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RESEARCH NOTE

TOURISM PRODUCTIVITY INDICATORS IN A MULTIACTIVITY FRAMEWORK

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Measuring productivity has been a hot topic in tourism research recently. This research note suggests a tailored productivity indicator capable of dealing with two important features of the tourism suppliers. First, it takes the economic objective of the tourism entities into account, which better reflects the targets of tourism entities. Second, the indicator provides a suitable tool for evaluating performance of tourism suppliers under multiple activity scenarios, which better matches the characteristics of tourism services. The empirical illustration to the Chinese star-rated hotel industry highlights the advantages of the suggested indicator for the tourism industry. In particular, we find that Chinese hotels present better performances over time, but not for every activity. This indicator can also be applied to other tourism-related industries.

Key words: Productivity; Tourism; Multiactivity; Luenberger–Hicks–Moorsteen indicator

Introduction

Recently, the productivity of the tourism industry has been attracting increasing research attention (see, e.g., Assaf & Dwyer, 2013; Assaf & Tsionas, 2018; Barros et al., 2009; Dong et al., 2019; Goncalves, 2013; Walheer & Zhang, 2018; Zhang et al., 2016). For policymakers, such research is of great interest since the contribution of the tourism industry to economic growth has increased for many countries worldwide. Therefore, using reliable indicators of productivity changes is critical when deciding on policy implementations. For managers, these indicators are particularly important in quantifying performance, which is essential information for strategic decisions, such as making additional investments.

Indicators have been widely used to quantify productivity changes in various areas. However, indicators for the tourism industry have two

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shortcomings. One, the economic behavior of entities is neglected. In many settings, profit maximization represents the main aim of the entities. Two, most entities are multiactivity decision-making units. For example, hotels supply accommodation, food and catering, and entertainment services; travel agencies supply transport and accommodation; and tourism attractions supply tickets, food and catering, entertainment, and shopping opportunities. The multiactivity nature of these entities implies that modeling should be highly flexibility and have considerable discriminatory power.

The present study presents a new indicator taking these two features into account. The indicator takes the form of a Luenberger–Hicks–Moorsteen Index (LHMI; Briec & Kerstens, 2004). This indicator is based on the profit maximizing behavior of the entities, considers additional information about the decision process, and provides productivity results for each activity. Therefore, the new indicator is attractive for theoretical as well as practical reasons. From a theoretical point of view, the indicator retains desirable ingredients of the LHMI (i.e., being well-defined, additively complete, and fulfilling a certain number of desirable axioms) while incorporating new, tailored features. From a practical point of view, the new indicator provides valuable information by proposing performance evaluations for activities, while increasing the realism of the evaluation process. Overall, the new indicator is tailored to measure tourism industry productivity.

Methodology

Assume we observe multiactivity entities during T periods of time. For each activity m $\in \{1,\ldots,M\}$ at period t, every entity uses N inputs to produce Q outputs, captured by vectors $\mathbf{y}_t^m \in \mathbb{R}_+^Q$ and $\mathbf{x}_t^m \in \mathbb{R}_+^N$. The corresponding price vectors are $\mathbf{p}_t^m \in \mathbb{R}_+^Q$ and $\mathbf{w}_t^m \in \mathbb{R}_+^N$. Of note, this setting gives the option of considering different inputs and outputs for each activity m. Therefore, this setting is tailored to consider additional information about the production process. (For detailed discussions, see the application; also see Cherchye et al., 2016; Walheer, 2018a, 2018b.)

$$\pi_t^m\left(\mathbf{p}_t^m,\mathbf{w}_t^m\right)=\max_{\left(\mathbf{x}^m,\mathbf{y}^m\right)\in T_t^m}\left(\mathbf{p}_t^{m'}\mathbf{y}^m-\mathbf{w}_t^{m'}\mathbf{x}^m\right) \quad (1)$$

where $T_t^m=\left\{\left(\mathbf{x}^m,\mathbf{y}^m\right)\in\mathbb{R}_+^{Q+N} \mid \mathbf{x}^m \text{ can produce } \mathbf{y}^m\right\}$ represents the technology.

The definition of the notion of activity-specific profit efficiency measurement is (where $\mathbf{g}_{\mathbf{y}_t^m}\in\mathbb{R}_+^Q$ and $\mathbf{g}_{\mathbf{x}_t^m}\in\mathbb{R}_+^N$ represent the directional vectors of the outputs and inputs):

$$PE_t^m(\mathbf{y}_t^m,\mathbf{x}_t^m,\mathbf{p}_t^m,\mathbf{w}_t^m,\mathbf{g}_{\mathbf{y}_t^m},\mathbf{g}_{\mathbf{x}_t^m}) = \frac{\pi_t^m(\mathbf{p}_t^m,\mathbf{w}_t^m)-(\mathbf{p}_t^{m'}\mathbf{y}_t^m-\mathbf{w}_t^{m'}\mathbf{x}_t^m)}{(\mathbf{p}_t^{m'}\mathbf{g}_{\mathbf{y}_t^m}-\mathbf{w}_t^{m'}\mathbf{g}_{\mathbf{x}_t^m})} \quad (2)$$

$PE_t^m(\mathbf{y}_t^m,\mathbf{x}_t^m,\mathbf{p}_t^m,\mathbf{w}_t^m,\mathbf{g}_{\mathbf{y}_t^m},\mathbf{g}_{\mathbf{x}_t^m})$ provides a profit efficiency measurement in the direction of $\mathbf{g}_{\mathbf{y}_t^m}$ and $\mathbf{g}_{\mathbf{x}_t^m}$. $PE_t^m(\mathbf{y}_t^m,\mathbf{x}_t^m,\mathbf{p}_t^m,\mathbf{w}_t^m,\mathbf{g}_{\mathbf{y}_t^m},\mathbf{g}_{\mathbf{x}_t^m})=0$ reveals profit efficiency behavior for activity m. Profit inefficient behavior is captured by greater values. Profit efficiency measurement when taking all activities into consideration is given by:

$$PE_t(\mathbf{y}_t,\mathbf{x}_t,\mathbf{p}_t,\mathbf{w}_t,\mathbf{g}_{\mathbf{y}_t},\mathbf{g}_{\mathbf{x}_t}) = \frac{\sum_{m=1}^M \pi_t^m(\mathbf{p}_t^m,\mathbf{w}_t^m)-\sum_{m=1}^M(\mathbf{p}_t^{m'}\mathbf{y}_t^m-\mathbf{w}_t^{m'}\mathbf{x}_t^m)}{\sum_{m=1}^M(\mathbf{p}_t^{m'}\mathbf{g}_{\mathbf{y}_t^m}-\mathbf{w}_t^{m'}\mathbf{g}_{\mathbf{x}_t^m})} \quad (3)$$

$PE_t(\mathbf{y}_t,\mathbf{x}_t,\mathbf{p}_t,\mathbf{w}_t,\mathbf{g}_{\mathbf{y}_t},\mathbf{g}_{\mathbf{x}_t})$ means profit efficiency at the overall level, and greater values imply the opposite. (Note that $\mathbf{y}_t,\mathbf{x}_t,\mathbf{p}_t,\mathbf{w}_t,\mathbf{g}_{\mathbf{y}_t},\mathbf{g}_{\mathbf{x}_t}$ are matrices containing all activity-specific vectors.)

The LHMI for activity m is:

$$LHMI^m=\frac{1}{2}\{LHMI_t^m+LHMI_{t+1}^m\} \quad (4)$$

where

$$\begin{aligned}
LHMI_t^m = {} & [PE_t^m(\mathbf{x}_t^m,\mathbf{y}_t^m,\mathbf{p}_t^m,\mathbf{w}_t^m,\mathbf{g}_{\mathbf{y}_t^m},\mathbf{0}) \\
& -PE_t^m(\mathbf{x}_t^m,\mathbf{y}_{t+1}^m,\mathbf{p}_t^m,\mathbf{w}_t^m,\mathbf{g}_{\mathbf{y}_{t+1}^m},\mathbf{0})] \\
& -[PE_t^m(\mathbf{x}_{t+1}^m,\mathbf{y}_t^m,\mathbf{p}_t^m,\mathbf{w}_t^m,\mathbf{0},\mathbf{g}_{\mathbf{x}_{t+1}^m}) \\
& -PE_t^m(\mathbf{x}_t^m,\mathbf{y}_t^m,\mathbf{p}_t^m,\mathbf{w}_t^m,\mathbf{0},\mathbf{g}_{\mathbf{x}_t^m})], \\
LHMI_{t+1}^m = {} & [PE_{t+1}^m(\mathbf{x}_{t+1}^m,\mathbf{y}_t^m,\mathbf{p}_{t+1}^m,\mathbf{w}_{t+1}^m,\mathbf{g}_{\mathbf{y}_t^m},\mathbf{0}) \\
& -PE_{t+1}^m(\mathbf{x}_{t+1}^m,\mathbf{y}_{t+1}^m,\mathbf{p}_{t+1}^m,\mathbf{w}_{t+1}^m,\mathbf{g}_{\mathbf{y}_{t+1}^m},\mathbf{0})] \\
& -[PE_{t+1}^m(\mathbf{x}_{t+1}^m,\mathbf{y}_{t+1}^m,\mathbf{p}_{t+1}^m,\mathbf{w}_{t+1}^m,\mathbf{0},\mathbf{g}_{\mathbf{x}_{t+1}^m}) \\
& -PE_{t+1}^m(\mathbf{x}_t^m,\mathbf{y}_{t+1}^m,\mathbf{p}_{t+1}^m,\mathbf{w}_{t+1}^m,\mathbf{0},\mathbf{g}_{\mathbf{x}_t^m})].
\end{aligned}$$

In a similar vein, the indicator when considering all activities is given by:

$$LHMI = \frac{1}{2}\{LHMI_t + LHMI_{t+1}\} \quad (5)$$

where

$$\begin{aligned} LHMI_t = & [PE_t(\mathbf{x}_t, \mathbf{y}_t, \mathbf{p}_t, \mathbf{w}_t, \mathbf{g}_{\mathbf{y}_t}, \mathbf{0}) \\ & - PE_t(\mathbf{x}_t, \mathbf{y}_{t+1}, \mathbf{p}_t, \mathbf{w}_t, \mathbf{g}_{\mathbf{y}_{t+1}}, \mathbf{0})] \\ & - [PE_t(\mathbf{x}_{t+1}, \mathbf{y}_t, \mathbf{p}_t, \mathbf{w}_t, \mathbf{0}, \mathbf{g}_{\mathbf{x}_{t+1}}) \\ & - PE_t(\mathbf{x}_t, \mathbf{y}_t, \mathbf{p}_t, \mathbf{w}_t, \mathbf{0}, \mathbf{g}_{\mathbf{x}_t})], \end{aligned}$$

$$\begin{aligned} LHMI_{t+1} = & [PE_{t+1}(\mathbf{x}_{t+1}, \mathbf{y}_t, \mathbf{p}_{t+1}, \mathbf{w}_{t+1}, \mathbf{g}_{\mathbf{y}_t}, \mathbf{0}) \\ & - PE_{t+1}(\mathbf{x}_{t+1}, \mathbf{y}_{t+1}, \mathbf{p}_{t+1}, \mathbf{w}_{t+1}, \mathbf{g}_{\mathbf{y}_{t+1}}, \mathbf{0})] \\ & - [PE_{t+1}(\mathbf{x}_{t+1}, \mathbf{y}_{t+1}, \mathbf{p}_{t+1}, \mathbf{w}_{t+1}, \mathbf{0}, \mathbf{g}_{\mathbf{x}_{t+1}}) \\ & - PE_{t+1}(\mathbf{x}_t, \mathbf{y}_{t+1}, \mathbf{p}_{t+1}, \mathbf{w}_{t+1}, \mathbf{0}, \mathbf{g}_{\mathbf{x}_t})]. \end{aligned}$$

$LHMI^m > 0$ implies profit productivity improvement between t and t for activity m. By contrast, $LHMI^m < 0$ reflects profit productivity regress for activity m. Therefore, a value of 0 represents the status quo. *LHMI* has to be interpreted in an analogous manner but applies for the overall level.

In practice, computing profit efficiency scores is sufficient to obtain the indicators. Attractively, these scores can be obtained by solving linear programs. These programs are similar to the programs that Cherchye et al. (2016) considered, but extended to the dynamic context.

Empirical Illustration

To illustrate the benefits of the new indicator for the tourism industry, this study proposes an application to star-rated hotels in China. Data for 2005–2015 were collected for 30 provinces from the China Tourism Statistics Yearbooks, the China Star Hotel Statistics Report and the Wind Database. The directional vectors selected are the observed inputs and outputs. That is, this study investigates productivity improvement in all directions. These hotels are clearly multiactivity decision-makers. As Table 1 highlights, they provide three activities: accommodation, food and catering, and new services (e.g., entertainment and shopping). Table 1 provides the relative importance (in terms of revenue) of the three activities. It also indicates the decreasing importance of the accommodation activity in favor of the food and gathering activity. In other words, the traditional hotel activity decreases in importance over time. Moreover, the very motivation for hotels to provide multiple services is to obtain larger profits.

The productivity analysis considers three inputs: number of rooms (used only for the accommodation activity), total fixed assets, and number of employees (used for the three activities). Thus, this method increases the realism of the modeling by allocating inputs to every activity. Table 2 presents the averages of the indicators per province. These results clearly highlight that considering the multiactivity nature of hotels is critical in evaluating and understanding hotel performance. The results reveal an improvement for all provinces with an average of 0.18 for the period. In addition, the improvements per activity are consistent with the changes discussed in Table 1. Indeed, food and catering contribute the most to the productivity improvement; accommodation contributes less; and new services contribute the least. At the provincial level, most economically developed regions represent the best practice in the industry, whereas relatively backward and unique tourism resource provinces, sometimes helped by the local government investing significant amounts in tourism infrastructure, show considerable progress.

At the general level, this empirical illustration highlights the advantages of the suggested indicator for the tourism industry. The results per activity are pertinent for Chinese policymakers and managers,

Table 1
Relative Importance of the Three Activities

	Accommodation	Food and Gathering	New Services
Average level	0.47	0.40	0.13
Change for the period	−0.12	0.15	0.03

Table 2
Average Luenberger–Hicks–Moorsteen Index (LHMI) Results per Province

Province	LHMI	LHMI[1]	LHMI[2]	LHMI[3]
Anhui	0.10	0.19	0.40	0.15
Beijing	0.01	0.01	0.02	0.02
Chongqing	0.25	0.01	0.33	0.02
Fujian	0.17	0.19	0.36	0.05
Gansu	0.25	1.20	0.24	0.98
Guangdong	0.08	0.13	0.07	0.01
Guangxi	0.05	0.16	0.08	0.04
Guizhou	0.15	0.04	0.17	0.02
Hainan	0.04	0.32	0.43	0.03
Hebei	0.08	0.20	0.12	0.01
Heilongjiang	0.07	0.20	0.16	0.03
Henan	0.13	0.11	0.15	0.12
Hubei	0.20	0.26	0.16	0.19
Hunan	0.06	0.03	0.14	0.08
Innermongolia	0.56	0.13	0.74	0.04
Jiangsu	0.04	0.12	0.06	0.02
Jiangxi	0.05	0.46	0.30	0.03
Jilin	0.07	0.02	0.09	0.01
Liaoning	0.01	0.00	0.01	0.01
Ningxia	1.17	0.00	2.90	0.01
Qinghai	1.22	1.05	2.52	0.03
Shaanxi	0.37	0.12	0.49	0.02
Shandong	0.02	0.01	0.04	0.01
Shanghai	0.03	0.03	0.03	0.04
Shanxi	0.03	0.06	0.05	0.03
Sichuan	0.04	0.00	0.09	0.02
Tianjin	0.05	0.16	0.21	0.02
Xinjiang	0.03	0.24	0.17	0.01
Yunnan	0.02	0.10	0.10	0.01
Zhejiang	0.01	0.01	0.01	0.02
Average	0.18	0.19	0.35	0.07

providing additional valuable information that facilitates taking policy and strategic decisions.

Conclusion

Productivity analysis is attracting increased attention in tourism research. However, researchers often neglect the economic optimization behavior and the multiactivity aspect of tourism suppliers. This study suggests a new indicator taking these two into account, while retaining desirable features of existing productivity indicators. To prove the usefulness of the new indicator, this study computes profit productivity changes in 2005–2015 for 30 Chinese provinces.

Notably, the new indicator is more demanding than existing productivity indicators in that it requires specification of the economic behavior, directional vectors, and different activities, which implies observing more data. However, this indicator can be applied when such data are unavailable, using the potential solutions that Cherchye et al. (2016) and Walheer (2018a, 2018b) discussed.

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