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Multiunit restaurant productivity assessment using three-phase data envelopment analysis

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Abstract

This paper focuses on uncontrollable variables' effects on multiunit restaurant productivity using data envelopment analysis (DEA). We argue the importance of first considering managerially uncontrollable (nondiscretionary) variables as inputs in the actual DEA model, with managerially controllable variables considered post hoc for their relationship to the efficiency scores. We illustrate the merits of this approach using data from a chain of 62 full-service restaurants. From a large number of candidate inputs, we arrive at a short list of uncontrollable inputs: hourly server wage, restaurant seats, and a coding variable representing whether the restaurant is a stand-alone facility. Output variables in our model were daily sales and tip percentage. We find that just under 12% of the restaurants operate efficiently and that the average efficiency for the chain is 82%.

Keywords: Service management; Restaurants; Productivity; Data envelopment analysis

1. Introduction

Productivity assessment has long been considered important for service-related organizations (Bloom, 1972; Doutt, 1984; Reynolds, 2003). During economic downturns, operators look to increase productivity by attempting to maintain sales while minimizing costs; in economic booms, operators strive to leverage inputs to attain disproportionately greater increases in outputs such as overall sales volume (Brown and Dev, 1999).

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Moreover, productivity measurement, monitoring, and improvement lead to overall gains in profitability, leading service firms to focus on achieving productivity gains as an overarching objective (Eccles, 1991).

In the foodservice industry, researchers have focused largely on partial-factor productivity indices that stem from Bloom's (1972) definition of productivity: a ratio of output measured in specific units and any input factor also measured in specific units. Such measures include sales per labor hour (Jablonsky, 1994), revenue per available seat hour (Kimes et al., 1998) or transactions per hour (Filley, 1983). While useful for specific intertemporal or intrafirm analyses, these measures have limited utility and frequently do not adequately correlate to technical or operational efficiency, reflecting only specific operational attributes (Reynolds, 1998).

In particular, most partial-factor ratios fail to account for potentially meaningful differences among foodservice operations. For example, sales per labor hour may be subject to differing wage levels. Even total-factor productivity models, as recommended by Brown and Hoover (1990), are not adequate for comparing multiple units with considerably different operating characteristics. Furthermore, both partial- and total-factor ratios statistically generate only an average measure. While useful for comparison purposes, related averages reveal little regarding the best operations—those that might better serve as benchmarks.

While still residing in the output-to-input ratio measurement domain, data envelopment analysis (DEA), which Charnes et al. (1978) first proposed as an evaluation tool for decision units, solves many of the problems associated with the aforementioned measures by integrating multiple outputs and inputs simultaneously. The operations-research-based approach allows for both controllable (discretionary) and uncontrollable (nondiscretionary) variables, producing a single relative-to-best productivity index that relates all units under comparison. Thus, DEA allows for assessment of contingent productivity, which takes into account the performance of each restaurant despite differing combinations of operating characteristics given that operating conditions are similar (c.f., Sexton et al., 1994). This also allows operators, as recommended by Farrell (1957), to use the best performing units as bases for evaluation.

Researchers interested in service-industry productivity have applied data envelopment analysis to a variety of sectors including banking (Jemric and Vujcic, 2002; Sherman and Ladino, 1995), insurance (Mahajan, 1991), nursing (Nunamaker, 1983), public services (Hammond, 2002), and telecommunications (Uri, 2001). Very few have analyzed the hospitality industry. Morey and Dittman (1995) examined data from 55 hotels while Anderson et al. (2000) applied the technique to a slightly smaller sample. Donthu and Yoo (1998) applied DEA to foodservice, although their study focused on quick-service restaurants only as an example of a general retailing environment.

Of the handful of DEA studies using hospitality-related business data, all share the commonality of analyzing a combination of controllable and uncontrollable variables in a single step or phase. As noted by Cooper et al. (2000) and explained in greater detail later in this paper, such an approach may lead to inaccurate efficiency scores. Moreover, such an approach may integrate variables that have no causal relationship to the outputs, further confounding the results.

The objective of this study, then, is to first focus on the uncontrollable variables as inputs in the DEA model using similarly positioned restaurants within a single chain. We then explore the effects of controllable variables having leveled the playing field in terms of