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A Comparative Analysis of R.E.I.T.s, R.E.O.C.s and P.R.E.O.C.s Using a Stochastic Frontier Approach

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Abstract

Although the first real estate investment trust (R.E.I.T.) was created in 1960s, according to the latest data of 2018, only 13 out of 28 European countries had such systems on their stock-exchange. Many economists have published detailed studies stating the advantages of R.E.I.T.s, however, the developing part of Europe is still slow to react with legislative initiatives. This article extends the existing research on R.E.I.T. efficiencies and compares them to private real estate operating companies (P.R.E.O.C.s) as well as real estate operating companies (R.E.O.C.s) across the U.S., Canada and the European Union by using a stochastic frontier, panel-data models of translog cost functions while trying to identify whether a significant benefit arises from different corporate structures. The results confirm that out of 666 companies under consideration, all types

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of 2014–2016, REITs on average were less reliant on short-term debt, they had a lower debt-to-equity ratio, were more efficient at managing costs in three stochastic translog models and partially in fourth, had a stronger economy of scale effect when their assets size increased, and remained competitively profitable though were outperformed in the profit and revenue area.

Keywords:

1. Introduction

The concept of real estate investment trusts (R.E.I.T.s) started early in 1960s when President Eisenhower signed the Public Law 86-779 into play, which gave an opportunity to invest in large-scale income producing real estate (R.E.). Fast forward to 2017, there were more than 477 R.E.I.T.s globally, which represented 41% of all listed R.E. operating companies (National Association of Real Estate Investment Trusts, 2017). However, only 13 out of 28 European countries in 2018 had an existing law structure and operating property investment trusts, including fairly recent R.E.I.T. system members like Germany and Italy which joined in 2007 (National Association of Real Estate Investment Trusts, 2017). In the developed part of Europe, R.E.I.T.s' market share by market capitalisation in 2017 was only 57.16%, and 42.84% were occupied by Non-R.E.I.T.s,[1] while in emerging markets the R.E.I.T.s share size was as low as 20.9%. Compared that to the U.S., R.E.I.T.s market share by market capitalisation was 99.41%, while Non-R.E.I.T.s had less than 1%–0.59% (EPRA, 2017).

One of the reasons why R.E. Trusts in the U.S. in 2017 were the majority listed property operating companies was because many scientific studies dating back to 1997 had found the profound benefits of R.E.I.T.s. According to Bers and Springer's (1997)

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types of leverage, management style and individual corporate characteristics over the years under consideration. Anderson, Springer, and Lewis (2003) extended the cost efficiency research and found that trust companies were relatively efficient with most firms facing an increasing return to scale.

Similarly, some other authors, like Latipah, Tahir, and Zahrudin (2012), Cotter and Richard (2015), Ambrose, Highfield, and Linneman (2005), Ambrose, Fuerst, Mansley, and Wang (2016), Falkenbach and Niskanen (2012), Isik and Topuz (2010), and Ambrose and Linneman (1997), argued that tax-exempt REITs were significantly less reliant on leverage than their tax counterparts, were better suited in finding new capital funds and seizing the moment of opportunities, and had better liquidity, superior source of capital and cost efficiency (Hoesli & Oikarinen, 2014). Brounen, Mahieu, and Veld (2013) stated that the firms which did transit to R.E.I.T. regime experienced a decrease in their leverage, a slight jump in stock turnover levels and larger dividend pay-outs.

Despite the many benefits, the majority of European countries have been resilient to the idea of publicly-traded R.E. trusts, as Clayton, Eichholtz, Geltner, and Miller (2007) states, for fear it will distort the competition when national R.E.I.T.s multiply. Furthermore, the high yield on R.E.I.T. stocks endures a high degree of risk, which makes R.E.I.T. stocks extremely volatile (Kawaguchi, Jarjisu, & Shilling, 2012). It was found that R.E.I.T.s volatility increases with firm leverage, higher inflation shocks and the use of short-term debt (Li, 2012). The two studies – one carried out by Miller and Springer (2007) and another by Vogel (1997) – stated that the empirical findings contradict previous studies on economies of scale. The latter study postulated that the existing growth in the R.E.I.T. industry arose because of external factors but not due to the exceptional operating performance, meanwhile the Miller and Springer's (2007) stochastic modelling case showed no signs of existing economies of scale and even found some evidence of existing diseconomies. The papers presented by Gentry et al. (2003) and Brounen, Ling, and Vaessen (2016) who used interest rate proxies, also indicated that since R.E.I.T.s were considerably leveraged, they were quite sensitive to interest rate and bond yield changes, which at an aggregate level made the R.E. market more unstable and lead to somewhat similar market corrections as the housing bubble crisis in 2007–2008.

Nevertheless, the majority of the above-mentioned studies did not include a full-scale comparison of all the types of real estate (R.E.) companies because they focused on the

conclusions on whether it is a wise policy for other European countries to implement R.E. Trust systems in their markets and whether these systems will be beneficial and sustainable in the long run. Therefore, the purpose of this paper is to conduct an econometrical cost efficiency analysis for three different types of R.E. operating companies by using debt ratios and the stochastic frontier panel-data method. Consequently, a conclusion on whether a deeper investigation should be considered for creating a new legal entrance for R.E.I.T.s to come into place to the rest of emerging European markets is desired.

The study concludes that on average R.E.I.T.s were more cost efficient than Non-R.E.I.T.s in three out of four models and retained a lower short-term to long-term liability ratio. The R.E.I.T.s seem to be a more sustainable approach to R.E. market development, so the possibility of implementing such structure in individual countries should be thoroughly discussed at economic and political levels.

The remainder of this article is structured as follows. Section 2 analyses the existing theoretical literature of the relatable studies that were conducted earlier. Section 3 describes the data collected and the econometrical methodology used for modelling efficiencies. Section 4 presents the results and interprets their meanings. Section 5 provides the recommendations and concludes the findings of the empirical research.

2. Theoretical background and literature overview

The research on R.E.I.T.s is much more limited than the research on other economic issues, especially in terms of comparative cost efficiencies among different types of R.E. companies. Scherer (1995) was the first to point out that when R.E.I.T.s merge, economies of scales occur. Two years later an empirical study by Bers and Springer (1997) was published to test the hypothesis. Three-hundred and thirty-four observations were collected for the period of 1992–1994, and the significant evidence of R.E.I.T.s economies of scale was found. The findings suggested that for larger R.E. companies scaling efficiency disappeared, therefore an optimal R.E.I.T. size existed, although it did depend on numerous factors like management type, difference in leverage, above average assets size and other individual characteristics. Another discovery revealed that geographical location made no impact, and the impact of time

1993, when with control for basic cost factors, the returns to scale coefficient amounted to 1.2; the smallest economic scaling was recorded in 1992 with the coefficient equal to 1.06, and the results remained consistent with two and one output models. Total percentages of the firms exhibiting economies of scales with different control factors for years 1992, 1993, 1994 were as follows: 71%–88%, 84%–90% and 68%–98%, respectively.

In all the cases, the majority of firms emitted considerable benefits to the market. Ambrose, Ehrlich, Hughes, and Wachter (2000) similarly analysed R.E.I.T. income growth and profitability in 1990s. Their research implied that for smaller property operating companies, net operating income growth rates exceeded average growth rates in the markets, therefore below average in size R.E.I.T.s were generating revenue and operating economies. Interestingly, the authors did not find any economies of scales for larger R.E.I.T.s. A different perspective was provided by Ambrose and Linneman (1997) stating the natural implication that larger R.E.I.T.s in regard to capital cost had a double economy of scale. Building on past research, Ambrose et al. (2005) found that large Trusts had an increasing growth opportunity while succeeding at lowering costs, thus concluding a direct relationship between firm profitability and firm size. Additionally, an inverse relationship was found between REIT size and weighted average cost of capital (W.A.C.C.), which meant that larger corporations managed to lower systematic risks. The same economies of scale were found in Asian R.E.I.T.s by Sing, Sham, and Tsai (2009). With employment of semi-log quadratic models, positive scaling effects were found in all the types of expenses, except for property management fees, after controlling for exogenous factors, like a country, a year, a diversification strategy and growth. However, no advantages in revenue, operating income and equity costs for larger Asian R.E.I.T.s were discovered.

Contrary to the researchers mentioned before, Anderson and Shelor (1999) found that R.E.I.T.s were generally inefficient over the period of 1992 to 1996, with the efficiency scores presented between 44.1% and 60.5%. Strangely, three years later, Anderson et al. (2002), using a different sample size of 173 companies for a different time period of 1995 to 1997, found R.E.I.T.s to be generally cost efficient with increasing returns to scale. More conflicting evidence was presented in Miller et al.'s (2007) study, where with stochastic frontier panel data for the period 1993–2003 little evidence of economies of scales was discovered. The results also indicated that inefficacy increased over time, and higher leverage led to higher efficiency scores. Vogel (1997) also

mergers, while McIntosh, Liang, and Thompkins (1991) and Mcintosh, Ott, and Liang (1995), who analysed approximately 250 trading days for 14 years (1974–1988), found that larger companies were having poorer return on investment and were as risky as smaller R.E.I.T.s with regards to their beta coefficients.

Sadly, most of these studies were conducted on the U.S. companies, while the research on European companies is even more limited. Among the few authors that analysed European R.E.I.T.s are Schacht and Wimschulte (2008), who studied German companies in terms of liquidity and risk/return characteristics. Their results showed that G.-R.E.I.T.s had the opportunities to accumulate substantial capital in the medium term and thus facilitate a more cointegrated German property and the capital market. Newell, Adair, and Nguyen (2013), who delivered a S.I.C. (French-called R.E.I.T.s) analysis for the period 2003–2012, found robust evidence that French R.E.I.T.s gave superior risk-adjusted returns and served as a great portfolio diversification tool. Newell and Marzuki (2018), who analysed S.I.C.I.M.I.s (Spanish R.E.I.T.s), stated that over the period of 2014 to 2018, the Spanish R.E.I.T.s gave good risk-adjusted returns compared to bonds, and were deeply contributing to diversification of mixed portfolios.

Although all of the above-mentioned studies do provide substantial arguments for implementation of the R.E.I.T. system in the rest of Europe, they do not compare all three types of property income generating companies, which are as follows:

1. L.R.E.I.T.s (listed real estate investment trusts, R.E.I.T.s),

2. L.R.E.O.C.s (listed real estate operating companies, R.E.O.C.s),

3. P.R.E.O.C.s (private real estate companies, can also be abbreviated to P.R.E.C.s).

Comparative knowledge on different types of R.E. companies is very limited. A paper was published by Ambrose et al. (2016) where both L.R.E.O.C.s and L.R.E.I.T.s that strictly operated in the EU were analysed, and a sample of 236 companies was collected. Evidently, it was found that larger companies were more profitable and endured lower expenses. The additional findings revealed that economies of scales existed but were more prominent for smaller firms, while company mergers did not result in synergy. Authors Hoesli and Oikarinen (2014) with a sample of the companies from the U.S. and the U.K., confirmed one-to-one relationship with publicly-traded R.E. performance and privately traded R.E. investment performance in three out of four U.S.

sector horizon. A study by Naranjo and Ling (2003) showed that R.E.I.T.s' passive portfolios outperformed the benchmark of private R.E. companies by 49 basis points annualised over the period of 1994 to 2012. Authors also discovered that R.E.I.T.s served as a primary information broadcast channel to private firms. While analysing R.E.I.T.s and R.E.O.C.s, Ascherl and Schaefers (2018) found that the former provided a significantly lower under-pricing than the latter, although Chinese scientist Bo-Sin et al. (2008), who studied R.E.I.T.s and private companies in the U.S., Australia, Japan and Singapore, concluded that Trusts should not be viewed as a complete substitute for direct property investment. Brounen et al. (2016) carefully studied 732 listed R.E. companies in 10 different countries and analysed what effects interest rate loadings had on daily operations of the firms. Their findings suggest that interest rate sensitivity is more prominent for private R.E. companies with large parts of short-debt maturities and low occupancy ratios.

Generalising the past studies, it can be stated that they contain certain problems and limitations. Firstly, although some studies compared R.E.I.T.s to private companies or R.E.I.T.s to other publicly listed R.E. firms, the comparisons were not made for efficiency estimates and a full 3-type comparison was not conducted. For this reason, it is hard to say to which extent one group of companies surpasses others. The other problems identified in some of the studies were a small sample size and a possible inconsistency in the financial reporting of expenses and revenues, which authors themselves admit. These inaccuracies might have caused some biases in the results estimated for the sampled countries. Additionally, most of the studies are quite old (from the 1990s) or for some countries non-existent at all. A concise and easy on the eye comparison of the most impactful research papers on R.E.I.T.s over the period of the last 20 years is presented in Table 1.

Table 1. Most impactful previous research on R.E.I.T.s performance.

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3. Data and econometric methodology

As the purpose of this article is to find out whether there are profound benefits of creating a new legal entrance for R.E.I.T.s to come into the rest of emerging European markets, the following countries were chosen for examination: the U.S., Canada, the U.K., Germany, France, Italy, Spain, Belgium, Norway, Sweden, Lithuania, Estonia, Bulgaria, Poland, Austria, Switzerland, the Netherlands, Greece, Finland, Slovenia, Latvia, Hungary, Croatia and the Czech Republic. The data for the model was collected for three different types of property-income operating companies: R.E.I.T.s, R.E.O.C.s and P.R.E.O.C.s. Even though some countries did not have R.E.I.T.s at all, they were chosen purposely to see how an existing firm structure compares to the countries that have R.E.I.T.s. In order for the information to be as precise as possible, the credible databases were chosen: for listed R.E.I.T.s and R.E.O.C.s, the information was obtained from the official Bloomberg terminal and directly from S.E.C. reports, while the information about P.R.E.O.C.s was extracted from the Bureau van Dijk Orbis database. On Orbis database, private companies were filtered by employing the following sector activity tools:

1. L688101 – buying and selling of own R.E.

2. L68202 – renting and operating of own leased residential R.E.

3. F41201 – construction of residential and non-residential buildings

4. L68320 – management of R.E. on a fee contract basis

5. 236210 – industrial building construction

6. 5313 – activities relating to R.E.

The R.E.O.C.s in the U.S. mostly covered R.E. service, brokerage firms, construction and hotel service providing companies, while in Europe the activity landscape of listed R.E.O.C.s was much broader and interconnected to all the sectors. Although there is no empirical research explaining this tendency, one of the plausible explanations is that in 15 E.U. countries R.E.O.C. is the only available stock exchange option that can do business in all the sectors. It might also be the case that R.E.I.T.s are fairly new in the European R.E. market.

If any companies had any missing data, it was inputted by finding balance sheets or income statements on the official websites of these companies. In all of the sample

The latest period available for such type of analysis was the period of 2014–2016. The limitations for the variables mostly came from P.R.E.O.C.s due to the fact that many regulations over limited liability companies differed from those over listed companies. Many of the private firms are lagging two years behind in reporting the newest data, some companies are not obliged to report, and many of them only have a three-year period of the data available. In total this article examines 666 observations. The summary statistics of the main variables are displayed in Table 2.

Table 2. Summary statistics for main variables.

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The method chosen for the econometrical model was a stochastic frontier analysis (S.F.A.) method for panel data created by Battese and Coelli (1992). Data envelope analysis and S.F.A. are considered the golden standards in econometrics, however S.F.A. has an edge since it can separate noise from efficiency and can better align with the randomness that exists in the data (Aigner, Lovell, & Schmidt, 1977). The cost S.F.A. function has the following simple and logarithmic forms:

$$C=C(y, w, u, v) \quad \ln C = f(y, w) + \ln u + \ln v \quad u \geq 0,$$

(1) where c measures the cost, y stands for the output quantity vector, w is the vector input price, u accounts for cost inefficiency, and v accounts for statistical noise in the model. Rearranging the equation to:

$$C = c(w,y) e^u e^v \quad u \geq 0,$$

(2) let us use the Shephard technical efficiency (C.E.) calculation for the chosen S.F.A. function in the following form:

$$CE = \frac{c}{c(w,y) e^v} = \frac{f(x) e^u e^v}{c(w,y) e^v}$$

(3)

The S.F.A. model is estimated by a maximum likelihood estimation (M.L.E.) using the normal (Gaussian) probability distribution. The equation of this probability density function is:

$$f(x_i.......x_n|x_i\beta, \sigma) = \frac{1}{2\pi\sigma^2}\exp\left(-\frac{(y_i-x_i\beta)^2}{2\sigma^2}\right),$$

(4) where x represents observed data values, xβ is the theta value for M.L.E., and σ stands for the standard deviation. Assuming a normal (Gaussian) distribution of the noise term v and a positive half-normal distribution of the inefficiency term u, the distribution of the residuals for a cost function is acknowledged to be right-skewed in the case of cost inefficiencies. Translog was chosen as a function type for S.F.A. It is represented by the following equations (Henningsen, [2014](#)):

$$\ln C = \alpha_0 + \sum_{i=1}^{m}\alpha_i \ln y_i + \sum_{i=1}^{n}\beta_j \ln w_j + \sum_{i=1}^{m}\sum_{r=1}^{m}\pi_{ir}\ln q_i \ln q_r$$

(5)

$$\ln c(w,y) = \alpha_0 + \sum_{i=1}^{N}\alpha_i \ln w_i + \alpha_y \ln y + \frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N}\alpha_{ij}\ln w_i \ln w_j + \frac{1}{2}\alpha_{yy}(\ln y)^2 + \sum_{i=1}^{N}\alpha_{iy}\ln w_i \ln y,$$

(6) where w denotes the price vector, y – the output vector quantity, β – a calculated coefficient of the translog function for a particular firm, and α – the coefficient for M.L.E. results.

It is of crucial importance to choose the right inputs and outputs for the model to be successful. Regarding the output, some authors, like Bers and Springer ([1997](#)), Anderson et al. ([2002](#)), Miller et al. (2007), Ambrose et al. ([2016](#)) and others, used total assets as their main output, while other authors added total revenue into the mix. Bers and Springer (1998) argued that assets was a reliable output because it was highly correlated with market capitalisation; second, assets showed low variance, therefore results in general were more consistent; and third, the outcomes were on average less biased. For the cost side, various variables were used historically and differed quite a lot among the authors. Combinations of the sum of interest expenses, general administrative expenses, depreciation, property operating expenses, other expenses and total debt were used. For the input prices, proxies were created in all of the prior studies. Miller, Clauretie, and Springer ([2006](#)) used proxies of interest expenses divided by total debt (average cost of debt) and average other expenses divided by assets (average prices of other inputs). Another proxy used by Topuz, Darrat, and Shelor ([2005](#)) was property operating expenses divided by assets, which showed how much property expenses were needed for R.E. investments. For one of the price proxies, Ambrose et al. ([2016](#)) used a weighted average cost of capital (W.A.C.C.) which was calculated as follows:

$$WACC = \frac{E}{V}R_e + \frac{D}{V}R_d,$$

(7) where Re denotes cost of equity, Rd – cost of debt, E – market values of a firm's equity, D – market values of a firm's debt, and V – the sum of a firm's equity (E) and a firm's debt (D). Cost of debt (Rd) was calculated by dividing the interest rate against total debt, while cost of equity (Re) was calculated by the Nobel Prize awarded capital asset pricing model (C.A.P.M.), expressed in this equation:

$$Re = r_f + r_m - r_f * \beta,$$

(8) where rf denotes the risk-free rate, rm−rf is the risk premium, and β stands for the unsystematic risk. The risk-free rate is usually considered as the rate of U.S. treasury bills, while rm can be taken as S&P 500 annual total return. The beta coefficient shows corporate rate of return movement to the market changes: if the rate is equal to 1, it is aligned with the market; if it is over 1, it exaggerates the market movements; finally, if it is minus 1, it means that the risk is interchangeable. A couple of studies on the size of the beta coefficient for R.E.I.T.s in the U.S. and Europe can be found. The research by Connors and Jackman ([2000]) revealed that on average the U.S. R.E.I.T.s had the beta of 0.38, which indicated that R.E. companies fluctuated almost independently from the market. Similarly, Jong and Tik ([2015]) found that Asian R.E.I.T.s had the beta around 0.46.

The cost of labour price proxy can be obtained just like in Maudos et al.'s (2002) research by dividing personnel expenses by the number of employees. Control variables also have to be included because higher leveraged companies face higher total cost. For this reason, a debt to equity ratio was included in the model. Cost elasticities (scale efficiencies) for translog functions are calculated by taking first degree derivatives in respect to assets: if elasticity is above 1, it shows cost-growth determined diseconomies; if the values are under 1, it shows economies of scales. The formula can be represented by this equation below:

$$\frac{\delta \ln Cost}{\delta Asset} = \alpha_{1i} + 2 * \pi_{11i} \ln Assets$$

(9)

After specification of the function types, 4 different models were constructed for 666 firms in a three-year period. The first model uses assets as an output and measures the efficiency of cost to create assets:

$$lnCost1(\text{ INT exp} + G\_A) = \alpha01 + \alpha11 lnAssets + \pi111 lnAssets*lnAssets + \beta11 \ln(Wacc) + \beta21$$
$$\ln(INT\_EXP\, Total\_debt) + \beta31 \ln Other\_OEAssets + \beta41 \ln$$
$$G\_AEmp + \gamma11 Debt\ ratio + \lambda11 Time + v1 + u1$$

(10)

The second model imposes revenue as its quantity variable:

$$lnCost2(\text{INT exp} + G\_A) = \alpha02 + \alpha12 lnRevenue + \pi112 lnRevenue*lnRevenue + \beta12 ln(WACC) + \beta22 lnOther$$
$$OEAssetsGAemp\ + \beta32 lnINT\_EXP$$
$$Total\_debt + \beta42 lnG\_AEmp + \gamma12 Debt\ ratio + \lambda12 Time + v2 + u2$$

(11)

The third and fourth models are the extended translog functions of [equations (10)](#) and [(11)](#) (due to the notation longitude, mathematical sigma's notations were added):

$$lnCost3(\text{INT exp} + G\_A) = \alpha03 + \alpha13 lnAssets + \pi113 lnAssets*lnAssets + + \beta13 ln(Wacc) + \beta23 lnINT\_EXP$$
$$Total\_debt + \beta33 lnOther\_OEAssets + \beta43 lnG\_AEmp + 12\sum i=1N\sum j=1N\alpha ij lnwi lnwj + 12\alpha yy(lny)2 + \sum i=1N\alpha iy lnwi lny + \gamma13 Debt\ ratio + \lambda13 Time + v3 + u3$$

(12)

$$lnCost4(\text{INT exp} + G\_A) = \alpha04 + \alpha14 lnRevenue + \pi114 lnRevenue*lnRevenue + \beta14 ln(Wacc) + \beta24 lnINT$$
$$EXP$$
$$Totaldebt + \beta34 ln(Other\_OEAssets) + \beta44 lnG\_AEmp + 12\sum i=1N\sum j=1N\alpha ij lnwi lnwj + 12\alpha yy(lny)2 + \sum i=1N\alpha iy lnwi lny + \gamma14 Debt\ ratio + \lambda14 Time + v4 + u4$$
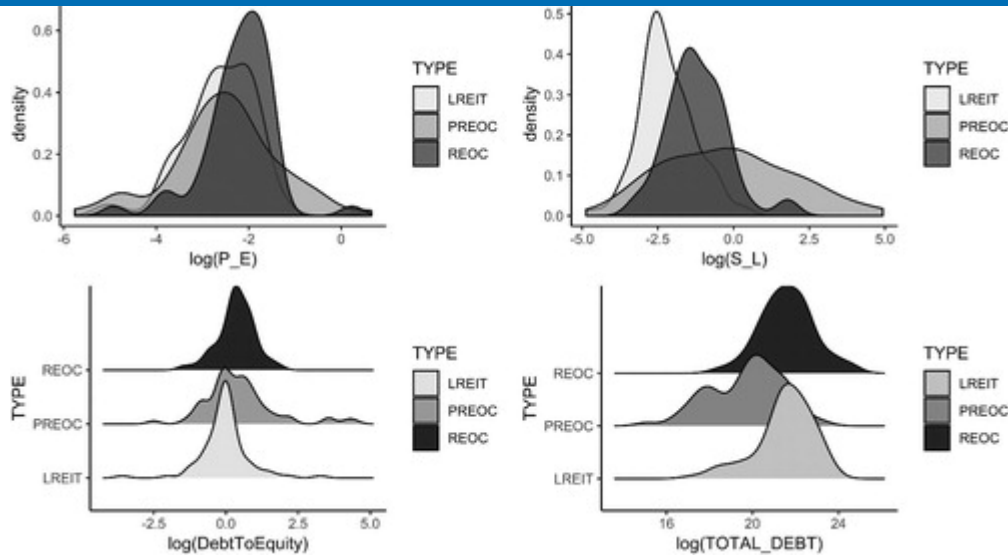
(13)

Since we obtained the panel data for the period of 2014 to 2016, a time variable was also included, which measures whether firms manage to become better at increasing their efficiency and debt management through gathering experience and enduring a learning curve over time.

4. Results and discussion

The information provided in Figure 1 with three different aspect ratios (P/E, S/L. D/E) and total debt size confirmed the substantial operating advantages of R.E.I.T.s. In our sample size, trust structure companies had a 70% less short-term debt maturity to long-term debt maturity ratio while comparing to L.R.E.O.C.s, and a 97.3% smaller ratio while comparing to P.R.E.O.C.s. Similarly, debt-to-equity ratio was 13% higher for R.E.O.C.s and 70% higher for private companies compared to R.E.I.T.s. Considering these measurements in a scenario of a financial crisis, similar to one that occurred in 2008, R.E.I.T.s (since they are considerably less leveraged) would have less of a struggle to cope with debt maturity problems. Therefore, at a first glance, they could establish a more sustainable growth of the R.E. markets in the developing part of Europe, while still retaining high profits and being in size on par with bigger R.E.O.C.s. According to Huynh, Paligorova, and Petrunia (2018), the explanation behind the significant gaps observed between P.R.E.O.C.s and public companies can be attributed to private firms' shorter life cycles, asymmetric information and higher systemic risk. For the banks the assessment of smaller firms' risk profile is more difficult, therefore for private firms' accessibility of long-term financing is also limited and P.R.E.O.C.s have little choice but to rely on balloon mortgages or other types of short-term financing options which in many cases are more expensive. In most cases under consideration, R.E.I.T.s emitted a smaller variance in the data and were more clustered together, while the other types of firms showed a 29%–44% greater standard deviation. This could be related to Bers and Springer's (1997) finding that R.E.I.T.s do have an optimal size at which they are most cost efficient.

Figure 1. On the top left, a 3-year average (2014-2016) profit to equity ratio, on the top right, a 3-year average shot-term to longterm debt ratio, on the lower left a 3-year average debt to equity ratio, and on the low right, a 3-year average total debt accumulated for different types of RE companies are depicted. Source: Authors' elaboration based on the data gathered from Bloomberg, Bureau Van Dijk and SEC.

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The results of the four translog models can be observed in Table 3. Interestingly, the variable time was insignificant in all four models at a 0.05% interval, just like in Bers and Springer's (1997) research which suggests that companies do not become more efficient with experience. That could also mean that in order for R.E.I.T.s to be able to take advantage of time, a different recourse of a management style and a different perspective of the board of directors are needed, but the former infrequently occurs in a 10-year period.

Table 3. Stochastic frontier estimation.
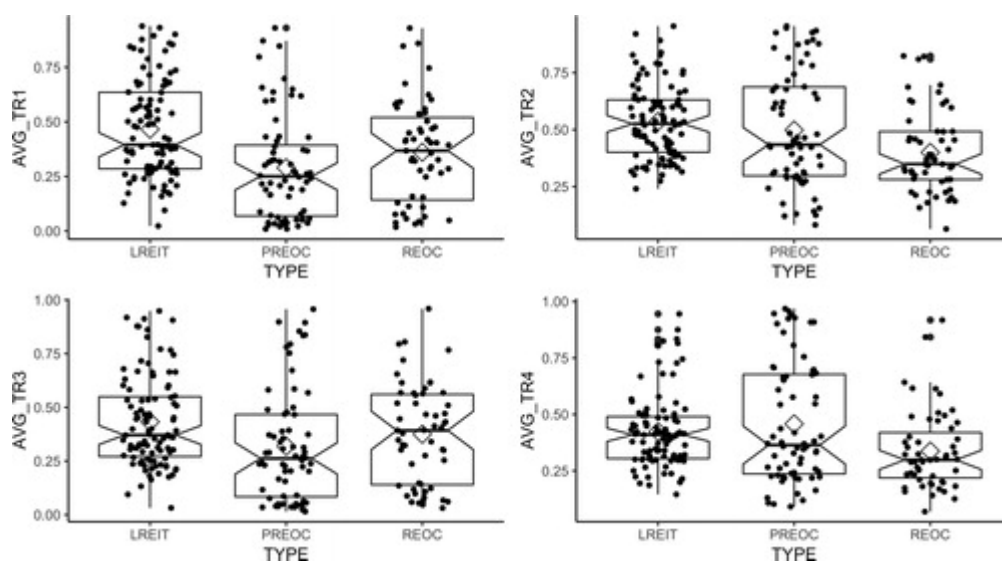
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It also confirms that R.E. as a product is a very bureaucratic mechanism which requires many permits from the state and other third parties involved. A time period of three years is too short to have an accumulated experience.

However, a favourable aspect is that throughout the period of 2014–2016, the central banks did not make any significant interest rate changes. This way, the influence of exogenous variables on base interest rates was avoided. If the rates had changed, it could have meant that the firms might have got less cost efficient through time. This is something that was not considered by Miller et al. (2007) who concluded that inefficiency grew over time without taking interest rate changes into account. Another

counterparts in efficiency[2] measures, with better cost management results varying from 7% up to 37.9%. Only in the fourth Translog model, the private firms managed to be 8% more productive, while R.E.O.C. were 20% more inefficient. Higher productivity of P.R.E.O.C.s in the last model, according to Degryse, Goeij, & Kappert (2010), can be explained by the overcompensation mechanism that private enterprises have to adopt. Since P.R.E.O.C.s do not have access to better financing options in comparison to listed firms, they have to compensate by being more efficient in their revenue and profit areas to afford short-term financing. The standard deviation for our models was consistently lower for an average R.E.I.T. company compared against its counterparts, reaching an average four-model-value of 19.7, while P.R.E.O.C.s acquired 25.1, and L.R.E.O.C.s – 20.4 standard deviations. These differences for better visualisation are depicted in Figure 2.

Figure 2. On the top left, a three-year average (2014–2016) efficiency boxplot for the 1st translog model, on the top right, a three-year average efficiency boxplot for the 2nd translog model, on the lower left, a three-year average efficiency boxplot for the 3rd translog model, and on the lower right, a three-year average efficiency boxplot for the 4th translog model in different types of RE companies are depicted. Source: Authors' elaboration based on the data gathered from Bloomberg, Bureau Van Dijk and SEC.

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An accurate and a comprehensive comparison of the results acquired from our four translog panel data models with the results obtained by other authors was not possible since all other models only compared R.E.I.T.s among themselves or with other listed income property companies and used different compositions, methodologies, time

a significant margin, it does seem that in general the efficiencies are somewhat in a similar value ballpark. Topuz et al. (2005) for R.E.I.T. companies estimated the efficiencies varying from 35 to 9% depending on the years chosen; by applying the D.A.E. method, Harris (2012) found the efficiencies varying from 51 to 33%, while for time period of 2013–2016 Ambrose et al. (2016) found the efficiencies to be 32%, 35%, and 36%, respectively. Thus, our estimated values fit somewhere in between of the prior research results.

Economies of scales were also detected, confirming the previous findings by Ambrose et al. (2005, 2016), Bers and Springer (1997) and Anderson et al. (2003). Likewise, as firms became bigger in their asset size, they were able to cope with cost externalities better than smaller companies with the value of mean economies of scale amounting to 0.74 for the first model with output assets. The mean differences can be observed in Figure 3.

Figure 3. On the top left, a three-year average (2014–2016) elasticities density plot for the first translog model, on the top right, a three-year average elasticities density plot for the second translog model, on the lower left, a three-year average elasticities to asset size for the first translog model, and on the lower right, a three-year average efficiency to assets for the second translog model in different types of R.E. companies are depicted. Source: Authors' elaboration based on the data gathered from Bloomberg, Bureau Van Dijk and SEC.
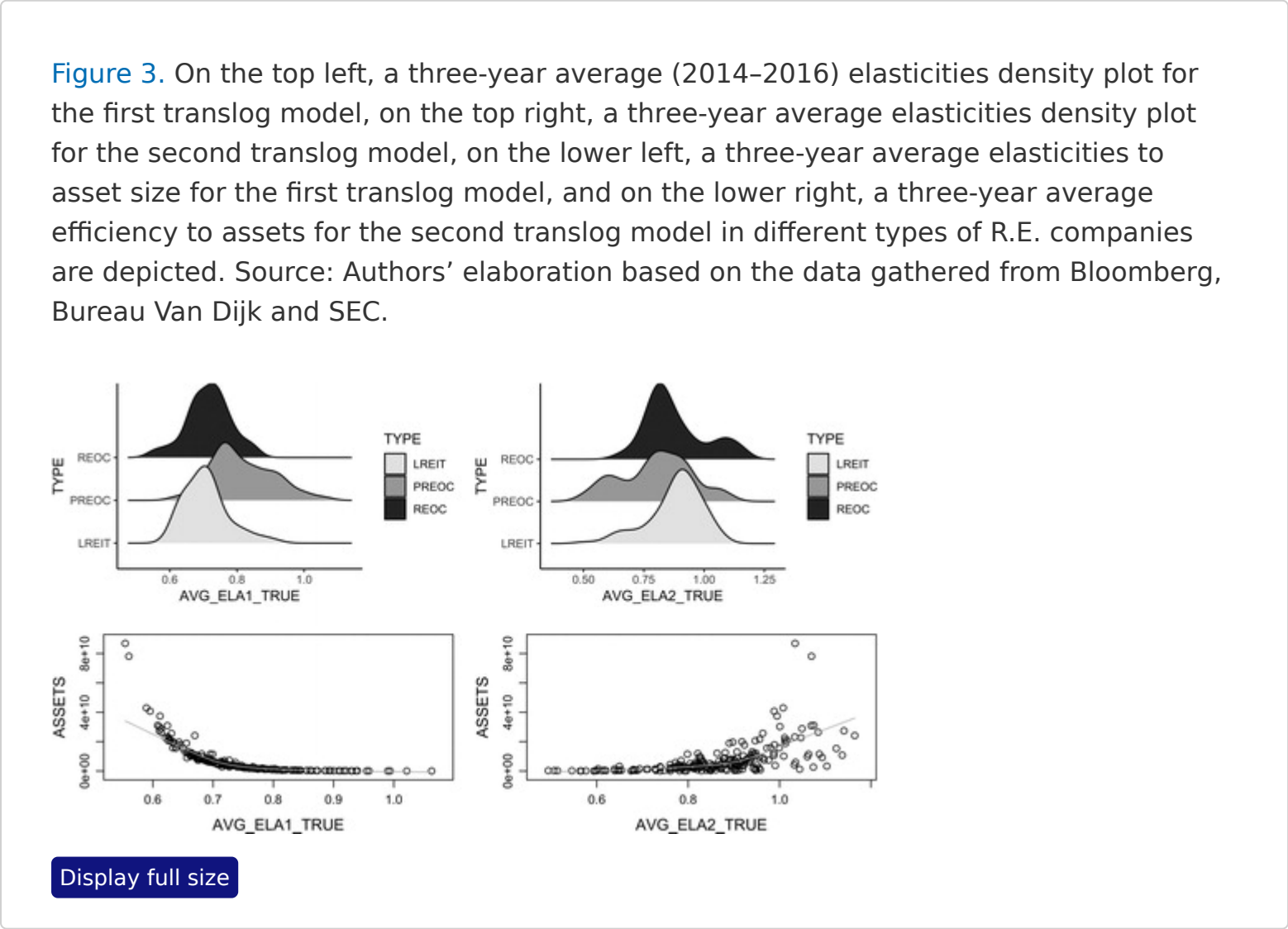

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R.E.I.T.s had on average 13% and 1.1% larger economies of scales against private firms

find long-term debt financing solutions. This is especially true when we are analysing R.E. business as much of it is based on leverage. When capital financing is limited, growth prospects become narrow. A reversed relationship was found with revenue output, meaning that smaller firms have the biggest growth potential with the average economies of scales of 0.85 for the second model. With regards to the revenue variable, R.E.I.T.s were found to perform poorer in the aspect of growth with the second model values of –9% and –0.3% against private and R.E.O.C.s firms, respectively. Only two L.L.C. R.E. firms experienced diseconomies of scales when analysing assets T.R. model, while 26 companies, 12 of which were REITs, six – P.R.E.O.C.s, and nine – R.E.O.C.s, experienced revenue diseconomies. Even though applying different modelling techniques, Ambrose et al. ([2016](), [2005]()) detected similar values where economies of scales for firms amounted to 98.8% with output assets and 83.2% with output revenue, while Miller et al.'s, (2006) results found economies of scales for companies to be closer to 98% with output assets and 99% with output revenue.

5. Conclusion

As the emerging economies in Europe are looking for the ways to catch up with the developed part of the world with regards to expanding their R.E. markets, R.E.I.T.s systems were a successful and promising market infrastructure for many countries. Numerous studies dating back to 1998 up to 2016, established concrete evidence that R.E.I.T.s had economies of scales related to their technical, allocative and scale efficiencies. Although previous studies were slightly contradictory, the newest research of Ambrose et al. ([2016]()) once again confirmed that R.E.I.T.s and R.E.O.C.s have a substantial potential for growth. Nevertheless, no study emerged that would differentiate the types of property operating companies (P.R.E.O.C.s, R.E.O.C.S., R.E.I.T.s) and would compare them directly with one another.

For this reason, this study developed four translog stochastic frontier models that measured each company's individual technical efficiency, economies of scales and debt ratios. The stochastic frontier method was chosen instead of D.E.A. because it can separate noise from efficiency and can better align with the randomness that exists in the data even though both D.E.A. and S.F.A. are considered the golden standards for efficiency analysis.

The results show that REITs on average were from 70% to 97.3% less dependent on short-term maturities against their counterparts, were more clustered and similar in size since their standard deviation was from 29% to 44% smaller than that of the other types of firms and had a 70% and 13% smaller debt-to-equity ratio in comparison to P.R.E.O.C.s and L.R.E.O.C.s, respectively. The output of translog functions indicated that R.E.I.T.s on average were from 7% to 37.9% more efficient, and only in the fourth model private companies surpassed R.E.I.T.s by 8% in their efficiency. Just like in prior research, economies of scales were confirmed for all of the companies because when firms become bigger in their asset size, they tend to grow faster than their cost externalities. Noticeable differences were found among the types of companies where with output assets economies of scales for R.E.I.T.s on average were bigger by 9% and 1.1% against P.R.E.O.C.S. and R.E.O.C.s, respectively, while with output revenue P.R.E.O.C.s and R.E.O.C.s outperformed R.E.I.T.s by 9% and 0.3%, respectively. Time variable seems to have had no effect on efficiency, concluding that in order for R.E.I.T.s to be more efficient, a considerable management changes have to be allowed. Also, since the R.E. market is a very bureaucratic environment because of the state regulations, this makes the process of strategic efficiency growth harder to implement in R.E.I.T.s unlike in other types of firms in a three-year period.

Policy implications driven from these conclusions are as follows: R.E.I.T.s seem to have a well-documented performance advantages against other types of firms; therefore, it is reasonable to advise for the developing part of Eastern Europe to consider adopting this system into their stock exchange. Nevertheless, some additional circumstances should be considered because peculiarities[3] of a country may determine whether R.E.I.T.s can be successfully implemented. The regulations for R.E.I.T.s differ across Europe, therefore the countries should look carefully at what tax provisions, dividend payment ratios and market concentration levels might suit their markets best.

For further research, we suggest authors to delve into how different tax regimes, dividends, legal provisions, corporate policies or capital inflows can affect R.E.I.T.s efficiencies. Perhaps similar company profiles could be chosen for sector analysis. Additionally, a comparative multi-level analysis of continental differences could show how well R.E.I.T. systems are being integrated in Europe with regards to other countries and whether there exists a significant control parameter variance among different regions.[23]

Notes

1 Non-R.E.I.T.s – public or private companies that are operating in the real estate sector but do not have tax deductibles, annual obligatory dividend distribution from cash flows and are not limited to the amount of which their operations have to come from rental income.

2 The efficiencies analysed in the section of results and discussion are all technical efficiencies; except for economies of scales, they are the measures which can be called scale efficiencies.

3 Noticeable taxation, dividend and corporate policy differences exist between 23 European countries and 50 U.S. states in this research. Although this issue is beyond the scope of our article, we found no earlier research to address these discrepancies. It is difficult to know whether they have any distorting effects on our model when analysing firm structure-to-structure.

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