (accessed October 10, 2018).
- Linneman, P. and Ambrose, B. (1997), "REIT organizational structure and operating characteristics", *Journal of Real Estate Research*, Vol. 21 No. 3, pp. 141-162.
- McIntosh, W., Ott, S. and Liang, Y. (1995), "The wealth effects of real estate transactions: the case of REITs", *Journal of Real Estate Finance and Economics*, Vol. 10 No. 3, pp. 299-306.
- McIntosh, W., Liang, Y. and Thompkins, L. (1991), "An examination of the small-firm effect within the REIT industry", *Journal of Real Estate Research*, Vol. 6 No. 1, pp. 9-18.
- Marzuki, J.M. and Newell, G. (2018), "The emergence of Spanish REITs", *Journal of Property Investment & Finance*, Vol. 36 No. 5, pp. 495-508.
- Miller, N., Clayton, J., Eichholtz, P. and Geltner, D. (2007), *Commercial Real Estate Analysis and Investments*, LEAP Publishing Services, Nashville, TN.
- Miller, S.M., Clauretje, T.M. and Springer, T.M. (2006), "Economies of scale and cost efficiencies: a panel-data stochastic-frontier analysis of real estate investment", *Journal of the Manchester School Press*, Vol. 74 No. 4, pp. 483-499.
- Newell, G., Adair, A. and Kim Nguyen, T. (2013), "The significance and performance of French REITs (SIICs) in a mixed-asset portfolio", *Journal of Property Investment & Finance*, Vol. 31 No. 6, pp. 575-588.
- PWC (2017), "Compare and contrast Worldwide Real Estate Investment Trust (REIT) Regimes", available at: [www.pwc.com/sg/en/real-estate/assets/pwc-compare-and-contrast-complete-worldwide-reit-regimes-2013.pdf](http://www.pwc.com/sg/en/real-estate/assets/pwc-compare-and-contrast-complete-worldwide-reit-regimes-2013.pdf) (accessed November 7, 2018).
- Schacht, U. and Wimschulte, J. (2008), "German property investment vehicles and the introduction of G-REITs", *Journal of Property Investment & Finance*, Vol. 26 No. 3, pp. 232-246.
- Scherer, P. (1995), "Investors capitalize on REIT's industry through LBOs", *Business Credit*, Vol. 97 No. 9, pp. 1-38.
- Sham, H.T., Sing, T.F. and Tsai, C. (2009), "Are there efficiency gains for larger Asian REITs?", *Journal of Financial Management of Property and Construction*, Vol. 14 No. 3, pp. 231-241.

- 
- Sin, T.J., Chun-Kei, S. and Yat-Hung, C. (2008), "Time-varying performance of four Asia-Pacific REITs", *Journal of Property Investment & Finance*, Vol. 26 No. 3, pp. 210-231.
- Tahir, H., Latipah, S. and Zahrudin, Z. (2012), "Measuring efficiency of real estate investment trust using data envelopment analysis approach, paper presented at The Fifth Foundation of Islamic Finance Conference, Kedah, July, available at: [www.researchgate.net/publication/259009941\\_Measuring\\_Efficiency\\_of\\_Real\\_Estate\\_Investment\\_Trust\\_Using\\_Data\\_Envelopment\\_Analysis\\_Approach](http://www.researchgate.net/publication/259009941_Measuring_Efficiency_of_Real_Estate_Investment_Trust_Using_Data_Envelopment_Analysis_Approach)
- Topuz, J.C. and Isik, I. (2006), "How efficient the REITs are upon entry?", paper presented at 2010 IABR & ITLC Conference, South-Eastern Oklahoma, available at: [www.researchgate.net/publication/255671318\\_How\\_Efficient\\_The\\_REITs\\_Are\\_Upon\\_Entry](http://www.researchgate.net/publication/255671318_How_Efficient_The_REITs_Are_Upon_Entry)
- Topuz, J.C. and Isik, I. (2017), "Meet the 'born efficient' financial institutions: evidence from the boom years of US REITs", *The Quarterly Review of Economics and Finance*, Vol. 66 No. C, pp. 70-99.
- Vogel, J. (1997), "Why the conventional wisdom about REITs is wrong", *Journal of Real Estate Finance*, Vol. 14 No. 2, pp. 7-12.

### Further reading

- Aigner, D., Lovell, S. and Schmidt, P. (1977), "Formulation and estimation of stochastic frontier production function models", *Journal of Econometrics*, Vol. 6 No. 1, pp. 21-37.
- Anderson, D.C. and Shelor, M. (1999), "The financial performance of REITs following initial public offerings", *Journal of Real Estate Research*, Vol. 16 No. 2, pp. 375-386.
- (Data set) Bloomberg (2017), "Bloomberg terminal: professional stock data and research tool", available at: [www.bloomberg.com/professional/solution/bloomberg-terminal/](http://www.bloomberg.com/professional/solution/bloomberg-terminal/) (accessed November 10, 2018).
- [Data set] Security exchange commission (2018), available at: [www.sec.gov/](http://www.sec.gov/) (accessed in October 14, 2018).
- National Association of real estate investment trusts (2017), "Global real estate investment", available at: [www.reit.com/investing/global-real-estate-investment](http://www.reit.com/investing/global-real-estate-investment) (accessed November 8, 2018).

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