

CONTENTS

<i>List of figures</i>	<i>vii</i>
<i>List of tables</i>	<i>ix</i>
<i>Preface</i>	<i>xii</i>
1 What is benchmarking and why is it useful?	1
2 Linear programming in one lesson	15
3 The technique of benchmarking	31
Case study 1: Spanish restaurants	36
Case study 2: Indian banks	41
Case study 3: Korean quality management	45
Case study 4: Austrian banking deregulation	46
4 Efficiency, productivity, and profitability	49
Case study 5: U.S. manufacturing	57
Case study 6: U.S. hotels	61
Case study 7: European railways efficiency	62
5 Ranking	63
Case study 8: Dutch economics and business schools	74
6 Returns to scale	77
Case study 9: U.S. real estate investment trusts	91
Case study 10: European railways returns to scale	95
7 Concluding remarks	97
<i>References</i>	<i>101</i>
<i>Index</i>	<i>105</i>

1

WHAT IS BENCHMARKING AND WHY IS IT USEFUL?

To give an example of the difference between the *comparative* concept of efficiency and the *absolute* concept of productivity Professor Subhash Ray quoted the late comedian Henny Youngman. When asked “How is your wife?” Youngman responded, “Compared with what?”¹ Indeed, a precise answer to such a question requires a yardstick or reference point and that is not always easy to find. Moreover, there may be disagreement on what constitutes an “ideal” reference point; it may vary between cultures, businesses, or even individuals. Yet the very concept of benchmarking requires the use of reference points.

The compromise put forward in this book is that a reference point need not be *the* reference point, applicable indiscriminately to all business units or other objects we want to compare. Differ-

1 Subhash Ray’s soundbite was at the Fifth International Symposium on Data Envelopment Analysis and Performance Management, Indian School of Business, Hyderabad (2007). Mladjenovic (2002) gives the same quote.

ent business units deserve different benchmarks to be measured up to. This raises the question: what are those benchmarks?

The basic theme of this book is that a reference point need not be preconceived, but can be the outcome of the analysis. Objects are measured—possibly in different dimensions—and we then consider the collection of all objects. We then calculate how much better an object under consideration could be if we reallocated our resources to substitutes with the same proportions of measures. One of the advantages of this methodology is that it requires no single reference point. This approach is relevant when measures are given by multiple figures, in other words when objects score in *different* dimensions.

The performance measurement literature speaks of *decision making units*. It is rather peculiar language—geared towards business analysis—but the concept is widely applicable. For Henny Youngman the “decision making unit” is a wife. More classical examples of decision making units are divisions within a corporation, supermarkets in a chain, branches of a bank, and firms within an industry. In such contexts the idea of benchmarking is simple. We conduct a thought experiment, and ask how much better a decision making unit *could* perform if it were free to adopt the practices of the other units. Here a decision making unit is treated like a machine that transforms inputs (its resources) into outputs (its scores in different dimensions). The input–output proportions (between resources and scores) are like a recipe, and constitute the practice of the decision making unit.

Let us a look at a simple example, a single output industry with three firms (see Table 1.1). One firm employs labor, another capital, and a third both. For simplicity I assume that each firm produces one unit of output, and that the specialized firms (that is, on the input side) use one unit of their respective inputs. The third firm employs l units of labor and k units of capital, where l and k are positive numbers. Could the third firm perform better? If it uses more input than firm 1 or 2, it could. Let’s look at this more closely.

The only alternative for firm 3 would be to adopt the specialized practices of firms 1 and 2. Since we assumed that each of them transforms one unit of input to one unit of output, the

WHAT IS BENCHMARKING AND WHY IS IT USEFUL?

Table 1.1 Three firms producing the same output with different inputs

	Firm 1	Firm 2	Firm 3
Units of output	1	1	1
Units of labor input	1	0	l
Units of capital input	0	1	k

alternative mode of production would yield a hypothetical output of $l + k$. If this figure falls short of the actual output of firm 3 (one unit, by assumption), the answer is no, firm 3 cannot produce more. Hence, if $l + k < 1$, the answer is no, firm 3 cannot improve its performance. But if $l + k$ is more, say 1.1, firm 3 *can* produce more. Its output, 1, can be *expanded* by employing its resources using the practices of the other firms. The expansion factor would be 1.1, and is called *potential output*. Since firm 3 produces only $1/1.1 = 91\%$ of its potential output, we say it is 91% efficient. The two cases ($l + k < 1$ and $l + k > 1$) are encompassed by a single formula for the so-called *expansion factor*, which is denoted by e . In our example $e = \max\{l + k, 1\}$. If $l + k < 1$, this expansion factor equals 1, confirming that the firm can do no better, and otherwise the expansion factor is $l + k$. *Efficiency* is defined as the ratio of actual output (1) to potential output (e): $1/e$. This definition extends beyond the example. If a firm could produce 25% more if it were to process its inputs using best practice techniques, it produces only 80% of its potential output (since 1 is 80% of 1.25) and we therefore say it is 80% efficient.

Instead of asking how much more firm 3 could produce given its inputs, we might ask how much less input it would need to produce its output. We shall see that this problem reformulation does not alter the measures, at least when there are no scale effects. Let me first present a simple numerical example of Table 1.1, in Table 1.2 (overleaf).

In Table 1.2, firm 3 commands a lot of input, in fact more than it needs. If it adopted the specialized techniques of firms 1 and 2 (which produce output in a one-to-one ratio from either input), output would rise to $\frac{3}{4} + \frac{1}{2} = \frac{5}{4}$ units. The flipside of the coin is

THE ECONOMICS OF BENCHMARKING

Table 1.2 Numerical example of three firms producing the same, single output

	Firm 1	Firm 2	Firm 3
Units of output	1	1	1
Units of labor input	1	0	$\frac{3}{4}$
Units of capital input	0	1	$\frac{1}{2}$

that firm 3 can contract its inputs by a factor of $\frac{4}{5}$ to produce its output.

Consider a contraction of firm 3's inputs of l units of labor and k units of capital in the slightly more general Table 1.1, by a factor $c < 1$, so that $c \times l$ units of labor and $c \times k$ units of capital remain available to firm 3. If firm 3 were to stick to its own practice, its output would fall back by the same factor below the initial output level of 1. Hence the only way it can hope to preserve its level of output is to adopt the practices of firms 1 and 2. This diversification would yield $c \times l$ of output using firm 1's technology plus $c \times k$ of output using firm 2's technology, and the total output would be the targeted quantity of 1 if $c(l + k) = 1$.

Hence the contraction factor equals $c = 1/(l + k)$. This number is a *contraction* factor, $c < 1$, only if $l + k > 1$, as is the case in Table 1.2, where $l = \frac{3}{4}$ and $k = \frac{1}{2}$. Otherwise firm 3 would already be efficient and it would be unproductive to adopt the alternative practices; input contraction would not be feasible. To incorporate the qualification $l + k > 1$, the contraction factor is modified as $c = \min\{1/(l + k), 1\}$. This contraction factor happens to be the inverse of the expansion factor $e = \max\{l + k, 1\}$. And since efficiency is defined as the inverse of the expansion factor, we may conclude that efficiency can also be seen as the percentage of the inputs used that is necessary to produce the outputs.

As I have already suggested, this result holds generally provided there are *constant returns to scale*. This assumption means that it is always possible to expand (or contract) all inputs and outputs with a common factor. This is not a bad assumption in manufacturing. If you want to produce double the number of cars, you

WHAT IS BENCHMARKING AND WHY IS IT USEFUL?

need double the number of engines, tires, and so on. In other sectors, including web-based information services, you need not double all your inputs when you want to reach double the number of customers. There are benchmarking models that do not assume constant returns to scale, but they are a little more complicated, and we shall look at them later in the book.

Our single output firms are a simplification of the real world, where firms produce a variety of products, and moreover are assessed in terms of different criteria. Firms score in different dimensions, but only two are required to understand the principles of benchmarking. Consider an industry with two outputs. For ease of explanation I now assume there is a single input, labor. In Table 1.3, three firms each employ one worker. Firms 1 and 2 are specialized, now on the output side, with firm 1 producing one unit of good 1 and firm 2 one unit of good 2. Firm 3 produces y units of good 1 and z units of good 2.

Table 1.3 Three firms producing different outputs with the same input

	Firm 1	Firm 2	Firm 3
Units of output 1	1	0	y
Units of output 2	0	1	z
Units of labor input	1	1	1

Let us pursue the same reasoning as in the previous thought experiment, and ask how much more output firm 3 could produce. Since we do not want to add apples and oranges, we consider an expansion of both its outputs by a common factor, which we can call e again. In other words, we fix the mix of products. This procedure handles all sorts of demand conditions. It is only natural when the products are perfect complements, like whisky and soda, or hardware and software, but even if the products are substitutes, like whisky and vodka, or laptops and desktops, it is a sensible approach. By fixing the output mix we rule out expansions which make use of marketing information about customers' willingness to substitute, and therefore our estimate of

potential output will be conservative. Hence we consider the hypothetical situation in which firm 3 produces not y but ey units of good 1 and not z but ez of good 2, and ask how big expansion factor e can be.

The only alternative technologies available to firm 3 are the specialized ones of firms 1 and 2. Since firms 1 and 2 are equally labor intensive and the ratio of outputs of firm 3 is y to z in Table 1.3, the best use of the specialized techniques is obtained by dividing the labor of the worker of firm 3 between $y/(y+z)$ for the production of the first output and $z/(y+z)$ for the production of the second output. Since the specialized techniques yield one unit of output per input, the outputs would be $ey = y/(y+z)$ and $ez = z/(y+z)$. Comparison with the actual outputs y and z shows that the expansion factor of firm 3 is $e = 1/(y+z)$.

This number is an *expansion* factor, $e > 1$, only if $y+z < 1$. Otherwise, i.e. if $y+z \geq 1$, firm 3 would already be efficient and it would be unproductive to adopt the alternative practices; output expansion would not be feasible. If we include the qualification $y+z < 1$, the expansion factor of firm 3 is modified as $e = \max(1/(y+z), 1)$. As before, the efficiency of firm 3 is given by the inverse expression, $1/e = 1/\max(1/(y+z), 1)$, and this can be rewritten as $e = \min(y+z, 1)$. The latter expression reveals that if firm 3's total output ($y+z$) is less than 1, then its efficiency is less than 100%, while if total output of firm 3 is equal to or more than 1, its efficiency is the full 100%.

Now let me turn to the important issue of valuations. In Table 1.3 the diversified firm produces quantities y and z of the respective outputs. If it is not efficient—producing only $y+z < 1$ of total output—the best-practice firms or *benchmarks* are the specialized firms. Since each benchmark firm transforms one unit of (labor) input into one unit of the respective outputs, the efficient production prices are 1 for each product, expressed in labor costs. Now if these production prices prevail, the diversified firm, firm 3, would operate at a loss, because revenue would be $1*y + 1*z$, cost would be 1, and the former is less than the latter. These prices are called *accounting prices*. Since they reflect the costs of the best production practices, accounting prices of outputs are knife edge, too low to sustain less than fully efficient production activities.

WHAT IS BENCHMARKING AND WHY IS IT USEFUL?

Benchmarking—either by determining the greatest expansion factor for the outputs given the inputs, or by determining the smallest contraction factor for the inputs given the outputs—is useful because it maps the potential of a decision making unit, quantitatively—comparing actual output with potential output—and qualitatively—by identifying the best practices that would bring about the potential output. In the last example (at least when output of the diversified firm totals less than 1), more could be produced with the technologies of the specialized firms, and therefore it would be rational to adopt these best practices. When the pool of decision making units is much larger than three, it is more difficult to identify the best practice techniques for a decision making unit, and we need the operations research technique of linear programming to spot the benchmarks, but the idea remains the same.

There is a difference between benchmarking an individual decision making unit, like Mrs. Youngman, and benchmarking all decision making units, like the population of wives. The constellation of decision making units that are each other's peers is called an *organization*. The organization could be a corporation (comprising divisions), a chain (of supermarkets), a bank (of branches), or an industry (consisting of firms). The benchmarking of an organization against other organizations is not conceptually different from the benchmarking of a decision making unit against its peers. For example, we could analyze how much better a bank could perform if it benchmarked its branches against each other, but it might also learn from measuring itself against the other players in the industry. The same linear programming tool can be used for internal benchmarking as for competitive benchmarking.

Internal benchmarking is practiced only by big organizations, which include many business units. The more units there are as a backdrop for comparisons, the greater the likelihood is that other units with a similar scope of outputs and of inputs will be available for comparison. After all, the objective of benchmarking is to “steal” production or business processes from similar, but better units. The advantages of competitive benchmarking are that we fish in a bigger pool for best practices, thus setting a

THE ECONOMICS OF BENCHMARKING

higher standard, and that we can make comparisons at the company level, which includes elements not captured at the division level, such as overhead. The drawback of competitive benchmarking is, of course, the difficulty of acquiring the data.

External or competitive benchmarking is applicable both to business units and to corporations. In the former case, comparable intra-company information is required for different companies. In Table 1.4 this case is denoted by the box “Competitive benchmarking.” In the latter case aggregate company data are compared, which is less demanding. This case is the box “External benchmarking” in Table 1.4.

Table 1.4 A taxonomy of benchmarking

	Reference organization	
Decision making unit	Corporation	Industry
Business unit	Internal benchmarking	Competitive benchmarking
Corporation	Organization benchmarking	External benchmarking

There is an interesting intermediate level of benchmarking, in between internal and external or competitive benchmarking. It is the benchmarking of an organization by measuring it against its own constituent parts. The idea is borrowed from economic theory, which has developed a subtle technique to measure the efficiency of an economy without comparing it with other economies. Here inefficiency encompasses not only suboptimal production of outputs by firms (excessive use of inputs), but also the subtle form of inefficiency economists call *allocative inefficiency*. All firms in an economy may produce efficiently, but the allocation of resources may be suboptimal. The same logic is

WHAT IS BENCHMARKING AND WHY IS IT USEFUL?

applicable to a corporation. There may be scope for performance improvement by reallocating resources between business units. If so, the units may be efficient, but the organization is not. This source of inefficiency can be exposed without benchmarking the organization against its competitors, by benchmarking the organization against its own parts. If we benchmark an organization internally, a subtle conceptual issue emerges. We have to resolve the issue that benchmarks are specific to the decision making unit being considered. While internal and competitive benchmarking are the same ballgame from the point of view of technical analysis, *organization benchmarking* is distinct in that it requires some extra work.

If we simply assess the performance of a branch manager—perhaps to determine her bonus—by benchmarking her branch against all other branches, the result of our analysis will be idiosyncratic in the sense that the benchmark or benchmarks against which we measure her up must have comparable profiles of services and of resources. Different decision making units may turn out to have different benchmarks. There are two grounds for such differences. On the *output* side, branches may focus on different products: for a bank, say, perhaps mortgages or business loans. On the *input* side branches may employ different processes, such as more or fewer automated teller services, or also be not comparable in the nature of certain inputs. Air-conditioning is important in some regions and indeed may be more or less efficient, but irrelevant in others. In short, your benchmarks must be comparable in terms of the mix of outputs and the mix of inputs.

If, however, we benchmark a bank against its own branches, then we analyze the performance of the organization given the bank's *total* inputs and *total* outputs. We do so by analyzing how much better the organization could perform if not only each decision making unit operated efficiently, but also the organization's resources were allocated optimally. This problem can also be solved by the operations research technique of linear programming, but this time the benchmark valuations relate to the organization as a whole. The results are no longer specific to decision making units, and can be used to rank them objectively. More precisely, the accounting prices of the organization can be used to

THE ECONOMICS OF BENCHMARKING

value the contributions of all units, *without* running into the problem that the weights in the valuation differ across firms and may influence the results. This feature renders organization benchmarking distinct. The company-wide accounting prices can be used to reallocate resources between business units and to design bonus plans.

The difference between benchmarking decision making units and the organization as a whole is subtle, because it emerges only if inputs or outputs are multi-dimensional and weights are needed to compare the performance contributions of components. In the literature this problem is often a no-brainer, because performance weights are considered to be given in the analysis, and then there is no reason indeed to change them as we benchmark one decision making unit, another, or the entire organization. In practice, however, it is not easy to assign weights to different performance components. Universities struggle to compare educational achievements with research output, business schools factor in starting salaries of their graduates, and businesses themselves juggle with not only financial targets, but also others, like customer satisfaction. How do we weigh the importance of all these different performance facets? Ultimately this is a *valuation* problem, and the determination of values is the classical problem of the science of economics. This is why the theory expounded in this book is the *economics* of benchmarking.

Paradoxically, the economic approach to benchmarking taken in this book is particularly useful for organizations that are *not* run as a traditional economic unit. The economic theory of the firm departs from the proposition that the menu of possible strategies is limited by the technological possibilities. This proposition is reflected in the modeling of strategies as combinations of inputs and outputs, a framework that encompasses many choices, like which products to produce, how much of each, when, and using which inputs in which proportions. The standard assumption of economic theory is that the prices are determined in the market place and can be used to value the benefits and costs of alternative strategies. This assumption is not innocent but it presumes that there are complete markets.

Many organizations produce services that are not traded in the

WHAT IS BENCHMARKING AND WHY IS IT USEFUL?

market place, and therefore cannot be evaluated in financial terms, such as revenues. That does not free them from economic problems, such as cost minimization or maximizing the output of the desired services. This is where benchmarking becomes important. Pure business enterprises have the great advantage that there are natural measures for their strategies, namely the prices of the output and input components, which moreover allow for aggregation into a single aggregate: profit. Since the discounted stream of expected profits is reflected in the stock price, there is a one-dimensional score and “benchmarking” is reduced to reading stock listings in the newspaper. But other organizations, including nonprofits and various intermediate types like publicly provided services, need management tools to weigh the importance of different output and input components.

Benchmarking is such a tool, albeit indirectly. It is based on the comparison of different and possibly non-financial output and input components between decision making units, such as exam scores and teacher resources in education; overhead and outreach in charities; personnel, equipment and success rates in health care. It not only marks the relative performance of the different units, it also determines the importance of the different components. In other words, benchmarking has the capacity to put numbers on the different components of an organization’s outputs and inputs. This feature is particularly helpful where markets fail to fulfil the function, as they do for nontraditional organizations, including nonprofits. It may also resolve the puzzle that benchmarking may be more widespread among semi-public organizations than purely private ones.

For the airline industry, Francis, Humphreys and Fry (2005) present the interesting information reproduced in Table 1.5.

The authors make the following observations:

When examining the performance improvement techniques used in relation to ownership, the results are not necessarily what might have been expected. There is a tendency for those airlines with a government stake in ownership to make greater use of performance improvement techniques.

THE ECONOMICS OF BENCHMARKING

Table 1.5 Performance improvement techniques used in relation to ownership

Technique	Government stake %*	No government stake %**	Total %
Benchmarking	100	78	88
Quality management systems (ISO9000/BS5750 or similar)	74	36	54
Balanced scorecard	58	32	44
Business process reengineering	53	27	39
Activity-based costing	42	27	34
Total quality management (TQM)	37	10	22
Environmental management systems (e.g. ISO14000)	32	5	17
Value-based management	16	14	15
Business excellence model/EFQM	11	5	7

* Percentage use by airlines with a government stake in ownership.

** Percentage use by airlines without a government stake in ownership.

Source: Francis, Humphreys and Fry (2005).

Contrary to the authors I am not surprised by the more extensive use of benchmarking in semi-government businesses. Benchmarking can be used as a performance measurement tool, which comes in handy in environments where not all objectives are monetarized by markets. In the semi-public sphere, there are typically multiple objectives, some monetarized, others not. Benchmarking can be used to value the non-monetary objectives. Moreover, even when objectives are monetarized—by price-setting semi-government organizations—it is not always clear how this should be done, and benchmarking offers some useful solutions. In short, benchmarking is an instrument that can be employed to fill the gaps where markets do not reign. This pricing role of benchmarking is little known, but I place it center stage.

The central idea of this book is to benchmark without preconceived preferences for different performance measures, and simultaneously to reveal the implicit weights. It has a slightly unusual implication for the organization of the book. Since I want to take the reader quickly to valuation issues, I have placed linear

programming up front, even though it is technically the most demanding chapter.

In order not to scare you to death, I have invested quite some effort into making Chapter 2 palatable. It does not assume any mathematical knowledge, and the theory is introduced in a rather geometrical way, with what I hope you will see as slick pictures. I center the analysis on the concept of an accounting price, which will be used as the revolving door between all chapters. I realize that an accounting price is no easy concept, and suggest you take your time to read the next chapter. Once you grasp it, the fruits will be rewarding. And as a bonus you will acquire a deep insight into this branch of operations research, including its climax, the main theorem of linear programming. This theorem imputes the benefits of an efficient decision making unit or organization to the contributing inputs. Roughly speaking, the inputs are rewarded according to their scarcities. The main point of linear programming is that it determines the rewards.

At least that is my view. Most texts are different, and stress the mechanics of linear programming. While in the old days that may have been useful, nowadays any computational aspect is a piece of cake, even for grandmothers' laptops. My focus on valuation issues immediately pays off in the next chapter, where I explain the technique of benchmarking. The novelty of this approach is that it uncovers the role of preference weights in benchmarking, without the need to fix them in some preconceived manner.

Another great advantage of putting accounting prices center stage is that they facilitate a crisp discussion of some seemingly related but quintessentially different concepts, namely those of efficiency, productivity, and profitability. While the nuances may have been clear to Henny Youngman when he thought of his decision making unit, the concepts tend to be confused in business thinking. The apparatus of benchmarking explains them through a series of simple examples, and is a useful tool for performance ranking, the topics of Chapters 4 and 5. The flip-side of the coin of taking the reader quickly to an accounting price framework for benchmarking is that standard, more technical modifications on the returns to scale must wait until Chapter 6.

Further reading

I shall end each chapter with suggestions for some further reading. For the traditional approach to benchmarking I recommend Camp (1989) and Bogan and English (1994). They present benchmarking as a comparison tool, and emphasize implementation issues in the organization. For the application of benchmarking to quality management I recommend Zairi (1996) and Watson (2007). The latter also provides a smorgasbord of practicalities as a taxonomy of business benchmarking, an alternative to my Table 1.4.

INDEX

A

accounting cost–revenue ratio, 42
 accounting prices, xviii, 6, 9–10, 13,
 19–20, 38–41, 53–5, 63–8, 98
 implications for return to scale-
 models, 91–91–5
 negative, 25
 no room for profit in, 20, 39
 sorting variables by profitability,
 23
 variation across decision making
 units 63–4
 activity-based costing, 12
 Afriat, S. N., 83
 Aigner, D. J., 58–9, 60
 airline industry, xvii, 11–12
 Ali, Agha Iqbal, 46–7
 allocative inefficiency, 8
 Anderson, Randy I., 61
 applications of benchmarking, xvii
 Austria, 46–7

B

Balanced Scorecard, 12, 32, 73
 Banker, R. D., 83
 banks
 in Austria, 46–7
 in India, 41–2
 Baumol, William J., xi,
 benchmark, the, xiv, 6, 9, 35, 65
 author's own, xi
 benchmarking,
 as application of linear program-
 ming, 31
 best used with caution, 99–100
 consultancies, xiii
 definition of, xiii, xiv, 11
 levels of, xv, 7–8
 limitations of traditional, 99
 and productivity analysis, 58
 software, xiii
 types of, xviii, 7–10 (*see also* indi-
 vidual types by name)
 use of, 7, 11, 12, 31, 98
 best practice, identifying and copying,
 xiv

see also benchmark

bonus plans *see* rewards for
 management
 bounds, 15, 38
 Buffa, Frank P., 36
 business excellence model, 12
 business process reengineering, 12

C

Charnes, A., 83
 Cherchye, Laurens, 74–5
 Chu, S. F., 58–9
 Coelli, Timothy J., 62, 95
 company-level benchmarking, xv, 7–8,
 70–1, 99
 competition, perfect and pricing, 20
 competitive benchmarking, xv, 7–8
 competitiveness, measurement of, 46
 complementary slackness, 21, 23, 39
 constraints, 16, 17, 24–5, 38, 64
 binding and nonbinding, 21, 92
 nonnegativity, 22, 39, 92
 price normalization, 39
 consultancies, xiii–xiv
 contraction factors, 4
 Cooper, W. w., 83
 cost
 definition, 29
 minimization, 11
 and value ratio *see* value–cost
 ratio
 cost–quality trade-off, xiv–xv, 99
 criteria for benchmarking, xiii–xiv, 32
 customer satisfaction, xiv, xvii, 32, 45,
 73, 97

D

Darrat, Ali F., 91
 data
 from competitors, xv
 database, internal, 36
 difficulty of acquiring, 8
 prices as, 55
 and scale economies, 79–81
 data envelopment analysis (DEA),
 xvi–xvii, xix, 35–6, 61, 78, 84–5

INDEX

- advantages of, 61
 compared with stochastic frontier analysis, 61–2
 disadvantages of, xvi–xvii
 Ratio DEA model, 69
 and returns to scale, 85–90
 tendency to over-estimate inefficiency, 95
- Debasish, Sathya Swaroop, 41–2
 decision making units, 2, 31–2
 hypothetical representing inactivity, 85
 run at small intensities, 84
 size of pool, 7
- differences vs ratios, xvii
 Disraeli, Benjamin, xi, xiii
 distribution, normal and half-normal, 60
- Dittman, D. A., 61
 dual equation/constraint function, 20, 22–3, 39, 40, 94
 duality analysis, 18
- E**
 econometrics, 58–9
 economics of benchmarking, 10
 efficiency, xvii
 as basis for ranking, 63
 changes in, 51
 as comparative concept, 1, 52
 as cost/value ratio of inputs, 44
 definition of, 3–4, 41, 43, 51
 and degrees of inefficiency, 59
 measurement of, 3–6, 36
 not linked to profitability, 49
 scores of banks, 41–2
 scores for Dutch universities, 75
 scores of hotels, 61
 scores of railways, 62, 95
- environmental management systems, 12
- error(s)
 of measurement, 95, 99
 specification, 61
 term, 59–60
- estimation, 58
- Excel, xviii, 15, 23, 25–30, 33, 43, 58
 bug, 26n3
 formulas in, 26–7
 naming of variables and constraints in, 25
 settings, 26
- expansion factor, 3, 5, 6, 24, 33, 42, 44, 51
 optimal, 40
- external benchmarking, xv, 8
- F**
 Färe, Rolf, 83
 feasible set, 16
 Førsund, Finn R., 83
 Foster, Lucia, 57
 Francis, Graham, xvii
 Fry, Jackie, xvii
 further reading, 14, 30, 47, 62, 76, 95
- G**
 Gascho Lipe, Marlys, 32
 Georgescu-Roegen, N., 43
 Giménez-García, Victor M., 36
 government stake and use of benchmarking, 11–12
 Grosskopf, Shawna, 83
 Gstach, Dieter, 46–7
- H**
 Haltiwanger, John, 57
 Hicks, J. R., 50
 Hjalmarsson, Lennart, 83
 hotels example, 61
 Humphreys, Ian, xvii
- I**
 India, example from 41–2
 industry-level benchmarking, xv
 input(s)
 allocable and non-reallocable factors, 36
 of banks, 41, 47
 in benchmarking, xvii
 commonality needed for benchmarking, 32
 conversion to outputs, 2
 fixed, 82
 of hotels, 61
 measurement of, 59
 minimally required and actual, 44
 multi-dimensional, 9–10
 non-financial, xviii, 11
 for real estate investment trusts, 91
 scarcity of, xv, 64, 69
 space, 35–6
 in Total Quality Management, 45
 of universities, 74
 use in benchmarking, xvii
- internal benchmarking, xv, 7
 International Standards Organization (ISO), 45–6
- K**
 Kaplan, Robert S., 32, 73

INDEX

- Kennedy, Senator Ted, xiii
 Korea, 45–6
 Kuosmanen, Timo, 74–5
- L**
 Lagrange multipliers, 19
 linear programming, xviii, 7, 9, 15–30,
 33–4, 38, 55, 64
 applications of, 23
 as economic not engineering
 concept, xviii
 in Excel, 25–30
 first-order conditions, 20
 main point of, 13
 main theorem of, 21, 40, 42
 Logan, James, 83
 Lovell, C. A. K., 60
- M**
 manufacturing industry, 57–8
 markets
 in economic theory, 10
 perfectly competitive, 20
 presence or absence of, 53
 Martínez-Parra, José Luis, 36
 measurement, units of, 39
 monopolies, 20, 49–50, 59
 Morey, R. C., 61
- N**
 Netherlands, the, 74–5
 nonprofit organisations, xvi, 11, 97
 Norton, David P., 32, 73
- O**
 objectives
 monetarization of, 12
 non-monetary, 12
 operations research, 9, 13
 organization
 benchmarking, 8–10
 definition of, 7, 31
 objectives, 11, 99
 size, 7, 53
 output(s)
 of banks, 41, 47
 as basis for benchmarking, xvii
 measurement of, 59
 multi-dimensional, 9–10
 non-financial, xviii
 optimization, 40
 potential, 3, 24
 proportions fixed in benchmark-
 ing, 40
 for real estate investment trusts, 91
 scores, xvii
 space, 37
 in Total Quality Management, 45
 of universities, 74
- P**
 Perelman, Sergio, 62, 95
 performance improvement systems,
 11–12
 performance measures, xiii, 12, 32,
 97–8
 price(s)
 accounting prices *see* accounting
 prices
 accounting vs market, 20, 44, 50,
 55, 98
 exogenous and endogenous, 55–6
 information not used in bench-
 marking, 44
 normalization constraint, 39
 normalization function, 92, 94
 not available, xvi, 46–7
 not copiable, 57
 relationship with quantity, 68–9
 shadow prices *see* shadow prices
 pricing of resources, xv
 product life cycle, 52
 production functions, 81–3
 productivity, xvii, 50–1, 56–7, 82–3
 analysis vs efficiency analysis, 58
 vs efficiency, 1, 51–2
 marginal, 22, 69
 and returns to scale, 78, 82–3
 profitability, xvii, 52–3, 56–7
 as criterion for benchmarking,
 xiii, xvii
 not related to performance, 20,
 49–50, 53–4
 and stock prices, 11
 profits
 and accounting prices, 92
 negative and zero, 39–40
 and other performance measures,
 11, 97
 public sector, 11–12, 41–2
- Q**
 quality
 and cost trade-off, xiv–xv, 99
 management in Korea, 45–6
 management systems, 12
- R**
 railways, 62, 95, 99
 ranking, xix, 63–73

- ratios
 accounting cost–revenue ratio, 42
 input to output, xvii, 2
 revenue/cost ratio, 43, 55, 57, 69, 72
 value–cost ratio, xiv, 44, 98–9
 vs differences, xvii
- Ray, Subhash, 1
- readership of the book, xviii
- real estate investment trusts, 91
- reference points, 1–2
 as outcome of analysis, 2
- regression analysis, 59–60
- rent seeking, 64
- resource allocation, xv, xvi, 2, 8–9, 33–4, 36, 44, 66–7, 70
- resources *see* inputs
- restaurant example, 36
- returns to scale *see under* scale
- revenue/cost ratio, 43, 55, 57, 69, 72
- rewards for management, xvi, 9, 36, 67, 99
- roadmap of the book, xviii–xix
- S**
- S-shaped function, 81–2, 90
- Salterio, Steven E., 32
- scale, 77–75
 economies and diseconomies of, xix, 78, 91
 constant returns to, 4, 33–4, 78–80, 89–90
 decreasing returns to, 78–80, 84, 85–6, 88, 91–2
 enveloping decreasing returns to, 86–7
 enveloping increasing returns to, 87
 increasing returns to, 74, 78, 79, 81, 88–9, 90, 93–4
 returns and data envelopment, 85–90
 types of returns, 77
 variable returns, 81–4, 89, 90–1, 95
- scatter diagrams, 34–5, 37, 80, 81
- Schefczyk, Michael, xvi–xvii
- Schmidt, P. J., 60
- sensitivity report, 28–9
- shadow prices, 19, 38, 42, 74, 91, 94
see also accounting prices
- shadow rental rate, 19
- shadow wage rate, 19
- Shelor, Roger M., 91
- Sipiläinen, Timo, 74–5
- skewness, measures of, 60
- slacks, 21, 22, 61
- small enterprises, xiii, 47
- Spain, 36
- specialization of business units, xiv, 2–6
- Speckbacher, Gerhard, 97–8
- statistical analysis, 58
- stochastic frontier analysis, xix, 58, 60
 compared with DEA, 61–2
- Syverson, Chad, 57
- T**
- Topuz, John C., 91
- Total Quality Management (TQM), 12, 45
- Twain, Mark, xi, xiii
- U**
- U-shaped average cost, United States, examples from, 57–8, 61, 91
- universities, evaluation of, 74–5
- V**
- valuation problems, 10
- value of output equal to resource cost, 29
- value-based management, 12
- value–cost ratio, xiv, 44, 98–9
- vectors, 18–19
- W**
- weighting, xiv, xv, 10, 13, 69–73
 self-preferred, 69
- Y**
- Yli-Viikari, Anja, 49
- Yoo, Hanjoo, 45–6
- Youngman, Henny, 1, 2, 52