# Industry Analysis: Supermarkets

## Idea In Short

Supermarkets converts food and household merchandise, suppliers, labor, stores, refrigeration, logistics and data into outputs that customers can purchase, regulate, finance, or operationalize. The strategic priority is to defend the point in the value chain where scarce capability, customer access, or operating scale creates pricing power. Margin tends to accrue to firms that control store density, purchasing scale, private labels, loyalty data, local convenience and supply-chain execution, while standardized activity remains exposed to procurement and substitution. The sector matters because it coordinates procurement, assortment, replenishment, merchandising, fulfillment and store operations for households, foodservice buyers and local communities and its economics are being reshaped by private-label growth, online grocery, automation, retail media, value-seeking and fresh-food differentiation. Bargaining power is shifting as technology changes distribution, regulation changes participation and customers gain more ways to compare or replace suppliers.

Supermarkets can be analyzed as a set of linked economic stages rather than as a single market label. The sector coordinates food and household merchandise, suppliers, labor, stores, refrigeration, logistics and data, transforms them through procurement, assortment, replenishment, merchandising, fulfillment and store operations and reaches customers through physical stores, pickup, delivery and e-commerce grocery channels. The strategic question is where value becomes scarce, who controls that scarcity and how technology or regulation can change the answer.

## Industry at a glance

Definition and scope. This analysis covers grocery retailers operating supermarkets, hypermarkets, neighborhood stores and related omnichannel grocery services; excludes food manufacturing and wholesale distribution. The boundary matters because adjacent activities can have different regulation, capital intensity, customer economics and profit pools. Keeping the scope narrow makes the competitive diagnosis more useful for

executives deciding where to invest, partner, automate, or exit.

Economic role. The sector serves households, foodservice buyers and local communities. It depends on food and household merchandise, suppliers, labor, stores, refrigeration, logistics and data and reaches demand through physical stores, pickup, delivery and e-commerce grocery channels. Its output is valuable when it improves customer economics, reduces risk, increases access, or satisfies a requirement that customers cannot easily meet internally.1

Indicative metrics. Common revenue patterns include product margin, private-label margin, retail media, memberships, delivery fees and supplier-funded promotions. Capital intensity is shaped by distribution centers, cold chain, payment systems, supplier networks and food regulation, while labor intensity depends on how much procurement, assortment, replenishment, merchandising, fulfillment and store operations can be standardized. Regulation intensity is driven by the cost of maintaining compliance, safety, data, licensing, or quality requirements.2

## Industry segmentation

The sector separates into distinct operating models because customers buy different forms of value and because the location of scarce resources changes across the value chain. The relevant segments below are useful for comparing economics without treating the whole industry as one market.

1. Traditional supermarkets: The segment emphasizes a different combination of food and household merchandise, suppliers, labor, stores, refrigeration, logistics and data and customer requirements. Its economics depend on the degree of differentiation, operating scale and customer switching cost.

2. Hypermarkets and supercenters: The segment emphasizes a different combination of food and household merchandise, suppliers, labor, stores, refrigeration, logistics and data and customer requirements. Its economics depend on the degree of differentiation, operating scale and customer switching cost.

3. Discount grocers: The segment emphasizes a different combination of food and household merchandise, suppliers, labor, stores, refrigeration, logistics and data and

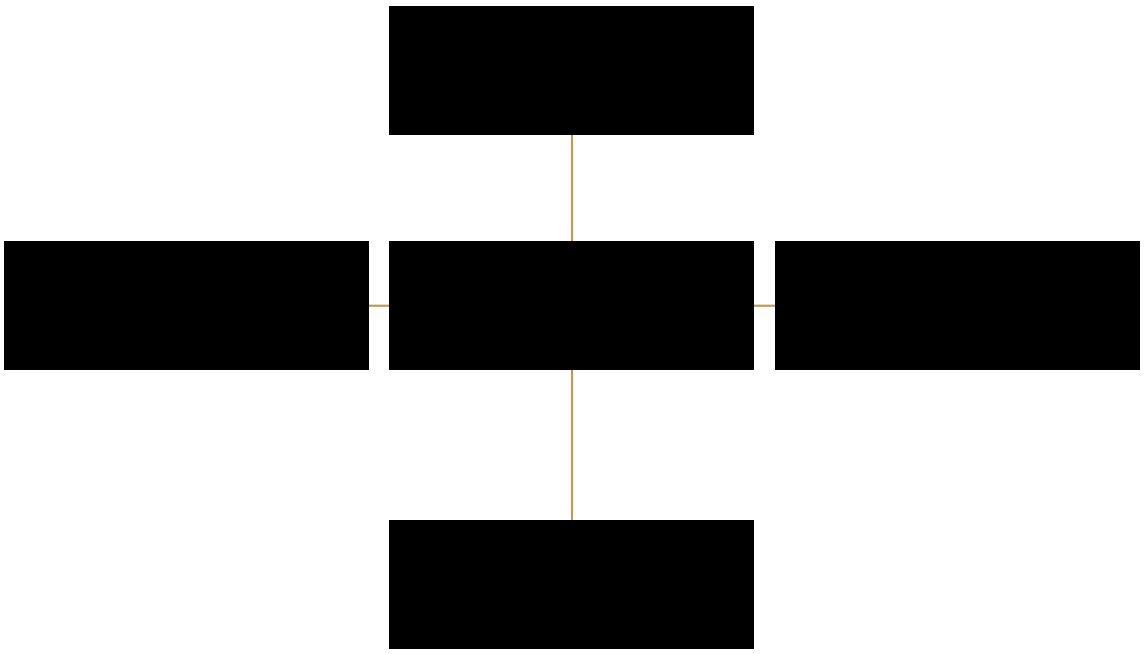
customer requirements. Its economics depend on the degree of differentiation, operating scale and customer switching cost.

4. Natural and specialty grocers: The segment emphasizes a different combination of food and household merchandise, suppliers, labor, stores, refrigeration, logistics and data and customer requirements. Its economics depend on the degree of differentiation, operating scale and customer switching cost.

5. Online and omnichannel grocery: The segment emphasizes a different combination of food and household merchandise, suppliers, labor, stores, refrigeration, logistics and data and customer requirements. Its economics depend on the degree of differentiation, operating scale and customer switching cost.

## Market structure: Porter's Five Forces

The Five Forces analysis shows how store density, purchasing scale, private labels, loyalty data, local convenience and supply-chain execution, customer concentration, supplier constraints and substitution interact. The forces are dynamic: technology can lower entry costs, regulation can raise them and consolidation can alter buyer and supplier power simultaneously. The objective is to identify which structural variable is most likely to change the industry's profit pool over the next planning cycle.3



Porter's Five Forces for Supermarkets

## Bargaining power of buyers

Customer power in Supermarkets depends on concentration, switching cost, procurement sophistication and the consequences of service failure. Buyers include households, foodservice buyers and local communities. Large or professional buyers can pressure price when offers are comparable, but their leverage falls when a provider controls a scarce capability, delivers high reliability, or becomes embedded in assortment, price, promotions, loyalty, private labels and service. In this industry, the key variable is not buyer size alone. It is the buyer's credible outside option and the time required to move to it. Management should track renewal behavior, price realization, concentration and the share of revenue exposed to formal procurement.

| Dimension | Observation |
| --- | --- |
| Concentration | Large accounts can represent a material share of demand in households |
| Switching friction | Moving away from an embedded assortment, price, promotions, loyalty, private labels and service relationship can |

| Dimension | Observation |
| --- | --- |
| | impose operational cost |
| Price transparency | Comparable offers make formal procurement more effective |
| Outcome sensitivity | Reliability and failure costs can outweigh headline price |

Bargaining power of buyers

## Bargaining power of suppliers

Supplier power in Supermarkets comes from the scarcity and substitutability of food and household merchandise, suppliers, labor, stores, refrigeration, logistics and data. Critical suppliers may include people, technology vendors, infrastructure owners, raw-material producers, or regulated service providers. Power rises when qualification is slow, switching interrupts operations, or a supplier controls a bottleneck. It falls when the buyer can standardize specifications, dual-source, redesign the process, or build capability internally. The most exposed firms map supplier concentration to the economic cost of disruption rather than relying on a generic procurement score.

| Dimension | Observation |
| --- | --- |
| Input scarcity | food and household merchandise, suppliers, labor, stores, refrigeration, logistics and data become leverage points when supply is specialized or constrained |
| Qualification time | Validation, training, or redesign can delay replacement |
| Concentration | A narrow supplier base can move margin upstream |
| Mitigation | Dual sourcing, redesign, integration, or long-term contracts can reduce exposure |

Bargaining power of suppliers

## Rivalry among existing competitors

Rivalry is shaped by the number and strength of competitors, the degree of product differentiation, fixed costs and the intensity of customer switching. Firms compete across physical stores, pickup, delivery and e-commerce grocery channels and increasingly around store density, purchasing scale, private labels, loyalty data, local convenience and supply-

chain execution. High fixed costs or excess capacity can push competitors toward discounting. Strong differentiation can redirect rivalry toward quality, service, ecosystem access, or brand. Management should distinguish temporary price competition from a structural decline in willingness to pay.

| Dimension | Observation |
|---|---|
| Market shape | Scale players and focused specialists can compete in different segments |
| Differentiation | Competition can shift toward store density, purchasing scale, private labels, loyalty data, local convenience and supply-chain execution rather than price |
| Capacity economics | High fixed costs can intensify price competition when demand weakens |
| Consolidation | M&A can change coverage, purchasing power and investment capacity |

Rivalry among existing competitors

## Threat of new entrants

Entry into Supermarkets requires more than a product. A credible entrant must assemble distribution centers, cold chain, payment systems, supplier networks and food regulation and earn trust in a market where customers already have alternatives. Digital tools can reduce launch costs, but regulation, integration, capital requirements, customer acquisition and operating reliability can preserve incumbent advantages. Entry is most plausible when a new model removes a constraint, targets a neglected segment, or uses a lower-cost distribution mechanism. Incumbents should therefore monitor business-model innovation rather than only direct competitors.

| Dimension | Observation |
|---|---|
| Capital needs | Entry may require investment in distribution centers, cold chain, payment systems, supplier networks and food regulation |
| Credibility | References, approvals, or operating history can reduce buyer risk |
| Technology | Digital delivery can lower the cost of serving a narrow segment |

| Dimension | Observation |
| --- | --- |
| Scale | Incumbents can spread compliance and platform costs across larger revenue bases |

Threat of new entrants

## Threat of substitutes

Substitution occurs when customers solve the underlying need through another product, workflow, technology, or internal capability. Relevant alternatives to Supermarkets can emerge from adjacent sectors and from changes in customer behavior. Substitution risk increases when the industry's output becomes standardized and easy to compare. It decreases when the service is embedded in a workflow, carries high failure costs, or depends on trusted infrastructure. Management should track the customer's total process and the economic attractiveness of alternatives, not just conventional competitors.

| Dimension | Observation |
| --- | --- |
| Internalization | Customers may bring selected activities in-house |
| Adjacent technology | New tools can alter the preferred workflow |
| Behavior change | Customers can change channels or consumption patterns |
| Integration | Deep embedding in assortment, price, promotions, loyalty, private labels and service can make replacement slower |

Threat of substitutes

## Value chain and profit pools

The value chain in Supermarkets can be read through five recurring stages: upstream inputs, production or processing, distribution and logistics, the customer interface and enabling infrastructure. The precise activities differ by segment, but the economic logic is consistent. Profit follows control over scarce resources, customer access, or operating density rather than following the number of activities a firm performs.

## Upstream inputs

Food and household merchandise, suppliers, labor, stores, refrigeration, logistics and data. The key question is whether supply is abundant, differentiated, or constrained. Qualification

and switching costs can transfer bargaining power upstream. In Supermarkets, management should map revenue, contribution margin, working capital and capital employed to this stage instead of treating the industry as a single pool.

## Production and processing

Procurement, assortment, replenishment, merchandising, fulfillment and store operations. Scale matters when it lowers unit cost, improves yield, or increases utilization. Automation matters when it changes the economics of the process rather than merely reducing headcount. In Supermarkets, management should map revenue, contribution margin, working capital and capital employed to this stage instead of treating the industry as a single pool.

## Distribution and logistics

Physical stores, pickup, delivery and e-commerce grocery channels. Distribution creates advantage when density, reliability, speed, or access lowers the delivered cost of serving customers. In Supermarkets, management should map revenue, contribution margin, working capital and capital employed to this stage instead of treating the industry as a single pool.

## Customer interface

Assortment, price, promotions, loyalty, private labels and service. The interface determines who owns the relationship, data, renewal decision and pricing conversation. This can capture more value than the underlying production step. In Supermarkets, management should map revenue, contribution margin, working capital and capital employed to this stage instead of treating the industry as a single pool.

## Enabling infrastructure

Distribution centers, cold chain, payment systems, supplier networks and food regulation. Infrastructure can create barriers through standards, licenses, network access, financing, or compliance systems that competitors cannot reproduce quickly. In Supermarkets, management should map revenue, contribution margin, working capital and capital employed to this stage instead of treating the industry as a single pool.

## Profit pool

Profit in Supermarkets tends to concentrate where customers face meaningful consequences from failure and where suppliers control scarce capability. That favors businesses with store density, purchasing scale, private labels, loyalty data, local convenience and supply-chain execution. Standardized work remains necessary, but it is more exposed to procurement and substitution. Profit pools can shift when private-label growth, online grocery, automation, retail media, value-seeking and fresh-food differentiation alter customer willingness to pay or change which capabilities are scarce.4

A useful management view separates transaction margin, recurring-service margin and the economic value of customer access. This prevents a common error: treating revenue growth as evidence that the firm controls the attractive part of the value chain. The better question is whether incremental revenue improves price realization, utilization, retention, or return on capital.

## Industry economics and business models

Money is made in Supermarkets through a small set of recurring patterns. The sector supports product margin, private-label margin, retail media, memberships, delivery fees and supplier-funded promotions. Each pattern allocates risk differently across demand, capacity, input prices and customer behavior. Fixed-price commitments transfer delivery risk to providers, while usage-based pricing shifts volume risk toward customers; recurring contracts can improve predictability but may constrain upside when market conditions move sharply.

Business model design should match the pricing unit to the economic value created. Customers may be buying capacity, access, certainty, expertise, performance, or an outcome. Pricing the wrong unit can increase revenue while adding service complexity and weakening returns.

## Cost drivers & scalability

The main cost base includes merchandise, labor, rent, refrigeration, logistics, shrink, technology and waste. Fixed costs matter when facilities, platforms, specialist teams, or infrastructure must remain available regardless of volume. Variable costs rise with units,

transactions, usage, or customer activity. The strategic task is to identify where scale lowers unit cost and where scale instead adds coordination cost.

Scale is valuable when it improves procurement, utilization, data density, network coverage, or service quality. Scope is valuable when one capability can support adjacent products without duplicating the cost base. The flywheel is strongest when better delivery improves trust or engagement, which improves retention and utilization, which then funds further process investment.

Unit economics should connect operating drivers to customer economics. Service models should monitor utilization, productive capacity, quality and retention. Digital models should track acquisition cost, infrastructure cost, engagement and lifetime value where applicable. Asset-heavy models should isolate throughput, yield, downtime and return on capital.

## Moats, advantages and strategic levers

Defensibility in Supermarkets can come from cost advantage, differentiation, network effects, switching costs, regulatory access, or data and learning. The strongest sector-specific sources are store density, purchasing scale, private labels, loyalty data, local convenience and supply-chain execution. A moat is credible only when it changes customer choice or competitor economics.

Cost advantage can arise from scale, location, process design, utilization, or procurement. Differentiation can come from quality, reliability, brand, specialized knowledge, or workflow integration. Network effects matter when additional users improve the value of the system, while switching costs arise when replacing a provider requires migration, retraining, qualification, redesign, or loss of accumulated data.

Regulatory moats are strongest when compliance requires time, evidence, or operating history. Data moats become meaningful when repeated activity improves prediction, quality, or workflow performance. Management should not label ordinary customer relationships as moats unless those relationships survive a credible competing offer.

## Strategic levers

An entrant or incumbent can pull several levers, but each should be tied to a clear economic

hypothesis. The objective is to improve price realization, lower delivered cost, increase retention, or gain control over a scarce input or customer interface. This section should be read with the firm's specific operating model and customer mix in view. The relevant management test is whether the stated mechanism improves economics under plausible competitive conditions.

## Customer segment focus

Prioritize customers for whom store density, purchasing scale, private labels, loyalty data, local convenience and supply-chain execution has measurable value rather than pursuing the largest theoretical market. The decision should have a measurable leading indicator and an explicit review point. Growth initiatives become expensive when management cannot state which structural variable they are changing.

## Product scope

Decide whether to own the full workflow around procurement, assortment, replenishment, merchandising, fulfillment and store operations or dominate one high-value step. The decision should have a measurable leading indicator and an explicit review point. Growth initiatives become expensive when management cannot state which structural variable they are changing.

## Integration versus partnering

Integrate when control of food and household merchandise, suppliers, labor, stores, refrigeration, logistics and data or distribution centers, cold chain, payment systems, supplier networks and food regulation changes economics; partner when scale or access is more valuable than ownership. The decision should have a measurable leading indicator and an explicit review point. Growth initiatives become expensive when management cannot state which structural variable they are changing.

## Geographic or channel expansion

Expand where customer density and supply conditions improve the economics of physical stores, pickup, delivery and e-commerce grocery channels. The decision should have a measurable leading indicator and an explicit review point. Growth initiatives become

expensive when management cannot state which structural variable they are changing.

## Ecosystem orchestration

Use standards, platforms, data, or partnerships to become a coordination point for assortment, price, promotions, loyalty, private labels and service. The decision should have a measurable leading indicator and an explicit review point. Growth initiatives become expensive when management cannot state which structural variable they are changing.

## Structural risks, regulation and trends

Structural risk in Supermarkets comes from thin margins, food inflation, labor costs, shrink, supplier power and intense local competition. Regulatory change can alter who may participate, what evidence is required and which costs are unavoidable. Technology can change the relative economics of labor, capital, distribution, or customer acquisition. Supply shocks can change which side of the market holds bargaining power.5

Demand should be modeled through customer budgets, demographics, technology adoption, replacement cycles and regulatory requirements where relevant. Supply should be modeled through capacity additions, consolidation, labor availability, productivity and investment timing. That approach is more useful than relying on a single market forecast.

Three scenarios are useful. In the base case, private-label growth, online grocery, automation, retail media, value-seeking and fresh-food differentiation continue at a measured pace and incumbents adapt. In a compression case, price transparency or automation reduces differentiation faster than expected. In a scarcity case, regulation, supply disruption, or concentrated capacity shifts power toward scarce resources. A resilient strategy remains viable across all three.

## Strategic playbook

A new entrant should begin with a narrow customer problem where incumbent cost structures or workflows are poorly matched to the need. The wedge should exploit a specific friction in assortment, price, promotions, loyalty, private labels and service or a change created by private-label growth, online grocery, automation, retail media, value-seeking and fresh-food differentiation. Build-versus-buy decisions should follow the source

of defensibility. Proprietary process knowledge often favors internal development; broad infrastructure often favors partnerships.

Incumbents should defend the part of the business that owns customer trust and recurring economics, then redesign low-differentiation work. Technology investment should lower cycle time, error rates, or delivered cost without weakening the capability customers still value. Portfolio reviews should ask which products improve bargaining power and which simply add revenue.

Executives should establish leading indicators such as win rate, price realization, retention, supplier concentration, utilization, quality, working capital and return on incremental capital. Those measures reveal structural change earlier than revenue growth alone.

## Operating discipline

The economics of supermarkets become clearer when management separates structural drivers from temporary operating conditions. A strong year can come from favorable demand, constrained supply, unusual pricing, or a competitor's execution problem. Those conditions can support earnings without strengthening the underlying position. Management should therefore track the variables that remain relevant when the cycle turns: customer retention, price realization, utilization, conversion cost, working capital and the return generated by incremental investment. These measures reveal whether the organization is becoming more efficient or simply benefiting from the market. They also help distinguish a genuine competitive advantage from a temporary scarcity premium. A useful operating review connects commercial outcomes to the process that produces them, so changes in revenue can be traced to volume, mix, price, productivity, or capacity rather than being treated as one aggregate result.

## Investment choices

Capital allocation should follow the same logic. Investment in capacity is attractive when the organization has evidence of durable demand and can earn an acceptable return after maintenance, working capital and compliance costs. Technology investment is attractive when it changes throughput, quality, labor productivity, customer acquisition, or switching costs. Partnerships are attractive when another party owns infrastructure or distribution that would take too long to reproduce. Acquisitions can accelerate capability, but they also

introduce integration risk and can inflate the price paid for assets whose scarcity is temporary. Management teams should state the economic mechanism before approving major investment. That discipline is especially useful in supermarkets, where changes in technology, regulation, or customer behavior can make yesterday's bottleneck less scarce. The best investment is not the one with the largest addressable market; it is the one that strengthens the firm's position under plausible future conditions.

## Customer economics

Customer economics provide a second lens on strategy. A provider can appear differentiated internally while customers view the offer as interchangeable. The test is what the customer would lose by switching. Losses can include downtime, retraining, qualification, data migration, relationship capital, service disruption, or the risk of an inferior outcome. When those costs are real, the provider can often defend price more effectively. When they are low, the provider needs a different source of advantage, such as lower cost, better availability, stronger brand, or a more convenient distribution model. Management should interview customers around the decision process rather than asking whether they like the product. The more useful questions concern the alternatives considered, the failure consequences, the approval process and the reason the customer renews. Those answers reveal where value actually sits in supermarkets.

## Competitive response

Competitor behavior should also be modeled explicitly. A price cut can signal excess capacity, a strategic investment, a customer-acquisition campaign, or a temporary response to weak utilization. An acquisition can signal a desire for scale, technology, geography, or customer access. A new entrant may appear disruptive while still depending on the same infrastructure as incumbents. Management should therefore analyze competitor moves through the resources they commit and the constraints they remove. This prevents overreacting to visible tactics. The relevant question is whether a competitor is changing the economics of supermarkets. If it is, the response should target the underlying mechanism rather than copy the surface feature. If it is not, disciplined execution may be more valuable than a costly strategic response.

## Scenario planning

Scenario planning should focus on variables that can move the profit pool rather than producing a long list of generic risks. For supermarkets, management can construct cases around demand growth, input availability, technology adoption, regulation and competitive concentration. Each case should identify which customers become more valuable, which assets become stranded and which suppliers gain leverage. The organization can then test whether its current portfolio remains viable. This approach also clarifies which options should be preserved. A firm may choose to maintain a partnership, delay capacity, preserve cash, or keep a technical capability alive because the option becomes valuable in a scarcity scenario. The discipline is to make those choices explicit before the market moves. Strategic flexibility has an economic value when the cost of preserving it is lower than the cost of rebuilding the capability after conditions change.

## Management metrics

A concise management dashboard should connect strategy to operating evidence. The exact measures vary across segments, but the logic is consistent: track the economic driver, the customer response and the capital required to produce the result. This makes it easier to see whether growth is improving the position or increasing exposure to a weak part of the value chain. It also creates a common language for strategy, finance, operations and commercial teams. When those teams use the same drivers, portfolio decisions become easier to compare and challenge.

## Caselet

Kroger: operating through structural change This section should be read with the firm's specific operating model and customer mix in view. The relevant management test is whether the stated mechanism improves economics under plausible competitive conditions.

## History and operating model

Kroger provides a public example of how the economics of Supermarkets can be managed through changing market conditions. Its operating history can be examined through public filings, institutional disclosures and sector evidence. The case is useful because it connects strategic positioning to the practical constraints of food and household merchandise, suppliers, labor, stores, refrigeration, logistics and data and distribution centers, cold chain, payment systems, supplier networks and food regulation. The organization developed an

operating model around a specific customer need and then adjusted its capabilities as technology, regulation, competition, or demand changed.

The operating model shows why scale alone does not guarantee attractive returns. Management must decide which activities should remain proprietary, which can be standardized and which are better sourced from partners. In Supermarkets, those choices determine the balance between fixed cost, flexibility, service quality and customer control. The case also shows the value of sequencing investments:

> capabilities that strengthen the customer interface can create the demand visibility needed to justify capacity or technology investments upstream

## Industry dynamics

The case reflects the forces shaping Supermarkets. Customers can compare alternatives more easily when offers become standardized, while suppliers gain leverage when specialized inputs are scarce. Regulation can create both cost and protection, depending on whether compliance raises the cost of entry or simply adds overhead to every participant. Technology can reduce the cost of delivery while also lowering entry barriers. The company therefore has to decide whether technology is primarily a cost lever, a differentiation tool, or a new distribution channel.

Competitive pressure also changes with market maturity. Early growth can reward capacity expansion and customer acquisition, but later stages often reward utilization, retention, procurement discipline and portfolio selection. A company that continues to optimize for volume after the market becomes more competitive can create revenue without creating economic value. The case highlights the need to adjust operating priorities as the profit pool moves.

## Value capture

The value-capture question is where Kroger earns returns relative to the broader value chain. The answer depends on control of store density, purchasing scale, private labels, loyalty data, local convenience and supply-chain execution, not simply on market share. A

firm can hold a large volume position while suppliers, platforms, or customer procurement functions capture much of the economics. Conversely, a focused provider can earn stronger returns when its capability is embedded in the customer's workflow or when replacement would impose meaningful operational risk.

Public evidence should therefore be read through unit economics rather than headline growth. Revenue growth matters when it improves utilization, lowers acquisition cost, strengthens purchasing power, or increases the value of a network or installed base. It matters less when growth requires disproportionate capital, discounts, incentives, or working capital. This distinction is central to evaluating strategic quality in Supermarkets.6

## Strategic lesson

For executives in Supermarkets, the case supports a practical rule: invest around the constraint that competitors cannot remove quickly. That constraint may be access, trust, regulation, operating density, specialized knowledge, infrastructure, or data. Protect that constraint while using technology to reduce the cost of serving customers. Avoid copying the visible features of a successful incumbent without understanding the economic mechanism underneath them.

The case also shows why portfolio discipline matters. Attractive segments can change as technology lowers costs or regulation alters participation. Management should revisit the source of advantage whenever customer switching becomes easier or a supplier bottleneck becomes less scarce. A durable strategy keeps the organization close to the point where customer value and structural scarcity meet.

- 1U.S. Census Bureau Retail Sales
- 2U.S. Department Of Agriculture Food And Nutrition
- 3Federal Trade Commission
- 4U.S. Food And Drug Administration
- 5Bureau Of Labor Statistics
- 6Securities And Exchange Commission

## Summary

Supermarkets is an economic system built around procurement, assortment, replenishment, merchandising, fulfillment and store operations and the reliable delivery of value to households, foodservice buyers and local communities. Its profit pools favor firms that combine store density, purchasing scale, private labels, loyalty data, local convenience and supply-chain execution with disciplined cost management. The principal pressures are thin margins, food inflation, labor costs, shrink, supplier power and intense local competition, while structural opportunity comes from private-label growth, online grocery, automation, retail media, value-seeking and fresh-food differentiation. Strategic choices should center on segment focus, scope, integration, technology investment and control of the customer interface. Entrants should target a narrow constraint they can remove more efficiently than incumbents. Established firms should protect the relationships and capabilities that create switching friction while redesigning low-differentiation work.