Tourism Management 69 (2018) 1–11

Contents lists available at ScienceDirect

Tourism Management

journal homepage: www.elsevier.com/locate/tourman

Profit Luenberger and Malmquist-Luenberger indexes for multi-activity decision-making units: The case of the star-rated hotel industry in China☆

Barnabé Walheer*,[1], Linjia Zhang[2]

International Business School Suzhou, Xi'An Jiaotong-Liverpool University, China

ARTICLE INFO

Keywords:
Destination management
Profit efficiency
Luenberger index
Malmquist-Luenberger index
Multi-activity
Hotel
China

ABSTRACT

Due to the vigorous economic development of the tourism industry in China, the number of star-rated hotels has rapidly increased. As a result, techniques to evaluate the performances of star-rated hotels have gained in popularity. In this paper, we develop two indexes for dynamic settings: the profit Luenberger and Malmquist-Luenberger indexes. The distinguishing features of our indexes are three-fold. One, we adopt an economic perspective by considering that hotels are profit maximizers. Two, we model hotels as multi-activity decision-making units by considering that they provide multiple services. Three, our indexes are nonparametric, and work when prices are partially observed. We apply our technique to 30 provinces during 2005–2015. We find that star-rated hotels present better performances over time, but not for every activity. Next, we highlight particular patterns for the provinces. These results are useful for managers to better target their investments, and also for policy makers.

1. Introduction

The tourism sector is playing an increasing important role in China. As proof, China is ranked in fourth position with regard to both intentional tourism arrivals and receipts in 2016 (Travel and Tourism Economic Impact 2017 report), and the growth rate of that sector was higher than the GDP growth rate from 2005 to 2015 (Chinese Tourism Statistic Yearbook 2017). As such, the tourism sector income has increased over past decades, while its contribution to the GDP has importantly increased over time (the contribution of tourism to GDP was 4.11% in 2005 and 5.99% in 2015). Regarded as an influential component of the tourism sector, the hotel industry can be used to foster tourism, and even local economic development, as it contributes to output, job creation and business opportunity. In 2015, the revenue of Chinese star-rated hotels accounted for nearly 60% of the total hotel revenue, and the growth rate of their revenue was important in past decades (Chinese Tourism Statistic Yearbook 2017). This mainly explains why this type of hotels has attracted the major share of international and domestic investments. Therefore, star-rated hotels represent the main segment of the hotel industry in China, implying that the performances of these hotels can accurately reflect the progress of the Chinese hotel industry, as well as the tourism industry.[3]

With the booming of the tourism sector, fierce competition is imposed on the hotel industry. As a result, the evaluation of hotel performances has received important attention in the literature. Among the techniques available to conduct a performance analysis, nonparametric efficiency analysis has gained in popularity for the hotel sector, and for the tourism industry in general.[4] The popularity of this method could be explained by two main reasons. On the one hand, nonparametric efficiency analysis does not require any functional specification of the production process, but rather reconstructs the production possibilities using the observed data. This is attractive as the production process is, in general, unobserved for the hotels; and imposing assumptions about the production process may have huge impacts on the performance results. On the other hand, the performances are evaluated using efficiency scores that are easy to interpret and to compute. From a practical point of view, efficiency scores can be used to increase profit or reduce costs, and also for strategical or tactical purposes.

☆ We thank the Editor Chris Ryan, the Associate Editor Bob McKercher, and the referees for their comments that have improved the paper substantially.

* Corresponding author.
E-mail addresses: barnabe.walheer@xjtlu.edu.cn (B. Walheer), linjia.zhang@xjtlu.edu.cn (L. Zhang).

[1] This work is supported by the National Natural Science Foundation of China under Grant No. 71750110539.
[2] This work is supported by the Heilongjiang Philosophy and Social Sciences Research Planning Project under Grant No. 16JYE10.

[3] Note that some authors have argued that, in some cases, star-rated hotel performances do not reflect the progress of the hotel industry. See, for example, Nunez-Serrano, Turrion, and Velazquez (2014) for a discussion of star-rated hotels in Spain.

[4] See, for example, Assaf and Magnini (2012), and Madanoglu and Ozdemir (2016) for the US; Huang, Mesak, Hsu, and Qu (2012), Zhang and Cheng (2014), Yang and Cai (2016), and Yang et al. (2017) for China; Chen (2007), and Shyu and Hung (2012) for Taiwan; Fernandez and Becerra (2015); Oses, Gerrikagoitia, and Alzua (2016), and Rodreguez-Algeciras and Talon-Ballestero (2017) for Spain; and Peypoch (2007), Botti, Peypoch, Robinot, and Solonandrasana (2009), and Zhang, Botti, and Petit (2016) for France.

https://doi.org/10.1016/j.tourman.2018.05.003
Received 7 December 2017; Received in revised form 25 April 2018; Accepted 12 May 2018
Available online 23 May 2018
0261-5177/

The distinguishing features of our efficiency analysis are two-fold. Firstly, we adopt an economic (as opposed to engineering) perspective on efficiency. That is, we start from an economic model by assuming that hotels are profit maximizers.[5] In general, profit efficiency evaluations are more stringent than, for example, cost efficiency evaluations. Indeed, cost minimization is, by its initial definition, a necessary condition for profit maximization; but the opposite is not true. As a result, profit efficiency evaluations can signal additional potential performance improvements. Next, profit efficiency analysis takes the overall production process (i.e. the input and output sides) into account, while other economic behaviour ignores one of the two sides. This has also be pointed out by Arbelo-Perez, Arbelo, and Perez-Gomez (2017) for the hotel industry.

Next, we model hotels as multi-activity decision-making units. The majority of the hotels not only provide accommodation, but also other supplement services such as catering and entertainment. The multi-activity nature of the hotels is closely related to their profit maximization behaviour. Indeed, we consider that the main reason why hotels choose to provide multiple services is because they are looking for more profits. In other words, their multi-activity nature is motivated by their profit maximizer behaviour. Also, considering more than one activity implies the presence of economies of scope for the hotels, which represents a prime economic motivation to propose more than one service. Importantly, the multi-activity nature of the hotels imply that they could use different types of inputs for each activity. Some inputs could be used for all activities, while other inputs could be allocated to specific activity. Overall, considering hotels as multi-activity decision making units increases the realism of the profit efficiency analysis.

When profit efficiency is of interest over several periods of time, a popular method is to rely on indexes. Two main indexes have been used by practitioners for those contexts: the Luenberg index, introduced by Chambers (2002) after Luenberger (1992) that is defined as a difference of profit efficiency measurements; and the Malmquist-Luenberger index, introduced by Chung, Färe, and Grosskopf (1997) after Malmquist (1953) and Luenberger (1992) that is defined as a ratio of profit efficiency measurements. While those indexes have demonstrated their usefulness for practical exercises, they do not fit with the requirements of our analysis of the star-rated hotel industry in China.[6] In particular, those indexes do not take the multi-activity aspect of the hotels into account. As such, to match with our requirements, we extend those indexes in that direction. The new indexes offer two extra advantages. Firstly, besides providing profit efficiency results for the overall production process, the new indexes also give the option to evaluate profit efficiency for each activity separately. This represents valuable information that can be used to better manage and monitor the hotels. Next, the new indexes give the possibility to allocate the inputs to each activity. All in all, the new indexes offer the advantages of increasing the realism and the discriminatory power of the efficiency analysis. They can therefore be used by managers to better quantify and monitor the performances of the hotels. Also, they represent valuable information for policy makers to better target their policy implementations.

The rest of the paper is structured as follows. In Section 2, we define the profit Luenberg and Malmquist-Luenberger indexes when considering multi-activity decision makers. In Section 3, we analyze the star-rated hotel industry in China using our new indexes. In Section 4, we present a summary and a discussion of our results. Finally, we conclude in Section 5.

[5] For profit efficiency analysis, refer, for example to Sahoo and Tone (2013), Sahoo et al. (2014), Boussemart, Crainich, and Leleu (2015), and Cherchye et al. (2016). In the context of the hotel industry, refer, for example, to Botti et al. (2009), Ratsimbanierana, Sbai, and Stenger (2013), and Zhang et al. (2016).

[6] For previous works using performance indexes for the tourism industry, see, for example, Barros and Alves (2004) and Barros (2005) for the Malmquist index for Portuguese public-owned hotels, Cracolici, Nijkamp, and Cuffaro (2007) for the Malmquist index for Italian regions, Peypoch (2007) for the Luenberger index to French tourism industry Barros, Peypoch, and Solonandrasana (2009) for the Luenberger index for Portugal hotels, Assaf and Agbola (2011a, b) for a bootstrapped Malmquist index for Australian hotels, Sun, Zhang, Zhang, Ma, and Zhang (2015) for the Malmquist index to Chinese regions.

2. Methodology

We consider that we observe Decision Making Units (DMUs) during T periods of time. For each period t, every DMU uses N inputs: $\mathbf{x}_t$, to produce M outputs: $\mathbf{y}_t$. Also, the input prices of period t is captured by $\mathbf{p}_{x,t}$, and the output prices by $\mathbf{p}_{y,t}$. To facilitate our notation, we regroup the inputs and outputs into a netput vector: $\mathbf{z}_t = \begin{bmatrix} \mathbf{y}_t \\ -\mathbf{x}_t \end{bmatrix}$. Its corresponding price vector is thus given by $\mathbf{p}_t = \begin{bmatrix} \mathbf{p}_{y,t} \\ \mathbf{p}_{x,t} \end{bmatrix}$. Therefore, the actual profit at time t is given by $\mathbf{p}_t{}'\mathbf{z}_t = \mathbf{p}_{y,t}{}'\mathbf{y}_t - \mathbf{p}_{x,t}{}'\mathbf{x}_t$.

The particularity of our procedure is to consider each activity separately, proxied in practice, by a specific output.[7] Let us denote the m-th output at time t by y_t^m (i.e. $(\mathbf{y}_t)_m = y_t^m$), the inputs used to produce that particular output by $\mathbf{x}_t^m$, and their respective price by $p_{y,t}^m$ (i.e. $(\mathbf{p}_{y,t})_m = p_{y,t}^m$) and $\mathbf{p}_{x,t}^m$. As done previously, we can simplify our notation by defining the netput vector associated with output m as $\mathbf{z}_t^m = \begin{bmatrix} y_t^m \\ -\mathbf{x}_t^m \end{bmatrix}$, and its corresponding prices as $\mathbf{p}_t^m = \begin{bmatrix} p_{y,t}^m \\ \mathbf{p}_{x,t}^m \end{bmatrix}$.

2.1. Input allocation

Attractively, the definition of inputs used to produce a specific output m ($\mathbf{x}_t^m$) can be used to allocate the inputs to the output-specific production processes. In general, two types of inputs can be used to produce the outputs. Some inputs could be used to produce certain outputs. That is, these inputs are allocated to specific output production processes.[8] Next, some inputs could be used to produce all the outputs, i.e. these inputs are not allocated to specific output production processes.[9] These inputs could also be interpreted as public good (they are non-rival and non-exclusive to the output production processes), and, therefore, they give rise to economies of scope in the production process (see Panzar and Willig (1981) and Nehring and Puppe (2004)). As such, these inputs form a prime economic motivation to produce more than one output, i.e. considering more than one activity.[10]

Intuitively, the inputs used to produce every output $\mathbf{x}_t^m$ must be connected to the initial input vector $\mathbf{x}_t$. Formally, we have the following relationships between the output-specific inputs and the inputs:

$$(\mathbf{x}_t)_n = (\mathbf{x}_t^1)_n + ...(\mathbf{x}_t^M)_n = \sum_{m=1}^{M} (\mathbf{x}_t^m)_n, \text{ if input } n \text{ is allocated,} \quad (1)$$

$$(\mathbf{x}_t)_n = (\mathbf{x}_t^m)_n, \text{ if input } n \text{ is not allocated.} \quad (2)$$

As the inputs used to produce specific outputs can be different, nothing guarantees that, in general, their prices coincide. Moreover, as those inputs are related to the input vector $\mathbf{x}_t$, their prices must also be related. We obtain the following relationships between the output-specific input price and the input prices:

$$(\mathbf{p}_{x,t})_n = (\mathbf{p}_{x,t}^m)_n, \text{ if input } n \text{ is allocated,} \quad (3)$$

[7] Note that the indexes could be extended to the cases when several outputs represent an activity. We consider that one output proxies one activity for simplicity.

[8] These types of input have been considered in, for example, Färe and Grosskopf (2000), Färe, Grosskopf, and Whittaker (2007), Tone and Tsutsui (2009), Cherchye et al. (2013), Walheer (2016a, b, 2018a), and Silva (2018)

[9] These types of input have been considered by, for example, Cherchye et al. (2013), Cherchye et al. (2016), Ding, Dong, Liang, and Zhu (2017), and Walheer (2018 b, c, d, e).

[10] Note that the setting can be fairly easily extended to other types of inputs; as, for example those considered in Salerian and Chan (2005), Despic, Despic, and Paradi (2007), and Cherchye, De Rock, and Walheer (2015).