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The Likely Effects of Price Increases on Commissary Patronage

A Review of the Literature

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Preface

The Defense Commissary Agency (DeCA) is an agency of the U.S. Department of Defense (DoD) that operates 245 commissaries worldwide (DeCA, 2014a). American military commissaries sell groceries and household goods to active-duty, Guard, Reserve, and retired members of all seven uniformed services and to eligible members of their families at cost plus a 5-percent surcharge, saving customers an average of more than 30 percent when compared with civilian supermarkets.

In early 2014, the Secretary of Defense announced that the annual taxpayer subsidy for DeCA would be reduced by nearly \$1 billion over three years, from the current \$1.4 billion to \$444 million; only stores that are overseas and in remote locations would continue to receive direct subsidies. Under the new plan, all commissaries would continue to receive free rent and pay no taxes. Although Congress ultimately rejected this plan, DoD's fiscal year 2016 budget request also included cuts to DeCA's budget (Jowers, 2015).

Assuming no change in commissary sales, it is expected that prices in commissaries would have to rise by almost 29 percent to accommodate the \$1 billion reduction in the taxpayer subsidy, thereby reducing the savings from shopping at a commissary from an estimated 30 percent to 10 percent (DoD, 2014). This change would move commissaries toward the business model of the military exchanges, which are for-profit retail stores operated by the services that do not receive significant appropriations. To determine the potential consequences of the predicted commissary price increase, the Office of the Under Secretary of Defense for Personnel and Readiness asked RAND to review how price increases have affected grocery retailers in the private sector and analyze how these results might translate into changes in sales and revenues for DeCA, as well as the secondary and nonmarket effects of a change in commissary pricing, and to suggest a strategy to gather the information needed to estimate the relevant effects more precisely.

This research was conducted within the Forces and Resources Policy Center of the RAND National Defense Research Institute, a federally funded research and development center sponsored by the Office of the Secretary of Defense, the Joint Staff, the Unified Combatant Commands, the Navy, the Marine Corps, the defense agencies, and the defense Intelligence Community.

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Summary

The Defense Commissary Agency (DeCA) operates 245 commissaries worldwide, selling groceries at cost plus a fixed markup to cover capital costs for replacement and modernization. Operating costs of the commissaries are funded by an appropriation from the U.S. Department of Defense (DoD) totaling approximately \$1.4 billion per year as of 2014. Largely due to this subsidization, commissaries can save military families and retirees an average of 30 percent when compared with retail supermarkets (DeCA, 2014a). As such, many servicemembers view access to the commissary system as an important nonpay benefit and an integral part of their overall compensation package.

In early 2014, DoD proposed cutting the annual subsidy to commissaries from \$1.4 billion to \$444 million. According to DoD, this change would result in an increase in the overall price level for nonisolated commissary stores and a decrease in savings, but commissary patrons should continue to enjoy savings on grocery purchases of about 10 percent or more (DoD, 2014). Congress did not pass these cuts into law for the fiscal year (FY) 2015 budget, but an early draft of the FY 2016 budget proposal included a 25-percent cut to DeCA's budget (Jowers, 2015).

To determine the consequences of the predicted commissary price increase from the original proposal, the Office of the Under Secretary of Defense for Personnel and Readiness asked RAND to review how price increases have affected grocery retailers in the private sector and analyze how these results might translate into changes in sales and revenues for DeCA, as well as the secondary and nonmarket effects of a change in commissary pricing, and to suggest a strategy to gather the information needed to estimate the relevant effects more precisely.

The economic literature from studies of grocery retailers in the private sector suggests that store choice depends on both the fixed and variable costs of shopping. Non-price, or "fixed," costs depend on store-dependent characteristics like location, quality, and product assortment. They do not change with the bundle of goods purchased at each trip. Variable costs are the costs of the goods purchased and are directly affected by aggregate price levels of a store.

Estimates of the responsiveness of demand to non-price and variable costs vary substantially across studies. Most studies suggest that when there are available substi-

tute stores, the increase in revenue due to an increase in price levels will be offset more than proportionally by the negative effect of a decrease in quantity purchased on revenues. If these findings hold true for a change in the price of goods sold at commissaries, then an increase in prices will decrease revenues. As such, raising overall price levels will not be a successful strategy to cover shortfalls in costs caused by the elimination of the annual DoD appropriation. Raising prices will also negatively affect servicemembers and retirees who currently patronize the commissary system through increased grocery bills, though the absolute magnitude of the change in overall expenditures will likely not be equal to the percentage price increase. Furthermore, there are several potential secondary and nonmarket effects of increasing commissary price levels that might further influence a benefit-cost calculation of a change in commissary pricing structures.

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Abbreviations

ACSI	American Customer Satisfaction Index
CBO	Congressional Budget Office
COLA	cost of living adjustment
CONUS	contiguous United States
DeCA	Defense Commissary Agency
DMDC	Defense Manpower Data Center
DoD	U.S. Department of Defense
DoDI	Department of Defense Instruction
EDLP	everyday low price
FY	fiscal year
hi-lo	a variable promotional pricing policy
MWR	Morale, Well-Being and Recreation
OCONUS	outside the contiguous United States
OSD	Office of the Secretary of Defense
SNAP	Supplemental Nutrition Assistance Program
WCF	working capital fund
WIC	Women, Infants, and Children

Introduction

Overview and Research Objectives

In early 2014, the Secretary of Defense proposed that the annual taxpayer subsidy for the Defense Commissary Agency (DeCA) would be reduced by \$1 billion over three years, from the current \$1.4 billion to \$444 million.¹ Under this plan, all commissaries will continue to receive free rent and pay no taxes, but only stores overseas, as well as 25 remote and isolated stores in the United States, will continue to receive direct subsidies. To accommodate the proposed subsidy reduction, commissaries were expected to trim costs and raise prices, reducing the average patron savings from about 30 percent to about 10 percent (U.S. Department of Defense [DoD], 2014).

To identify the potential consequences of the predicted commissary price increase, the Office of the Under Secretary of Defense for Personnel and Readiness asked RAND to review how price increases have affected grocery retailers in the private sector and analyze how these results might translate into changes in sales and revenues for DeCA, as well as into secondary and nonmarket effects on the welfare of the 11.7 million members of the military community who are currently authorized to shop at commissaries. RAND was also asked to suggest a strategy for gathering the information needed to measure the relevant effects. In addition to capturing the lessons learned from the experience of the private retail food industry—i.e., supermarket chains and “big box” retailers—the report identifies the data and methods that could be used to estimate the impact of subsidy reductions on the military commissary system and the military community with greater precision.

¹ Initially, the fiscal year (FY) 2017 budget was announced as \$400 million—a \$1 billion cut from the current FY—but it was later adjusted to \$444 million with inflation adjustments, according to a DeCA official. Congress ultimately did not pass this plan, but DoD’s FY 2016 budget request included a 25-percent cut in DeCA’s budget (Jowers, 2015).

Approach and Methodology

To identify the potential consequences of a subsidy reduction and change to the military commissary system's business plan, RAND researchers examined how price increases have affected comparable retailers in the private sector. We conducted a systematic review of studies done in the United States on how consumers choose where to shop and how they respond to changes in grocery product prices. In particular, we reviewed studies on the responsiveness of consumers to changes in price levels at supermarkets and how that responsiveness results in shifts in shopping behavior between stores. We explore the implications of these research findings for DeCA operations, military families, and the whole military community.

The studies we reviewed came from economics, management science, and marketing academic journals; we also reviewed studies conducted by market research firms, consulting companies, and industry groups. In addition, we reviewed past studies conducted by the U.S. Government Accountability Office and Congressional Budget Office (CBO).

Our literature review was supplemented by exchanges with DeCA officials, such as Teena Standard, the executive officer to the director; subject matter experts, such as Justin Hall, assistant director, Morale, Well-Being and Recreation (MWR) and Resale Policy, Office of the Assistant Secretary of Defense (Military Community and Family Policy); and other stakeholders. The purpose of our exchanges was to identify available data that could be used to make a more precise estimate of the effect on patronage of a subsidy reduction and consequent price increase that is specific to the commissaries' conditions.

Our ability to generalize from studies of private sector retailers to the commissaries is limited because there are substantial differences in consumer responses to price changes by family size, age group, income level, and education level, as well as by store and market attributes. Accordingly, the effects on the commissaries can more directly be addressed by using data collected on commissary operations or from commissary patrons. As a result, we also describe what original research might be needed to more precisely understand the impact that subsidy reductions could have on the military commissary system and its customers.

In addition to assessing the primary impact on DeCA's customers, we also sought to identify potential secondary impacts on the whole military community, including those individuals who do not regularly use military commissaries. These include spillover effects on the military exchanges, effects on MWR programs, and effects on servicemember perceptions about the attractiveness of military life.

The Economics of a Commissary Price Increase

Basic Economics of a Price Increase

When prices rise for goods in an economy, consumers generally respond by decreasing the quantity that they demand. There are two effects that determine the magnitude of this change. The *income effect* is the reduction in quantity demanded due to the fact that the overall price level of goods in the economy has increased; that is, consumers generally have less purchasing power due to the price increase. In effect, their real incomes have decreased. The *substitution effect* of the price increase is the reduction in quantity demanded due to the fact that the goods experiencing the price increase are now relatively more expensive, and consumers will tend to purchase fewer of them as a result. The overall observable change in quantity demanded is the sum of the income and substitution effects.¹

One useful measure that describes the change in quantity demanded given a price change is elasticity. Elasticity is a measure of the responsiveness of one variable to a change in another in terms of percentage changes. The own-price elasticity of demand measures the percentage change in the quantity demanded of a good (in this case, goods sold by military commissaries) given a percentage change in the price of that same good (hence the terminology *own-price*). Own-price elasticities are negative because demand generally decreases as prices rise. In only a few very special theoretical cases will the demand for an item rise as the price of the item rises. This is generally not the case for items sold at supermarkets.

To illustrate the concept, an own-price elasticity of -1.5 means that a 1-percent increase in the price of a good results in a 1.5-percent decrease in the quantity demanded. In this case, because the own-price demand elasticity is less than -1 , demand is said to be *elastic*, or relatively responsive, to price changes, and total revenues to the merchant (and, equivalently, expenditures by patrons) will decrease. Own-price demand elasticities that lie between -1 and 0 are termed *inelastic*, meaning that an associated price

¹ We note that while the income and substitution effects in economic theory deal with quantity changes, actual substitution behavior may take several forms, including reductions in quantity and substituting to lower-priced and/or lower-quality goods due to the income effect.

change will increase revenues and expenditures, even though the total quantity sold will decrease. An own-price demand elasticity equal to -1 is termed *unit elastic*. For unit elastic demand, a change in prices is exactly offset by a change in quantity sold, leaving total revenue unchanged. Own-price demand elasticities typically increase as the number of substitutes for a good or service increases or as the time horizon gets longer.²

An increase in commissary prices will affect both the commissary store (in terms of quantity demanded and revenues) and commissary patrons (in terms of a loss in purchasing power and a potential change in the bundle of goods and services consumed, leading to overall grocery bill changes). The magnitude of these changes depends on the relevant price elasticities of demand. We discuss each in turn in the next sections.

Market Effects of a Commissary Price Increase on Commissary Sales and Revenue

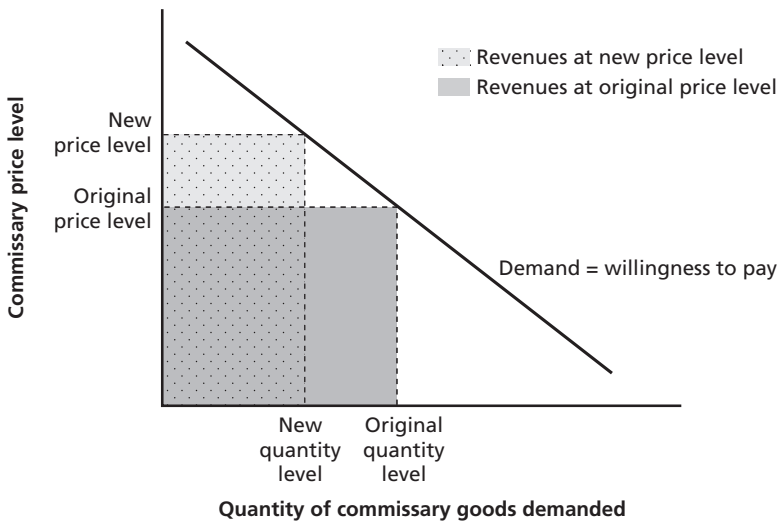
Due to the combination of income and substitution effects, an increase in commissary prices will cause a movement along the demand curve for commissary goods, likely reducing the quantity demanded. The total size of this change depends on the magnitude of the price increase and the responsiveness of consumers to the price change—i.e., on the own-price demand elasticity for commissary goods.

For the commissary stores themselves, this change will affect not only quantities, but also revenues. Revenues will increase if the overall effect of the increase in price (earning more per unit on what is still sold) outweighs the overall effect of the decrease in quantity (selling fewer goods). This occurs only if the demand is inelastic, or, equivalently, if the own-price demand elasticity for commissary products is less than 1 in magnitude.

Figure 2.1 graphically shows the effect of a hypothetical price change on the quantity demanded and revenues of commissaries. The areas of the shaded rectangles are measures of total revenue for the store. Note that the height of the revenue rectangle increases with the price change, representing the increased price level on all goods that are still sold at the commissary. However, the length of the revenue rectangle decreases, representing the decrease in quantity sold. Which effect dominates depends on the shape of the demand curve and is summarized by the own-price demand elasticity.

² Elasticities are typically estimated for small changes in prices or other characteristics, especially since large-scale price changes across all product offerings as would result from ending the subsidies at commissaries are rarely, if ever, seen in competitive markets. Nevertheless, these estimates provide a means of measuring the likely lower bound of such large-scale changes.

Figure 2.1
Effect of a Price Change on Commissary Revenues



Market Effects of a Commissary Price Increase on Commissary Patrons

The effects of an increase of commissary prices on commissary patrons are slightly more complicated, given the possibilities of substitution to alternative retailers of grocery products. However, changes in shopping patterns are still explained via the income and substitution effects.

The increase in prices at commissaries first decreases the overall level of purchasing power for the consumer, or, equivalently, it reduces the consumers' real income. This results in an overall decrease in consumption across all goods and services that are positively related to income and an increase in consumption for all goods and services that are negatively related to income. At the aggregate level, demand for grocery items is likely positively related to income for most consumers. As such, the income effect associated with a commissary price increase will decrease the purchase of commissary goods.

The substitution effect in the case of a commissary price increase takes two forms. First, for those commissary patrons who are willing and able to trade the relatively more expensive commissary goods for other types of (relatively cheaper) goods, the quantity of commissary groceries purchased will decrease. Second, the change in relative prices between commissaries and substitute retailers will tend to increase overall demand for those stores' products. This will reduce the quantity of commissary grocer-

ies sold to these customers.³ These two cases are not mutually exclusive, as consumers can exhibit both behaviors at all patronized stores.

In general, the ability to utilize substitute retailers will lessen the impact of the commissary price increase on consumers, but it will increase the impact on commissary sales. The easier it is for a consumer to switch to a different retailer, and the lower the difference in the original commissary price level and the substitute's price, the better off the consumer will be. At price points nearly 30 percent below substitute supermarkets, it might be expected that the income effect is dominant for many consumers, especially if price is the dominant driver of store choice decisions. Nevertheless, the overall effect of the combined income and substitution effects from an increase in commissary prices on most, if not all, commissary patrons is negative.

³ Note that, strictly speaking, the definition of *commissary goods* is very broad, and that, in reality, it would be possible for patrons to purchase a greater quantity of lower-priced goods per trip when prices increase. *Quantity* in this model could then be conceptualized as a generalized quantity index.

Commissary Background

The Commissary System

As noted, DeCA is a DoD agency that operates 245 commissaries worldwide—178 in the 48 contiguous United States (CONUS) and 67 outside the contiguous United States (OCONUS). The commissaries are operated according to DoD policy, which stipulates that the commissary benefits are extended to active-duty, Reserve component, and retired servicemembers, as well as their families and other select groups (Department of Defense Instruction [DoDI] 1330.17). Due to below-market pricing policies, commissaries are viewed as an important source of noncash benefits and an “integral element of the military pay and benefits package for active duty personnel” (DoDI 1330.17).

According to DeCA’s most recent figures, the average customer savings rate across the whole system was 30.5 percent for FY 2013 (DeCA, 2014a). DeCA’s calculated savings rate is an aggregated estimate of savings that compares DeCA price levels with the average U.S. commercial supermarket prices for the identical product. Although there is no legislation stipulating the exact commissary savings rate that should be provided, previous DoD policy required that the savings rate be maintained at 30 percent or higher (DoD, 2008).

Because of this pricing strategy, commissaries occupy a unique “positioning tier” among groceries, offering relatively high levels of service with very low prices (van Lin and Gijbrecchts, 2014).¹ DeCA sells its products at a lower cost than supermarkets by selling them at cost from the supplier plus a 5-percent surcharge. In FY 2013, DeCA sales were approximately \$5.9 billion, with total employment of approximately 17,000 (American Logistics Association, 2014). Revenues from commissary sales are put into the Commissary Resale Stocks, which are used to restock commissary inventory. The Commissary Resale Stocks are a part of DeCA’s working capital fund (WCF).

The other part of DeCA’s WCF is commissary operations that arise from commissaries, areas, and headquarters activities, such as personnel costs, travel, transportation

¹ Positioning tiers are typically described as service (high service, high price), value (midservice, midprice), and (hard) discount (low service, low price).

of goods, utilities for overseas commissaries, and other support necessary for DeCA operations (DeCA, 2013). These costs are paid with funds annually appropriated by Congress. DeCA received approximately \$1.4 billion in congressionally appropriated funds in FY 2013 (DeCA, 2013).

The current DeCA business structure requires a subsidy to sustain its operations under current pricing policies. The 5-percent surcharge added at the point of sale is applied to DeCA's Surcharge Collections Trust Fund, which is used for capital development and maintenance fees, such as most construction, and improvements in store information technology and equipment, as well as the cost of collection of dishonored checks (DeCA, 2013). Therefore, DeCA's operating model is distinct from that of the commercial supermarkets in that it has no margin to use for both operating costs and capital expenses (Dove/Willard Bishop, 2004).

Table 3.1 provides a comparison of a subset of 171 commissaries with the overall grocery industry using 2012 data (American Logistics Association, 2014). As seen in the table, commissaries tend to have higher average weekly sales per square foot, attract large-bundle shoppers, are slightly smaller than the average supermarket, and are open slightly less frequently. However, it should be noted that averages may hide significant differences across commissary locations. Commissaries make up approximately 1–2 percent of total supermarket and commissary sales in the U.S. market.

Proposal to Eliminate Commissary Subsidies

For the past several years, the costs and benefits of maintaining such subsidy levels have been under heavy scrutiny because of the downward pressure on the total defense

Table 3.1
Commissary Comparison with Commercial Supermarkets

Measure	Actual Commissary Measure	Commissary Measure Adjusted for Savings	Supermarket
Weekly revenue/sq. ft.	\$17.36	\$24.59	\$10.22
Weekly revenue	\$577,421	\$817,784	\$318,170
Average customer purchase	\$65.79	\$93.17	\$35.01
Annual revenue (all stores)	\$5.1 billion	\$7.3 billion	\$602.6 billion
Sq. ft./store	33,261	n/a	46,000
Avg. days open per week	6.2	n/a	7
Avg. hrs. open per day	9.7	n/a	12–24

SOURCES: American Logistics Association, 2014. Supermarket data from Food Marketing Institute, 2015.

NOTES: Commissary sales are from 2012 for U.S. commissaries with sales over \$2 million (171 stores). Measures adjusted for savings were calculated using the 29.4-percent average U.S. savings level.

budget. In March 2014, DoD released its FY 2015 budget proposal to Congress, which contained a \$1 billion reduction in DeCA's annual subsidy over three years—from the current \$1.4 billion to \$444 million in FY 2017. Under this proposal, all commissaries will continue to receive free rent, to pay no federal taxes on their corporate income, and to avoid the cost of most state and local excise taxes. In addition, commissaries will continue not to collect sales tax. Only stores in overseas or remote U.S. locations, however, will continue to receive direct subsidies, presumably to preserve access to common grocery items sold at the stores. As of January 2015, Congress has blocked this plan from taking effect.² The DoD plan anticipated that the reduction in subsidies would decrease the average savings rate from 30 percent to around 10 percent (DoD, 2014). This implies an increase the commissary price level of just under 29 percent.³ This increase is on average across all goods in the stores.⁴ Despite public speculation, DoD did not plan for any commissary closures (DoD, 2014).

Summary of the Commissary System's Benefits and Costs

As currently operated, the commissary system provides a fairly substantial nonpay market benefit to active-duty servicemembers and retirees, with average savings across the country for a representative bundle of goods near 30 percent over traditional supermarkets and a smaller savings advantage over discount food retailers such as Walmart. However, in order to provide this benefit, the commissary system is subsidized via a budget appropriation of approximately \$1.4 billion per annum. Past and recent proposals to eliminate this subsidy (most recently, decreasing the subsidy to \$444 million) have been made in the name of reducing the DoD budget. However, should this appropriation be eliminated, prices at commissaries will likely rise and/or stores may no longer be financially viable. Thus, the elimination of the appropriation, while reducing the DoD budget, comes at a cost borne primarily by those currently and formerly in the armed forces.

In the following chapters, this report focuses on the potential market and non-market effects of price increases at many of the nation's commissaries. We examine

² DoD's FY 2016 budget proposal included an approximate 25-percent cut in the commissary budget.

³ Consider a wholesale price of a basket of goods of \$100. Given the 5-percent surcharge and 1-percent fee at commissaries, the price of this basket at commissaries will be \$106. Assuming a 30-percent savings over other retail, the average price at a supermarket will be \$151.43. Keeping this figure constant and reducing the savings rate to 10 percent over supermarkets by raising commissary prices would require a price increase at commissaries to \$136.29, or an approximate 28.6-percent price increase. This calculation is invariant to the initial wholesale price.

⁴ A move to variable pricing, in which different margins are introduced for each good in the store, would likely result in a nonuniform increase in prices across items. However, as detailed in the following chapter, store choice is likely driven by perceptions in overall price levels, which we take as given from the DoD plan.

the problem through a behavioral lens—namely, the determinants of store choice in the context of groceries. To do so, we review the literature about the determinants of grocery store choice and the responsiveness of consumers to changes in the overall level of store prices, primarily by using estimates from the private sector. On the basis of this review, we provide a range of estimates on the market effects of double-digit price increases on commissary sales and revenues, in addition to the likely changes in the grocery bills of commissary patrons. We also discuss the effects of the increase on possible second-order and nonmarket benefits of the commissary system. As there is scant literature regarding the store choice behavior of commissary patrons, and because the commissaries occupy a unique niche in the grocery industry, we propose a future research project to more fully understand the impact of increased prices on military families' grocery store choice.

Conceptual Determinants of Store Choice

The choice of where consumers buy groceries is generally conceptualized as one in which a consumer decides the following elements (Figurelli, 2013):

- **timing:** *when* to purchase groceries
- **location:** *where* to purchase groceries
- **bundle:** *what* groceries to purchase.

Given the large number of retail establishments and substitute products available to consumers in most locations, consumers typically face a great deal of choice when deciding to purchase groceries. Changes in both individual and store-level characteristics can induce a change in shopping behavior. Although convenience often trumps price (Market Force Information, 2014), consumers report year after year in consumer surveys that they place a high importance on price in choosing what to buy and where to shop (Progressive Grocer, 2013). Price sensitivity can vary widely, however, and is systematically related to the characteristics of consumers in a market area and features of the competitive environment (Hoch et al., 1995).

There is also considerable evidence that consumers base their store selection decisions on attributes unrelated to market prices of the goods sold at the stores, such as convenience, travel costs, service, quality, product variety, and habit (Walters and MacKenzie, 1988). Consumers thus face two types of costs when shopping: price-based “variable” costs that depend on what is purchased, and non-price—or “fixed” costs, as they are termed in the economics and marketing literatures—such as travel time, that are unrelated to the bundle actually purchased.¹ In most models of store choice, a planned shopping bundle is assumed, and consumers choose a retailer based on the expected prices and non-price costs. Once they reach that location, the bundle actually purchased may change.

In the following subsections, we document the major determinants of the decision to shop for groceries and compare commissary performance with private grocery

¹ Travel costs are essentially fixed, as they do not depend on the bundle purchased by the consumer (Bell, Ho, and Tang, 1998).

substitutes where such information is available. While the primary concern of this research report is responsiveness to price, the other non-price factors serve to exacerbate or mitigate the effect of price changes for a particular consumer or set of consumers. These caveats are discussed following the analysis in Chapter Six.

Price

The expected price of a bundle of goods and services is a key determinant of the shopping choice. All else equal, a consumer would prefer a lower price to a higher price for an identical item or group of items. However, in the context of store choice, consumers may not have perfect information regarding price levels at all potential alternative locations (Bell, Ho, and Tang, 1998). Consumer perceptions of price levels can depend on several factors, including previous experience, time spent comparing prices, marketing efforts, and store reputation. Consumer sensitivity to prices also varies widely across stores. Hoch et al. (1995) found that more than two-thirds of the store-to-store variation in consumer price sensitivity can be explained by 11 variables related to consumer demographics and the competitive environment in a market area. These include income levels, ethnicity, education, family size, female labor force participation, home values, the average distance from one store to competitor supermarkets and warehouses, and the size of a store relative to that of competitor supermarkets and warehouses.

Prior research has shown that departures from expected prices on a trip-to-trip basis can induce additional purchases and can possibly affect store choice for subsequent trips. Many empirical studies reported high price sensitivity (Guadagni and Little, 1983; Kalyanaram and Little, 1994). Past research also found that shoppers respond positively to temporary price discounts and promotions in both store and bundle choice (Wilkinson, Mason, and Paksoy, 1982; Gupta, 1988). Studies by Walters and MacKenzie (1988) and Walters (1991) found that discounts not only increase purchases of sale goods but also increase store traffic. Furthermore, price promotions in one store significantly decrease sales of complementary and supplementary goods in competing stores. However, there is evidence that long-term store selection depends more on perceptions of average aggregate price levels across stores (Alba et al., 1994; Rhee and Bell, 2002).

In the nonmilitary retail grocery market, stores pursue different pricing strategies. In general, pricing strategies are divided into everyday low price (EDLP) and promotional pricing (hi-lo) stores (Bell, Ho, and Tang, 1998; Richards and Hamilton, 2006). Most supermarkets fall generally within the hi-lo category, with everyday prices typically high on average, but with weekly promotions offering deep discounts on selected items. Walmart is an example of an EDLP retailer. It chooses to offer many identical food items at an average price about 7 to 27 percent lower than traditional supermarkets as a result of its relatively unique cost structure (Hausman and Leibtag, 2007;

Volpe and Lavoie, 2007).² Private groceries compete on price and non-price attributes (such as quality and assortment); the entry of Walmart Supercenters into a local market causes prices charged by other supermarkets and grocers to fall by about 1 to 8 percent (Volpe and Lavoie, 2007; Basker and Noel, 2009).

In the commissary system, prices are set by law at cost plus 1 percent to cover shrinkage and an additional 5-percent surcharge. DeCA also receives shelf-stocking and store reset support from vendors in the form of labor that is not offered to commercial customers (Dove/Willard Bishop, 2004).³

This results in prices that are, on average, approximately 30 percent lower than alternative stores, offering an attractive monetary benefit to active and retired servicemembers. This figure is calculated by DeCA on the basis of a comparison of 37,000 universal product codes at 30 U.S. commissary locations with the same products at other civilian stores, such as traditional grocery retailers, wholesale stores that sell directly to consumers (e.g., Sam's Club), convenience stores, and drugstores that carry food (Bushatz, 2014).⁴ In fact, the commissary benefit is sometimes cited as the most important non-health care benefit available to servicemembers (Dove/Willard Bishop, 2004). For this reason, commissaries are most directly comparable to EDLP substitutes on the price attribute, but they can offer goods at even lower price levels than these stores.

Travel Costs

Travel costs to and from a particular retail establishment are the major determinant of non-price costs to a consumer. Given their different physical locations, retail stores are spatially differentiated, meaning that for a given consumer, the travel costs of shopping at different locations will differ. Travel costs, by definition, are not related to the planned shopping bundle that consumers intend to purchase at the time of a trip. All else being equal, a consumer will prefer lower travel costs. It has been estimated that up

² These pricing types are not necessarily hard and fast. In general, hi-lo stores can be in a service (high service, high price) or value (midservice, midprice) positioning tier, while EDLP stores are typically in the discount tier (low service, low price).

³ Dove/Willard Bishop (2004) reports that vendors view 100-percent promotional pass-through, in which all promotional benefits are passed on to consumers, the high share of category sales, and the ability to build brand loyalty at an early age as the benefits that justify the increased level of service at commissaries. They estimate the profitability difference in favor of commissaries relative to supermarkets due to the unique format of the former to be just under 3 percentage points, due primarily to savings on discounts and allowances and sales and marketing expenses.

⁴ We take this figure as given. However, we note that this is an average figure across 30 locations and that the savings will depend on local market conditions and the bundle actually purchased by a consumer. Furthermore, this figure does not affect the analysis of Chapter Six, except to the extent that a larger degree of price savings over substitute retailers would tend to decrease overall price responsiveness for commissary products.

to 70 percent of the variation in supermarket choice decisions is explained by location (Bell, Ho, and Tang, 1998).

Sensitivity to non-price costs, such as travel time, may depend on income, as Ellickson and colleagues noted in a recent study. They found that consumers “find travel costly, and this burden increases significantly with income, consistent with the increased opportunity cost of time” (Ellickson, Griecob, and Khvastunovb, 2014). Similarly, Figurelli (2013) notes that the costs of travel time can differ across consumers. Larger families (regardless of the number of children), families with no children, and senior households are less willing to incur large travel costs (all else being equal), while families with children, young households, families with a low or medium work load, and married couples are more willing to incur travel costs. In general, those consumers who are readily able to convert time into income (i.e., those with high opportunity costs) are generally more sensitive to travel time as an attribute.

Overall, it appears that military families are willing to tolerate longer travel times because of the savings they realize at commissaries; this factor will be significantly diminished if subsidiaries are reduced or eliminated. On average, commissaries are located approximately 2.5 times farther away than local grocery stores (American Logistics Association, 2014). Table 4.1 displays results from a 2011 DeCA survey that show the distribution of distance from home zip code to the closest commissary.

Given the relatively large distances military families must travel to reach a commissary, it is unsurprising that “inconvenient location” is a top reason families provide for not shopping there. Others include the additional costs of base security and inconvenient operating hours (Dove/Willard Bishop, 2004).⁵ Nonetheless, military families responding to a survey conducted by the American Logistics Association in 2014 reported by a two-to-one margin that they are willing to tolerate these inconveniences

Table 4.1
Distribution of Commissary Patron Home Zip Code to Closest Commissary by DeCA Region

Region	<1 Mile	1–5 Miles	5.1–10 Miles	10.1–20 Miles	>20 Miles	Average Miles
DeCA East	14.3%	19.1%	29.4%	24.3%	12.8%	13.1 miles
DeCA Europe	67.1%	8.6%	2.1%	15.6%	6.7%	8.0 miles
DeCA West	20.1%	18.6%	24.4%	23.0%	14.0%	11.9 miles
Overall	21.0%	18.1%	25.0%	23.0%	12.9%	12.3 miles

SOURCE: DeCA, 2012.

NOTES: DeCA has five regional categories in total: Central, East, and West, which encompass the continental United States and Puerto Rico; and Europe and Pacific, which include Europe, Asia, and Africa. This survey shows 20,814 responses from DeCA patrons in East, Europe, and West: 8,958 responses from East, 2,556 responses from Europe, and 9,300 from West.

⁵ On average, commissaries are open 6.23 days per week and 9.74 hours per day, while supermarkets average 7 days per week and 12–24 hours per day (American Logistics Association, 2014).

in order to save 30 percent on their grocery bill (American Logistics Association, 2014). That result suggests that low prices induce many commissary patrons to drive a great deal farther to shop at the commissary than most grocery shoppers travel to reach a supermarket. It further suggests that, if commissary prices increase, patrons may substitute away from commissaries and instead choose a discounter or traditional supermarket as a primary shopping location.

Planned Purchase Bundle

The size of the basket of goods a shopper plans to buy is also a key factor influencing store choice. Shoppers who plan to purchase large baskets of goods will tolerate higher non-price costs and favor stores with lower prices, whereas a shopper who simply plans to pick up a can of soda is more likely to select a convenient store with lower non-price costs and higher prices.⁶

The average customer purchase at commissary stores is \$65.79, which is far larger than the \$35.01 average customer purchase at other supermarkets (American Logistics Association, 2014). When coupled with the higher average distance to a commissary relative to a grocery store, this suggests that a disproportionate fraction of the commissary's shoppers are what Bell and Lattin (1998) call "large-basket" shoppers. These are shoppers who are prepared to travel long distances to shop at the commissary for large baskets of goods, but who are particularly sensitive to changes in variable costs (i.e., prices).

Quality of Products

Quality is an important determinant of store choice for many consumers, particularly the quality of nonpackaged, perishable foods (such as fresh produce) (Richards and Hamilton, 2006). As with price, consumers may have imperfect information regarding potential food quality at substitute retail outlets. In general, however, consumers will prefer higher quality, all else being equal.

Commissaries buy both brand-name and non-brand-name products for resale. The former includes processed grocery products, household products, beverages, and so on, while the latter includes fresh items, such as fruits, vegetables, and meat, and in-store operations like deli and bakery services. According to U.S. Code Title 10, Section 2486 (e), all brand-name items offered by the commissary that are sold regularly in commercial groceries on a regional or national basis qualify for use of noncompetitive procurement procedures (DoDI 1330.17). DeCA makes its selection of brand-name

⁶ The rationale is that the non-price "fixed" costs are spread out over a larger base in the case of the former.

items based on such factors as product quality, availability of products, and demonstrated and anticipated customer demands. All non-brand-name products and services are purchased through a formal competitive solicitation process, and the products and services are selected on a best-value basis.

According to DeCA's internal customer survey, as shown in Table 4.2, the quality of meat and miscellaneous food products (dry, frozen, and dairy) ranked consistently highest, whereas the quality of bakery and produce items were ranked relatively lower. However, the differential between categories is relatively low. Among all survey questions—not just food quality—asked in the survey, “meat quality and selection” was one of the top-ranking categories, and “produce quality and selection” was one of the lowest-ranking categories.

Quality of Service

In addition to the goods purchased at a retail location, some customers may value the quality of service that is provided by the staff. This service quality is considered a non-price cost of shopping at a particular store, as higher levels of service can be interpreted as lowering the (total) costs of purchasing a bundle of goods through such mechanisms as lowering search costs and faster checkouts (Bell, Ho, and Tang, 1998). In fact, there is often a direct relationship between price and service level; higher-priced stores tend to offer more service, while lower-priced stores pass savings to customers through lower levels of service (Bell, Ho, and Tang, 1998; van Lin and Gijsbrechts, 2014).⁷

Table 4.2
Commissary Customer Service Survey: Product Quality

Survey Questions	2004	2005	2006	2007	2008	2009	2010	2011	2012 ^a	2013 ^b
Produce quality/selection	4.38	4.47	4.52	4.52	4.54	4.61	4.62	4.66	4.54	4.25
Meat quality/selection	4.46	4.56	4.62	4.63	4.64	4.72	4.73	4.77	4.65	4.44
Deli quality/selection	4.44	4.51	4.59	4.58	4.59	4.65	4.65	4.69	4.60	4.36
Bakery quality/selection	4.36	4.45	4.52	4.53	4.53	4.60	4.61	4.64	4.54	4.27
Selection of other items (dry, frozen, and dairy)	4.47	4.55	4.61	4.61	4.61	4.69	4.69	4.74	4.62	4.39

^a In 2012, a change in survey score definitions resulted in overall deflation of scores. For example, the description for a score of 1 was changed from “very poor” to “poor,” and a score of 5 was changed from “very good” to “excellent.”

^b 2013 scores were negatively affected by the government shutdown.

SOURCE: DeCA, 2014c.

⁷ In Bell, Ho, and Tang (1998), EDLP stores tended to have the highest fixed costs and lowest variable costs, while hi-lo stores tended toward the opposite.

Sirohi, McLaughlin, and Wittink (1998) found that service quality has a large and significant impact on perceptions of overall merchandise quality at grocery stores, which in turn have significant direct impacts on overall customer store loyalty. They argue that increasing customer retention has two important effects: (1) It can help the store maintain and gradually grow its customer base, and (2) the profits earned from each individual customer grow the longer the customer remains loyal to the store. Existing customers also tend to purchase more than new customers (Rose, 1990). In addition, according to a study by the U.S. Department of Consumer Affairs (Peters, 1988), costs to retain customers are about 80 percent lower than the costs to acquire new customers.

Compared with the grocery industry average, customer satisfaction with commissary service is higher. According to the American Customer Satisfaction Index (ACSI), DeCA's customer satisfaction score has ranged from 80 to 82 between FY 2010 and FY 2013, as compared with 75 to 77 for the grocery industry average (DeCA, 2013). Specifically, customers consistently gave the highest scores to DeCA employees' attitude and assistance among different categories of customer satisfaction in DeCA's annual Commissary Customer Service Survey (DeCA, 2014c).

Assortment of Products and Services

The assortment of products in a given retail establishment may be a determinant of store choice. The "fundamental theory of store choice," which Reilly (1931) termed the *law of retail gravitation*, suggests that a shopper's probability of choosing a retail outlet is inversely related to its distance from the shopper's home, but positively related to its size (Baumol and Ide, 1956; Huff, 1964; Brown, 1989). In other words, shoppers may be willing to travel farther to shop at larger stores that offer a greater variety of products than to smaller stores that offer fewer products.

Consumers may prefer outlets with a broad selection of products to minimize the number of trips necessary to purchase a particular bundle of goods, or, at a finer level, they may prefer a store that offers multiple substitutes within a given category of good (e.g., a choice between two name-brand products and a store-labeled generic option). Variety may also serve as insurance against future changes in preferences (as transition to another store may be costly) or to provide satisfaction from attributes not present in a single good (Richards and Hamilton, 2006). However, this preference may be reversed for consumers who view making such choices as costly. There is some evidence that supermarkets and other retailers may jointly compete on both price and variety in order to attract new customers and increase sales (Richards and Hamilton, 2006).

In addition to product assortment, changes in the type and number of services provided by supermarkets and their competitors can help to differentiate stores, with the effect of changing market shares and overall profitability. Using fluid milk as a case study, Bonanno and Lopez (2009) found that as the number of in-store services

increases, responsiveness to milk prices decreases and costs and milk prices increase, but the loss in sales is more than made up for through the attraction and retention of relatively price-insensitive customers.

It is unclear how large the influence of store size or product assortment really is. Some studies find that when assortment is decomposed as a multidimensional variable (number of brands offered, number of products per brand, number of sizes per product, proportion of products that are unique to the retailer, and the availability of a household's favorite brand), product assortment has a larger effect on sales than do retail prices or distance (Briesch, Chintagunta, and Fox, 2009). Many studies support the finding that increasing assortment size has a positive effect on store traffic and long-term patronage (Fox, Montgomery, and Lodish, 2004; Fox, Postrel, and McLaughlin, 2007). However, other studies failed to find a positive relationship between assortment and sales (Hoch, Drèze, and Purk, 1994; Broniarczyk, Hoyer, and McAlister, 1998). The recent study by Ellickson, Griecob, and Khvastunovb (2014) found a positive relationship but concludes that consumers dislike travel much more than they like scale.

The assortment of goods and services in the commissaries is determined by DeCA's sales directorate's periodical assessment of brand, quality, sales performance, price, variety, and available shelf space. DeCA optimizes product assortment based on store size calculated from linear feet of shelving space (DeCA, 2014b). However, the average square footage per store is considerably larger for regular supermarkets (approximately 46,000 sq. ft.) than for commissaries (approximately 33,261 sq. ft.), though this average may mask significant differences in stores across the commissary system (American Logistics Association, 2014).

Brand offerings per product category are typically lower than conventional grocery stores, and out-of-stock rates are typically higher, though, again, there may be significant differences between commissaries (Dove/Willard Bishop, 2004). Thirty-eight percent of commissary customers felt that the product assortment in commissaries was the same as that of retail stores, while 33 percent preferred commissaries' assortment and 29 percent thought retail stores were better (Defense Manpower Data Center [DMDC], 2012). In locations where square footage, brand offerings, and stocking rates are low and there are significant substitutes, military retirees and other authorized shoppers who live far away from a commissary store may be attracted to larger competitor stores if the discount they receive at the commissary declines. That said, when DoD announced its plan to reduce the subsidy to the commissaries, the plan was said to include efforts to expand the variety of products sold in stores, which could potentially offset the effects of a price increase (DoD, 2014).

Store Loyalty

Many consumers exhibit persistent behaviors when making grocery store choices. The tendency to shop at a particular location over multiple shopping trips—store loyalty—is a determinant of store choice.

Store loyalty can take several forms. Consumers may be loyal to a store brand (e.g., Safeway, Albertsons, the commissary), or they may be loyal to a particular store location (e.g., the closest grocery store, regardless of brand) (van Lin and Gijsbrechts, 2014). This type of loyalty is unrelated to the planned shopping bundle. One reason for store loyalty is the perceived cost of switching to another location, though loyalty may also be partly explained simply through consumer preferences (van Lin and Gijsbrechts, 2014; Bell, Ho, and Tang, 1998).⁸ For commissaries, loyalty may be due primarily to the overall price advantage, with large price changes eroding this behavior.

In addition, loyalty to a store may be related to the planned shopping bundle. This has been termed *category-dependent* store loyalty and is defined by patronage to a particular retailer for a particular good or set of goods (e.g., purchasing meat at a Costco but sauces from a Trader Joe's) (Bell, Ho, and Tang, 1998).

Direct comparative evidence regarding store loyalty between private supermarkets and commissaries is rare. However, according to DeCA records, 94 percent of total commissary patrons and 88 percent of active-duty commissary patrons have shopped in commissaries for more than one year, suggesting a significant degree of loyalty (DeCA, 2014c). Approximately 65 percent of servicemembers' families shop at commissaries every week, and approximately 75 percent use commissaries as their primary source of groceries, according to a nonscientific 2013 poll of just over 2,000 servicemembers performed by the *Military Times* (Jowers and Tilghman, 2013).⁹

Household Demographics

In addition to store-level determinants of choice, grocery shopping preferences may be influenced by household demographics, including income, education, household structure (including the number of dependents and the age of household members), ethnicity, gender, and average expenditures on food, as well as the cost of storage within a household. One empirical finding that has been confirmed in numerous studies conducted over the decades—and which is referred to as *Engel's law* after 19th-century

⁸ Switching costs can include search costs to gain more information about alternatives, learning costs related to gaining experience about a relatively new location, or the loss of intrinsic benefits of being familiar with a particular location (van Lin and Gijsbrechts, 2014). Loyalty can also be interpreted as lowering the fixed costs of shopping at a store (Bell, Ho, and Tang, 1998) or, equivalently, increasing the benefits due to increased knowledge and/or familiarity with a store (Rhee and Bell, 2002).

⁹ We define *primary source* as spending more than 50 percent of their monthly grocery budget at commissaries.

economist Ernst Engel—is that the fraction of income that people spend on food decreases as their income increases. In other words, the income elasticity of demand for food is between 0 and 1. More broadly speaking, the budget shares that households devote to different categories of consumption tend to vary with income, but to differing degrees. Whereas the shares of income devoted to food and housing decline markedly with income, the shares devoted to clothing and transportation are relatively constant. Table 4.3 presents recent budget share data from the United States.

A related finding is that price shocks have different effects on the budget shares devoted to each spending category (Deaton and Muellbauer, 1980). A 2008 study by Du and Kamakura examining the way consumers allocate their consumption budget theorized that every household allocates its discretionary income among competing needs and wants so that when the consumption budget is exhausted, all expenditure categories offer the same marginal utility per dollar. The study then simulated household reactions to changes in prices or income and explored how these changes will affect different consumption categories. It predicted that a large increase in the prices of goods in an essential category, like food at home or gas, affects the poorest quintile more dramatically than the richest quintile. In their simulation, the poorest quintile responds to a 50-percent increase in gas prices by reducing the quantity consumed by 43 percent, whereas the richest quintile hardly reduces the quantity consumed at all. In other words, demand for essential goods is elastic among the poorest quintile but

Table 4.3
Percentage of Average Annual Consumer Expenditure on Major Components in the United States in 2013, by Income Quintile

Expenditure	Lowest Quintile	Second Quintile	Third Quintile	Fourth Quintile	Highest Quintile
Food	16.32	14.68	13.48	13.01	11.27
Housing	40.03	36.84	34.85	32.43	31.14
Transportation	14.86	17.99	18.99	18.54	16.99
Personal insurance and pensions	2.07	5.08	8.23	11.21	15.56
Health care	7.99	8.75	7.94	7.45	5.80
Entertainment	4.47	4.35	4.70	4.87	5.17
Cash contributions	2.58	3.24	3.07	3.56	4.17
Apparel and services	3.23	3.19	3.13	3.17	3.08
All other expenditures	8.45	5.88	5.61	5.76	6.81

SOURCE: Bureau of Labor Statistics, 2014.

NOTE: Consumer units include families, single persons living alone or sharing a household with others but who are financially independent, and two or more persons living together who share expenses.

inelastic among the richest. More recent studies provide considerable empirical evidence that responses to price changes can vary by income, family size, age group, and education level (Figurelli, 2013; Hoch et al., 1995). People with lower incomes tend to be more price-conscious—i.e., they are more likely to report remembering the prices of goods recently purchased and more likely to recall the prices correctly (Gabor and Granger, 1961). Poorer consumers and those with large families are also typically more responsive to changes in price; this is because they spend more of their disposable income on groceries and therefore tend to devote more time to price shopping. While some studies find that age has mixed effects (Hoch et al., 1995), others find that, holding income constant, price search behavior increases with age because elderly people, many of whom are retired, tend to have more leisure time (Carlson and Gieseke, 1983). By contrast, wealthier, more educated consumers are less price sensitive, partly because they have higher opportunity costs and therefore devote less attention to shopping (Hoch et al., 1995). Price-sensitive consumers in competitive markets can achieve sizable gains from price shopping because store promotions and discounts are generally not coordinated in competitive retail markets.

These findings may be particularly important for DeCA because over one-half of the 5.9 million eligible commissary shoppers are retirees, and one-quarter of active-duty personnel are of rank E-1–E-3. As such, commissary shoppers are likely to have lower incomes than the average grocery shoppers in many markets, suggesting higher price sensitivity and greater willingness to travel for price savings (Dove/Willard Bishop, 2004; see Table 4.1). Heavy shoppers of the commissaries, those who spend on average about \$3,000 per year in 34 trips, have an annual income between \$30,000 and \$50,000 and are either under 35 or over 55 years old (Burns, 2012). Light shoppers, who spend \$450 per year in seven or eight trips on average, earn above \$100,000 annually and are under 55 years old (Burns, 2012). Eligible patrons who do not shop at the commissaries tend to have lower incomes and to be single or have smaller families (Burns, 2012). This population likely includes many people who do not patronize grocery stores at all. Many single, low-income shoppers have been observed to rely on local convenience stores rather than grocery stores, due to mobility and storage restrictions (Piacentini, Hibbert, and Al-Dajani, 2001). Furthermore, many single, junior enlisted personnel who live in military barracks eat in the military galleys instead of buying groceries and cooking.

Non-Price Store Attributes

Store-specific features (unrelated to product or service quality) could also affect store choice, including the cleanliness of the store, the layout and equipment available, and the overall “atmosphere” of the specific location. When compared with competing grocery stores, commissaries’ layout and equipment (e.g., self-checkout) generally resemble

that of a standard commercial supermarket. Facility conditions are monitored through a composite metric called the Facility Condition Index, with upkeep and upgrades funded through the Surcharge Collections Trust Fund (DeCA, 2013). In addition, DeCA tries to keep up with industry practices. For example, following industry trends, DeCA plans to expand its online order and curbside pickup services that were started in 2013 (Jowers, 2014).

Finally, store atmosphere, broadly defined as the collection of nonmarket attributes that are valued by customers, is another factor that influences store choice. For example, upscale grocers such as Whole Foods typically have higher prices, but patrons may perceive a nonmarket benefit from shopping there—e.g., “being seen” at a socially desirable location or signaling environmental bona fides (Kahn, 2007). One notable customer perception of commissary atmosphere is that 65 percent of patrons find the commissary shopping experience to be more secure and safe than that of retail grocery stores (DMDC, 2012).

We next turn to a review of the effect of price increases on store choice.

Previous Estimates of the Effect of Price Increases on Store Choice

Previous research has quantitatively estimated the impact of changes in store characteristics, including price levels, on grocery store choice. Most, if not all, of these studies involve data from firms operating in a highly competitive retail environment with similar price levels between stores. As such, a price change tends to induce both income and significant substitution effects, as similarly priced goods are available from other stores.

However, to our knowledge, there have been no statistical studies that explicitly model the store visit and revenue effects of price changes on commissaries, though a report by Dove/Willard Bishop (2004) used survey data to estimate the responsiveness of commissary patrons to changes in price levels. As such, in this chapter, we review the literature on grocery store choice in the broader retail environment. We first introduce the concept of own-store price elasticity, which is a quantitative measure of consumer responsiveness to changes in overall price levels at a retailer. We then briefly qualitatively describe the expected impacts of an increase in price levels on store patronage behavior. Finally, we review the literature to obtain a range of quantitative estimates of own-store price elasticities in the private grocery market.

Potential Effects of Commissary Price Increases

Any increase in the general level of prices for commissary products will result in the following effects:¹

¹ It should be noted that an expected commissary price level increase would not be temporary, as in a sale on certain goods and/or services, but rather a permanent change in prices. As such, elasticities based on temporary price changes are not appropriate, but those that use an aggregate price index across stores or chains, representing overall price levels, are likely to be more accurate. In what follows, we focus on overall price levels.

1. Some servicemembers and retirees currently using commissaries as their primary grocery will switch primary stores (but may maintain some reduced level of commissary purchases).
2. Some servicemembers and retirees currently using commissaries as a secondary grocery will switch secondary stores (but may maintain some reduced level of commissary purchases).
3. Servicemembers and retirees who will maintain commissaries as their primary grocery may lower their total commissary purchases.
4. Servicemembers and retirees who will maintain commissaries as a secondary grocery may lower their total commissary purchases.

These responses come directly from the income and substitution effects associated with a price change. A double-digit percentage increase in prices would constitute an unprecedentedly large increase in the variable cost of shopping (i.e., the costs that vary with the basket of goods purchased) and should therefore be expected to have a negative effect on the number of military retirees and families who patronize the commissary and on the value of purchases made during each visit. The negative effect on convenience purchases of small baskets is expected to be relatively small, but because these purchases only account for a relatively small fraction of the commissary's revenues, they could be insufficient to sustain the stores. By contrast, the negative effect on large-basket purchases, especially by shoppers with high travel costs, is expected to be large.

The overall magnitude of the sum of these effects from the standpoint of a commissary store can be summarized with an elasticity that gives the (expected) percentage change in aggregate quantity of sales at the store given the (expected) percentage change in prices. We term this measure *own-store price elasticity*, to distinguish it from the *own-price elasticity* implied by a price change for an overall category of food regardless of purchase location (see the next section for more details).

The distinction between an *own-store price elasticity* and an *own-price elasticity* for a product category is important when discussing the likely impacts of a commissary price rise. For the commissaries themselves, the *own-store price elasticity* is a measure of the likely percentage change in quantity demanded at the store given a percentage price change at that store. It thus summarizes the responsiveness of demand faced by that store. Impacts on store revenues should be computed using this elasticity.

On the other hand, the *own-price elasticity* (for, say, all grocery products or individual categories of products) is the relevant measure to estimate impacts on commissary patrons themselves. This is because patrons can shift purchases to other stores, and the own-price elasticity takes this into account by capturing all inter-store and inter-good relationships, including any change in the bundle of goods typically purchased and the store(s) at which the goods are purchased.

Estimates of Consumer Responsiveness to All Grocery Prices

Estimating demand and accurately predicting substitution patterns and price elasticities are highly complex because of the multidimensional nature of shoppers' choices. Grocery stores carry thousands of goods. Each store is surrounded by other stores that carry many of the same goods but also provide some distinct offerings. For example, the own-price elasticities of food products and other household goods are not identical and can vary quite widely. A meta-study by Andreyeva, Long, and Brownell (2010) that reviewed 160 U.S.-based studies found that the own-price elasticities of foods and nonalcoholic beverages ranged from -0.27 to -0.81 . These elasticities are not store specific, but rather represent the aggregate demand for foods and nonalcoholic beverages across all potential retail outlets. Food away from home, soft drinks, juice, meats, and fruit are found to be most responsive to price changes (-0.7 to -0.8), but eggs are least responsive. The appendix provides more details about the estimates of own-price elasticities for various categories of grocery items from three different sources in the academic literature.

Demand for various products is interrelated. The extent of the interrelationship is summarized by the cross-price elasticity of demand, which represents the percentage change in demand for one good, given a percentage change in the price of a second good. Different pairs of goods exhibit unique cross-price elasticities of demand. This is true not only within stores but also across stores. Cross-price elasticities range from negative values for substitutable goods to positive values for complementary goods. A complementary good is one that is used in conjunction with another good so that when the demand for one increases so does the demand for the other. For example, an increase in the price of peanut butter at Store A may decrease demand for peanut butter, jelly, and bread at Store A but increase demand for those goods at Store B, while also increasing demand for cream cheese and other spreads at Store A. The price sensitivities of demand for individual goods differ across stores, based on differences in consumer characteristics and competitive environment (Hoch et al., 1995).

The own-price elasticities of grocery products are useful in calculating the overall effect of a change in prices of groceries on the quantity demanded of groceries, taking into account all inter-store and inter-good relationships.

Estimates of Consumer Responsiveness to Store-Specific Price Levels

In this section, we review the literature on own-store elasticities associated with a change in prices at one store. We focus on the literature involving U.S. retail establishments and limit the investigation to only permanent changes in the overall store level.² It should be noted that each empirical study takes a different approach for con-

² Different empirical approaches assume that price expectations are formed in differing ways. The important point is that these are not own-store elasticities based on promotional pricing, but rather long-term changes in

trolling for the factors discussed in Chapter Four, and the elasticity estimates reflect this variation. In addition, these studies tend to be concentrated on groceries operating at a higher overall price level with multiple substitutes at similar prices, suggesting a strong substitution effect. One study by Dove/Willard Bishop (2004) dealt directly with DeCA; other studies, while not dealing directly with DeCA, still provide useful information.

In their study, Dove/Willard Bishop (2004) investigated the feasibility and financial impact of variable pricing strategies on DeCA's bottom line while maintaining customer savings and provided five estimates of own-store price elasticities, ranging from -0.3 to -2.6 .³ Two of the estimates were based on the 2002 and 2003 ACSI studies and varied with the level of assumed price increase. Observing a 2-percent increase in prices, the authors calculate a "conservative" own-store price elasticity of -1.7 , indicating that a 1-percent increase in commissary price level would result in a 1.7-percent decrease in quantity sold.⁴ The estimated own-store price elasticity became more negative for a 5-percent increase in prices and was reported as being -2.6 , indicating a scale effect. Apparently, the larger price increase caused the other non-price factors to have a relatively large impact when the price increase was larger. No data are reported for price level increases greater than 5 percent.

Experience in the private sector can be informative here, and we summarized a number of studies:

- Chan et al. (2006) provide estimates of the own-store price elasticities of store traffic and of store revenues, using data on 31 grocery stores across four chains in a large metropolitan area. Using data on all stores in the four grocery store chains, Chan et al. investigated own-*chain* price elasticities of store traffic.⁵ They found that if the price of every good inside all stores within some chain increases by 1 percent, while price levels in all other chains remain constant, then on average store traffic in that chain will be reduced by 0.04 to 0.17 percent. This suggests that consumers remained loyal to their preferred grocery store chain when prices changed by small amounts. A 1-percent increase did not induce considerable switching behavior. Rather, own-chain elasticity was observed to be fairly low. To investigate how individual *stores* might be affected, Chan et al. looked at a

price-level expectations.

³ The research assessed the feasibility of moving to variable pricing strategies while maintaining a 30-percent price advantage for commissary patrons.

⁴ The change in total revenue, or sales, associated with this change takes into account both the change in prices and the change in quantities and equals 1 plus the own-store price elasticity. As such, the sales elasticity associated with an own-store price elasticity of -1.7 is equal to -0.7 .

⁵ We use the term *own-chain elasticity* to refer to the responsiveness of sales to changes in the overall price level at a chain of grocery stores. A major limitation of this study is the exclusion of meat and vegetable purchases from the data.

selection of four stores across three chains in the sample, three of which were located close to each other and competed head to head. They found that the own-store price elasticities of store traffic ranged from -0.71 to -3.25 , and that the own-store price elasticities of store revenues ranged from -1.57 to -6.05 .⁶ In other words, if the price of every good inside one of the stores increased by 1 percent while the prices at nearby competitor stores remained constant, then on average store traffic was reduced by 0.71 to 3.25 percent, and store revenue was reduced by 1.57 to 6.05 percent. Converting these revenue figures, the implied own-store price elasticities are -2.57 to -7.05 .⁷ The paper only reports the results of a 1-percent price increase and does not comment on whether these elasticities are constant as prices increase. If the elasticities calculated by Chan et al. are assumed to be constant across all price changes, then the results imply that a 30-percent increase in the price level at a commissary store with nearby competitors could reduce store traffic by between 21.3 and 97.5 percent and could reduce store revenues by more than 49.5 percent and as much as 100 percent.

- Smith (2004) estimated a model of consumer choice and expenditure for supermarkets in the United Kingdom. The article reports estimated overall demand elasticities for supermarket firms for a household with median income. Under various modeling specifications, the estimated elasticities range from about -0.5 to about -1.0 .
- Ellickson, Griecob, and Khvastunovb (2014) provide the most recent published evidence on consumer sensitivity to various aspects of consumer store choice. Although the statistical model used did not allow for a strict own-store elasticity estimate, the parameter values allow for estimating how a particular chain-specific store's revenues would change if an index of price/quality changed to match that of another chain. The model also allows for rich patterns of substitution across chains. While these magnitudes are not necessarily useful for quantitative analysis of price changes, it is of particular interest to note that Walmart Supercenters are the major or second competitor for many of the hi-lo grocery chains that would be considered close commissary substitutes, with additional substitution toward grocery chains that are considered nearly equivalent in terms of prices/quality by consumers. As such, if commissary prices were to increase, we expect that Walmart and traditional grocers would be the main beneficiaries.
- Richards and Hamilton (2006) estimated elasticities across standard hi-lo grocery stores for fresh fruit in the Los Angeles market. In general, the own-store price elasticity estimates (based on an overall price index) ranged from -0.67 to

⁶ Given restrictions on the data, the authors note that these are lower-bound estimates.

⁷ The own-store price elasticities are in terms of quantity demanded, rather than revenue. Revenue elasticities equal 1 plus own-store price elasticities, by definition.

- 1.15, with an average very close to –1.0.⁸ Stores in the sample were substitutes for each other. In addition, the authors found a positive relationship between product offerings and quantity demanded; a 1-percent increase in the number of products offered for sale was associated with a 0.18- to 0.68-percent increase in quantity demanded.
- Using a relatively unique approach, Rhee and Bell (2002) focused on the determinants of switching long-term allegiances to “main” stores (those in which customers make the majority of their weekly purchases). They found that shoppers change main stores rarely—on the order of 18 percent of all weeks. When they do transition, they tend to do so within store formats; that is, EDLP shoppers tend to substitute to other EDLP firms, while the same finding applies to hi-lo grocers. While these authors found no significant effect of prices on the probability of shifting allegiances, the prices in question were deviations from the weekly average across the sample, rather than an overall price index.
 - Artz and Stone (2006) estimated the effects of the entry of a Walmart Supercenter on shopping behavior in metropolitan counties in Mississippi. This study is relevant because of the large price differential between Walmart and traditional grocery stores, with Walmart prices typically 8 to 27 percent lower.⁹ The resultant market shares for the discounter in the grocery category were approximately 16 percent in nonmetropolitan areas and 4 percent in metropolitan counties, suggesting that up to nearly one-fifth of the market can shift because of an entrant with lower relative prices of this magnitude. If the entry of Walmart into an area induces the same response as a relative price increase of 8 to 27 percent for all incumbent grocers, then this implies own-store price elasticities in the range of –0.6 to –2 for nonmetropolitan counties and of –0.2 to –0.5 for metropolitan counties.¹⁰
 - Briesch, Chintagunta, and Fox (2009) modeled the key determinants of store choice and computed market share elasticities, using panel data on the four largest grocery store chains in Chicago. They found that increases in price levels led to a greater reduction in sales for chains with an EDLP pricing format than for those with a hi-lo format. Estimated market share elasticities for the two EDLP chains, which provide the best comparison with DeCA, were –0.33 and –0.26. By comparison, the market share elasticities for the two hi-lo chains were –0.10

⁸ This might be expected given substantial competition in the grocery sector, as setting prices where elasticities equal –1 maximizes revenues.

⁹ The discount price figures are from Hausman and Leibtag (2007).

¹⁰ A complicating matter when extrapolating these estimates to commissaries is that Walmart was a new entrant to the market, rather than a preexisting firm that changed format (say, from hi-lo to EDLP). Consumers may view the change in relative prices due to a new entrant differently than a direct increase in their primary supermarket’s prices due to differences in information about the new entrant. In addition, the new entry changes the costs associated with travel. Thus, there may be confounding effects in the substitution pattern, with responsiveness generally underestimated relative to a direct increase in price levels for a consumer’s main grocery.

and -0.19 . We note that these are calculated at the *chain* level, rather than the individual *store* level, and as such indicate a degree of chain loyalty.

Table 5.1 summarizes the responses of the cited literature. In general, own-store price elasticity estimates for small price changes range from -1.0 to -6.0 , suggesting relatively responsive demand to commissary price changes, though the implied responsiveness to a new EDLP market entrant is slightly smaller. As noted, with the exception of the estimates in Dove/Willard Bishop (2004), these estimates are based on behavior in the private retail market and are not specific to commissaries.

These estimates generally show that own-store elasticities of demand tend to be greater than 1 in absolute value, indicating that the demand for commissary products is likely relatively sensitive to price changes. However, most of these studies (and all of the formal statistical estimates) have been for private retailers operating in a competitive pricing environment. These retailers have additional strategies that might be used to offset the negative effects of price changes, masking the pure price change effect. Under current operating practices, commissaries do not have this flexibility. On the other hand, with price levels for commissaries considerably lower than for supermarkets and deep discounters, it is likely that the substitution effect may be lower in overall magnitude for those customers who shop primarily on the basis of price.

In the following chapter, we use the estimated range of elasticities presented here to investigate the possible market impacts of an increase in commissary prices on commissary revenues and the possible impacts of this increase on commissary patrons.

Table 5.1
Summary of Own-Store Price Elasticities in the Literature

Study	Study Setting	Estimated Own-Store Price Elasticity Range
Dove/Willard Bishop (2004)	Defense Commissary Agency	-0.3 to -2.6
Smith (2004)	The UK supermarket industry	-0.5 to -1.0
Chan et al. (2006)	31 U.S. grocery stores in four chains in a large metropolitan area	-2.6 to -7.1
Richards and Hamilton (2006)	Hi-lo grocery stores in Los Angeles	-0.7 to -1.2
Artz and Stone (2006)	Grocery stores in metropolitan counties in Mississippi	-0.2 to -2.0
Briesch, Chintagunta, and Fox (2009) ^a	The four largest grocery store chains in Chicago	-0.1 to -0.3

^a The estimates provided in Briesch, Chintagunta, and Fox (2009) are estimated at the chain level, rather than the store level.

SOURCE: Authors' analysis.

The Likely Effects of a Commissary Price Increase

In this chapter, we use the elasticity results from the literature to bound the projected market effects of an increase in commissary prices on commissary revenues. The effect of price increases on sales is important because it determines the ability of commissaries to recover any lost dollars due to a change in the annual appropriation from DoD, and thus cover their costs. For example, using a very simplified model that assumes no changes to current cost structure and a need to increase revenues by \$1 billion per year (in accordance with the FY 2015 budget proposal), the overall price level at all commissaries would need to increase by approximately 17 percent, *assuming no reduction in overall sales*. The same calculation assuming price changes on 70 percent of all transactions (as opposed to 100 percent) results in price increases of approximately 24 percent.¹ However, if commissaries were operating inefficiently, such that total costs could be trimmed by a hypothetical 10 percent of the current appropriation (approximately \$140 million), then the price increases under the two scenarios would total 14 to 20 percent.² Furthermore, in order to reduce the gap between commissary and average supermarket prices to 10 percent, the commissaries' prices would have to increase by nearly 29 percent.

An assumption of no reduction in overall sales is equivalent to assuming that commissary shoppers are completely unresponsive to prices.³ The empirical evidence reviewed in the previous chapter, however, strongly suggests that consumers are responsive to the overall level of prices at a given retail establishment, especially when substitutes are available.⁴ If an increase in prices reduces quantities demanded of commissary products, then any calculated change in revenues must take into consideration not only

¹ The 70-percent assumption is based roughly on the proportion of CONUS to OCONUS stores.

² We make no claims as to the feasibility of the efficiency gains. Rather, we use this example to suggest an inverse relationship between total costs and the amount of price increase necessary to make up the shortfall, assuming no price response.

³ That is, the own-store demand for commissary products is completely price inelastic. Graphically, this is equivalent to a vertical demand curve.

⁴ Note that the FY 2015 budget request explicitly excludes those locations where substitution possibilities are limited.

the change in price levels, but also the associated change in quantities. In particular, if the own-store price elasticity is greater than 1 in absolute value (that is, demand is elastic) for any level of price change, then an increase in prices will *decrease* total expenditures on commissary products (and thus, total revenues). As such, raising prices to a given level likely *will not increase revenues by the proportion of the price change*.

In the following sections, we show that increasing commissary prices can compensate for a decrease in overall appropriations to the commissary system only under very specific demand conditions—namely, when commissary patrons are unresponsive to price increases. Given the uncertainties associated with the own-price elasticity of commissary demand, we provide a range of estimates of revenue changes across this parameter. We then provide some discussion about the mitigating and exacerbating factors that influence demand responsiveness for commissaries and discuss the pricing policy that would maximize revenues. We also discuss the potential differences in response from four different groups of servicemembers and retirees.

Effects of a Price Increase on Commissary Revenues

In this section, we share how the assumptions regarding the own-store elasticity of demand can affect the total revenues of the commissary system for an across-the-board price level increase of 29 percent (necessary to lower the current price advantage of the average commissary bundle from 30 percent to 10 percent). This provides a sense of scale of how patron responsiveness translates into changes in commissary revenues. Given the lack of empirical evidence regarding an incumbent grocery in any location raising prices by double digits across the board, we must infer a likely response to increased commissary prices from the existing estimates of price responsiveness. As these estimates are typically derived using small price changes, they may be underestimates of the actual response due to the strength of the income effects involved in such a large change, the fact that private groceries have more flexibility in marketing strategy, and the fact that the price changes are likely to be relatively permanent and not subject to market forces.

In addition, we note that even an across-the-board price increase at all commissaries may have effects that vary by locality and across individuals. Price levels at substitute groceries likely differ across markets, and the number of substitutes to commissaries likely varies as well. For example, a region with a small number of substitutes and a large initial commissary price advantage will likely see less response to the price change than a region in which initial commissary prices are more comparable to a large number of substitutes. Due to different preferences and constraints, individuals and households will likely have different propensities to change shopping behavior as well. While we recognize these differences, the analysis that follows focuses on the aggregate demand for commissary products.

Table 6.1 shows the percentage change in unit sales, percentage change in revenues, and total revenue changes given a 29-percent increase in overall price levels for 70 percent of all commissary sales by dollar value, assuming a constant proportional demand response. We vary the responsiveness of consumers to price changes from being completely unresponsive (an own-store price elasticity of 0) to very responsive (an own-store price elasticity of -3.0) to price levels. The lower bound assumes that consumers will not change their consumption behavior at commissaries given a price level change. We use -3.0 as an upper bound due to the relatively large magnitudes of expected price changes, as well as survey evidence reported in Dove/Willard Bishop (2004) that suggests that responsiveness increases as the overall price level changes. Although this is a large range of the key response parameter, it brackets the available estimates.

The table shows that the change in total revenues decreases as consumer responsiveness increases (i.e., as the magnitude of the own-store price elasticity gets larger). If demand is completely unresponsive, then a 29-percent increase in prices will increase revenues by nearly \$1.2 million. In the more realistic cases when demand is responsive to prices, revenues can be unchanged or can decrease. For example, when the own-store elasticity is equal to -1.0 (at the low end of the likely response), a 29-percent increase in price causes an exactly offsetting demand response on quantity sold, resulting in unchanged revenue. For larger levels of responsiveness, the increase in prices results in decreased revenues overall, as the effect of the decrease in quantities outweighs the effect of the increase in prices. As such, when demand is relatively responsive to price changes, the commissaries will be unable to generate sufficient revenues to cover the loss of the appropriation by raising prices alone.⁵

Table 6.1
Effects of a 29-Percent Price Change by Demand Responsiveness

Own-Store Elasticity	Percentage Change in Quantity Sold	Percentage Change in Commissary Revenue	Dollar Change (\$ mil) in Commissary Revenue
Zero (unresponsive): 0	0%	29%	\$1,192
Low: -1.0	-29%	0%	\$0
Medium: -2.0	-58%	-29%	-\$1,192
High: -3.0	-87%	-58%	-\$2,383

NOTES: This table assumes that 70 percent of FY 2013 sales were affected by the price change. A 29-percent price increase would narrow the average savings on a typical commissary grocery bundle over traditional supermarkets from 30 percent to 10 percent.

⁵ This is in contrast to the implicit assumption in the CBO (2011) that a 7-percent increase in commissary (and exchange) price levels could increase revenues.

We next discuss the mitigating and exacerbating factors that likely influence the own-store demand responsiveness for commissaries. Each is analyzed assuming that the other factors are fixed, though there may be correlations across factors.

Factors Mitigating Major Sales Decreases for Commissaries

While many of the studies cited in the previous chapter suggest that price increases at commissary stores could have a large impact on sales, there are some factors that suggest that patrons may not be as responsive to price changes as the general public in private retail establishments. This section details those factors.

The first factor that tends to reduce price responsiveness to increased prices is store loyalty. Many studies find that consumers develop habitual shopping behaviors and display a tendency to become loyal to particular stores and brands. The probability that a household visits a store in a given week is higher for those households that spent more at that store the previous week (Figurelli, 2013). Store choices are found to be substantially more stable than brand choices (Bell, Ho, and Tang, 1998). Bell, Ho, and Tang found, for example, that only 21 percent of households ever visit more than two supermarkets. This suggests that current commissary shoppers may continue to patronize the stores out of habit, even if they are no longer the cheapest option in terms of travel and average shopping bundle costs.

A second factor that may contribute to lower price responsiveness is the quality of service that patrons experience at commissaries. As documented in Chapter Four, DeCA's customer satisfaction scores rank higher than those of the average supermarket, and commissaries' positioning tier tends to be a rather unique high-service, low-price strategy. While these features contribute to high sales, they may become unsustainable if DeCA's \$1.4 billion appropriation is reduced.

Finally, if price changes can be kept at a low level absent the subsidy, the search and other costs associated with locating and getting familiar with a new primary grocery store for many patrons may be larger than the overall increase in the cost of the average planned basket of groceries. For example, Fox, Montgomery, and Lodish (2004) found that the baskets of goods consumers buy are extremely stable over time, which suggests that consumers either fail to notice small changes in basket prices or are not sufficiently troubled to act on them and adjust their shopping habits accordingly. This idea of a price band around which consumers are generally nonresponsive to small changes in price has been formalized by other researchers (e.g., Monroe and Lee, 1999).

Factors Likely to Exacerbate Major Sales Decreases for Commissaries

The previous section identified characteristics of commissary patrons that tend to mute the responsiveness of demand to price changes. However, there are also several factors that suggest that own-store price elasticities could be greater for commissaries.

First, the fact that commissaries tend to be located farther from patrons' homes than substitute grocers will tend to increase the own-store price elasticity for commissaries. The reason is that in trading off the fixed costs of travel with expected price savings, the price level at an incumbent store for which a substitute becomes more attractive is decreasing in the distance to the incumbent. That is, the closer the incumbent store, the higher the price level can be before a consumer contemplates a switch to the substitute. As such, double-digit (or near-double-digit) price level increases at commissaries are likely to induce considerable substitution to other grocery retailers.

Second, the size of the planned purchase bundle for commissary patrons is typically larger than those at standard grocery stores and more in line with those at discount retailers. These large-basket purchases are consistent with consumers who are generally price and travel sensitive. Small reductions in commissary visits among these big-basket shoppers could translate into large reductions in sales and revenues.

Third, commissaries generally offer a smaller assortment of products than comparable retailers. To the extent that this variety is valued by consumers, the relationship between this characteristic and responsiveness to price is similar to those related to location—namely, the greater the variety, the more a consumer's primary store can increase prices before inducing a switch.

Fourth, a survey by DMDC (2012) found that 89 percent of commissary patrons believe that the overall savings rate they receive from shopping at commissaries is below 20 percent, which is much lower than DeCA's calculation of 30 percent. As a result, a large increase in commissary prices may be *perceived* as completely eroding the commissaries' price advantage over substitutes. As the perceived difference in price levels between commissaries and substitute stores decreases, a large price change will be more likely to induce substitution to alternative retailers. This might be especially true if the substitute stores in a region include EDLP retailers, such as Walmart.

Finally, the sociodemographic characteristics of commissary patrons generally suggest a high degree of relative price responsiveness. Nearly one-half of customers are retirees, and low-ranking enlisted personnel and their families tend to be on the lower end of the income scale. These characteristics, coupled with research that indicates that the financial benefits of commissaries among patrons are an important nonsalary benefit of military service, suggests a relatively high sensitivity to price increases (Dove/Willard Bishop, 2004).

We next turn to a discussion about the price level at which commissary revenues can be maximized without pricing merchandise at variable markups. We also discuss the effects of a potential price increase on commissary patron shopping behavior.

Effects of a Price Increase on Commissary Patron Shopping Behavior

In the context of store choice, an increase in the price level of commissaries causes different types of changes in shopping behavior. This can be characterized by four categories of servicemembers and retirees, depending on their use of the commissary system and their ability to substitute to alternative stores.

First, patrons of commissaries who do not alter their shopping behavior (i.e., who do not substitute to other retail locations partially or fully and do not change their planned purchase bundles) will experience an increase in their grocery shopping expenditures equal to the differential in prices for that bundle times the number of bundles purchased. For example, an increase in the commissary price level of 29 percent for a weekly basket of goods valued at \$66 (the current average) would increase annual expenditures by \$995 per year (over a baseline of \$3,432 per year). This implies a perfectly inelastic own-store demand for commissary products, which is extremely unlikely for most commissary shoppers.

Second, some patrons of commissaries who would not substitute at all to other stores would nevertheless decrease the quantity of goods purchased at the commissary due to income effects or substitution effects across goods as a result of the price increase. By cutting back on purchases (i.e., buying a different weekly bundle), these patrons partially offset the full impact of the expenditures on their grocery bill. In this situation, the lack of substitution to other stores implies that this consumer's own-store elasticity and the own-price elasticity of grocery demand are equivalent (at least over the implied price range). Because the demand for groceries is generally not responsive to price changes (i.e., inelastic), the effect on expenditures at commissaries will be positive (i.e., a patron will spend more on commissary goods over the course of the year). For example, a relatively nonresponsive consumer with an own-store elasticity of -0.5 would see his or her grocery bill increase by about \$466 per year. While there is likely a small subset of consumers like this, the empirical evidence suggests that, on average, the absolute magnitude of own-store price elasticities tends to be greater than 1.

Third, patrons of commissaries who substitute at least some portion of shopping trips to additional retail outlets (including those who will no longer utilize the commissaries at all) will also experience a loss of benefits between 0 and the full amount of the price increase. As with the previous case, this group of customers reduces purchases at commissaries in response to the price change, but may do so through substitution to other outlets as well as in response to a change in purchasing power at commissaries. It is likely, though not necessary, that the responsiveness of this group to price changes is larger than that of the previous group; that is, this group likely has an own-store demand elasticity that is larger in magnitude. Additionally, these consumers' own-store elasticities are likely larger than their own-price elasticities for groceries over all stores.

For example, assume that a commissary patron has an own-store elasticity for the commissaries of -1.5 but an own-price elasticity for groceries (overall) of -0.75 . A

29-percent price increase at commissaries will induce a fairly significant substitution response, with quantity demanded at the commissary store decreasing by 32 percent and expenditures for this customer at the commissary decreasing by \$410 per year.

However, this type of customer will spend more at substitute stores. Assume that the new price level (after substitution) is 15 percent greater than before the price change.⁶ Using the own-price elasticity of demand of -0.75 , total aggregate grocery expenditures will be \$255 higher than before the price change. Subtracting, this implies that grocery expenditures at the newly patronized non-commissary stores will total \$665 per year.

Finally, a fourth group of servicemembers may not currently use the commissary for grocery shopping. In this case, assuming standard demand conditions, the loss of market benefits for this group is 0, as consumer surplus is nonzero only if demand for a product is positive.

We now turn to the market effects on the aggregate commissary patron population. If the aggregate own-store elasticity of demand for groceries is perfectly nonresponsive (i.e., perfectly inelastic), and prices increased by 29 percent on 70 percent of the goods purchased at commissaries (by sales value), then the effect on total grocery bills would be a \$1.2 billion increase. There would be no substitution to other retail outlets, and the change in relative purchasing power would not have an effect on consumption (i.e., no income effects). As discussed in the previous chapter, this is not likely in practice.

The empirical evidence reviewed in the previous chapter suggests that demand for commissary products is likely responsive to price changes, though the overall demand for food and nonalcoholic beverages is relatively unresponsive (i.e., inelastic). The exact magnitude, however, is unknown. Because we are interested in the effects of the price increase on commissary patrons' grocery bills (taking substitution into account), it is appropriate to use the own-price elasticity for groceries to estimate overall grocery expenditure changes.⁷ In addition, as in the individual consumer class analysis presented above, the impacts will depend on the level of prices at the stores that are patronized after the price change. This, in turn, depends on the characteristics of the available substitute stores, including price and location, and consumer preferences.

Table 6.2 provides an estimate of the change in total commissary patron consumer grocery expenditures (assuming constant demand elasticities) for varying price increases (following substitution) between 10 and 30 percent. We present a range of own-price elasticity estimates from inelastic to unit elastic. By using this elasticity, the

⁶ Note that substitution will require this price level to be lower because the consumer could always choose to shop at the commissaries.

⁷ Another measure of the impact of commissary price increases on patrons consistent with economic theory would be the overall loss in consumer welfare as a result of the change. In essence, the loss of welfare would be the change in the overall willingness to pay for groceries less what actually must be paid. Unlike expenditures, this measure is not a financial cost to consumers.

Table 6.2
Change in Overall Grocery Expenditures from Effects of Varying Price Increases by Own-Price Demand Elasticity for Groceries

Own-Price Elasticity	10-Percent Price Increase	20-Percent Price Increase	30-Percent Price Increase
Zero (unresponsive): 0	\$413	\$826	\$1,239
Low: -0.33	\$272	\$537	\$794
Medium: -0.66	\$136	\$264	\$385
High: -1.0	\$0	\$0	\$0

NOTES: These data assume constant elasticity of demand. Dollar values are in millions. Quantity has been normalized to 1 and price normalized to total sales in calculations (without loss of generality). These data assume that planned non-commissary purchases remain unchanged.

table explicitly accounts for substitution away from the commissary and toward other retailers and presents the change in terms of total grocery bills across all stores. A starting point of \$4.13 billion in patron expenditures (approximately 70 percent of total commissary sales in FY 2013) is assumed.

The results in the table show that overall aggregate grocery bill changes as a result of the commissary price increase decrease significantly as the consumers are able to (1) substitute away from groceries and toward other goods (as the magnitude of the price elasticity increases) and (2) substitute toward lower-priced alternatives (as the realized price increase declines). The availability of substitute stores, their pricing strategies, the ease to which consumers can shift their shopping, and overall consumer preferences will ultimately determine the new realized price level and the own-price elasticity of demand.

Second-Order Effects of a Price Change

Approximately 80 percent of enlisted personnel and 70 percent of officers ranked the benefit from commissaries as a “high” or “the highest” of nonpay benefits (Jowers and Tilghman, 2013). The grocery savings generated through this benefit accrue to patrons of the commissary system. However, there may be spillover benefits to military service personnel above and beyond the savings on groceries:

1. As a form of non–base pay compensation, the commissary (and exchange) systems increase the overall financial return to military service, thus increasing the

attractiveness of the services versus other forms of employment. An increase in commissary prices would decrease this return, likely reducing both recruitment and retention of personnel. It may also result in bad publicity for the services, strengthening the effect. This cost accrues outside of the market for groceries and accrues to the services overall.

2. The demand for commissary and exchange products may not be independent. In the private sector, stores may engage in “twin location” strategies, under which stores that sell different goods are located close to each other, similar to commissaries and exchanges. In this way, stores can draw demand from one another and facilitate one-stop shopping, which is particularly favored by time-constrained households (Stahl, 1987; Haans and Gijsbrechts, 2010).⁸ As such, a change in the demand for commissary products may affect the demand for exchange products (and vice versa). This implies a negative cross-price elasticity of demand for commissaries and exchanges, suggesting a relationship in which an increase in the price of commissary goods will result in a decrease in quantity demanded of exchange goods. In the case of joint commissary-exchange patrons who make a long trip to take advantage of the potential savings for groceries (likely a larger share of their budget than exchange goods), the decrease might be quite large, and the associated loss of revenue could put additional pressure on the exchange system to cover costs. As reported by Jowers (2014), the director and chief executive officer of the Army and Air Force Exchange Service, Thomas Shull, stated in a memo to DoD that 20 to 30 percent of exchange customer traffic is tied to that of the commissaries. We are unaware of any empirical estimates of the cross-price elasticity between commissaries and exchanges.
3. Approximately \$300 million in dividends from exchange operation is used to support MWR programs within DoD. As mentioned above, an indirect hit in exchange sales due to significant loss in commissary sales could reduce or eliminate this dividend payment, as a greater proportion of revenues would be used to cover operating costs for exchanges. This loss of benefit would accrue to the beneficiaries of the quality of life programs.
4. The cost of living adjustment (COLA) formulas use commissary savings figures when determining year-to-year adjustments (Armed Forces Marketing Council, 2011). If the formulation remains the same, an increase in commissary prices will be capitalized into COLA adjustments. While this does not negatively affect servicemembers (and, in fact, provides a benefit that may at least partially offset the income effect of any price change), it does erode any potential savings

⁸ A reviewer makes the point that the supercenter business model is based on this synergy.

estimates from the elimination of the \$1 billion appropriation from the standpoint of DoD.⁹

5. Supplemental Nutrition Assistance Program (SNAP); Women, Infants, and Children (WIC); and other coupons can be redeemed at the commissaries. Many beneficiaries of these food assistance programs have been using the commissaries to maximize the value of these public health and nutrition programs. From 2007 to 2011, coupon redemptions have increased 300 percent. If the present customer savings rate were to decrease, SNAP and WIC beneficiaries would no longer enjoy the extension of purchasing power through redeeming coupons at the commissaries.

Nonmarket Effects of a Price Change

Finally, some benefits of the commissary system may accrue directly to servicemembers but are not linked to the use of the commissaries to purchase groceries. We term such impacts the *nonmarket effects* of an increase in commissary prices. Nonmarket values are measured by the willingness to pay (i.e., give up something of value) to keep a service, or the willingness to accept payment to give up a service.

Option values are benefits that accrue to an individual because he or she retains the right to use a good or service in the future. Some servicemembers and their families may not currently use the commissary system as their primary source of groceries, but they may value the option to do so in the future. This option value exists because future income is random, especially for spouses. In the case of loss of a job, unexpected medical expenses for family members, or other negative shocks to income, the lower prices of the commissary provide a means to minimize the impact of this shock to the family budget through shifting to commissary shopping. This same option may exist for current patrons as well. As long as a servicemember would be willing to pay in order to retain the commissary system as is, the option value of the system is positive.

Related to option value, some individuals may value the commissaries for any number of reasons unrelated to current or future use benefits.¹⁰ For example, an individual may place value on the satisfaction that his or her own family or his or her colleagues' families are financially secure, to which the commissary system may contribute (Armed Forces Marketing Council, 2011). Another example is the sense of community that commissaries help to establish within the military system. A reduc-

⁹ To the extent that the commissary system is viewed as an inefficient provider of groceries and related services, a full pass-through of the increased cost of living may result in a more inexpensive way to provide a similar benefit. However, this pass-through would limit any DoD budget savings to the amount of the inefficiency.

¹⁰ *Use benefits* refer to benefits that accrue to an individual or household due to current or future utilization of a resource, while *nonuse benefits* are not due to direct utilization.

tion in the commissary benefit may reduce or eliminate such benefits, termed *existence values* in the valuation literature.

To our knowledge, there has only been one empirical attempt to estimate the non-market value of the commissary benefit. Harrison (2012) used a variation on a choice experiment to estimate the stated relative value of commissary benefits, breaking the value of an attribute defined as “additional benefits and services” into seven component subattributes via a scale question about importance.¹¹ The report was not based on a random sample and thus is subject to selection bias. In addition, the paper does not report the overall value of commissaries, but rather the proportions of respondents who value the existence of the benefit more than the estimated \$600 cost to DoD per servicemember. Results showed that one-third of officers and only 6 percent of enlisted personnel valued the existence of the commissary benefit more than the \$600 cost. However, without more information on the magnitudes of the estimated benefits, it is impossible to know the total benefits generated.

Nonuniform (Variable) Pricing Strategies

Proponents of eliminating (in large part) the annual appropriation for the commissary system have pointed to the exchange system as a model that provides a retail benefit at significantly less cost per servicemember, at \$110 versus \$600 per person (Harrison, 2012). In fact, CBO has estimated that combining the three exchanges run by individual services and the commissary system could result in \$2 billion in operational savings per year, and that in conjunction with a \$400 per year cash grocery allowance, the overall budget savings would total \$1.3 billion annually in the long run (CBO, 2011). The analysis assumes that price levels would rise by approximately 7 percent as a result.

The transition to an exchange-type model, in which commissaries price goods and services with a variable margin (rather than at cost plus the 5-percent surcharge), has been extensively studied in the past, most recently by Dove/Willard Bishop (2004). We summarize the major results of that study here.

In order to generate positive margins given the elimination of the annual appropriation that covers operating costs, DeCA would have to (1) raise prices, (2) lower costs, or (3) implement some combination of the two.¹² The extent to which these instruments can be used to cover the potential shortfall absent the subsidy depends on the degree of inefficiency on the cost side and the behavioral response of consumers to price increases. To the extent that current commissaries are not operating at minimum

¹¹ A choice experiment essentially asks respondents to choose between a menu of options, with each option being defined by a set of attributes. Statistical procedures can then be used to estimate the change in utility associated with a change in one of the attributes. The ratio of marginal utilities can be used to value the attribute in question.

¹² Note that variable pricing strategies do not necessarily ensure positive profits for a store; rather, the margin implies a markup on a particular item or items.

costs, any increases in efficiency can be immediately used to generate a margin. However, as with consumer response, there may be changes in vendor response as a result of the price change.¹³ Movement away from the perceived benefits to the vendor of the current pricing and marketing system would likely reduce the level of vendor support and perhaps increase costs, reducing (or perhaps even eliminating) any potential benefit of extracting cost savings for wholesale merchandise. In addition, management of a variable pricing system would require additional expertise to manage the pricing system, also increasing costs. Finally, increased prices under relatively responsive demand will further reduce revenues, even as the higher price level increases revenues per unit sales. Ultimately, Dove/Willard Bishop found that the movement to a variable pricing system (absent significant operational savings due to consolidation with the exchanges) would result in costs greater than revenues, due largely to both vendor and consumer response.

The bottom line of their study is that changes in the structure of the commissary system must account for the behavioral responses on the input and the output sides of the business. Changes in perceived or actual net benefits for suppliers and consumers will result in changes to behavior that will ultimately impact cost and revenues, especially in the presence of substitute buyers (for vendors) or sellers (for consumers). Failure to take into account these behavioral responses will likely overestimate the benefits of increasing commissary prices (or moving to an exchange-type system). The extent of this overestimate, however, is an empirical question.

¹³ The authors document that wholesale vendors provide significant extra services to commissaries in exchange for 100-percent pass-through of promotional expenses, the large market shares they can achieve, and the ability to build brand loyalty as the primary benefits of supplying the commissary system.

Future Research

The studies and media articles we have examined as a result of this review of the literature are suggestive of the kind of problems DeCA will have if the subsidy it has received is dramatically reduced. The proposed reduction would result in price changes well beyond anything seen in the literature, suggesting the necessity for more dedicated research to pin down the effect of price increases on commissary sales with greater precision. This would require obtaining more detailed data on a far wider range of variables and estimating a detailed model of store choice and grocery competition for servicemembers and their families.

The recent studies by Figurelli (2013) and Ellickson, Griecob, and Khvastunovb (2014) illustrate the statistical methodologies that could be used in order to perform such a task. If possible, individual-level shopping behavior could be used to model the probability of store choice (or the transition from one main store to another, as in Rhee and Bell [2002]) as a function of aggregate price levels, the geographic distribution of consumers and stores, shopping habits, other observable store characteristics, and the sociodemographic characteristics of the shopper or the shopper's family. The outcome of such a study would be estimates of the own-price store elasticity of commissaries, taking into account differences across observable characteristics (and different demand responses for classes of commissaries). These elasticities could then be used to estimate the unit sales and revenue implications of changing commissary prices. They could also be used in conjunction with additional tools, such as RAND's Dynamic Retention Model, to estimate the effects on retention and recruitment. Ideally, statistical studies of demand would rely on actual price levels and purchases transacted in the marketplace. Unfortunately, the level of price variability in historical data is likely not sufficient to include double-digit planned increases in overall price levels at commissaries.

In addition, economists have developed methods to estimate the loss of nonmarket benefits such as those discussed in the previous chapter. These methods use survey data to estimate the "willingness to pay" to avoid negative changes that may affect groups of people. Such methods could, in theory, be used to estimate the loss in non-market benefits associated with the commissary system.

Conclusion

This report has reviewed how price increases have affected grocery retailers in the private sector through changes in store choice and how these results might translate into changes in sales and revenues within the commissary system. We found that the literature distinguishes between the fixed costs and variable costs of grocery shopping. *Fixed costs* refer to such store attributes as the quality of products and services, the assortment of product offerings, and the distance from a household. *Variable costs* refer to the cost of the basket of goods purchased on a given trip. Empirical estimates of the effect of average price levels on store choice suggest that consumers are typically responsive to changes in overall price levels.

Most estimates of store choice suggest that a 1-percent change in prices will result in a greater than 1-percent change in quantities demanded; i.e., there is elastic demand for grocery products at a particular store. In such a case, the loss in quantity demanded will more than offset the increase in prices, and revenues for the store will decrease. However, we were unable to locate any statistical studies that included commissaries in a store choice model. Nonetheless, the evidence supports the conclusions that other than the isolated and overseas commissary stores, demand for commissary goods and services is likely to be relatively responsive to changes in prices. In addition, the overall inelastic demand for grocery products across all stores suggests an increase in average grocery bills for commissary shoppers, though the exact magnitude of the increase depends on substitution possibilities to other stores and the overall responsiveness to grocery price levels.

We note, however, that commissaries offer a high level of service at a very low price, and the costs of changing shopping patterns may be large for some patrons. Moreover, servicemembers and retirees may value the nonmarket benefits associated with the commissary system—benefits that are largely unmeasured in previous studies. However, commissary patrons tend to purchase large bundles and share many of the characteristics of price-sensitive consumers, which might weaken such loyalty. In addition, commissaries tend to offer slightly fewer products than private supermarkets, are open less often, and tend to be located farther away than most substitutes; these are all reasons that would increase the propensity to switch away from commissaries in the event of substantial price changes.

In addition, there are possible second-order effects to be considered if subsidies are reduced and there is a commensurate increase in commissary prices. These include detrimental effects on recruitment and retention as nonpay benefits decrease, the loss of support to MWR quality-of-life programs, substitution away from exchange shopping if the two store types are complementary, and an increase in the COLA if commissary benefits remain a part of the formula.

A future research project using actual shopping data of commissary patrons coupled with questions to reveal preferences could be used to estimate the demand responsiveness of commissary patrons to changes in prices and the changes to the nonmarket benefits of the commissary benefit, given a price change.

Own-Price Elasticities of Individual Commodities

Table A.1
Own-Price Elasticities of Individual Commodities

Food Category	Hoch et al., 1995	Bell and Lattin, 1998	Andreyeva, Long, and Brownell, 2010
Soft drinks	-2.6	-0.5	-0.8
Crackers	-0.8	-0.6	
Cookies	-0.9		
Cereals	-1.1		-0.6
Canned seafood	-1.0		
Canned soup	-1.7		
Grahams/saltines	-1.5		
Frozen entrees	-1.7		
Juice	-1.9		
Dairy cheese	-1.4		
Butter/margarine		-0.6	
Ice cream		-0.4	
Coffee		-0.3	
Sweets/sugar		-0.5	-0.3
Hot dogs		-0.6	
Paper towels		-0.5	
Detergent		-0.1	
Bacon		-0.6	
Tissue		-0.2	

Table A.1—continued

Food Category	Hoch et al., 1995	Bell and Lattin, 1998	Andreyeva, Long, and Brownell, 2010
Beef			-0.8
Pork			-0.7
Fruit			-0.7
Poultry			-0.7
Eggs			-0.3
Milk			-0.6
Dairy			-0.7
Vegetables			-0.6
Fish			-0.5
Fats/oils			-0.5
Food away from home			-0.8
Average for all food categories	-1.5	-0.5	-0.6

SOURCE: Authors' analysis.

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