

Capitalis: Journal of Economic Stability, Banking, and Investment
Vol 1 No 3 September 2026, Hal 90-103
ISSN: 3163-6047 (Print) ISSN: 3163-6039 (Electronic)
Open Access: https://sovereignresearch.org/capitalis

Analysis of Short-Run and Long-Run Production Costs in Microeconomic Theory

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Article Info :
Received:
29-08-2026
Revised:
09-09-2026
Accepted:
21-09-2026

Abstract

Production costs influence output selection, temporary shutdown decisions, and capacity planning under different input constraints. This article examined short-run and long-run production cost structures, compared their underlying mechanisms, and considered implications for firm decisions. A narrative literature review synthesized microeconomic theory and relevant journal studies through conceptual classification, comparison, and mathematical illustrations. Short-run costs were examined using a hypothetical total cost function distinguishing fixed and variable expenditures, average costs, and marginal costs. The analysis showed that diminishing marginal returns can increase marginal cost, while spreading fixed expenditure across output initially reduces average total cost. The illustrative function yielded minimum average total cost of 30 at 10 output units. Long-run analysis emphasized flexible inputs, cost-minimizing capacity choices, and the envelope relationship between long-run and short-run average cost curves. A second hypothetical function reached minimum long-run average cost of 24 at six output units, illustrating economies and diseconomies of scale. Short-run operating decisions were interpreted using marginal revenue and marginal cost, together with the avoidable-cost shutdown criterion. These results distinguish theoretical cost relationships from firm-level measurements and do not constitute observed industrial efficiency outcomes. Their practical application requires empirical cost and production data, especially when technology, market conditions, and adjustment constraints differ.

Keywords: *Average Cost, Economies of Scale, Long-Run Costs, Marginal Cost, Short-Run Costs.*

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INTRODUCTION

Production costs constitute a central consideration in microeconomic analysis because they determine how firms allocate limited resources, organize production activities, and evaluate the economic consequences of changing output levels. In the short run, at least one production input remains fixed, creating constraints on output adjustments and influencing the behavior of total, average, and marginal costs. Long-run production decisions involve greater flexibility because firms can adjust their input combinations, production capacity, and operating scale in response to technological and market conditions. The relationship between fixed expenditures and price–cost margins demonstrates why cost composition must be considered when evaluating profitability and interpreting the economic performance of firms (Abraham et al., 2024). Demand uncertainty and supply-chain fluctuations introduce additional complications because changes in operating conditions may alter cost behavior and the financial consequences of production decisions (Chen et al., 2024). Research concerning production capacity under uncertainty further illustrates the relevance of scale selection to cost-related decisions extending beyond immediate operational adjustments (Wang et al., 2025). The distinction between short-run and long-run production costs consequently remains relevant to contemporary microeconomic analysis, particularly when examining how input constraints and production flexibility affect managerial choices (Simanjuntak et al., 2025).

Contemporary research on production costs has developed through several analytical directions involving cost structures, production-function estimation, operational efficiency, and economies of scale. Investigations of fixed costs and price–cost margins address the relationship between expenditure commitments and economic returns, emphasizing the analytical importance of distinguishing fixed

expenditures from costs associated with production activity (Abraham et al., 2024). Research on production-function estimation using cost information extends this discussion by examining how production relationships can be identified when output decisions are subject to restrictions (Malikov et al., 2025). The analysis of ray average cost and multioutput scale economies provides a complementary theoretical perspective by considering how production scale and output composition influence the interpretation of average costs (Cesaroni et al., 2026). Empirical investigations of corn farming further examine the relationship between economies of scale and production efficiency, demonstrating the relevance of operational performance when evaluating scale-related outcomes (Zhang et al., 2025). These research directions collectively establish that production costs cannot be interpreted independently of technological constraints, input allocation, production scale, and efficiency, although their different analytical objectives require careful comparison when explaining cost behavior across time horizons.

Despite these developments, the reviewed literature addresses several related aspects of production costs without consistently organizing them into a unified comparison of short-run and long-run cost relationships. Research connecting demand uncertainty with cost structure provides an explanation of how changing operating conditions interact with expenditure behavior, but its analytical focus differs from the theoretical relationship between variable inputs and marginal production costs (Chen et al., 2024). Dynamic optimization using the Cobb–Douglas production function introduces considerations of production costs and adjustment speed without directly resolving every distinction between fixed-capacity operations and fully adjustable production arrangements (Motoyama, 2025). Industry-specific research on economies of scale examines the economic consequences of expanding production, although such analysis does not necessarily explain the behavior of individual short-run cost components (Bennur & Malhotra, 2023). Recent managerial discussions of cost theory provide additional explanations of cost-related decision-making, but their managerial orientation does not eliminate the need for an explicit theoretical comparison of production horizons (Nessa & Supriyanto, 2026). These differences create a conceptual problem when diminishing marginal returns, short-run cost behavior, and long-run economies of scale are interpreted as equivalent explanations of changes in production expenditure. The research gap addressed in this study concerns the need to integrate these distinct analytical relationships into a coherent framework that clarifies their assumptions, economic mechanisms, and implications for production decisions rather than claiming that the underlying cost theories have not previously been developed.

The distinction between short-run and long-run production costs has practical implications because firms must determine whether changes in expenditure arise from existing capacity constraints or from decisions concerning production scale. Short-run increases in marginal costs may reflect diminishing marginal productivity under fixed-input conditions, whereas long-run changes in average costs can result from adjustments in plant size, input combinations, and production technology. Research concerning fixed costs and price–cost margins demonstrates the relevance of expenditure classification when evaluating economic performance and the relationship between costs and profitability (Abraham et al., 2024). The theoretical analysis of multioutput scale economies further indicates that scale-related cost behavior may become more complex when firms produce several outputs rather than a single homogeneous product (Cesaroni et al., 2026). Production-capacity research under uncertainty also highlights the importance of evaluating investment and operational-scale decisions when future production conditions cannot be determined with certainty (Wang et al., 2025). Without a clear distinction between the two planning horizons, managerial evaluations may incorrectly attribute temporary cost increases to permanent production inefficiency or interpret potential economies of scale as guaranteed reductions in realized production costs.

This study positions the distinction between short-run and long-run production costs as the principal analytical framework for interpreting cost behavior, production efficiency, and managerial decision-making within microeconomic theory. Recent discussions of short-run and long-run cost theory provide a foundation for distinguishing fixed and variable production inputs, while the present analysis extends that distinction to the relationships among cost measures and production-scale adjustments (Simanjuntak et al., 2025). Research on cost-based production-function estimation contributes to understanding the connection between production technology, input requirements, and expenditure relationships (Malikov et al., 2025). Dynamic production optimization provides an additional analytical reference for considering how production decisions and cost considerations

interact when adjustment processes extend across time (Motoyama, 2025). Evidence concerning the relationship between economies of scale and efficiency further indicates that production expansion and improved resource utilization should not automatically be interpreted as identical sources of cost reductions (Zhang et al., 2025). The proposed conceptual contribution lies in integrating these distinctions through a comparative interpretation of fixed costs, variable costs, total costs, average costs, marginal costs, production flexibility, and scale-related cost behavior. Rather than proposing an untested empirical cost function, the analysis clarifies how different assumptions concerning input adjustability, production technology, and operating capacity affect the interpretation of short-run and long-run production costs.

This study aims to analyze the structure and behavior of short-run and long-run production costs within microeconomic theory and to explain their implications for production decisions. The analysis first examines the relationships among total fixed cost, total variable cost, total cost, average cost, and marginal cost under conditions in which certain production inputs cannot be adjusted. It subsequently evaluates long-run cost behavior by considering input flexibility, cost-minimizing production arrangements, and the relationships among economies of scale, constant returns to scale, and diseconomies of scale. The study also seeks to distinguish diminishing marginal returns from scale-related cost mechanisms and to explain why these concepts represent different economic relationships. Through a conceptual synthesis of existing theoretical and research literature, the analysis compares the assumptions, cost structures, and managerial implications associated with the two production horizons without claiming to estimate firm-specific cost relationships. The expected contribution is a coherent analytical foundation for understanding production-cost adjustments, evaluating managerial choices, and supporting subsequent empirical research on cost efficiency and production-scale decisions.

RESEARCH METHODS

A narrative literature review was employed to examine the structure, behavior, and managerial implications of short-run and long-run production costs within microeconomic theory, without collecting primary data or estimating firm-specific cost functions. The secondary materials consisted of established microeconomics textbooks, classical theoretical publications, and national and international journal articles addressing production costs, production functions, efficiency, and economies of scale (Malikov et al., 2025). Source selection was based on direct relevance to production cost theory or its application to production decisions, with scholarly textbooks and journal articles constituting the principal materials reviewed. Three previously considered sources, comprising a preprint by Rahmi and colleagues, Silberston (1972), and Samuelson and Nordhaus, were excluded, although individual reasons for their exclusion and a systematic database-search procedure were not documented. Contemporary literature on managerial cost theory provided additional explanations of cost classification and the relevance of expenditure information to production decisions (Nessa & Supriyanto, 2026). Research examining fixed-cost commitments and price–cost margins contributed to interpreting the distinction between production expenditure, cost structures, and economic performance (Abraham et al., 2024).

Thematic synthesis involved identifying principal concepts, classifying the literature into basic cost concepts, short-run costs, long-run costs, and production decisions, comparing theoretical relationships, and integrating the findings into a comparative framework. Short-run cost relationships were examined using the hypothetical function $TC = 100 + 10q + q^2$, from which fixed costs, variable costs, average costs, marginal costs, and production outcomes under alternative market prices were derived. Long-run cost behavior was illustrated using $LTC = q^3 - 12q^2 + 60q$, with differentiation applied to determine long-run average cost, marginal cost, the minimum efficient scale, and relationships associated with economies and diseconomies of scale. The interpretation of scale-related cost behavior distinguished single-output cost relationships from the additional considerations associated with multioutput production (Cesaroni et al., 2026). Dynamic production optimization was considered as a complementary analytical perspective without introducing unobserved adjustment parameters or estimating an empirical production model (Motoyama, 2025). Mathematical results were evaluated for internal algebraic consistency, while conclusions concerning capacity selection and production efficiency were restricted to the assumptions of the hypothetical functions and the conceptual implications supported by existing research (Wang et al., 2025).

RESULTS AND DISCUSSION

Fundamental Concepts and Short-Run Production Cost Behavior

Production costs represent the economic value of resources employed in producing goods and services, reflecting the relationship between input utilization, output generation, and resource allocation. Microeconomic theory distinguishes economic costs from accounting expenditures by incorporating both explicit payments and implicit costs associated with alternative uses of productive resources (Mankiw, 2018). Explicit costs comprise direct monetary expenditures such as employee compensation, raw material purchases, equipment rentals, and other payments required to maintain production activities. Implicit costs represent the opportunity costs of resources owned by the firm, including managerial labor, internally supplied capital, and production facilities that could generate returns through alternative uses (Nicholson & Snyder, 2017). The distinction is particularly relevant to production decisions because accounting profitability does not necessarily indicate that a firm has achieved positive economic profits after considering the value of forgone opportunities. Contemporary discussions of managerial cost theory reinforce the importance of systematic cost identification for evaluating production alternatives and allocating limited organizational resources (Nessa & Supriyanto, 2026).

The classification of production costs into fixed and variable components provides the foundation for examining how expenditure changes as firms adjust output within an existing production capacity. Fixed costs represent expenditures that remain unchanged across relevant output levels during a particular operating period, while variable costs respond to changes in production activity (Simanjuntak et al., 2025). Examples of fixed costs include contractual facility rentals and certain equipment-related commitments, whereas variable costs may include production materials, energy consumption, and labor expenditures that vary with output. These classifications are conditional upon the production horizon and the capacity of firms to modify their input arrangements rather than permanent characteristics of individual expenditure categories (Varian, 2014). The short run refers to a production period in which at least one input remains fixed, limiting the firm's capacity to adjust its productive resources. In the long run, production inputs become adjustable, permitting firms to reconsider plant capacity, production technology, and the combination of resources employed in production (Pindyck & Rubinfeld, 2018). Table 1 summarizes the principal production cost concepts and the mathematical relationships used to examine expenditure behavior across alternative output levels.

Table 1. Summary of Production Cost Concepts

Concept	Formula	Interpretation
Total cost (TC)	$TC = TFC + TVC$	Aggregate cost at a given level of output
Average fixed cost (AFC)	TFC / q	Declines as output increases
Average variable cost (AVC)	TVC / q	Variable cost per unit of output
Average total cost (ATC)	$TC / q = AFC + AVC$	Overall cost per unit of output
Marginal cost (MC)	$\Delta TC / \Delta q$	Additional cost of an increment in output

The relationships presented in Table 1 establish the mathematical foundation for analyzing production costs without requiring observations from a particular firm or industrial sector. Total cost represents the combined value of fixed and variable expenditures, while average cost measures express these expenditures relative to the quantity of output produced. Average fixed cost declines as production increases because a constant expenditure is distributed across a greater number of output units (Mankiw, 2018). Average variable cost depends on the relationship between variable expenditure and production volume, making its behavior sensitive to the productivity of adjustable inputs. Marginal cost measures the additional expenditure associated with producing an incremental unit of output and serves as a central consideration in output optimization (Pindyck & Rubinfeld, 2018). These relationships also demonstrate that reductions in average fixed cost do not necessarily imply reductions in average total cost when variable expenditure increases sufficiently to offset the benefits of distributing fixed costs across additional production units.

The law of diminishing marginal returns explains a central mechanism underlying production cost behavior when firms operate with fixed productive capacity. As additional units of a variable input

are employed alongside unchanged quantities of fixed inputs, total output may initially increase at a relatively favorable rate because existing facilities are utilized more intensively. Beyond a particular production level, however, successive additions of the variable input may generate progressively smaller increments in output as the availability of complementary fixed resources becomes increasingly restrictive (Pindyck & Rubinfeld, 2018). Under constant input prices, declining marginal productivity raises the expenditure required to produce additional output units because progressively greater quantities of the variable input are needed for each incremental unit of production. The resulting increase in marginal cost reflects a technological relationship between input productivity and output rather than a necessary increase in the market price of production resources (Varian, 2014). This distinction is fundamental to short-run cost analysis because diminishing marginal returns arise under fixed-input conditions and should not be treated as equivalent to diseconomies associated with changing the scale of all production inputs. Recent discussions of short-run and long-run cost structures similarly emphasize the importance of input adjustability when interpreting production expenditure and its implications for managerial decisions (Simanjuntak et al., 2025).

The behavior of short-run average and marginal cost curves reflects the combined effects of fixed-cost distribution and changes in variable-input productivity. Average fixed cost decreases continuously as positive output expands, whereas average variable cost may initially decline before increasing when diminishing marginal returns become sufficiently influential (Nicholson & Snyder, 2017). Average total cost consequently depends on the interaction between declining average fixed cost and the trajectory of average variable cost, potentially producing the conventional U-shaped relationship between unit cost and production volume. Marginal cost also influences the direction of average cost changes because an additional unit produced below the existing average reduces that average, while an additional unit produced above it increases the average (Mankiw, 2018). Under differentiable cost relationships with interior minima, marginal cost intersects average variable cost and average total cost at their respective minimum points. These theoretical relationships require attention to the underlying cost function because the conventional shapes of cost curves are not automatically reproduced by every mathematically admissible representation of production expenditure.

A numerical illustration provides a basis for examining these relationships under a specified hypothetical production cost function rather than through empirical observations of an operating establishment. The original illustration assumes total cost is expressed as $TC = 100 + 10q + q^2$, where q represents the quantity of output and the constant term of 100 represents total fixed cost. Total variable cost is consequently $TVC = 10q + q^2$, while average fixed cost equals 100/q for positive output quantities. Average variable cost is $AVC = 10 + q$, and average total cost is $ATC = 100/q + 10 + q$, reflecting the contribution of both fixed and variable expenditures to unit production costs. Differentiating the total cost function with respect to output produces $MC = 10 + 2q$, indicating that marginal expenditure increases linearly as production expands. The use of differentiation provides a mathematical foundation for examining incremental cost relationships and identifying stationary points relevant to production decisions (Nabilla & Nursanti, 2024). Table 2 retains the original calculated values for three hypothetical output levels and permits a comparison of total expenditure, average variable cost, average total cost, and marginal cost.

Table 2. Hypothetical Illustration of Short-Run Costs

Output (q)	TC	AVC	ATC	MC
5	175	15	35.0	20
10	300	20	30.0	30
15	475	25	31.7	40

The numerical relationships in Table 2 demonstrate how expanding production changes total expenditure and individual unit-cost measures under the specified hypothetical function. At an output level of five units, total cost reaches 175, average variable cost equals 15, average total cost equals 35.0, and marginal cost equals 20. Increasing production to ten units raises total cost to 300 while reducing average total cost to 30.0, indicating that the distribution of fixed costs offsets the increasing average variable expenditure over this interval. At fifteen units, total cost increases to 475 and average total cost rises to approximately 31.7, reflecting the growing contribution of variable expenditure to total unit

costs. The mathematical interpretation is consistent with the general relationship between marginal and average costs, whereby average total cost reaches its minimum when marginal cost equals average total cost under the relevant differentiability conditions (Pindyck & Rubinfeld, 2018). Figure 1 identifies the corresponding short-run cost relationships and the minimum average total cost at an output level of ten units.

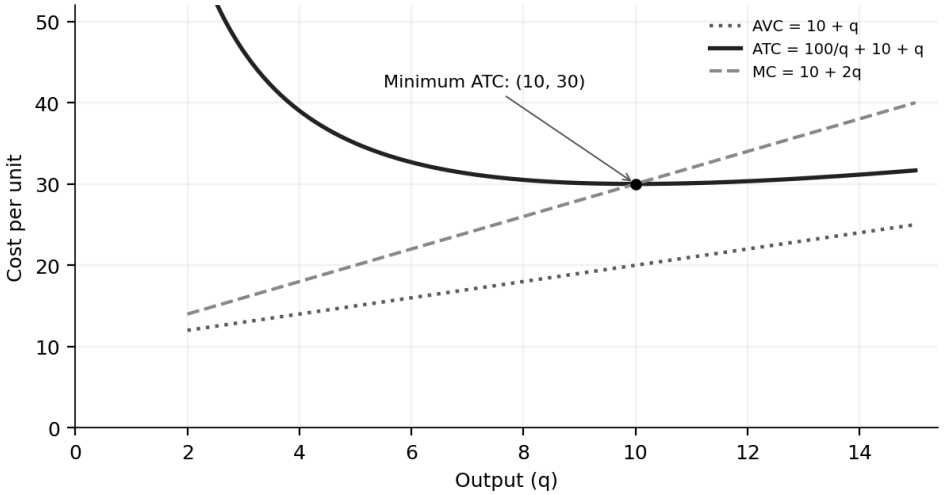


Figure 1. Short-Run Cost Curves with Minimum ATC at q = 10

The hypothetical cost function also permits a formal examination of the output level associated with minimum average total cost through differentiation. Marginal cost is obtained from the first derivative of total cost, while the first derivative of average total cost with respect to output is $-100/q^2 + 1$ (Nabilla & Nursanti, 2024). Setting this expression equal to zero yields $q = 10$ for positive output, which is the stationary point of the average total cost function. The second derivative of average total cost equals $200/q^3$ and remains positive for every positive output level, establishing that the stationary point represents a minimum rather than a maximum. At this output level, average total cost and marginal cost are both equal to 30, confirming the mathematical relationship illustrated by the original calculations. Nevertheless, the selected quadratic total cost function produces monotonically increasing average variable and marginal costs for positive output, meaning that it does not reproduce an initial declining segment of these curves. The illustration consequently demonstrates the distribution of fixed costs, increasing marginal expenditure, and minimum average total cost without establishing an empirically estimated production technology or a universally applicable short-run cost structure.

Long-Run Production Cost Structure and Economies of Scale

Long-run production cost analysis examines how firms adjust their productive resources when existing input constraints no longer determine the feasible scale of operations. Unlike short-run production conditions, the long run allows adjustments to labor, capital equipment, production facilities, and other inputs required to achieve different output levels. This flexibility enables firms to reconsider their production technology and input combinations rather than relying exclusively on adjustments within existing capacity. Microeconomic theory consequently distinguishes long-run cost behavior from short-run expenditure patterns because the former reflects choices among alternative production arrangements (Varian, 2014). Research concerning production functions estimated from cost information further demonstrates the analytical relationship between technological constraints, input requirements, and production expenditure (Malikov et al., 2025). Production capacity decisions under uncertainty introduce another consideration because the economic consequences of expanding operations depend on anticipated output requirements and the costs associated with different capacity choices (Wang et al., 2025). Long-run analysis therefore provides a framework for evaluating cost-minimizing production arrangements without assuming that increased production capacity necessarily improves efficiency or profitability.

The long-run average cost curve represents the minimum average expenditure required to produce each output level when all relevant production inputs can be adjusted. Its construction assumes that firms select feasible input combinations and production arrangements that minimize total expenditure for a given output under specified input prices and available technology. Unlike a single short-run average cost curve, long-run average cost incorporates the possibility of choosing among alternative production capacities (Pindyck & Rubinfeld, 2018). Research on the shape of ray average cost demonstrates that scale-related cost relationships require particular attention when production involves multiple outputs and different output configurations (Cesaroni et al., 2026). Cost-based production-function analysis also provides a methodological foundation for examining the relationship between production possibilities and expenditure requirements under specified output restrictions (Malikov et al., 2025). These relationships indicate that long-run cost minimization concerns the most economical feasible production arrangement at each output level rather than the assumption that a larger establishment always produces at a lower unit cost.

The relationship between long-run and short-run average costs can be interpreted through the envelope property of alternative plant-specific cost curves. Each short-run average cost curve represents production expenditure associated with a particular level of fixed capacity, while the long-run average cost curve identifies the lowest attainable unit cost across available capacity choices. Under conventional assumptions, the long-run average cost curve forms a lower envelope of short-run average cost curves and is tangent to the relevant short-run curve at the output where that capacity is optimal (Varian, 2014). The tangency point need not coincide with the minimum of an individual short-run average cost curve because the economically preferred capacity depends on the output level being considered. Along a declining long-run average cost segment, a selected plant may operate below the output associated with its own minimum short-run average cost. The relationship between production scale and average expenditure is particularly relevant to theoretical treatments of multioutput cost functions, where output composition introduces additional complexity (Cesaroni et al., 2026). The envelope interpretation consequently distinguishes cost reductions achieved through improved utilization of existing capacity from those obtained through selecting a different production arrangement (Nicholson & Snyder, 2017).

Economies of scale occur when long-run average cost declines as output increases, indicating that greater production volume can be achieved at progressively lower expenditure per unit. Potential sources include production specialization, more effective utilization of indivisible equipment, improved purchasing arrangements, and the distribution of capacity-related expenditure across larger output volumes. Industry-level research examining economies of scale in cosmetics production provides an empirical application of this cost relationship beyond its conventional theoretical presentation (Bennur & Malhotra, 2023). A constant long-run average cost indicates that unit expenditure remains unchanged as production expands, while diseconomies of scale arise when additional expansion increases average expenditure because of coordination requirements or other operational constraints. Research on corn production further emphasizes the importance of considering efficiency when examining scale-related production outcomes rather than assuming that expansion alone generates cost advantages (Zhang et al., 2025). These cost relationships should also be distinguished from technological returns to scale because changes in input prices and production arrangements can influence expenditure even when the underlying production technology remains unchanged.

The minimum efficient scale identifies the smallest output level at which a firm attains the minimum long-run average cost, providing a benchmark for evaluating production capacity under the assumed technological and market conditions. Before this point, increasing production may reduce average expenditure when economies of scale remain available, whereas further expansion cannot be presumed to generate additional unit-cost reductions. Research on production capacity in open-pit coal mining illustrates how scale considerations can be incorporated into capacity decisions when operating conditions involve uncertainty (Wang et al., 2025). The analysis becomes more complex when firms produce multiple goods because the cost consequences of expansion depend partly on changes in output composition and the possibility of sharing productive resources. Theoretical investigations of ray average cost and multioutput scale economies provide a framework for examining these relationships without treating all combinations of products as economically equivalent (Cesaroni et al., 2026). Research examining economies of scale within production networks introduces another analytical dimension by considering how scale-related relationships interact with market concentration and

interdependent production activities (Betancourt-Gómez, 2026). Minimum efficient scale should consequently be interpreted as a condition derived from a particular cost structure rather than a universally applicable production quantity across industries or technologies.

A numerical illustration permits examination of long-run cost behavior through the hypothetical total cost function $LTC = q^3 - 12q^2 + 60q$, where q represents the quantity of output. Dividing long-run total cost by output yields $LRAC = q^2 - 12q + 60$, while differentiation produces the long-run marginal cost function $LRMC = 3q^2 - 24q + 60$. These relationships allow average and marginal expenditure to be compared across output levels without requiring empirical observations from an operating firm. The ratio LRAC/LRMC provides an indicator of scale economies where marginal cost is positive, with values above one corresponding to declining average cost and values below one corresponding to increasing average cost. Mathematical approaches to dynamic production optimization similarly demonstrate the relevance of cost functions and differentiation in evaluating production choices under specified functional assumptions (Motoyama, 2025). Table 3 preserves the original hypothetical calculations at output levels of three, six, and nine units to illustrate economies of scale, minimum efficient scale, and diseconomies of scale.

Table 3. Hypothetical Illustration of Long-Run Costs

Output (q)	LRAC	LRMC	LRAC/LRMC	Scale condition
3	33	15	2.20	Economies of scale
6	24	24	1.00	Minimum efficient scale
9	33	87	0.38	Diseconomies of scale

The numerical relationships in Table 3 demonstrate how long-run average and marginal costs change as production moves across alternative output levels under the specified hypothetical function. At an output level of three units, long-run average cost equals 33 while marginal cost equals 15, producing an LRAC/LRMC ratio of 2.20 and indicating declining average expenditure as production expands. Increasing output to six units reduces LRAC to 24, where marginal cost also equals 24 and the corresponding ratio reaches 1.00. This output represents the minimum efficient scale because the derivative of LRAC, expressed as $2q - 12$, equals zero at $q = 6$ and its second derivative is positive. At nine units, LRAC increases to 33 while LRMC rises to 87, producing a ratio of approximately 0.38 and indicating diseconomies of scale. These relationships are consistent with the theoretical distinction between economies and diseconomies of scale, although their numerical magnitudes arise exclusively from the assumed cost function rather than empirical production observations (Cesaroni et al., 2026). Figure 2 represents the conceptual envelope relationship between long-run average cost and alternative short-run average cost curves surrounding the minimum efficient scale.

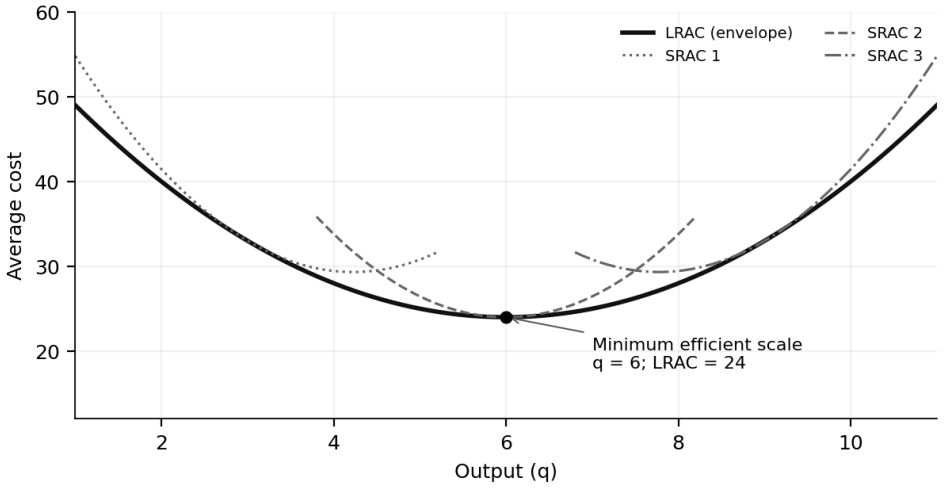


Figure 2. LRAC as an Envelope of Illustrative SRAC Curves

Long-run production efficiency requires distinguishing cost reductions attributable to production scale from improvements associated with input allocation, managerial practices, and technological performance. Research examining economies of scale in corn farming addresses the interaction between production scale and efficiency, indicating that scale-related outcomes warrant evaluation alongside operational performance (Zhang et al., 2025). Evidence concerning technical and economic efficiency in agricultural production also demonstrates the relevance of resource allocation when evaluating whether productive inputs are utilized economically (Irawan et al., 2026). Although the hypothetical cost function identifies a minimum long-run average cost at six output units, this result cannot establish the optimal capacity of an actual firm operating under different input prices, technologies, or market conditions. The envelope representation also depends on assumptions concerning available production arrangements, while real-world capacity adjustments may involve uncertainty, organizational restrictions, and changes in technology. These limitations indicate that long-run cost theory provides a conditional framework for comparing production alternatives, whereas identifying an economically efficient operating scale for a specific enterprise requires appropriately measured production and expenditure data.

Comparison of Production Cost Horizons and Implications for Firm Decisions

Short-run and long-run production cost analysis address different managerial decisions because the flexibility of productive resources changes across the two planning horizons. Short-run analysis examines how firms determine economically appropriate output levels while operating with existing facilities, equipment, and other inputs that cannot be immediately adjusted. Long-run analysis instead concerns the selection of production capacity, technological arrangements, and input combinations that minimize expenditure across alternative output levels. Recent discussions of production cost theory emphasize that distinguishing fixed and variable inputs is essential for interpreting cost behavior under different production conditions (Simanjuntak et al., 2025). Research on production-function estimation using cost information further demonstrates the relationship between technological restrictions and the expenditure required to achieve specified production outcomes (Malikov et al., 2025). The central distinction concerns whether firms are optimizing production within an existing capacity constraint or selecting the economically appropriate capacity itself, making the two cost frameworks complementary rather than interchangeable.

Differences between the production horizons are reflected in the composition of costs, the behavior of average expenditure, and the economic mechanisms underlying cost-curve relationships. In the short run, total expenditure comprises fixed and variable costs, while average total cost reflects the combined influence of fixed-cost distribution and changes in variable-input productivity. Long-run expenditure incorporates adjustments to all productive inputs, enabling firms to evaluate alternative operating capacities through the relationship between output and minimum attainable average cost. The conventional U-shaped short-run average cost curve is associated with fixed-input constraints and diminishing marginal returns, whereas the long-run average cost curve reflects scale-related expenditure relationships (Varian, 2014). Research on multioutput scale economies demonstrates that these relationships may become more complex when production involves several goods with different resource requirements (Cesaroni et al., 2026). Demand uncertainty also complicates cost planning because fluctuations in required output can interact with expenditure commitments and operational arrangements (Chen et al., 2024). Table 4 summarizes the original theoretical comparison by retaining the distinctions concerning input flexibility, cost classification, cost-curve behavior, and production decisions.

Table 4. Comparison of Short-Run and Long-Run Production Costs

Dimension	Short run	Long run
Input flexibility	Some inputs are fixed; others are variable	All inputs are variable
Types of costs	Fixed and variable costs	All inputs adjustable; no fixed inputs
Source of cost-curve shape	Diminishing marginal returns	Economies and diseconomies of scale

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Average cost curve	U-shaped SRAC (ATC)	LRAC as the envelope of SRAC curves
Relationship between curves	One SRAC curve for each plant size	LRAC touches the SRAC curves from below
Decision-making focus	Output level under existing capacity	Plant scale and productive capacity

Short-run production decisions require firms to evaluate the additional revenue and expenditure associated with marginal changes in output while maintaining their existing productive capacity. Under the conventional profit-maximization framework, an interior optimal output satisfies the equality between marginal revenue (MR) and marginal cost (MC), provided that the relevant conditions for a profit maximum are fulfilled. For a perfectly competitive price-taking firm, marginal revenue equals the prevailing market price, allowing the decision rule to be expressed as P = MC at an appropriate operating optimum (Pindyck & Rubinfeld, 2018). Mathematical applications of marginal cost functions demonstrate how differentiation can identify candidate production levels associated with profit maximization under specified revenue and cost relationships (Nabilla & Nursanti, 2024). Nevertheless, equality between marginal revenue and marginal cost does not independently establish that production should continue because the firm must also compare the financial consequences of operating with those of temporarily suspending production. Research examining fixed costs and price–cost margins reinforces the importance of expenditure commitments when interpreting profitability and distinguishing the economic implications of different cost structures (Abraham et al., 2024).

Temporary shutdown decisions depend on the relationship between market revenue and costs that can be avoided by suspending production within the relevant operating period. Fixed costs that remain unavoidable during temporary closure do not disappear when production stops, whereas variable expenditures associated with operating activities can generally be avoided. Under the conventional perfectly competitive framework, a firm earning sufficient revenue to cover average variable cost may continue production even when the market price remains below average total cost (Nicholson & Snyder, 2017). When the market price equals or exceeds average total cost at the selected output, the firm covers its economic production costs and may earn a nonnegative economic profit. If the market price falls below the minimum attainable average variable cost, temporary shutdown becomes preferable because operating would generate a greater loss than the unavoidable fixed-cost commitment (Mankiw, 2018). At the minimum average variable cost, a firm may be indifferent between operating and temporary shutdown under the simplified assumptions of the standard competitive model. Managerial interpretations of production costs consequently require separating avoidable expenditures from committed costs rather than treating every accounting expense as equally relevant to short-run operating decisions (Nessa & Supriyanto, 2026).

The hypothetical short-run cost function introduced previously, $TC = 100 + 10q + q^2$, provides a numerical illustration of production decisions under alternative market prices. Its marginal cost function, $MC = 10 + 2q$, permits the competitive firm's candidate output to be calculated using the condition P = MC whenever positive production is economically justified. At a market price of 50, the resulting output equals 20 units, generating total revenue of 1,000 and total cost of 700, with a positive economic profit of 300. When the market price decreases to 25, the candidate output falls to 7.5 units, generating total revenue of 187.5 against total cost of 231.25 and producing an economic loss of 43.75. At a market price of 8, positive production cannot cover average variable cost because $AVC = 10 + q$ exceeds the prevailing price for every positive output level. Table 5 reproduces the original hypothetical production outcomes and corresponding operating decisions, demonstrating the use of marginal cost analysis in evaluating production and temporary shutdown choices (Nabilla & Nursanti, 2024).

Table 5. Short-Run Production Decisions at Three Hypothetical Prices

Price (P)	Output (P = MC)	Revenue	TC	Profit/loss	Decision
50	20	1,000	700	+300	Produce
25	7.5	187.5	231.25	−43.75	Produce; loss below TFC of 100
8	No positive output	0	100	−100	Shut down; P < minimum AVC of 10

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The numerical results in Table 5 illustrate how the relationship between market prices and production costs determines whether continued operation is economically justified. At a price of 50, the firm produces 20 units and earns an economic profit of 300, indicating that revenue exceeds both variable expenditure and the fixed-cost commitment. Reducing the price to 25 results in an economic loss of 43.75, but continued production remains preferable because the loss is smaller than the fixed cost of 100 that would remain payable during temporary closure. The latter decision demonstrates that operating at an accounting or economic loss does not automatically require shutdown when revenue contributes toward unavoidable fixed costs (Pindyck & Rubinfeld, 2018). At a price of 8, production is discontinued because the market price falls below the minimum average variable cost of 10, making the unavoidable fixed-cost loss of 100 economically preferable to operating. For the specified function, minimum average variable cost is approached as output tends toward zero, rather than occurring at a positive production level, which distinguishes the illustration from more general cost functions exhibiting initially declining average variable costs. These calculations are conditional demonstrations of the conventional competitive production model and do not establish actual operating decisions, cost parameters, or profit outcomes for a particular firm.

Long-run production decisions involve the selection of economically appropriate capacity rather than adjustments limited to the utilization of existing production facilities. Under the conventional perfectly competitive framework with identical firms, free entry, and unchanged technology and input prices, long-run equilibrium tends toward a market price equal to minimum long-run average cost when firms operate at an efficient scale (Varian, 2014). The hypothetical long-run function presented in Table 3 identifies a minimum long-run average cost of 24 at an output level of six units, where LRAC and LRMC are equal. This result identifies the minimum efficient scale for the assumed function but does not imply that every operating firm should independently choose six units regardless of market prices, revenue conditions, or technological differences. Research on corn production demonstrates the relevance of efficiency to the relationship between production scale and economic performance, indicating that expansion should not be interpreted as an automatic source of lower unit costs (Zhang et al., 2025). Production-capacity analysis under uncertainty further indicates that long-run investment decisions must account for changing operational requirements and the economic consequences of alternative capacity arrangements (Wang et al., 2025).

The conceptual comparison establishes that short-run cost minimization, profit-maximizing output selection, and long-run production-scale decisions address related but analytically distinct economic problems. Managers operating under fixed-capacity constraints must evaluate marginal production expenditure and avoidable costs, while long-run planning requires the assessment of input flexibility, capacity investment, and attainable average expenditure. Research on price–cost margins indicates that fixed-cost commitments and market conditions complicate profitability assessments, particularly when firms possess pricing power and marginal revenue differs from the market price (Abraham et al., 2024). The influence of demand uncertainty on cost structures further suggests that production planning cannot rely exclusively on deterministic cost relationships when output requirements and operating conditions fluctuate (Chen et al., 2024). Empirical research concerning production costs and profitability in the bakery and cake industry provides an illustration of the practical relevance of cost analysis, although industry-specific findings cannot independently establish the general validity of a particular theoretical cost function (Saragih et al., 2018). The basic framework also simplifies differences among technologies, input adjustment periods, multiproduct operations, and organizational arrangements that can influence realized production expenditure. Further empirical investigation using firm-level cost records, input quantities, production volumes, and capacity information would be necessary to assess the applicability of the theoretical relationships across industries and to estimate the economic consequences of alternative production decisions.

CONCLUSION

The review establishes input adjustability as the principal distinction between short-run and long-run production costs within microeconomic theory. In the short run, fixed and variable inputs coexist, while changes in production volume influence total, average, and marginal costs through their relationships with input productivity. Diminishing marginal returns eventually increase marginal cost, whereas the distribution of fixed expenditure across additional output units contributes to the

conventional U-shaped average total cost curve. Under standard differentiable cost assumptions, marginal cost intersects average variable cost and average total cost at their respective interior minimum points. The hypothetical short-run function demonstrates that average total cost reaches its minimum of 30 at an output level of 10 units, although average variable cost increases throughout the positive output range. In the long run, all production inputs become adjustable, allowing firms to select alternative capacities, with the long-run average cost curve forming the lower envelope of feasible short-run average cost curves. The hypothetical long-run function identifies a minimum average cost of 24 at six output units, illustrating the distinction between economies and diseconomies of scale without establishing an optimal production scale for actual firms.

These theoretical distinctions have implications for operational management, production planning, and the allocation of productive resources across different decision-making horizons. Short-run output decisions depend on the equality between marginal revenue and marginal cost at an appropriate profit-maximizing output, while temporary shutdown decisions depend on whether market revenue can cover avoidable production costs. The hypothetical calculations demonstrate that continued production may remain economically preferable despite operating losses, whereas prices below minimum average variable cost justify temporary shutdown under conventional competitive assumptions. Long-run decisions instead require evaluating production capacity, cost-minimizing input combinations, and the potential benefits and limitations of expanding operational scale. The conceptual contribution of this review lies in integrating cost classifications, marginal analysis, production flexibility, and scale economies into a comparative framework that distinguishes short-run efficiency from long-run capacity optimization. Its conclusions remain conditional upon established microeconomic assumptions and hypothetical cost functions, without providing empirical estimates of production costs, technological efficiency, or profitability across actual enterprises. Future research should employ firm-level expenditure records, production quantities, input utilization data, and econometric cost-function estimation to evaluate these relationships and identify industry-specific economies of scale, particularly among Indonesian manufacturing and agricultural enterprises.

REFERENCES

Abraham, F., Bormans, Y., Konings, J., & Roeger, W. (2024). Price-cost margins, fixed costs and excess profits. *The Economic Journal, 134*(663), 2655–2684. https://doi.org/10.1093/ej/ueae037

Aji, J. M. M., Rondhi, M., Suwandari, A., Hapsari, T. D., Januar, J., Yanuarti, R., & Rokhani. (2023). Determinants of cost inefficiency and farmer performance in broiler contract farming. *Tropical Animal Science Journal, 46*(3), 382–388. https://doi.org/10.5398/tasj.2023.46.3.382

Ayuningtyas, R. R., Ekowati, T., & Prastiwi, W. D. (2022). Added value of soybean into tempeh chips in Kedungjenar home industry centre, Blora Regency. *Jurnal Manajemen dan Agribisnis, 19*(3), 481. https://doi.org/10.17358/jma.19.3.481

Bennur, S., & Malhotra, D. K. (2023). Scaling up beauty: An analysis of economies of scale in the cosmetics industry. *Journal of Applied Business and Economics, 25*(2), 243–251. https://doi.org/10.33423/jabe.v25i2.6110

Betancourt-Gómez, M. E. (2026). The impact of market concentration and economies of scale on production networks: A new nonlinear input–output framework. *Economic Systems Research, 38*(2), 218–234. https://doi.org/10.1080/09535314.2025.2581177

Cesaroni, G., Kerstens, K., Sadeghi, J., & Van de Woestyne, I. (2026). The shape of ray average cost and its role in multioutput scale economies: Some generalizations. *Applied Economics, 58*(39), 8179–8194. https://doi.org/10.1080/00036846.2025.2536874

Chen, C. X., Liang, J., Yang, S., & Zhu, J. (2024). The bullwhip effect, demand uncertainty, and cost structure. *Contemporary Accounting Research, 41*(1), 195–225. https://doi.org/10.1111/1911-3846.12908

Diewert, W. E., Nomura, K., & Shimizu, C. (2025). Estimating flexible functional forms using macroeconomic data. *Empirical Economics, 69*, 2671–2697. https://doi.org/10.1007/s00181-025-02727-y

Hernawati, H., Syaukat, Y., Firdaus, M., & Suwarsinah, H. K. (2023). The impact of irrigation on the allocative and economic efficiencies on rice farming: A case study in West Nusa Tenggara Province. *Jurnal Manajemen dan Agribisnis, 20*(3), 491. https://doi.org/10.17358/jma.20.3.491

.

Irawan, F. W., Setiadi, A., & Auralia, M. (2026). Technical and economic efficiency analysis of cayenne pepper farming in Magelang Regency, Central Java. *Jurnal Manajemen dan Agribisnis, 23*(2), 166–178. https://doi.org/10.17358/jma.23.2.166

Lee, S., & Kang, N. (2026). Modular mechanism design optimization in large-scale systems with manufacturing cost considerations. *International Journal of Precision Engineering and Manufacturing-Green Technology, 13*(2), 565–589. https://doi.org/10.1007/s40684-025-00770-9

Maharani, I., Kusnadi, N., & Fariyanti, A. (2024). The impact of credit constraint on productivity and technical efficiency of sugarcane in Indonesia. *Jurnal Manajemen dan Agribisnis, 21*(1), 35. https://doi.org/10.17358/jma.21.1.35

Malikov, E., Zhao, S., Kumbhakar, S. C., & Bernstein, D. H. (2025). Estimating production functions using costs when outputs are restricted. *Econometric Reviews, 44*(4), 433–461. https://doi.org/10.1080/07474938.2024.2419389

Mankiw, N. G. (2018). *Principles of Microeconomics* (8th ed.). Cengage Learning.

Mas-Colell, A., Whinston, M. D., & Green, J. R. (1995). *Microeconomic Theory*. Oxford University Press.

Mohammad Nor, N. A. A., Buda, M., Mohd Nor, N., Wong, K. S. K., Sharifuddin, J., & Suhaimee, S. (2024). Cost efficiency analysis of broiler production in Peninsular Malaysia. *Tropical Animal Science Journal, 47*(3), 402–408. https://doi.org/10.5398/tasj.2024.47.3.402

Motoyama, Y. (2025). A dynamic optimization model considering cost and speed in the Cobb-Douglas production function. *Decision Analytics Journal, 14*, Article 100535. https://doi.org/10.1016/j.dajour.2024.100535

Mufahamah, E., Fitriani, W., & Pramesti, P. R. (2026). *Pengambilan Keputusan Biaya: Dasar Membangun Perusahaan yang Menguntungkan*. Detak Pustaka.

Nabilla, Z. S., & Nursanti, Y. B. N. B. (2024). Penerapan limit fungsi mencari keuntungan maksimum dari biaya marginal. *Eqien-Jurnal Ekonomi dan Bisnis*, *13*(02), 168-176. https://doi.org/10.34308/eqien.v13i02.1624

Nazri, F. A., Tinaprilla, N., Fariyanti, A., & Baga, L. M. (2026). Technical efficiency and profitability of smallholder dairy cattle farming post-FMD: A stochastic frontier analysis in West Java. *Jurnal Manajemen dan Agribisnis, 23*(1), 17–31. https://doi.org/10.17358/jma.23.1.17

Nessa, M. L., & Supriyanto. (2026). Teori biaya dalam pengambilan keputusan manajerial: Kajian systematic literature review. *Jurnal Pendidikan Sosial dan Humaniora, 5*(2), 2444–2458. https://publisherqu.com/index.php/pediaqu/article/view/4221

Nicholson, W., & Snyder, C. (2017). *Microeconomic Theory: Basic Principles and Extensions* (12th ed.). Cengage Learning.

Palatnik, R. R., Freer, M., Levin, M., Golberg, A., & Zilberman, D. (2023). Algae-based two-stage supply chain with co-products. *Ecological Economics, 207*, Article 107781. https://doi.org/10.1016/j.ecolecon.2023.107781

Pindyck, R. S., & Rubinfeld, D. L. (2018). *Microeconomics* (9th ed.). Pearson.

Rosidah, A., Irham, Masyhuri, & Perwitasari, H. (2023). Sugarcane production efficiency: A case study on PTPN X partner farmers. *Jurnal Manajemen dan Agribisnis, 20*(1), 56. https://doi.org/10.17358/jma.20.1.56

Saragih, R., Teguh, M., & Harunurrasyid. (2018). Pengaruh biaya produksi terhadap keuntungan industri roti dan kue di Kota Palembang. *Jurnal Ekonomi Pembangunan, 16*(1), 27–33. https://doi.org/10.29259/jep.v16i1.8875

Simanjuntak, N., Ginting, I. D. B., Padang, P., Sihombing, A. A., & Siringoringo, E. (2025). Teori biaya (short run long-run). *Jurnal Manuhara: Pusat Penelitian Ilmu Manajemen dan Bisnis, 3*(3), 41–51. https://doi.org/10.61132/manuhara.v3i3.1848

Sukirno, S. (2016). *Pengantar Teori Mikroekonomi [Introduction to microeconomic theory]* (3rd ed.). RajaGrafindo Persada.

Tinaprilla, N., Muflikh, Y. N., Yanuar, R., & Permata, K. I. (2024). The roles of smart fertigation in chili farming. *Jurnal Manajemen dan Agribisnis, 21*(1), 95. https://doi.org/10.17358/jma.21.1.95

Varian, H. R. (2014). *Intermediate Microeconomics: A Modern Approach* (9th ed.). W. W. Norton & Company.

.

Wang, S., Cao, B., Bai, R., & Liu, G. (2025). Determination of production capacity for open-pit coal mines under uncertainty: A model based on economies of scale. *PLOS ONE, 20*(1), Article e0312130. https://doi.org/10.1371/journal.pone.0312130

Wijaya, A., Rifin, A., & Hartoyo, S. (2022). Determining technical and resource-use efficiency in rice production in East Java. *Jurnal Manajemen dan Agribisnis, 19*(1), 48. https://doi.org/10.17358/jma.19.1.48

Zhang, N., Zhang, Q., & Geng, X. (2025). Revisiting economies of scale: The moderating role of efficiency in corn farming. *Frontiers in Sustainable Food Systems, 9*, Article 1621038. https://doi.org/10.3389/fsufs.2025.1621038