



## EFFICIENCY ASSESSMENT OF LISTED REAL ESTATE COMPANIES: AN EMPIRICAL STUDY OF CHINA

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**ABSTRACT.** This study measures performance and efficiency of the Listed Real Estate Companies (LRECs). Three types of Data Envelopment Analysis (DEA) approaches are employed, which are CCR-DEA, BCC-DEA and Super-Efficiency-DEA models. Based on these DEA approaches, we conduct an empirical analysis on the 94 LRECs in China stock markets according to the 2009 Annual Financial Statements. Registered Capital, Asset Value, Employee Number, and Operation Cost are adopted as the inputs factors, while the output factors are denoted by Revenue and Profit. In general, this empirical research delivers four outcomes: firstly, an integrated assessment system and a ranking of the LRECs are established, which provides useful information for investors who are seeking for indirect exposure in the Chinese real estate market. Secondly, the average Overall Efficiency (OE), Pure Technical Efficiency (PTE) and Scale Efficiency (SE) of the LRECs are 0.78, 0.84 and 0.92 respectively. Thirdly, 69% of the inefficient LRECs are classified as increasing returns to scale and could further increase operating efficiency by scale expansion. Fourthly, the employees slack is prevalent at 18.96% for the inefficient LRECs.

**KEYWORDS:** Listed real estate company; Input-output; Efficiency; Scale economics; DEA; China

### 1. INTRODUCTION

Over the last two decades, China has achieved amazing economic growth, accompanied by rapid development of her real estate market. The demand for urban land and new dwellings has substantially increased due to the fast growth of urbanization (Hui and Yue, 2006). It is widely accepted that the real estate industry is an important booster for the recent China's economic development, especially after

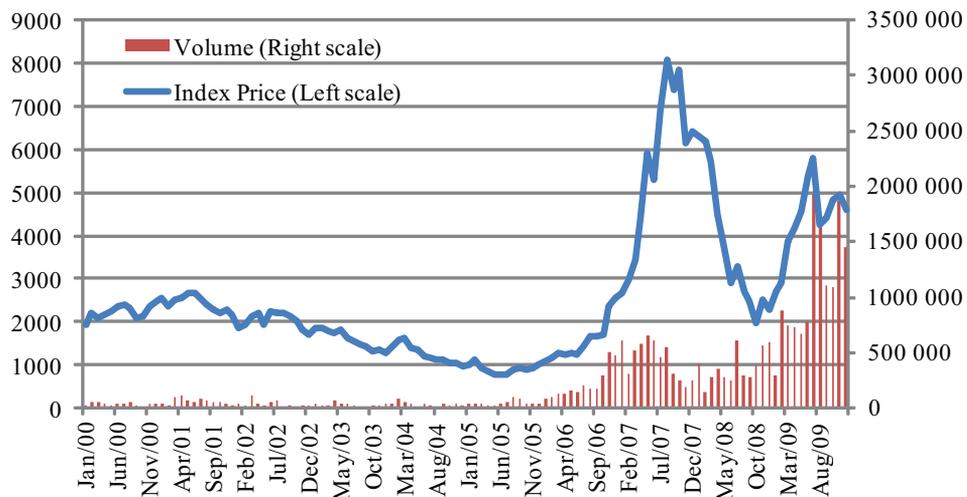
the Housing Policy Reform in 1998. Accompanying her economic development, the China stock market is becoming one of the biggest security markets in the world. The huge and sustaining economic growth creates lots of opportunities for worldwide investors to profit from China's booming economy. More importantly, it provides a safe hedge against tumultuous events from the international financial markets to some extent. Among all the China

stocks, the property stocks have benefited profoundly during the last five years, due to the tremendous growth in housing prices and the urbanization process, as well as the rise in China's currency exchange rate.

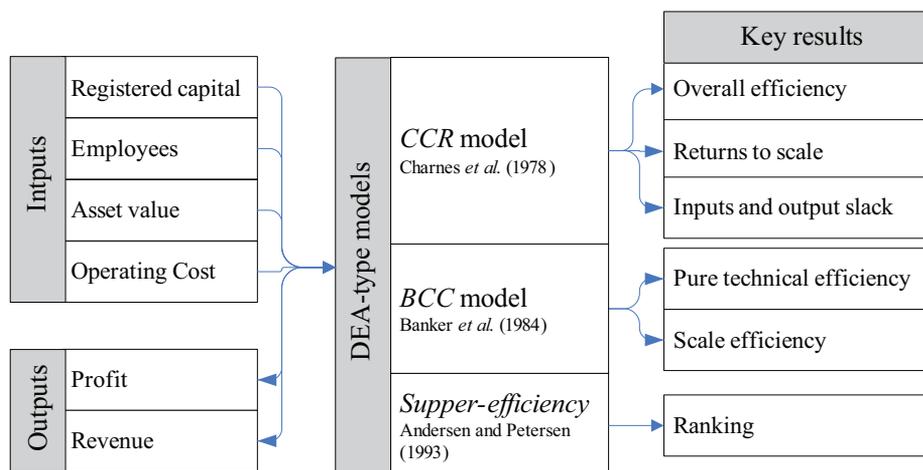
As we can see in Figure 1, China property stock index (left scale) rocketed in early 2006, doubling and then tripling before peaking in Oct, 2007. Although China's property market presents indubitable growth potential, huge volatilities are imbedded in the property stock prices, just like the enormous decline after the 2007 U.S. Subprime Crisis (see Hui et al., 2010 for example). Now, though foreign investors are still paying increasing attention to the well-run China property market, they are keen to seek indirect property investment opportunities in the Chinese stock market. However, there still remains one fundamental question: how to build up the portfolio? This is because this emerging market, which contains nearly one hundred property securities, seems mysterious to most cross-border investors. In this regard, evaluating operation efficiency will be useful to better understand the way that a company operates, and has been widely adopted in many previous studies (see Chau and Wang,

2001; Anderson et al., 2002; Coelli and Rao, 2005; Hu and Wang, 2006; Thakur et al., 2006; Chau et al., 2005 for examples). Besides, it is plausible to assume that the performance of the real estate securities can be discriminated indirectly in terms of the operating efficiency of their underlying companies. In other words, a company with higher operational efficiency (i.e. produce some outputs using relatively lower inputs) will enjoy higher capital increment in the listed security market.

The purposes of this paper are twofold (see Figure 2). The first purpose is to develop a DEA-based selection criterion of LRECs from a perspective of performance and operating efficiency, and explore the scale efficiency of the LRECs. The second purpose is to find out the best operating LRECs using the Super-efficient DEA model. The structure of this paper is laid out as follows: Section 1 provides the background for the study. Section 2 presents a brief review of previous studies on the evaluation of real estate securities. Section 3 presents the methodologies and models used in this study. Section 4 presents empirical results with the case of China. The last section concludes the paper.



**Figure 1.** Historical China property security composite index: Jan, 2000 to Dec, 2009. Source: Bloomberg



**Figure 2.** An overview of the research framework

## 2. LITERATURE REVIEW

Operational efficiency is considered to be one of the key issues and important selection criterions for the listed securities. In the last few years, many academic literatures (e.g. Bers and Springer, 1997; Anderson et al., 2000) have empirically investigated the operational efficiency of Real Estate Investment Trusts (REITs). Bers and Springer (1997) use the trans-log cost function to estimate economies-of-scale for a sample of REITs during the period of 1992–1994. Their empirical results show that economies-of-scale exist for REITs for all years under investigation. Besides, they also find that the individual characteristics (i.e. type of management and degree of leverage) affect the magnitude of the scale economy. Later on, Anderson et al. (2002) use DEA approach to estimate economies-of-scale and inefficiency for REITs using a time series sample from 1992 to 1996. They find that those technically inefficient REITs are results of both poor input utilization and failure to operate at constant returns to scale, which means that most of the inefficient REITs could be further improved by company expansion. Besides, their results also imply that internal REIT management is positively related to all measures of efficiency (see

also Anderson and Springer, 2003 for another example). Miller and Springer (2007) estimate the operating efficiencies of REITs using the stochastic frontier models and panel data. This model can identify frontier cost improvements, returns to scale, and cost inefficiencies over time. In contrary to the previous studies, they find no evidence of scale economies and some evidence of scale diseconomies (see Miller et al. 2006 for another example). However, the stochastic frontier techniques are not competent for studying multiple outputs that are jointly produced, because this approach is normally limited to focus on single output at a time.

Although the operational efficiency of REITs has been well discussed by real estate economists, there has been little systematic analysis of the listed real estate companies, especially in the emerging economy like China. Chau et al. (2003) analyze the returns of twelve listed property companies and one property portfolio in Hong Kong using the style analysis approach. The results suggest that indirect and direct real estate are becoming closer substitutes for each other; and the performance of a property company is mainly attributable to its investment style characterized by the implied portfolio rather than management skills. Hui et al. (2007) examine the

economic performance of Hong Kong property companies in term of Economic Value-Added (EVA). They find that the companies which diversified into other sectors performed better than those focused solely on real estate sector. They further argue that both the Singapore's and Hong Kong's property companies do not perform well from an EVA perspective. Wang and Wang (2009) use the DEA approach to analyze the efficiency of twenty LRECs in China from 2000 to 2007. They find that the efficiency of real estate industry is greatly influenced by the control policies. However, their results cannot further identify those extreme efficient companies. Besides, their study only focuses on the well known LRECs but does not cover all the LRECs in China, which might make the results incomplete and somehow biased. This is because the reputation and scale of a company do not necessarily mean a higher level of operational efficiency. Chau et al. (2010) empirically investigate the linkage between direct and indirect real estate in terms of corporate governance structures, their results show that the China listed property companies had a weaker linkage between direct and indirect real estate than that of Hong Kong.

### 3. METHODOLOGY AND MODEL SPECIFICATION

Data envelopment analysis (DEA) is a popular non-parametric method in both operations research and economics studies for the estimation of the production frontiers and the relative efficiencies of a homogenous set of Decision-Making Units (DMUs: listed real estate companies). DEA is a multi-factor productivity analysis model, which is specifically designed to deal with multiple outputs and inputs without pre-assigned weights and without imposing any functional form on the relationships between variables. Within the DEA framework, the performance is evaluated with respect to an efficient frontier, which is constructed by examining linear combination of the DMUs

under study and determining the minimum necessary input level to achieve a given output level (see Anderson et al., 2002). In general, there are three advantages of DEA approach: First, it measures the efficiency by converting multiple inputs into multiple outputs. Second, it does not require any assumptions about the functional form of the production function or prescribed weights to be attached to each input and output. Third, it explores and identifies the underlying causes of the inadequate (for example, slack in input factors).

#### 3.1. The CCR model

The *Charnes-Cooper-Rhodes* (CCR) model is proposed by Charnes et al. (1978), built on the idea of Farrell (1957). It assumes that there is no significant relationship between the scale of operations and efficiency, which is well known as constant returns to scale (CRS). Under this assumption, the large LRECs are just as efficient as the small ones in converting inputs to outputs. In this study, we adopt the input-oriented model, which means the inputs are minimized and the outputs are kept at their current levels. A relative efficiency score of a test  $DMU_j$  can be obtained by solving the following fractional program:

$$\begin{aligned} & \text{Max} \sum_{r=1}^s u_r y_{rj} \bigg/ \sum_{i=1}^m v_i x_{ij} \\ & \text{Subject to :} \\ & \sum_{r=1}^s u_r y_{rj} \bigg/ \sum_{i=1}^m v_i x_{ij} \leq 1; \quad y_{rj}, x_{ij} > 0; \quad v_i, u_r \geq 0; \\ & j = 1, \dots, n; \quad i = 1, \dots, s; \quad r = 1, \dots, m \end{aligned} \quad (1)$$

where:  $m$  and  $s$  are the number of inputs and outputs factors respectively;  $\mathbf{y}_j = (y_{1j}, \dots, y_{sj})$  is a given  $s$  dimensional vector of  $s$  outputs of  $DMU_j$ ; and  $\mathbf{x}_j = (x_{1j}, \dots, x_{mj})$  is a given  $m$  dimensional vector of  $m$  inputs of  $DMU_j$ .  $\mathbf{v}_j$  and  $\mathbf{u}_j$  are the weights given to  $\mathbf{x}_j$  and  $\mathbf{y}_j$  respectively. Weights are not allowed to fall below non-zero small positive numbers in order to prevent the mathematical omission of

an output or an input in the iterative calculation of efficiency. Both  $\mathbf{v}_j$  and  $\mathbf{u}_j$  in DEA are derived from the data instead of being fixed in advance and may vary from different DMUs (see Cooper et al., 2007, Chapter 1 for more details). Specifically, for each  $DMU_j$ , we can find the best vector weight  $\mathbf{u}_j = (u_{1j}, \dots, u_{sj})$  and  $\mathbf{v}_j = (v_{1j}, \dots, v_{mj})$  that maximize the ratio between the weighted outputs and weighted inputs. In fact, both input and output slacks may exist in model (1). Hence, the fractional program in (1) is subsequently converted to a linear programming format and a mathematical dual with slacks as shown in program (2):

$$\theta^{OE} = \text{Min } \theta - \varepsilon \left( \sum_{i=1}^m S_i^- + \sum_{r=1}^s S_r^+ \right)$$

Subject to :

$$\sum_{j=1}^n \lambda_j x_{ij} + S_i^- = \theta x_{i0}; \quad (i = 1, 2, \dots, m); \quad (2)$$

$$\sum_{j=1}^n \lambda_j y_{rj} + S_r^+ = y_{r0}; \quad (r = 1, 2, \dots, s);$$

$$\lambda_j \geq 0; \quad S_i^- \geq 0; \quad S_r^+ \geq 0$$

where:  $\theta^{OE}$  is the relative overall efficiency (OE);  $\lambda_j$  is the dual variable.  $S_i^-$  and  $S_r^+$  represent input and output slacks, respectively. Generally, a DMU is efficient if and only if  $\theta^{OE} = 1$  and  $S_i^- = S_r^+ = 0$  for all  $i$  and  $r$ . The efficient targets of inputs and outputs are  $\hat{x}_{i0} = \theta^{OE} x_{i0} - S_i^{-*}$  and  $\hat{y}_{r0} = \theta^{OE} y_{r0} - S_r^{+*}$  respectively.

### 3.2. The BCC model

The BCC DEA model proposed by Banker et al. (1984) further relaxes the CRS assumption to variable returns to scale (VRS) by adding a restriction of  $\sum_j \lambda_j = 1$ . The CRS efficiency score in model (2) represents the overall technical efficiency, while the VRS efficiency score (see program (3)) denotes the pure technical

efficiency (PTE). Besides, the BCC DEA model further decomposes the OTE into pure technical efficiency (PTE) and scale efficiency (SE), namely  $SE = OE / PTE$ .

$$\theta^{PTE} = \text{Min } \theta - \varepsilon \left( \sum_{i=1}^m S_i^- + \sum_{r=1}^s S_r^+ \right)$$

Subject to :

$$\sum_{j=1}^n \lambda_j x_{ij} + S_i^- = \theta x_{i0}; \quad (i = 1, 2, \dots, m); \quad (3)$$

$$\sum_{j=1}^n \lambda_j y_{rj} + S_r^+ = y_{r0}; \quad (r = 1, 2, \dots, s);$$

$$\sum_j \lambda_j = 1;$$

$$\lambda_j \geq 0; \quad S_i^- \geq 0; \quad S_r^+ \geq 0$$

### 3.3. The Super-efficient DEA model

A common weakness of the above DEA models is that a considerable number of DMUs is typically characterized as efficient, unless the sum of the number of inputs and outputs is small relative to the number of observations. Hence, Andersen and Petersen (1993) proposed the removal of the unit under evaluation from the reference set. In other words, when a DMU under evaluation is not included in the reference set of the envelopment models, the resulting DEA models are called super-efficiency DEA models. This procedure allows the determination of the unit's relative placement regardless of whether the unit is efficient or not. It can be used in identifying the extreme efficient DMUs. It should be noted that the modification of the super-efficiency will not impact the technical score of those inefficient units, which will still fall below the frontier, in the same manner as before (see Zhu, 2008, Chapter 10; Nahra et al., 2009 for details and examples). Some studies show that the super efficient CRS model may be infeasible; however, Zhu (1996) proves that the input-oriented CRS super efficient model is infeasible if and only

if a certain pattern of zero data occurs in the inputs and outputs of DMU. In this study, all inputs and outputs are strictly positive, which will ensure that all the DMUs have feasible solutions. For the input-oriented CRS super-efficiency DEA model, the linear programming model is shown as follows:

$$\begin{aligned}
 & \text{Min} \theta^{\text{super}}; \\
 & \text{Subject to:} \\
 & \sum_{\substack{j=1 \\ j \neq 0}}^m \lambda_j x_{ij} \leq \theta^{\text{super}} x_{i0}; \quad (i = 1, 2, \dots, m); \\
 & \sum_{\substack{j=1 \\ j \neq 0}}^s \lambda_j y_{rk} \geq y_{r0}; \quad (r = 1, 2, \dots, s); \\
 & \lambda_j \geq 0; \quad (j \neq 0)
 \end{aligned} \tag{4}$$

where: the  $\theta^{\text{super}}$  is the super efficiency score.

## 4. EMPIRICAL STUDIES

### 4.1. The data structure

The inputs and outputs selection procedure is one of the critical tasks for the follow-up efficiency analysis. Specifically, the data sources for this study consist of 94 LRECs in China's stock markets (both Shenzhen and Shanghai Stock Exchanges) according to the *2009 Annual Financial Statements*. There are four types of input factors adopted in this study: Registered Capital, Asset Value, Employee Number, and Operation Cost. On the other hand, there are two types of outputs factors: Revenue and Profit. The descriptive statistics of input and output factors of the selected LRECs are given in Table 1.

### 4.2. Ranking efficient units in DEA models

All the CCR-DEA, BCC-DEA and Super-Efficiency-DEA models are calculated using the DEA Frontier software developed by Zhu (2008); the detailed results are shown in Table A1 in the Appendix. According to the CCR-DEA model, only 12 out of 94 (namely 12.8%) LRECs are operating on the efficient frontier, and the total efficiency had a mean score of 0.78 (see Figure 3-A). Besides, the BCC-DEA model reveals that the PTE of the inefficient LRECs is 0.84 (see Figure 3-B), and it also suggests that there are 10 inefficient LRECs having optimal input utilization (i.e. PTE=1), while the SE is less than one. In other words, they still deviate from the efficient frontier due to the scale inefficiencies. On the other hand, the average score of SE is 0.93 (see Figure 3-C). These results imply that there are more possibilities for efficiency gain by better utilization of the input variables than taking advantage of scale efficiency, which further corroborates the findings of Bers and Springer (1997).

In order to discriminate the performance of these 12 operating efficient LRECs, the Super-Efficiency-DEA model was employed. As illustrated in the 7<sup>th</sup> and 8<sup>th</sup> columns (namely, S-E and Ranking) of Table A1, we have the top-ranked LRECs in terms of the Super-Efficiency Scores. More specifically, the top-ten LRECs are 000609.SZ, 600648.SH, 000042.SZ, 000502.SZ, 600663.SH, 600658.SH, 000517.SZ, 000797.SZ, 000838.SZ and 002208.SZ respectively. These ranking results could serve as useful selection criterion for the listed property investors.

**Table 1.** Descriptive statistics for the data

|         | Factors                          | Min | Max    | Mean  | Std. Dev. | Skewness | Kurtosis |
|---------|----------------------------------|-----|--------|-------|-----------|----------|----------|
| Inputs  | Registered capital (Million RMB) | 107 | 10995  | 948   | 1315      | 5.39     | 37.40    |
|         | Employee number (person)         | 20  | 17616  | 1124  | 2320      | 4.91     | 29.35    |
|         | Asset value (Million RMB)        | 230 | 137609 | 10065 | 18536     | 4.76     | 27.32    |
|         | Operating Cost (Million RMB)     | 16  | 41122  | 2072  | 4716      | 6.71     | 52.36    |
| Outputs | Profit (Million RMB)             | 2   | 6430   | 429   | 849       | 4.93     | 29.62    |
|         | Revenue (Million RMB)            | 15  | 48881  | 2536  | 5693      | 6.51     | 49.34    |

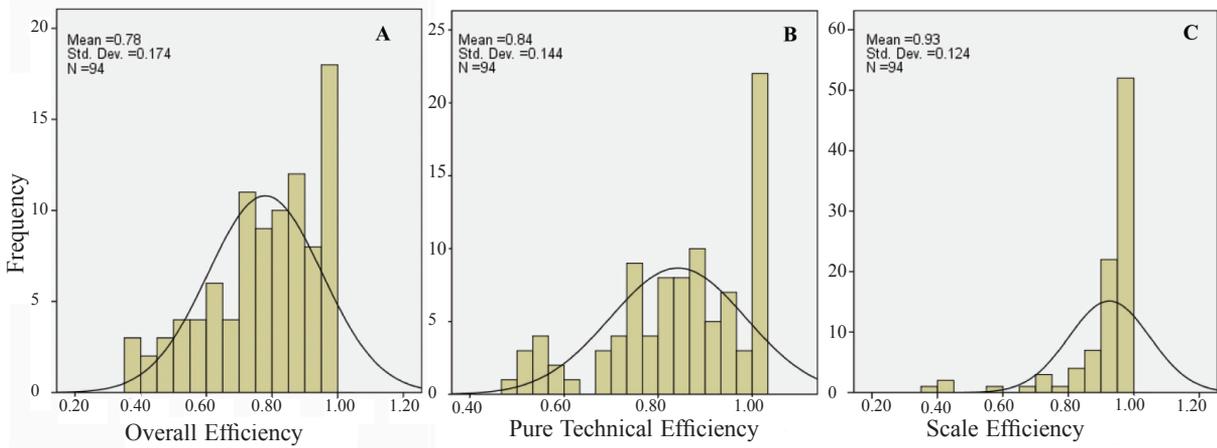


Figure 3. Frequencies of the OE, PTE and SE

4.3. Returns to scale

In classical microeconomic theory, the returns to scale refer to changes in output subsequent to a proportional change in all inputs. More clearly, if output increases by that same proportional change then there are constant returns to scale (CRTS). If output increases by less than that proportional change, there are decreasing returns to scale (DRS). If output increases by more than that proportion, there are increasing returns to scale (IRS). Specifically, a company achieved scale efficient (namely constant return to scale) only if it operates at the bottom of the assumed U-shaped curve.

In this study, we examine the nature of the scale efficiencies by determining the number of firms operating under constant, increasing, and decreasing returns to scale. As shown in Figure 4, only 14% of LRECs under study were operating at CRTS, given the relatively low efficiency scores. On the other hand, the inefficient LRECs are dominated by those exhibiting increasing returns to scale (i.e. 69%), suggesting that these LRECs could increase operating efficiency through company’s scale expansion, these results are coincident with the finding of Anderson et al. (2002), which

shows that most REITs are operating at IRS. The results can be interpreted that the Chinese real estate companies are still under the rapidly developing state, especially after the Housing Policy Reform in 1998.

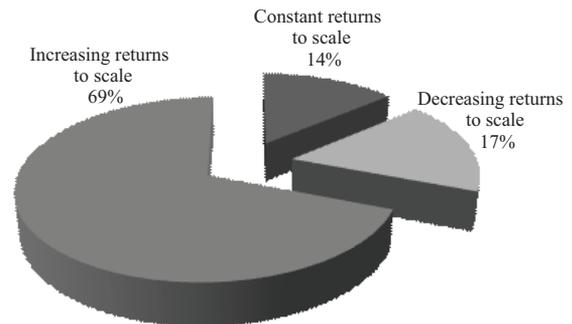
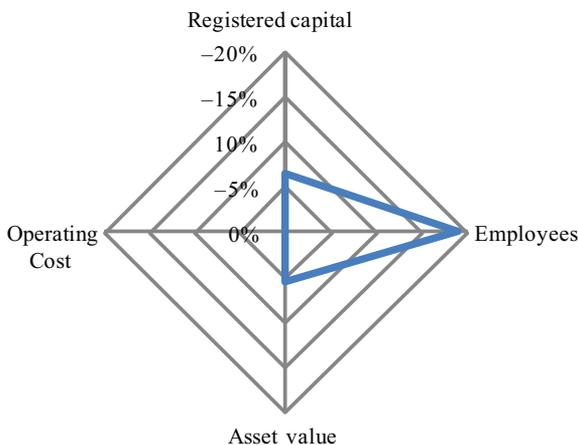


Figure 4. Scale efficiencies for all listed real estate companies

4.4. Slack adjustments of the input variables

The CCR-DEA model can identify the most efficient LRECs which operate on the frontier and serve as the benchmarks for those inefficient LRECs. Figure 5 illustrates the average slack ratio of outputs for the inefficient LRECs. The employees slack is prevalent at 18.96%, followed by registered capital and asset value,

which have 6.54% and 5.57% slack. It is worth mentioning that only one company has slack in the operating cost. These results could help real estate companies for staying competent in order to survive in such a competitive business environment. For example, the substantive of employees implies that most of the LRECs are inefficient with respect to employee input, which is a common phenomenon in the early stage of an industry.



**Figure 5.** Slack proportions of the inefficient LRECs

## 5. CONCLUSION REMARKS

This paper has employed three frontier-based DEA approaches to evaluate the operational efficiency of LRECs in China's stock markets. The DEA approach is a powerful, non-parametric technique that allows comparisons of diverse DMUs. Furthermore, a Super-DEA model is introduced to distinguish those LRECs that fall on the traditional DEA frontier. The empirical results deliver three valuable findings: that is, (1) a new, useful ranking list for LRECs in China, in terms of operating efficiency. Such list provides extremely important information for both institutional and individual investors in choosing appropriate LRECs. (2) The average OE, PTE and SE

are 0.78, 0.84 and 0.92 respectively, reflecting LRECs' different overall performance by different measures. (3) 69% of the inefficient LRECs are dominated by increasing returns to scale, which implies that these companies could further increase their operating efficiency through scale expansion. It also confirms that China's real estate industry is still in its early stage and has much potential to be further developed. All in all, this research has identified and quantified the input factors that affect the efficiency of LRECs. This essentially helps individual LRECs improve their input efficiency and enhance their chance of survival in the current competitive environment.

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**SANTRAUKA****NEKILNOJAMOJO TURTO KOMPANIJŲ, KURIŲ VERTYBINIAI POPIERIAI ĮTRAUKTI Į BIRŽOS SĄRAŠUS, EFEKTYVUMO VERTINIMAS: EMPIRINIS KINIJOS TYRIMAS****Xian ZHENG, Kwong-Wing CHAU, Eddie C. M. HUI**

Straipsnyje įvertinamas nekilnojamojo turto kompanijų, kurių vertybiniai popieriai įtraukti į biržos sąrašus (angl. *LRECs*), veiklos efektyvumas ir rezultatyvumas. Tam taikomi trys duomenų apgaubties analizės (angl. *DEA*) metodai, o būtent CCR-DEA, BCC-DEA ir Super-Efficiency-DEA metodai. Pritaikius šiuos duomenų apgaubties analizės metodus ir remiantis 2009 m. metinių finansinių ataskaitų duomenimis, buvo atlikta Kinijos akcijų rinkos 94-ių nekilnojamojo turto kompanijų, kurių vertybiniai popieriai įtraukti į biržos sąrašus, empirinė analizė. Įstatinis kapitalas, nominali aktyvų vertė, darbuotojų skaičius ir eksploatacinės išlaidos laikomi įeigos veiksniais, o išeigos veiksniais imamos pajamos ir pelnas. Šiuo empiriniu tyrimu galima pasiekti keturių rezultatų: pirmiausia, sudaryta integruoto vertinimo sistema ir nustatomi nekilnojamojo turto kompanijų, kurių vertybiniai popieriai įtraukti į biržos sąrašus, reitingai. Reitingų teikiama informacija naudinga investuotojams, siekiantiems netiesioginio dalyvavimo Kinijos nekilnojamojo turto rinkoje. Antra, nekilnojamojo turto kompanijų, kurių vertybiniai popieriai įtraukti į biržos sąrašus, vidutiniai dydžiai: bendras efektyvumas (angl. *OE*), grynasis techninis efektyvumas (angl. *PTE*) ir masto efektyvumas (angl. *SE*), atitinkamai sudaro 0,78, 0,84 ir 0,92. Trečia, 69 proc. neefektyvių nekilnojamojo turto kompanijų, kurių vertybiniai popieriai įtraukti į biržos sąrašus, priskirtos prie augančio pelno kompanijų, kurios gali kelti veiklos efektyvumą plėsdamos savo veiklą. Ketvirta, 18,96 proc. neefektyvių nekilnojamojo turto kompanijų, kurių vertybiniai popieriai įtraukti į biržos sąrašus, būdinga darbuotojų neveiknumas.

## APPENDIX

Table A1. Results of CCR-DEA, BCC-DEA and Super-Efficiency-DEA models

| DMU Name | OE        | RTS    | PTE        | SE     | S-E    | Ranking | Registered capital | Employees | Asset value | Operating Cost |
|----------|-----------|--------|------------|--------|--------|---------|--------------------|-----------|-------------|----------------|
| 1        | 600048.SH | 0.9978 | Decreasing | 1.0000 | 0.9978 | 0.9978  | 13                 | 0.00%     | -8.76%      | 0.00%          |
| 2        | 600052.SH | 0.9931 | Decreasing | 1.0000 | 0.9931 | 0.9931  | 15                 | 0.00%     | 0.00%       | 0.00%          |
| 3        | 600053.SH | 0.6123 | Increasing | 0.7005 | 0.8741 | 0.6123  | 76                 | -5.31%    | -15.21%     | 0.00%          |
| 4        | 600064.SH | 0.8766 | Increasing | 0.8769 | 0.9996 | 0.8766  | 32                 | 0.00%     | -43.55%     | 0.00%          |
| 5        | 600082.SH | 0.6906 | Increasing | 0.7306 | 0.9452 | 0.6906  | 70                 | -12.50%   | -6.91%      | 0.00%          |
| 6        | 600162.SH | 0.8736 | Increasing | 0.8805 | 0.9922 | 0.8736  | 34                 | 0.00%     | 0.00%       | 0.00%          |
| 7        | 600167.SH | 0.6085 | Increasing | 0.8512 | 0.7149 | 0.6085  | 77                 | 0.00%     | 0.00%       | 0.00%          |
| 8        | 600175.SH | 0.8765 | Decreasing | 1.0000 | 0.8765 | 0.8765  | 33                 | -10.98%   | 0.00%       | 0.00%          |
| 9        | 600185.SH | 0.4385 | Increasing | 0.5167 | 0.8487 | 0.4385  | 90                 | 0.00%     | 0.00%       | 0.00%          |
| 10       | 600215.SH | 0.5988 | Increasing | 0.6991 | 0.8566 | 0.5988  | 79                 | 0.00%     | 0.00%       | 0.00%          |
| 11       | 600223.SH | 0.8406 | Increasing | 0.8440 | 0.9961 | 0.8406  | 39                 | 0.00%     | 0.00%       | 0.00%          |
| 12       | 600225.SH | 0.8050 | Increasing | 0.8111 | 0.9924 | 0.8050  | 48                 | 0.00%     | 0.00%       | 0.00%          |
| 13       | 600239.SH | 0.8923 | Increasing | 0.8929 | 0.9994 | 0.8923  | 28                 | 0.00%     | -1.84%      | 0.00%          |
| 14       | 600240.SH | 0.7328 | Increasing | 0.7488 | 0.9786 | 0.7328  | 62                 | 0.00%     | -11.86%     | 0.00%          |
| 15       | 600246.SH | 0.8555 | Decreasing | 0.9015 | 0.9491 | 0.8555  | 37                 | -14.07%   | -24.24%     | 0.00%          |
| 16       | 600256.SH | 0.8198 | Increasing | 0.8208 | 0.9987 | 0.8198  | 42                 | 0.00%     | 0.00%       | 0.00%          |
| 17       | 600322.SH | 0.6169 | Increasing | 0.6249 | 0.9873 | 0.6169  | 75                 | -11.29%   | -25.11%     | 0.00%          |
| 18       | 600325.SH | 0.9976 | Decreasing | 0.9980 | 0.9997 | 0.9976  | 14                 | 0.00%     | -18.69%     | 0.00%          |
| 19       | 600376.SH | 0.8652 | Decreasing | 0.8662 | 0.9988 | 0.8652  | 36                 | 0.00%     | -31.37%     | 0.00%          |
| 20       | 600383.SH | 0.8052 | Decreasing | 0.8881 | 0.9067 | 0.8052  | 47                 | 0.00%     | 0.00%       | 0.00%          |
| 21       | 600393.SH | 0.8949 | Increasing | 0.9100 | 0.9834 | 0.8949  | 27                 | 0.00%     | 0.00%       | 0.00%          |
| 22       | 600463.SH | 0.7983 | Increasing | 0.8534 | 0.9354 | 0.7983  | 49                 | 0.00%     | 0.00%       | 0.00%          |
| 23       | 600533.SH | 0.7421 | Increasing | 0.7455 | 0.9955 | 0.7421  | 58                 | 0.00%     | 0.00%       | 0.00%          |

(Continued)

| DMU Name    | OE        | RTS    | PTE        | SE     | S-E    | Ranking | Registered capital | Employees | Asset value | Operating Cost |       |
|-------------|-----------|--------|------------|--------|--------|---------|--------------------|-----------|-------------|----------------|-------|
| (Continued) |           |        |            |        |        |         |                    |           |             |                |       |
| 24          | 600576.SH | 0.7798 | Increasing | 0.8499 | 0.9175 | 0.7798  | 54                 | -8.16%    | -70.40%     | 0.00%          | 0.00% |
| 25          | 600606.SH | 0.6633 | Increasing | 0.7429 | 0.8928 | 0.6633  | 72                 | 0.00%     | -48.36%     | 0.00%          | 0.00% |
| 26          | 600614.SH | 0.7407 | Increasing | 0.7408 | 0.9998 | 0.7407  | 60                 | -13.87%   | -63.40%     | 0.00%          | 0.00% |
| 27          | 600615.SH | 0.6246 | Increasing | 0.8894 | 0.7023 | 0.6246  | 74                 | -8.47%    | -20.85%     | 0.00%          | 0.00% |
| 28          | 600638.SH | 0.4635 | Increasing | 0.5478 | 0.8461 | 0.4635  | 88                 | 0.00%     | 0.00%       | -2.62%         | 0.00% |
| 29          | 600641.SH | 0.7618 | Decreasing | 0.7631 | 0.9983 | 0.7618  | 56                 | 0.00%     | 0.00%       | -16.54%        | 0.00% |
| 30          | 600648.SH | 1.0000 | Constant   | 1.0000 | 1.0000 | 3.3379  | 2                  | 0.00%     | 0.00%       | 0.00%          | 0.00% |
| 31          | 600657.SH | 0.8509 | Increasing | 0.8514 | 0.9994 | 0.8509  | 38                 | 0.00%     | -49.07%     | 0.00%          | 0.00% |
| 32          | 600658.SH | 1.0000 | Constant   | 1.0000 | 1.0000 | 1.2536  | 6                  | 0.00%     | 0.00%       | 0.00%          | 0.00% |
| 33          | 600663.SH | 1.0000 | Constant   | 1.0000 | 1.0000 | 1.3156  | 5                  | 0.00%     | 0.00%       | 0.00%          | 0.00% |
| 34          | 600665.SH | 0.7768 | Increasing | 0.7849 | 0.9897 | 0.7768  | 55                 | 0.00%     | -42.36%     | 0.00%          | 0.00% |
| 35          | 600675.SH | 0.8716 | Decreasing | 0.9672 | 0.9011 | 0.8716  | 35                 | 0.00%     | 0.00%       | 0.00%          | 0.00% |
| 36          | 600684.SH | 0.8372 | Increasing | 0.9135 | 0.9165 | 0.8372  | 40                 | 0.00%     | 0.00%       | 0.00%          | 0.00% |
| 37          | 600687.SH | 0.9010 | Increasing | 1.0000 | 0.9010 | 0.9010  | 26                 | 0.00%     | 0.00%       | -28.08%        | 0.00% |
| 38          | 600696.SH | 0.3959 | Increasing | 0.9355 | 0.4231 | 0.3959  | 92                 | -29.32%   | 0.00%       | 0.00%          | 0.00% |
| 39          | 600716.SH | 0.9260 | Increasing | 0.9333 | 0.9922 | 0.9260  | 22                 | -22.80%   | 0.00%       | -5.00%         | 0.00% |
| 40          | 600732.SH | 0.5608 | Increasing | 0.7742 | 0.7243 | 0.5608  | 81                 | -17.63%   | 0.00%       | -12.16%        | 0.00% |
| 41          | 600736.SH | 0.8209 | Increasing | 0.8209 | 1.0000 | 0.8209  | 41                 | 0.00%     | 0.00%       | 0.00%          | 0.00% |
| 42          | 600743.SH | 0.7409 | Increasing | 0.7509 | 0.9867 | 0.7409  | 59                 | -17.14%   | 0.00%       | -19.66%        | 0.00% |
| 43          | 600745.SH | 0.7538 | Increasing | 0.8166 | 0.9230 | 0.7538  | 57                 | 0.00%     | 0.00%       | 0.00%          | 0.00% |
| 44          | 600748.SH | 0.9598 | Increasing | 0.9647 | 0.9950 | 0.9598  | 18                 | -39.02%   | 0.00%       | -50.65%        | 0.00% |
| 45          | 600766.SH | 0.3535 | Increasing | 0.8345 | 0.4236 | 0.3535  | 94                 | -3.00%    | -21.90%     | 0.00%          | 0.00% |
| 46          | 600767.SH | 0.6025 | Increasing | 0.8851 | 0.6807 | 0.6025  | 78                 | -31.19%   | -11.27%     | 0.00%          | 0.00% |
| 47          | 600791.SH | 0.4333 | Increasing | 0.5513 | 0.7859 | 0.4333  | 91                 | -21.26%   | 0.00%       | -9.58%         | 0.00% |
| 48          | 600823.SH | 0.4521 | Increasing | 0.4868 | 0.9287 | 0.4521  | 89                 | 0.00%     | -2.91%      | -9.56%         | 0.00% |

(Continued)

| DMU Name     | OE     | RTS        | PTE    | SE     | S-E    | Ranking | Registered capital | Employees | Asset value | Operating Cost |
|--------------|--------|------------|--------|--------|--------|---------|--------------------|-----------|-------------|----------------|
| (Continued)  |        |            |        |        |        |         |                    |           |             |                |
| 49 601588.SH | 0.6416 | Decreasing | 0.6985 | 0.9184 | 0.6416 | 73      | 0.00%              | -41.47%   | 0.00%       | 0.00%          |
| 50 000002.SZ | 0.9182 | Decreasing | 1.0000 | 0.9182 | 0.9182 | 23      | 0.00%              | 0.00%     | 0.00%       | 0.00%          |
| 51 000006.SZ | 0.8899 | Increasing | 0.8900 | 0.9999 | 0.8899 | 29      | 0.00%              | 0.00%     | 0.00%       | 0.00%          |
| 52 000011.SZ | 0.6706 | Increasing | 0.6879 | 0.9748 | 0.6706 | 71      | 0.00%              | -60.14%   | 0.00%       | 0.00%          |
| 53 000014.SZ | 0.9174 | Increasing | 0.9616 | 0.9540 | 0.9174 | 24      | 0.00%              | 0.00%     | 0.00%       | 0.00%          |
| 54 000024.SZ | 0.9782 | Decreasing | 1.0000 | 0.9782 | 0.9782 | 17      | 0.00%              | -34.84%   | -24.72%     | 0.00%          |
| 55 000029.SZ | 0.7030 | Decreasing | 0.7438 | 0.9452 | 0.7030 | 68      | -10.20%            | -57.04%   | 0.00%       | 0.00%          |
| 56 000031.SZ | 0.5398 | Increasing | 0.5423 | 0.9955 | 0.5398 | 83      | 0.00%              | -23.83%   | 0.00%       | 0.00%          |
| 57 000042.SZ | 1.0000 | Constant   | 1.0000 | 1.0000 | 2.8996 | 3       | 0.00%              | 0.00%     | 0.00%       | 0.00%          |
| 58 000046.SZ | 0.5284 | Increasing | 0.5325 | 0.9924 | 0.5284 | 86      | 0.00%              | -29.02%   | 0.00%       | 0.00%          |
| 59 000150.SZ | 0.7801 | Increasing | 0.9498 | 0.8214 | 0.7801 | 53      | -19.76%            | -25.17%   | 0.00%       | 0.00%          |
| 60 000402.SZ | 0.7862 | Decreasing | 0.8831 | 0.8902 | 0.7862 | 51      | 0.00%              | 0.00%     | -17.89%     | 0.00%          |
| 61 000502.SZ | 1.0000 | Constant   | 1.0000 | 1.0000 | 2.5312 | 4       | 0.00%              | 0.00%     | 0.00%       | 0.00%          |
| 62 000506.SZ | 0.7060 | Increasing | 0.7247 | 0.9742 | 0.7060 | 67      | -2.06%             | -34.43%   | 0.00%       | 0.00%          |
| 63 000511.SZ | 0.8069 | Decreasing | 0.8074 | 0.9994 | 0.8069 | 46      | -45.88%            | 0.00%     | -19.75%     | 0.00%          |
| 64 000514.SZ | 0.7242 | Increasing | 0.7421 | 0.9760 | 0.7242 | 63      | -29.59%            | 0.00%     | -23.66%     | 0.00%          |
| 65 000517.SZ | 1.0000 | Constant   | 1.0000 | 1.0000 | 1.2275 | 7       | 0.00%              | 0.00%     | 0.00%       | 0.00%          |
| 66 000534.SZ | 0.8162 | Increasing | 0.8618 | 0.9471 | 0.8162 | 43      | 0.00%              | -57.99%   | 0.00%       | 0.00%          |
| 67 000540.SZ | 0.7384 | Increasing | 0.7440 | 0.9925 | 0.7384 | 61      | 0.00%              | -38.80%   | 0.00%       | 0.00%          |
| 68 000546.SZ | 0.9800 | Increasing | 1.0000 | 0.9800 | 0.9800 | 16      | -21.57%            | -20.00%   | 0.00%       | 0.00%          |
| 69 000558.SZ | 0.9093 | Increasing | 0.9302 | 0.9776 | 0.9093 | 25      | 0.00%              | 0.00%     | 0.00%       | 0.00%          |
| 70 000573.SZ | 0.4859 | Increasing | 0.5365 | 0.9057 | 0.4859 | 87      | -6.19%             | -31.60%   | 0.00%       | 0.00%          |
| 71 000608.SZ | 0.5606 | Increasing | 0.5921 | 0.9468 | 0.5606 | 82      | 0.00%              | 0.00%     | 0.00%       | 0.00%          |
| 72 000609.SZ | 1.0000 | Constant   | 1.0000 | 1.0000 | 7.6893 | 1       | 0.00%              | 0.00%     | 0.00%       | 0.00%          |
| 73 000616.SZ | 0.9340 | Increasing | 0.9377 | 0.9961 | 0.9340 | 21      | 0.00%              | 0.00%     | 0.00%       | 0.00%          |

(Continued)

| DMU Name    | OE        | RTS    | PTE        | SE     | S-E    | Ranking | Registered capital | Employees | Asset value | Operating Cost |        |
|-------------|-----------|--------|------------|--------|--------|---------|--------------------|-----------|-------------|----------------|--------|
| (Continued) |           |        |            |        |        |         |                    |           |             |                |        |
| 74          | 000628.SZ | 0.8783 | Increasing | 0.9443 | 0.9301 | 0.8783  | 31                 | 0.00%     | -68.76%     | 0.00%          | 0.00%  |
| 75          | 000631.SZ | 0.7073 | Increasing | 0.7083 | 0.9985 | 0.7073  | 66                 | 0.00%     | 0.00%       | 0.00%          | 0.00%  |
| 76          | 000638.SZ | 1.0000 | Constant   | 1.0000 | 1.0000 | 1.0198  | 12                 | 0.00%     | 0.00%       | 0.00%          | 0.00%  |
| 77          | 000667.SZ | 0.5368 | Increasing | 0.5675 | 0.9460 | 0.5368  | 84                 | -18.40%   | -22.66%     | 0.00%          | 0.00%  |
| 78          | 000711.SZ | 0.3871 | Increasing | 1.0000 | 0.3871 | 0.3871  | 93                 | -9.75%    | 0.00%       | 0.00%          | 0.00%  |
| 79          | 000718.SZ | 0.8102 | Decreasing | 0.8718 | 0.9293 | 0.8102  | 44                 | 0.00%     | -3.25%      | 0.00%          | 0.00%  |
| 80          | 000797.SZ | 1.0000 | Constant   | 1.0000 | 1.0000 | 1.2270  | 8                  | 0.00%     | 0.00%       | 0.00%          | 0.00%  |
| 81          | 000803.SZ | 0.8881 | Increasing | 1.0000 | 0.8881 | 0.8881  | 30                 | -43.76%   | -81.73%     | 0.00%          | 0.00%  |
| 82          | 000836.SZ | 0.8099 | Increasing | 0.8693 | 0.9318 | 0.8099  | 45                 | 0.00%     | -72.21%     | 0.00%          | 0.00%  |
| 83          | 000838.SZ | 1.0000 | Constant   | 1.0000 | 1.0000 | 1.1823  | 9                  | 0.00%     | 0.00%       | 0.00%          | 0.00%  |
| 84          | 000897.SZ | 0.5302 | Increasing | 0.5318 | 0.9971 | 0.5302  | 85                 | 0.00%     | 0.00%       | 0.00%          | 0.00%  |
| 85          | 000918.SZ | 1.0000 | Constant   | 1.0000 | 1.0000 | 1.0446  | 11                 | 0.00%     | 0.00%       | 0.00%          | 0.00%  |
| 86          | 000931.SZ | 0.9481 | Decreasing | 1.0000 | 0.9481 | 0.9481  | 19                 | 0.00%     | -76.02%     | 0.00%          | -0.01% |
| 87          | 000965.SZ | 0.7132 | Increasing | 0.7714 | 0.9246 | 0.7132  | 64                 | -5.42%    | 0.00%       | -17.87%        | 0.00%  |
| 88          | 000979.SZ | 0.5711 | Increasing | 0.9960 | 0.5735 | 0.5711  | 80                 | -48.36%   | -47.84%     | 0.00%          | 0.00%  |
| 89          | 002016.SZ | 0.7099 | Increasing | 0.8038 | 0.8833 | 0.7099  | 65                 | -9.40%    | 0.00%       | 0.00%          | 0.00%  |
| 90          | 002059.SZ | 0.6934 | Increasing | 0.8307 | 0.8347 | 0.6934  | 69                 | 0.00%     | -45.00%     | 0.00%          | 0.00%  |
| 91          | 002133.SZ | 0.7948 | Increasing | 0.8162 | 0.9737 | 0.7948  | 50                 | 0.00%     | 0.00%       | 0.00%          | 0.00%  |
| 92          | 002146.SZ | 0.9475 | Increasing | 0.9475 | 0.9999 | 0.9475  | 20                 | 0.00%     | 0.00%       | -1.86%         | 0.00%  |
| 93          | 002208.SZ | 1.0000 | Constant   | 1.0000 | 1.0000 | 1.1374  | 10                 | 0.00%     | 0.00%       | 0.00%          | 0.00%  |
| 94          | 002244.SZ | 0.7825 | Increasing | 0.7826 | 0.9999 | 0.7825  | 52                 | 0.00%     | 0.00%       | -9.47%         | 0.00%  |

Note: SH and SZ denote Shanghai Stock Exchange and Shenzhen Stock Exchange respectively; S-E denotes Supper Efficiency score.