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A study of consumers' perceptions of dynamic price strategies for perishable foods and the impact of the strategies on retailer performance

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By

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Abstract

Effective management of perishable foods is crucial for retailers to survive and prosper in the food retail market, as they take account for up to 50 percent of the industry's overall sales and consumers use them as a criterion to choose a retailer. However, food retailers face a challenge in pricing perishable foods. With the present prevailing pricing strategies, which discount the price of perishable foods when the expiry date is imminent, and daily stock replenishment practice, retailers often face the difficult situation where the display stock of a specific perishable food has a different remaining shelf-life but the same price. This may increase the waste due to unsold product; therefore, more dynamic price management for perishable foods is needed to facilitate a more efficient selling process.

Numerous studies have proposed dynamic pricing models for perishable products, which were designed to determine an ideal pricing structure to improve retailer performance, however, they have not considered consumer demand in relation to a situation where identical products have different values resulting in different prices being available at the same time. In addition, the available studies of dynamic pricing for perishable products evaluate the value of dynamic pricing from the retailers' perspective, in terms of profitability, and consumers' perceptions of such pricing have rarely been studied in the context of marketing studies.

This thesis, therefore, aims to demonstrate the value of dynamic pricing strategies for perishable foods from consumers' perspective, and compare the performance of different forms of dynamic pricing strategies by considering consumer demand in relation to such situations. Interviews were conducted with three food retail managers in different leading food retailers in South Korea, to gather practical information about the management of perishable foods. This interview data was then used as an input to the choice of sample product types for formal surveys to investigate consumers' perceptions of dynamic pricing strategies, and the design of a simulation model developed to compare the performance of different pricing approaches. The results presented in this thesis offers a significant contribution to the literature, providing a better understanding on the impact of dynamic pricing strategies for perishable foods from the consumers' perspective, an area that has received little attention. Moreover, this thesis provides a new insight into consumer demand that is particularly applicable to the pricing of perishable foods. The results of this thesis can be used as a guide for retailers seeking an effective pricing strategy for perishable foods.

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CHAPTER ONE

INTRODUCTION

1.1. RESEARCH BACKGROUND

Pricing is one of the most venerable topics in the field of marketing (Cannon and Morgan, 1990), and is considered to be a crucial marketing strategy on account of its significant influence on profitability (Hinterhuber, 2008; Jobber, 2004). It has a high impact on customer satisfaction and purchasing behaviour, which are the factors that significantly influence business performance (Fornell, 1992; Hermann et al., 2007; Reichheld and Sasser, 1990; Salvador et al., 2007; Smith and Sinha, 2002). In practice, managers in charge of pricing decision-making normally set the price by considering three key factors: costs of production, competitors' prices and customer value (Hinterhuber, 2008; Shapiro and Jackson, 1977). These are the basis of the three pricing approaches in common use: (1) cost-based pricing, in which the costs of production are taken into consideration (Jobber, 2004; Shapiro and Jackson, 1977); (2) competitor-based pricing, in which competitors' pricing of the same product type is considered (Armstrong and Collopy, 1996; Shapiro and Jackson, 1977); and (3) customer value-based pricing, in which customers' perception of the value of the product are taken into consideration (Forbis and Mehta, 1981; Shapiro and Jackson, 1977; Ulaga and Chacour, 2001).

For products that perish within a given time period (such as flight tickets, theatre seats, seasonal fashion goods, weekly magazines, sporting events, hotel rooms, short shelf-life perishable foods), a more complex procedure is required (Elmaghraby and Keskinocak,

2003). Consumers' purchasing decisions require a complex process that takes the perceived value and benefits of the product into consideration against the price (Shapiro and Jackson, 1977). They may therefore be unlikely to purchase if the price does not adequately reflect the perceived attributes of the product (Horngren et al., 2005; Shapiro and Jackson, 1977). The value of such perishable products deteriorates over time, and the price should therefore be continuously altered on the basis of those variations to maximize profitability (Elmaghraby and Keskinocak, 2003).

Among the variety of products distributed by the food retailing industry, perishable foods are considered as key items for success; perishable foods account for up to 50 percent of the industry's overall sales and consumers use them as a criterion when selecting a food retailer (Heller, 2002; First Research, 2009). The effective management of the perishables category is thus critical to the maintenance and enhancement of retailers' profitability and competitive edge in this highly competitive market, as different food retailer have to compete with each other by selling the same types of perishable food products to consumers (Hennessy, 1998). Despite the importance of perishable foods, however, food retailers face a challenge in pricing them.

Food retailers generally discount prices when the expiry dates of perishable foods are imminent. For example, large food retailers in South Korea discount the prices when only a few days of the selling period remains (Jin, 2011; Lee, 2007). Therefore, an individual perishable food item may have one of two possible price levels – with the original price and the discounted price. Most of the time, therefore, the majority of items of a specific perishable food product have an identical price and different remaining shelf-life, until the price is discounted when the expiry date is imminent. To put this differently, the price of an

individual item of a specific product will be the same as all other identical products on display, regardless of how long it and the others have actually been on the shelf, until the last few days of its shelf-life are reached.

It has been reported that consumers' willingness to pay typically decreases as perishable foods approach to their expiry dates, as a result of the association of value deterioration with a higher risk that freshness will have been lost (Eom, 1994; Tsiros and Heilman, 2005). The value of perishable foods decreases continuously during their selling period. The majority of food consumers normally check the expiry date before making a purchase; specifically, 88% of consumers always or frequently check the expiry date as reported by A. C. Nielson (Harcar and Karakaya, 2005). It is common-sense that, if the expiry date and price of perishable foods were checked by consumers, no-one would purchase a product with less remaining shelf-life if the price was the same as for those with a greater proportion remaining shelf-life. Consequently, this may lead to loss of sales and increased waste from expired foods since perishable products have little or zero salvage value beyond a given selling period (Elmaghraby and Keskinocak, 2003). The closer an item is to its expiry date, the more chance it has to remain unsold and be discarded. The above challenges highlight the necessity for perishable food pricing that more dynamically matches the price to the product's value, to minimise perishable food waste and improve customer satisfaction while maintaining retailers' profits. In addition to the issues above pertaining the retailers, one third of the food consumers buy is thrown away, however, this can be reduced if consumers plan their consumption better (Wrap, 2008). Therefore, more dynamic pricing of perishable foods should not only reduce waste due to unsold products, but also reduce waste generated by consumers in the post-sale stage through increasing the sales of products with relatively less

remaining shelf-life and simultaneously enhancing consumers' awareness of the need for consumption planning.

To confront such issues and challenges in the pricing of perishable products, numerous authors have proposed dynamic pricing models for perishables, to identify the optimal discounting mechanisms that can offer better trade-off options between price and value (Aviv and Pazgal, 2008; Besanko and Winston, 1990; Bitran and Mondschein, 1997; Dasu and Tong, 2010; Elmaghraby et al., 2008; Federgruen and Heching, 1999; Feng and Gallego, 1995; Gallego and van Ryzin, 1994; Panda et al., 2009; Stokey, 1979; Su, 2007; Transchel and Minner, 2009; Zhang and Chen, 2006; Zhao and Zheng, 2000). These studies suggested that retailers would benefit from decreasing the price of perishable products as the products approach the end of their selling period, to reflect the deterioration in the product's value. Furthermore, advanced systems for tracing value and thereby reducing concerns about safety, freshness and waste allow pricing strategists to develop a dynamic model specifically designed for perishable foods, which can maximize profitability by matching prices with more accurately identified shelf-life variations (Li et al., 2006, Liu et al., 2008).

1.2. RESEARCH NEEDS

A better understanding of the behaviour of consumers of perishable products can help retailers to develop a more effective pricing policy (Tsiros and Heilman, 2005). Given that the present pricing policy for perishable foods may not sufficiently compensate for the daily loss of value, a more dynamic pricing strategy may be needed to improve customer satisfaction by permitting better compensation. However, it is still questionable whether such a strategy would positively influence consumers' perceptions and retailers' performance.

Studies reported in the marketing literature have focused on investigating consumers' perceptions of price and the subsequent impacts on customer satisfaction (Hermann et al., 2007; Huddleston et al., 2008; Matzler et al., 2006; Salvador et al., 2007), purchasing behaviour and willingness to pay (Anderson, 1996; Dodds and Monroe, 1985; Morariu, 2008; Sweeney et al., 1999), which are important factors influencing business performance. Studies have also investigated consumers' perceptions of price-related promotions and temporary price discounts (Hartley and Cross, 1993; Martinez-Ruiz et al., 2006; Raghubir and Corfman, 1995). Studies have not, however, drawn a clear picture of the impacts of providing better trade-offs between price and value on customer satisfaction, and their influence on purchasing behaviour. In other words, though the available studies of optimal and dynamic pricing for perishable products demonstrate the effectiveness of pricing models from the retailers' perspective, consumers' perceptions of dynamic pricing models, particularly in terms of more dynamically compensating for value loss by price discounting, have rarely been studied.

Furthermore, studies of dynamic pricing of perishable products focus in particular on finding the optimal pricing structure under various demand assumptions that are well suited to non-food perishable products. Also, many existing studies have investigated heterogeneity in consumer evaluations, finding that when periodic pricing of a non-food perishable product results in the price of identical products being the same on any day, consumers have the choice of purchasing any of the products that is priced below their personal valuation or waiting for a later discount price. In the specific case of perishable food products, consumers' purchasing behaviour can differ from the typical pattern to other non-food perishable products, due to shorter shelf-lives with different expiry dates and prices on display simultaneously.

To sum up, it is proposed to develop a conceptual approach that will guide practitioners towards more dynamic management of pricing policies for perishable foods, which will more actively compensate customers for the loss of product value. A better understanding of the impact of a more dynamic pricing strategy from the consumers' perspective is necessary in conducting thorough evaluations of such strategies. Also, the consumer demand responding to the availability of the same products with different prices for different remaining shelf-lives at the same time, has rarely been considered in the literature on pricing for perishables. Therefore, it will be valuable to compare the performance of present common pricing strategies with that delivered by more dynamically managed alternatives, by considering such consumer demand.

1.3. RESEARCH QUESTIONS

To fulfil the identified research needs, this thesis investigates consumers' reactions to the dynamic price management of perishable foods and its probable impact on retailer performance. To that end, the following research questions were formulated after an extensive review of the literature:

If the price of perishable food products is more dynamically managed than present pricing strategies, what are the probable impacts on consumers' perceptions of the new tactics?

and

If the price of perishable foods is more dynamically managed than by present pricing strategies, what are the probable impacts on retailer performance?

1.4. SCOPE OF THE RESEARCH AND RESPONDENT SAMPLE

This study explores the potential impacts of dynamic pricing strategies for perishable foods on consumers' perceptions of such strategies, and on retailer performance. Consumer perceptions of pricing strategies may vary according to such external influences as the culture and social structure of the country concerned, so this study examines a specific case from one country and selects South Korea as a sample market.

A sample of 1,980 consumers in South Korea participated in this study, expressing their responses to the research questions. Two formal surveys were carried out, each questioning 990 consumers. Three fresh food managers from different leading South Korean food retailers were interviewed, as a source of practical information about the management of perishable foods operations, and ultimately as an input to the choice of sample product types for surveys and the design of a simulation model developed to compare the performance of different pricing approaches.

1.5. RESEARCH CONTRIBUTIONS

This thesis makes two contributions to the body of knowledge:

For academics, it offers a significant new contribution to the marketing and retailing literature. The findings provide a better understanding on the impact of dynamic pricing strategies, in the particular context of perishable food products, from the consumer perspective, which has received little attention in the marketing literature. In addition, the simulation model compares the effectiveness of different pricing approaches on retailer

performance, providing new insights into the demand feature with regard to perishable food products.

For the food retailing industry, it provides the basis of a useful understanding of the benefits of dynamic pricing of perishable foods, which could potentially encourage retailers to manage their pricing strategy more dynamically. The results of the studies in this thesis can be used as a guide for retailers seeking an effective pricing strategy for perishable food products, matched to their individual circumstances.

1.6. ORGANISATION OF THE THESIS

This thesis consists of seven chapters. Chapter 1 introduces the research background, defines the research need, states the research questions, describes the scope of the research and the research sample, and explains its contributions to academics and food retailers. Chapter 2 reviews relevant existing studies, which deal with: traditional pricing approaches; dynamic approaches for perishable products; food traceability systems and dynamic pricing approaches particularly designed for perishable foods; the antecedents and consequences of customer satisfaction; the impact of consumers' price perceptions on customer satisfaction and purchasing behaviour; and the impact of price discounting on purchasing behaviour.

Chapter 3 discusses the research methodology, presenting details of the overall research design and describing the research techniques employed by outlining the questionnaire design, data collection methods and data analysis procedures for the surveys conducted. It then describes and explains the simulation study undertaken. Chapter 4 opens with a specific description of the food retailing industry of South Korea, before presenting the data collected

in the interviews with food retailers there, providing an opportunity to identify the present business process for perishable foods in the food retail stores locally called 'marts'. Most importantly, it defines present pricing strategies for perishable foods and assists selecting the sample product types for the formal surveys as well as designing a simulation model to reproduce the present business environment in those retail outlets.

Chapter 5 defines more dynamic pricing strategies in the context of this thesis. It then describes the development of research hypotheses addressing the defined research questions, and presents the results of hypothesis testing with the data collected from the formal surveys. Through conducting simulation analysis, Chapter 6 compares the predicted impacts of different pricing strategies on retailer performance by considering the consumer demand in reaction to the availability of the same perishable food products with different prices for different remaining shelf-lives simultaneously. Finally, Chapter 7 draws the conclusions of the study, including an overview of the findings, and a discussion of the advantages and disadvantages of dynamic price management for perishable foods, and the research limitations and implications for future research.

CHAPTER TWO

LITERATURE REVIEW

2.1. INTRODUCTION

The purposes of this chapter are to establish a conceptual framework for the thesis, based on a thorough review of prior studies and theoretical papers that are relevant to the research topic. This chapter consists of five sections apart from the introduction and summary.

Section 2.2 provides the background to pricing strategy by reviewing traditional pricing approaches, including an economics-based procedure and three typically applied by managers in practice: cost-based, competitor-based and customer-based pricing. The comparative strengths and weaknesses of these approaches are identified and discussed.

Section 2.3 presents an in-depth review of previous studies examining pricing models applicable to perishable products, and Section 2.4 describes the emergence of advanced 'traceability systems' and resultant dynamic pricing models, developed specifically for the pricing of perishable foods over their shelf-life.

Section 2.5 reviews the literature of customer satisfaction, first defining it and then identifying its antecedents and consequences. The components of customer satisfaction are discussed, and the impacts on business performance and the impact of customers' perceptions of price on customer satisfaction. Section 2.6 focuses on the literature relating consumers' price perceptions and purchasing attitudes.

Finally, Section 2.7 offers a summary and discussion of the whole body of literature reviewed in the chapter.

2.2. TYPICAL PRICING APPROACHES

Price is defined by Black (2002, p.363) as "the amount of money paid for a good or service" and by Jobber (2004, p.913) as "the agreed value placed on the exchange by a buyer and seller". In other words, price is an estimated and agreed sum of money a buyer has to pay to acquire a product or receive a service from a seller. The term 'pricing' refers to the strategic and executive processes that lead to a decision about the price of an offering, based on the simultaneous consideration of different types of relevant information (Ingenbleek et al., 2003).

The economics discipline approaches pricing by examining supply and demand relationships (Ison and Wall, 2007; Sloman and Sutcliffe, 2004), and cost-based, competitor-based and customer-based pricing approaches are frequently used by pricing managers in practice (Hinterhuber, 2008; Shapiro and Jackson, 1977).

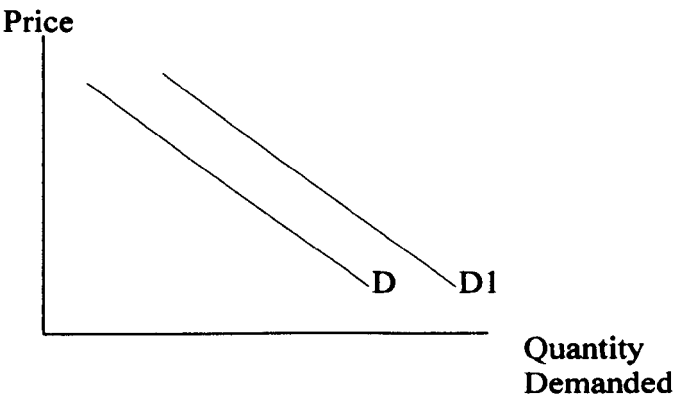
This section now presents a broad overview of theoretical and practical pricing approaches.

2.2.1. Economics-based Pricing

Pricing can be discussed from the economics standpoint in terms of supply and demand. Thweatt (1983) pointed out that the terminology 'supply and demand' was introduced initially by Sir James Stewart in his 1767 publication, *Principles of political economy*, and by

Adam Smith in his 1776 publication, *Wealth of nations*. Since then, according to Humphrey (1992), 'supply and demand' has been used and developed into the conventional supply-demand diagram, for example, Antoine-Augustin Cournot's 1838 publication, *Researches into the mathematical principles of the theory of wealth*; Jules Dupuit's 1844 publication, *On the measurement of the utility of public works*; Hans von Mangoldt's 1863 publication, *The exchange ratio of goods*; and Fleeming Jenkin's 1870 publication, *The graphic representation of the laws of supply and demand.* The supply-demand diagram was then developed further and popularised by Alfred Marshall in his textbook published in 1980, *Principles of economics.*

The general relationships between price and *demand* can be represented as follows:

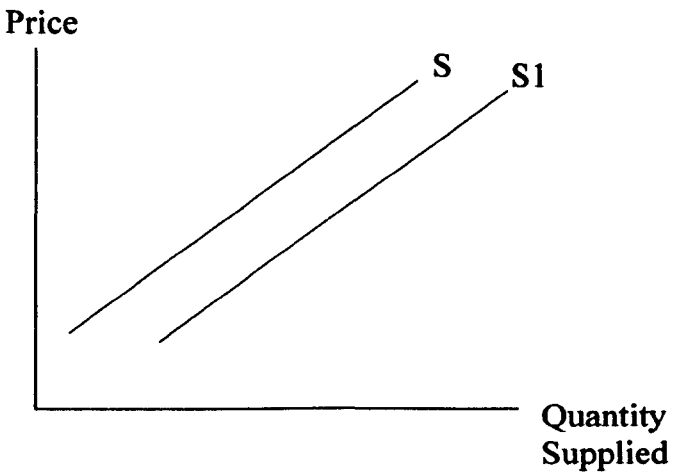


***Source*: Adapted from Ison and Wall (2007)**
Figure 2.1: The relationship between demand and price

As the Figure shows, the demand curve normally slopes downwards from left to right, indicating that a decrease in price leads to an increase in the quantity demanded, and *vice versa.* It can also shift to the right from D to D1 (an increased quantity demanded at the same price) or to the left from D1 to D (decreased demand at the same price) in response to

possible changes in the demand conditions. Ison and Wall (2007) and Sloman and Sutcliffe (2004) state that the shift of the demand curve to the right occurs if there is: an increase in the price of a substitute product; an increase in household disposable income and the products are normal goods; an improvement in product quality; or a successful promotional campaign. These effects are subject to the *ceteris paribus* assumption of "all other things of relevance remaining the same or other things being equal" (Ison and Wall, 2007, p.24). A shift to the left from D1 to D will occur if, *ceteris paribus*, there is: a decrease in the price of a substitute product; a decrease in household disposable income; a deterioration in product quality; or a successful promotional campaign by a competitor (Ison and Wall, 2007; Sloman and Sutcliffe, 2004).

The general relationships between price and *supply* can be represented as follows:

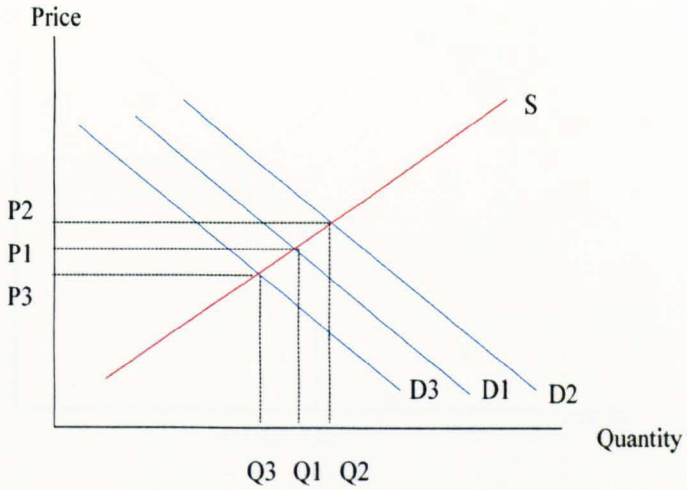


***Source*: Adapted from Ison and Wall (2007)**
Figure 2.2: The relationship between supply and price

Here, the supply curve normally slopes upwards from left to right, indicating that an increase in price leads to an increase in the quantity supplied, to increase profitability, and

vice versa. The supply curve can shift to the right, from S to S1, (an increased quantity supplied at the same price) or to the left from S1 to S (decreased supply at the same price) in response to possible changes in the supply conditions. It will shift to the right if, *ceteris paribus*, there is: a decrease in the price of a substitute in production; a decrease in production cost; an improvement in production technology; or the introduction of a subsidy on the product (Ison and Wall, 2007; Sloman and Sutcliffe, 2004). It will shift to left if, *ceteris paribus*, there is: an increase in the price of a substitute in production; an increase in production cost; a deterioration in production technology; or the introduction of a tax on the product (Ison and Wall, 2007; Sloman and Sutcliffe, 2004).

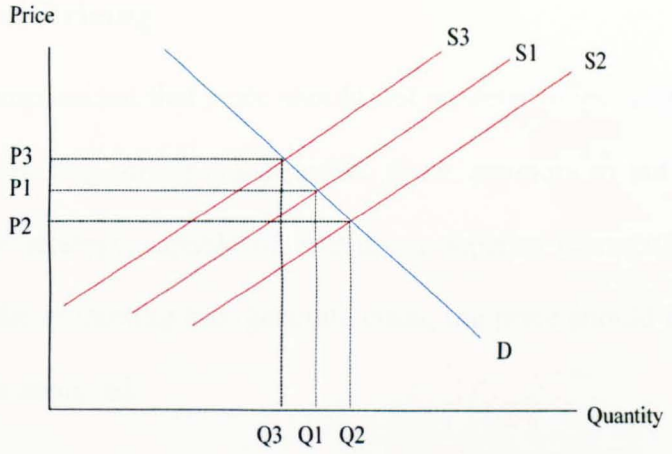
We are now in a position to see how the equilibrium price, at which the quantity demanded equals the quantity supplied, and quantity are determined on the basis of the relationships between demand and price, and supply and price. The general impacts of an increase or decrease in demand and supply on equilibrium price and quantity traded are as follows: an increase in the quantity demanded will increase the equilibrium price and the quantity, and *vice versa*; an increase in the quantity supplied will decrease the equilibrium price and increase the quantity, *vice versa* (Ison and Wall, 2007; Sloman and Sutcliffe, 2004). These causal relationships are represented graphically in Figures 2.3 and 2.4.



***Source*: Adapted from Ison and Wall (2007)**

Figure 2.3: The impacts of changes in demand on equilibrium price and quantity

An equilibrium price and quantity (the sustainable levels at which there is no shortage or surplus) occurs when the quantity demanded is equal to that supplied, and is the only situation in which the needs of sellers and buyers are mutually reconciled (Sloman and Sutcliffe, 2004). As Figure 2.3 shows, when the demand curve shifts to the right from D1 to D2, indicating an increase in the quantity demanded, equilibrium price and quantity simultaneously increase from P1 to P2 and Q1 to Q2, respectively. By contrast, when the demand curve shifts left from D1 to D3, indicating a decrease in demand, equilibrium price and quantity decrease from P1 to P3 and Q1 to Q3, respectively. These shifts imply that an increase in the quantity demanded by buyers will increase both equilibrium price and quantity, while a decrease will decrease both equilibrium price and quantity (Ison and Wall, 2007; Sloman and Sutcliffe, 2004).



***Source*: Adapted from Ison and Wall (2007)**

Figure 2.4: The impacts of changes in supply on equilibrium price and quantity

Figure 2.4 shows that, when the supply curve shifts to the right from S1 to S2, indicating an increase in the quantity supplied, equilibrium price and quantity shift from P1 to P2 and Q1 to Q2, respectively. This implies that an increase in supply leads to a decrease in the equilibrium price and an increase in quantity (Ison and Wall, 2007; Sloman and Sutcliffe, 2004). By contrast, when the curve shifts left from S1 to S3, indicating a decrease in supply, equilibrium price and quantity shift from P1 to P3 and Q1 to Q3, respectively. This implies that reduced supply leads to increased equilibrium price and decreased quantity (Ison and Wall, 2007; Sloman and Sutcliffe, 2004).

The supply and demand diagram has become the most widely used economic model of price determination. However, it is argued that the resulting solutions have not been developed as management tools, but rather as theoretical models, and other approaches to pricing are therefore more frequently used in practice (Jobber, 2004). The practical pricing approaches are discussed in subsequent sub-sections.

2.2.2. Cost-based Pricing

Jobber (2004) emphasized that price should not be determined in isolation from the other elements of the marketing mix (product, price, place, promotion) but mingled with them to produce a coherent strategy capable of creating a superior competitive advantage. As the other elements of the marketing mix generate costs, the price should be set to cover those if profitability is to be achieved.

Cost information can be a valuable input to the efficient setting of the selling price of a product or service (Drury, 2000; Horngren et al., 2000). Manufacturing companies frequently employ cost-based pricing, setting the price on the estimated costs of production plus a standard industry mark-up on average costs, to generate the required profit margin (Hanson, 1992; Horngren et al., 2005). The same approach is also common among retailers, in which case the mark-up is the difference between the cost of purchasing the product from the supplier and the ticket price at the point of sale (Sung and Lee, 2000).

Table 2.1 shows a hypothetical example of cost-based pricing.

Year 1	
Direct costs (per unit)	£2.00
Fixed costs	£200,000.00
Expected sales (unit)	100,000.00
Cost per unit	
Direct costs (per unit)	£2.00
Fixed costs (200,000 / 100,000)	£2.00
Full costs	£4.00
Mark-up (10%)	0.40
Price (cost plus mark-up)	£4.40
Year 2	
Expected sales (unit)	50,000.00
Cost per unit	
Direct costs	£2.00
Fixed costs (200,000 / 50,000)	£4.00
Full costs	£6.00
Mark-up (10%)	0.60
Price (cost plus mark-up)	£6.60

***Source*: Jobber (2004)**

Table 2.1: Example of cost-based pricing

The cost-based pricing can be put into practice in two distinct ways; (1) 'full-cost pricing', which takes both direct and fixed costs into consideration, and (2) 'direct-cost pricing', which considers direct costs only. The table shows direct costs per unit at £2.00 and annual fixed costs (such as those relating to head-office administration and manufacturing facilities) at £200,000, representing a full cost per unit of £4.00. With expected sales of 100,000 units in year 1 and a desired 10% mark-up, the full-cost price is calculated as £4.40. If sales reach only half the target that year, fixed costs per unit are increased to £4.00. With the same 10% mark-up and a new full cost per unit of £6.00, the indicated price is £6.60. In the case of direct-cost pricing, which does not take fixed costs into account, the same figures would result in a calculated price of £2.20 in both years.

Hanson (1992) and Shapiro and Jackson (1977) pointed out that cost-based pricing is simple to implement; it is possible to determine fair prices without precise information on demand and other market conditions and is convenient to base pricing on internal cost information if there is straightforward communication among divisions within a company. On the other hand, it ignores factors related to the competition and customers.

2.2.3. Competitor-based Pricing

Rather than relying on production or retailing costs to set a selling price, managers can use the prices of similar products or services offered by competitors as the benchmark (Jobber, 2004). According to Shapiro and Jackson (1978, p.120), this approach can be particularly applicable when "a marketer's company, its products, its image and position in the marketplace, and its cost structure are exactly like the competition's".

A study conducted by Sung and Lee (2002) pointed out that, when a company introduces a similar or identical product to the market, the price can be set by reference to the competition, provided the company's price-image policy is close to the competitors'. If the company's price-image is comparatively lower or higher than the competitor, then the price should be set at a correspondingly lower or higher level.

Conversely, when a competitor introduces a similar or identical product, pricing decision-makers need to consider two competitive scenarios, in order to maintain their position in the market (Armstrong and Collopy, 1996). Those are: to set the price below the competitor's, but risk a substantial loss; or to set it at a higher rate for superior profitability, but risk allowing the competitor to thrive on its lower price.

Companies have to react tactically to their competitors' price variations, given that price has a powerful influence on consumer demand (Armstrong and Collopy, 1996). Shapiro and Jackson (1978, p.120) pointed out that the competitor-based pricing approach can help managers to hold the competition in check, but it may make it more difficult for them to "either to build on their products' and company's unique strengths or to adjust for their unique weaknesses". For instance, a pricing decision-maker can set the price at a relatively lower rate than a market leader with a superior reputation, but may thereby harm profitability and decrease the product's value in a long-term (Armstrong and Collopy, 1996).

2.2.4. Customer Value-based Pricing

In the context of marketing, Hinterhuber (2004, p.769) defined customer value as, "the difference between perceived benefits and sacrifices" or "the maximum amount a customer would pay to obtain a given product". In other words, customer value can be created when the customer makes trade-offs between perceived benefits, which Ulaga and Chacour (2001) call the 'get' component, and the perceived sacrifices, which they call the 'give' component, in a supplier's offering. Alternatively, it can be viewed as the highest price a customer would want to pay to acquire a particular product, assuming the communication of adequate information about the product and similar products offered by competitors (Forbis and Mehta, 1981).

It is on this basis that the third of the approaches to pricing typically taken in practice is to base the price on evaluation of the economic value customers place on the product or service (Hinterhuber, 2008). This customer value-based pricing approach is procedurally more

complex than others focused on costs and competitors (Shapiro and Jackson, 1978).

Hinterhuber (2008) identified the following five methods for efficient measurement of the value customers place on a product:

- *Expert interviews* with such expert internal informants as senior representative of the marketing, product management, key account management, pricing, sales and finance functions.
- *Focus group discussions* with small groups of customers, to estimate the potential range of prices
- *Conjoint analysis* can measure customer value if the product is new or unfamiliar to the market in question. Customers can be asked to rank their preference for each of the new products.
- *Value-in-use assessment*, by interviews and observation of customers who are actually using the product for which a price is to be set.
- *Importance ratings*, of a set of existing and new and competing products, gathered by questionnaire from existing and potential customers.

Shapiro and Jackson (1977, p.119) stated that "when a customer buys a product he or she goes through a complex process of balancing the price of the product against the perceived benefits, costs, risks, and value in use of the product". No matter how good the product or service is, objectively, consumers may subjectively decide to purchase a substitute if the price does not adequately reflect the perceived benefits, costs, risks and value (Horngren et al., 2005; Shapiro and Jackson, 1977).

Since the marketing concept is based on an understanding of the drivers of customer value,

treating pricing strategy as a separate consideration can significantly influence the effectiveness of a marketing campaign (Cressman, 1999). Therefore, Ingenbleek et al. (2003) pointed out that customer value-based pricing is regarded as the most efficient approach among the three typical pricing approaches. It is particularly recommended when profit maximization is the primary objective of company (Cannon and Morgan, 1990).

Indeed, when perceived benefits exceed perceived sacrifices, or the highest price customers would wish to pay is higher than the proposed price of the product, higher profit can be achieved by increasing the price. According to Hinterhuber (2004), a 5% higher average selling price can generate a 22% increase in earnings before interest and taxes. On the other hand, the same authors concede that there are various obstacles to the accurate measurement of customer value, such as difficulties in communicating with customers and expert personnel.

2.2.5. Comparison of the Three Approaches

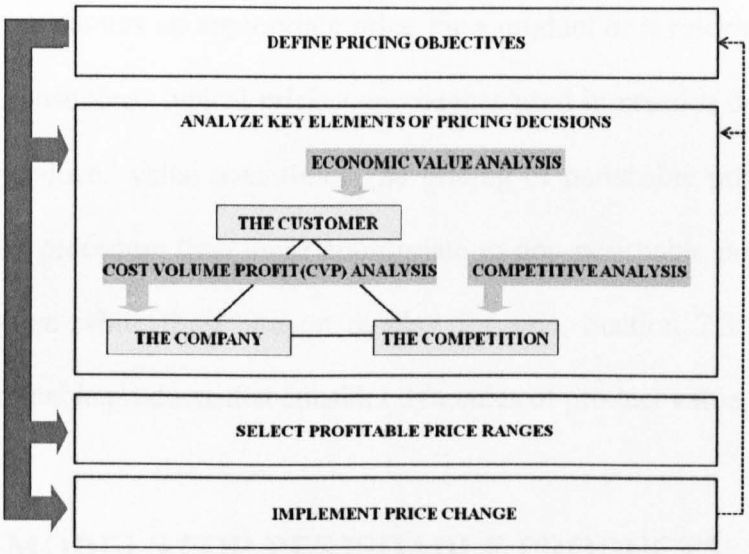
Cost-based, competition-based and customer value-based pricing strategies use different inputs to pricing decisions, and have their own strengths and weaknesses. Table 2.2 defines the three, compares those strengths and weaknesses, and offers an overall evaluation of each.

	Cost-based pricing	Competition-based pricing	Customer value-based pricing
Definition	Cost-based pricing approaches determine price primarily with input data from cost accounting	Competition-based pricing approaches use anticipated or observed price levels of competitors as primary source for setting prices	Customer value-based pricing approaches use the value that a product or service delivers to a predefined segment of customers as the main factor in setting prices
Main strength	Simple to implement	Helps to hold the competitor in check	Takes customer perspective into account
Main weaknesses	Does not take account of the competition and customers' willingness to pay	Does not take account of customers' willingness to pay	Data are difficult to obtain and interpret May lead to relatively high prices - need to take long-term profitability into account Customer value is not a given, but needs to be communicated
Overall evaluation	Overall, the weakest approach	A sub-optimal approach for setting prices; appropriate for commodities if (and only if) products or services cannot be differentiated	Overall the best approach, directly linked to customer needs

***Source*: Adapted from Hinterhuber (2008)**

Table 2.2: Comparison of typical pricing approaches

Given that the effectiveness of each pricing approach depends heavily on product and market circumstances (Ingenbleek et al., 2003), Hinterhuber (2004, p.678) advises managers to implement the framework shown in Figure 2.5, for successful implementation of pricing strategy, seeking answers to three key questions: "How do prices affect volumes and profits?; How will competitors react to different pricing strategies and what is the economic value of the product and service in question to different customer segments?".



***Source*: Hinterhuber (2004)**
Figure 2.5: Framework for pricing strategy

His framework for pricing provides managers with the opportunities to take three different elements of each pricing approach into account simultaneously (costs, customers and competition) and therefore can help managers to select the most pricing approach most appropriate to their pricing objectives.

Pricing is widely recognised as a key marketing tool that significantly influences consumers' purchasing decisions and companies' profitability (Hinterhuber, 2008; Jobber, 2004; Mulhern, 1997). Therefore, managers should decide on the appropriate pricing

approaches by taking into consideration the strengths and weaknesses of different pricing approaches, in order to place the company in a position to prosper in the market (Ingenbleek et al., 2003). Whether or not a pricing strategy is effective is determined by consumers. A pricing strategy can be deemed to have been successful if the profits of the business improve while it is in place (Chen and Simchi-Levi, 2006).

The marketing-related studies reviewed in Section 2.2, show that a complex procedure is required to charge customers an appropriate price for a product or service and prosper in the market. However, those three typical pricing approaches used in practice do not consider the variations in the products' value over time. The pricing of perishable products requires an even more complex procedure than those appropriate to non-perishable products, due to the deterioration in value while those are on display for sale. Section 2.3 discusses pricing approaches for perishable products that consider dynamics of product value.

2.3. PRICING MODELS FOR PERISHABLE PRODUCTS

2.3.1. Definition of Perishable Products

Gupta et al. (2003) described perishable products as those with a fixed lifespan and time-dependent physical decay. Such examples as airline tickets, theatre seats, seasonal fashion goods, weekly magazines, sporting events, hotel rooms, Christmas cards, flowers and perishable foods expire when they reach the end of a finite selling period, normally short, and either have zero salvage value thereafter or at least significantly deteriorate in value over time (Elmaghraby and Keskinocak, 2003; Gupta et al., 2003).

Van Donselaar et al. (2006, p.463) identified two criteria distinguishing perishables from

non-perishables, as follows: "The high rate of deterioration at ambient storage conditions requires specific storage conditions at the store and/or at the consumer to slow the deterioration rate. Frozen food is excluded since the rate of deterioration is very low in the freezer" and "The obsolescence date of the product is such that reordering for the products with the same date is impractical (e.g. periodicals, like newspapers and (bi)weekly magazines)".

In the case of food products, according to Tsiros and Heilman (2005), perishable products can be distinguished from non-perishable on the basis of the duration of the period from the production date to the date after which the product cannot be offered for sale. That expiry date, defining the 'shelf-life' of the product is normally printed on the product labels in one of three forms: "best before" is generally applied to product types such as baked foods, cereals, snacks and canned foods, to indicate when an item is no longer at its "best" quality; "use by" is generally applied to products types such as eggs, yeast or frozen pastry, to indicate the date at which a product is no longer of consumable quality; "sell by" informs shoppers of the latest date on which such products as meat, seafood, poultry, milk or bread should remain on the shelves. A shelf-life of thirty days or less is the normal definition of "perishable" (van Donselaar et al., 2006).

Sarker et al. (1997) note that perishable foods are sensitive to the age of the inventory, which negatively influences consumer confidence for three reasons: there are fewer days remaining until the expiry date, quality is perceived to have deteriorated due to aging, and a general notion of inferior quality attached to products that have been on the shelf for a long time.

2.3.2. Pricing Models for Perishable Products

Retail managers need to discount the prices of perishable products, dynamically, in order to maximize profitability by balancing a decrease or increase in the product's value associated as those products approach their expiry dates (Elmaghraby and Keskinocak, 2003; Feng and Gallego, 1995; Li, 2001). A study by Kincaid and Darling (1963) is a pioneer research proposing a pricing model for perishable products. They examined two contrasting scenarios. With one of which the retailer does not post a product price, but instead waits for potential buyers to make an offer for the product and then decides whether to accept the buyer's offer. With the other scenario, the retailer posts a product price after considering his estimation of price-sensitive demand. Since then, various studies have investigated pricing models designed for perishable products.

Numerous studies have investigated dynamic pricing models for perishable products with no replenishment of the inventory during a pre-determined selling period. Lazear (1986), in a study of 'periodic pricing', found that the profit can be increased by dividing a selling period into two stages and setting different prices for each stage. The demand model in the study assumed that a certain number of consumers arrived during each of the two stages, with their own 'reservation price' in mind: the maximum they are willing to pay. The retailer can set the price higher in the first stage and, if the product is not sold, suggesting overpricing, discount the price in the second stage. If the number of stages within the selling period increases, the initial higher price can be discounted by smaller increments as each stage passes. Periodic pricing can increase the probability of selling a product before its expiry date, compared with single-period pricing. For a product type with a shorter lifespan, the initial prices should be set lower and discounted more rapidly, to increase the probability of a sale.

Feng and Gallego (1995) focused on the optimum timing of price alterations, finding that the most effective pricing policy is to decrease the price when remaining time falls below a time threshold, depending on the number of unsold products. If expected demand is below the number of unsold products by the end of a given sales period, then it is optimal time to decrease the price. Smith and Achabal (1998) investigated the 'optimal clearance pricing model' and end-of-season inventory management, under the assumptions that sales are sensitive to price, seasonal variations and inventory level. They found that before the clearance period starts, the price should be set at a higher rate, and discounted at a higher rate during the clearance period. Initial discounting should be deeper than consumers have been habituated to accept, but extreme discounts should be avoided, especially if the product has a salvage value. Zhao and Zheng (2000) studied a dynamic pricing model for perishable products under non-homogeneous demand: that is, when the arrival rates and reservation prices vary over time. The study found that when a given inventory of a product has to be sold within a specified time period and consumers' willingness to pay for the product does not increase over time, then the price should be decreased with the level of inventory held over time; dynamic price alterations, set to compensate for fluctuations in demand, achieve higher revenue than optimal single price policy.

The dynamic pricing models of Feng and Gallego (1995), Lazear (1986), Smith and Achabal (1998) and Zhao and Zheng (2000) have made the implicit assumption that a product's value decreases as it approaches the end of selling period. These studies, therefore, suggest decreasing the price of a product over time to increase consumer demand. This assumption fits well with perishable products such as seasonal fashion items, weekly magazines, electronic goods and perishable foods whose value decreases as time passes. However, this assumption may not apply to other kinds of perishable product such as airline

tickets, sporting events and hotel rooms where consumers' willingness to pay may increase as the end of selling period approaches as a result of increasingly limited availability. The following studies have considered the possibility of increase in consumers' willingness to pay as the end of selling period approaches.

Gallego and van Ryzin (1994) and Bitran and Mondschein (1997) studied dynamic pricing policies for perishable products, such as seasonal fashion items and airline tickets. They considered the policy of continuous price changes during a given selling period, but noted that it would be unrealistic and difficult to apply in practice because of possible increased management costs. They therefore also examined 'discrete time pricing policies': that is, periodic pricing. Gallego and van Ryzin (1994) studied the pricing policies under price-sensitive and stochastic demand assumptions, and Bitran and Mondschein (1997) studied policies under conditions of stochastic demand with heterogeneous perceived value of the product and a non-homogeneous Poisson arrival pattern, for both continuous price alteration and periodic pricing policies. The latter found that, when the policy was periodic pricing, the initial inventory was small and the initial price was relatively high, the profit was higher if the variance in the maximum price consumers are willing to pay was also higher. On the other hand, for a small initial inventory and a relatively lower initial price, the profit was higher when the variance in that reservation price was lower. If retailers lacked information on consumers' willingness to pay, a larger number of variations in the retail price was unavoidable. In that case, the recommendation was to set the initial price at a high level and alter the price according to consumers' reactions, in order to increase the profits.

Li (2001) studied an optimal dynamic pricing policy particularly designed for such non-storable perishable products such as airline tickets, hotel rooms and car rental, using a series

of linear programming models to find optimal pricing decisions. It was assumed that each consumer desired either one unit of the product or none, and either did or did not care about the restriction imposed by an advance-booking requirement. The findings showed that, by setting the maximum restricted price at an appropriate level and rationing the sales at different prices, three prices could be charged, at most, to maximize revenue. Lin (2004) investigated a sequential dynamic pricing model, in which consumers arrived sequentially one at a time, and purchased a product or service if the price was lower than their individual reservation price. This pricing model can be especially applicable to the reserving of airline seats, hotel rooms and events tickets, since it is necessary to continuously alter the price in order to provide a fair price to the right customer at the right time.

Tsiros and Heilman (2005) found that consumers' willingness to pay for perishable food products decreases continuously throughout the duration of the shelf-life. In this context, the dynamic pricing models of Feng and Gallego (1995), Lazear (1986), Smith and Achabal (1998) and Zhao and Zheng (2000) are more appropriate than those proposed by Bitran and Mondschein (1997), Gallego and van Ryzin (1994), Li (2001) and Lin (2004). However, in practice, the inventory of perishable food products can be readily replenished, an aspect that the pricing models that are reviewed in this sub-section fail to consider. Dynamic pricing models that consider the inventory replenishment are discussed in section 2.3.3.

2.3.3. Joint Pricing and Inventory Replenishment Models for Perishable Products

Many prior studies have investigated pricing models developed to maximize the profits for perishable products in a market environment in which inventory can be readily replenished

during the selling season, which could be infinite. Subrahmanyan and Shoemaker (1996) proposed a model to set the initial inventory, re-orders and optimal prices for perishable products under conditions of stochastic demand. It offered particular advantages in the case of perishable products that typically have a relatively short lifespan and have reduced in value significantly by the end of selling season, under high demand uncertainty.

Federgruen and Heching (1999) investigated optimal strategies for profit maximisation by combining optimal pricing and inventory under price sensitive stochastic demand that is independent on consecutive period. Their study showed that, generally, optimal base stock levels would decrease and optimal list price would increase as the end of selling period approached. It found that the positive impacts of dynamic pricing on expected profit were significantly higher with single inventory replenishment than with two. In the same context, Zhang and Chen (2006) studied optimisation by modelling pricing and inventory control under unknown demand distribution. They found that a 'base-stock list price' policy is optimal in a broad range of market circumstances: when the level of inventory is lower than the level of base stock, then the inventory level should be raised to the base stock level and the list price charged; when the level of inventory is higher than the base stock, production and ordering should cease and the price should be discounted.

Rajan et al. (1992) explored optimal strategies by simultaneously taking into account pricing, ordering decisions (including costs), inventory cycle and the length of cycle under known demand condition that is a decreasing function with product aging. Since value deterioration over the product lifecycle is associated with a decrease in consumer demand, the researchers advised retailers to vary the selling price continuously over the inventory cycle, to maximize profits. Studies by Panda et al. (2009) and Transchel and Minner (2009) both

investigated temporary price discounting policy, or dynamic pricing and inventory models, in a framework of economic order quantity. The former study considered value deterioration over time, where demand was partly dependent on stock level and partly on stock and selling price when price discounts were offered. It found that an effective price discount policy could increase demand which mitigates to deplete the inventory level associated with profit maximization. The latter study showed the benefits of dynamic management of prices in an economic order quantity model that coordinated pricing and lot-sizing decisions where demand was dependent on the current price. It demonstrated that products which are unprofitable with static pricing can become profitable with a few price changes associated with increase in demand when the inventory level is high. The authors also provided numerical guidance on number, timing and size of price alterations during an order cycle, by considering the costs associated with price alterations.

The dynamic pricing models for perishable products that are reviewed in this sub-section consider the inventory replenishment, which is an essential aspect to take into account when evaluating the pricing for perishable foods. However, none of these studies consider the situation where the display stock of a specific product has different values. In addition, the dynamic pricing models examined in sections 2.3.2 and 2.3.3 have made the implicit assumption that consumers are 'myopic', non-strategically purchasing a product immediately if its price is below their valuation, therefore have not considered the possibility of postponing the purchase (Aviv and Pazgal, 2008; Elmaghraby et al., 2008). The perishable product dynamic pricing models that take into account 'strategic consumers' are reviewed in section 2.3.4.

2.3.4. Pricing Models for Perishable Products in the Presence of Strategic

Consumers

The likelihood that consumers may in fact be strategic or forward-looking has recently received increasing attention in the literature relating to dynamic pricing policies for perishable products.

Strategic consumer behaviour is something that marketers should pay close attention to. Consumers have become accustomed to sellers' pricing strategies, and have learnt to predict pricing patterns, which typically start at a high level and reduce significantly as retailers try to clear existing stocks. Such strategic consumer behaviour erodes retail margins. When consumers' expectations of price reductions are high, current demand may decrease (Jacobson and Obermiller, 1990). To understand consumers' strategic behaviour, it is necessary to understand how they react to prevailing retail prices. Indeed, it is argued that retailers experience diminishing margins as customers engage in 'strategic waiting', in the expectation of price reductions at the end of selling season or period (Cachan and Swinney, 2009).

Consumers have various options during the purchasing decision process, including the option to buy the product now, at the full price, or to wait until the retailer starts discounting (Jacobson and Obermiller, 1990; Su and Zhang, 2008). It is worth noting, however, that availability of a product will be high in the initial stages, while it is still on sale at the full price, but that the high demand generated by price discounting may cause a consumer who waits too long to miss the chance to purchase the product at all, especially if the retailer has no intention of replenishing it. Some consumers therefore choose to purchase the product when it is readily available because they understand that discounting triggers scarcity.

Aviv and Pazgal (2008) and Dasu and Tong (2010) have defined strategic consumers as those who are aware of the possibility of future price reductions, and consequently time their purchases by considering future purchase possibility in their valuation. They buy when the perceived value surpasses a threshold. Cases in point are customers waiting for Christmas sales, end-of-season reductions on fashion goods, discounted airline tickets and electronic products, and many others (Dasu and Tong, 2010). Assuming myopic consumers in developing optimal pricing policy fails to account for the possible effect of forward-looking behaviour (Aviv and Pazgal, 2008).

Stokey (1979) undertook one of the earliest studies in the literature to take account of strategic customer behaviour. It analysed the optimal structure of a pre-announced 'pricing path' of continuous adjustments, under the assumptions that consumers buy only one product and select the optimal time of purchase to maximise their net welfare gain. It was argued that price discrimination is frequently non-beneficial with respect to the seller's profitability, compared to a fixed-price policy. Similarly, Besanko and Winston (1990) studied the 'inter-temporal pricing problem' in the presence of consumers who acted as net welfare maximisers and purchased one unit at most. The study found that the price should be reduced over time and that consumers' purchasing behaviour has significant effects on pricing strategies. The study showed that the initial price should be set at a higher level and reduced more sharply if consumers are myopic than if they are strategic.

Su (2007) studied a dynamic pricing model under categorised consumer demand by assuming that each consumer had different perceptions of the value of the product and differed in the degree of patience with respect to the cost of waiting to purchase later; the

outcome was segments labelled 'high-valuation and patient'', high-valuation and impatient', 'low-valuation and patient' and 'low-valuation and impatient'. This heterogeneity was found to significantly affect the optimal markdown structure. For example, markdown policies are valuable when there are comparatively more high-valuation and impatient customers, who are likely to purchase the product at a high price at an early stage. Elmaghraby et al. (2008) studied the optimal markdown mechanism in the presence of pre-announced prices, deterministic price-sensitive demand, and strategic consumers demanding multiple units. They assumed that the set of consumers' valuations is known to the seller, but each individual's valuation is unknown. It was found that the markdown structure affected consumers' purchasing behaviour, and hence the sellers' profitability.

Aviv and Pazgal (2008) explained that dynamic pricing approaches can be put into practice in two distinct ways: as announced fixed-discount strategies or as contingent discounting strategies. With an announced fixed-discount strategy, the seller pre-determines and announces both a premium price that applies during the first part of the period that the product is on sale and a discounted price that in place during the second part. By contrast, a contingent discounting strategy announces the initial price but withholds the discounted price until a pre-determined point in time at which the seller decides what it should be. One advantage of the first strategy over the second is its simplicity; it is easier to implement without, as Aviv and Pazgal (2008, p.353) put it, "the burden of inventory counting (which is both costly and time consuming)". They suggest that retailers' inability to manage the complex procedures involved in implementing the contingent discounting strategy can lead to the choice of an announced fixed-discount strategy. Aviv and Pazgal (2008) investigated dynamic pricing for a seasonal fashion product and compared the performance of an announced fixed-discount strategy and contingent discounting strategy. Their study assumed

that customer arrivals would be stochastic under a two-period pricing scheme, that the perceived value of the product would decrease over time, and that value would be different for each customer. The main findings were that the expected revenue was lower with strategic consumers than with myopic consumers, and that announced fixed-discount pricing was more gainful for the retailer than contingent pricing policies when consumers are strategic. When consumers are myopic, the performance of announced fixed pricing and contingent pricing was found to be similar. Dasu and Tong (2010) studied multi-period dynamic pricing policies for perishable products with a fixed quantity to be sold over a finite selling season, when consumers were strategic. The findings were that dynamic pricing can be valuable when strategic consumers recognize the possibility of scarcity on account of stock-out of the product.

Prior studies reviewed in section 2.3, proposed dynamic pricing models by considering various demands that consider consumers' valuation assessments in the presence of myopic or strategic consumers. They have not, however, considered consumer demand in reaction to a situation where identical products have different values resulting in different prices available at the same time, which should be considered in pricing of perishable food products. With the printed expiry date on a food package, the perceived value of a specific type of perishable food products available on the display shelf is different depending on how long an individual product is displayed, therefore a new insight into demand feature particularly applicable for pricing of perishable foods is necessary. In addition, these studies demonstrate the effectiveness of dynamic pricing from the retailers' perspective with various mathematical assumptions, while studies investigating consumer response to dynamic pricing models are lacking, which is needed to provide a better understanding of the impact of dynamic pricing from the consumers' perspective.

2.4. TRACEABILITY SYSTEMS AND PRICING FOR PERISHABLE FOODS

The global food retail industry is facing challenges to its operational efficiency, which include issues relating to freshness, safety and wastage. Up to 15% of perishables are disposed of due to spoilage and damage (Ferguson and Ketzenberg, 2006). According to the commonwealth scientific and industrial research organisation (CSIRO), a global loss of approximately $20 billion has been reported, resulting from the deterioration of perishable foods during the storage and transportation (CSIRO, 2006). Consumer demand for safer and fresher food products has also increased (Beulens et al., 2005; Regattieri et al., 2007). Selling food products of inferior quality may not only seriously damage consumers' physical health, but may also have a negative effect on the profitability of individual producers and retailers, and of the food industry as a whole. For these reasons, the industry is under pressure to improve quality control and safety management (Beulens et al., 2005).

Greater coordination is required to effectively manage perishable foods than other consumer products due to their short lifespan and high sensitivity to temperature (Koutsoumanis et al., 2005). Consequently, numerous studies have advocated the implementation of what are known as 'traceability systems', to reduce concerns about the safety, freshness and wastage of perishable foods (Jansen-Vullers et al., 2003; Karkkainen, 2003; Kelepouris et al., 2007; Koutsoumanis et al., 2005; Regattieri et al., 2007; Sahin et al., 2007). The emergence of such systems has the potential not only to reduce those concerns, but also to provide the opportunity to develop innovative dynamic pricing strategies specifically for perishable foods, which can map price against the more accurate measures of

food value or remaining shelf-life (Li et al., 2006; Liu et al., 2008).

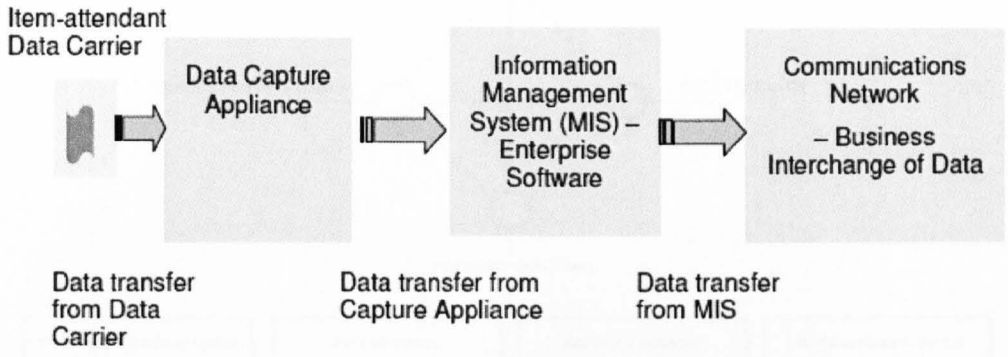
This section will review the literature associated with traceability systems.

2.4.1. Overview of Traceability Systems

In a study by Moe (1998, p.211), 'traceability' is defined as "the ability to track a product batch and its history through the whole, or part, of a production chain from harvest through transport, storage, processing, distribution and sales or internally in one of the steps in the chain for example the production step". Thus, a traceability system is a record-keeping procedure to identify and trace a product batch and its history including all steps in supply chain from produce to sales, with documented and recorded identification (Beulens et al., 2005). When traceability is applied to the food industry, it is defined by the EC regulation 178/2002 (European Commission 2002) as "the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution". This definition has been widely adopted in studies of food traceability, for example, FOODTRACE (2004), Jones et al. (2005), Kelepouris et al. (2007) and Regattieri et al. (2007).

FOODTRACE (2004, p.8), a concerted action programme of the European Union, describes the generic structure of a traceability system as being "essentially characterized by a vertical, minimalist item-attendant identification and data carrier backbone linked at nodes within the supply chain to a lateral structure of data processing and information management and storage systems through data capture, transfer or decoupling points". The structure shown graphically in Figure 2.6 provides an insight into how a food traceability system should be

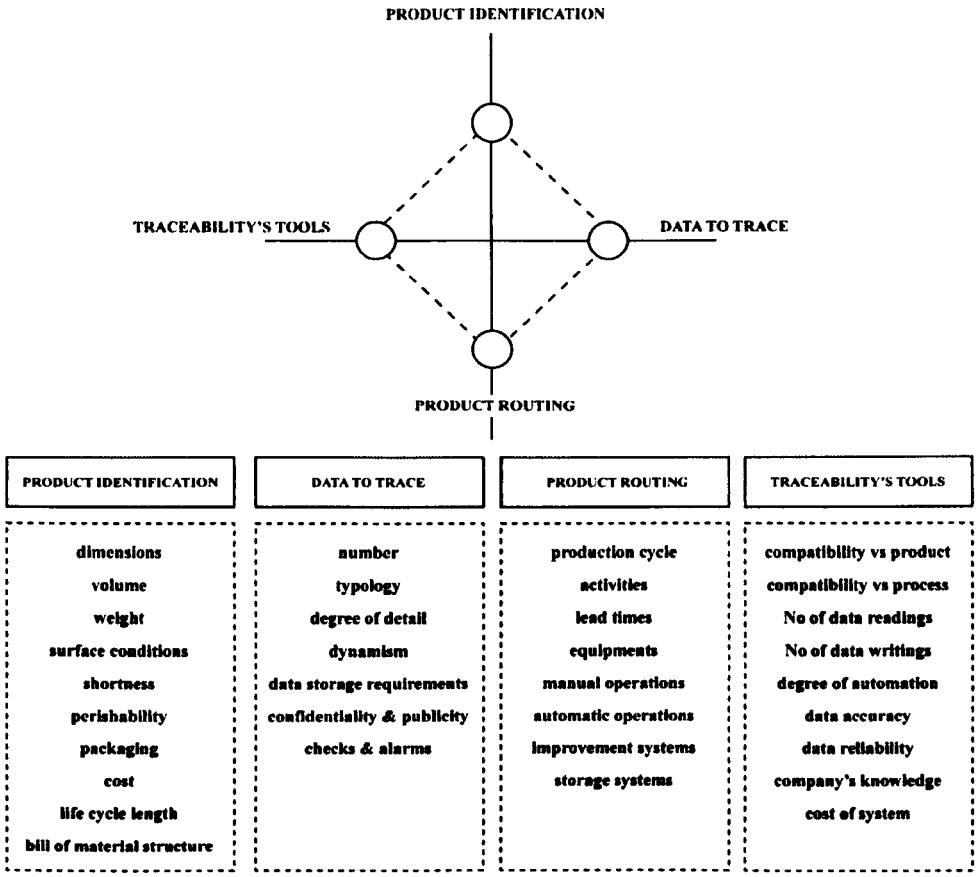
effectively implemented.



Source: FOODTRACE (2004)
Figure 2.6: Generic structure of traceability

The FOODTRACE project identified data carriers that are applicable in the food traceability chain: bar codes; RFID (radio frequency identification) and; 'sensory data carriers' (capable of handling data relating to temperature, pressure, humidity, vibration, and biological and chemical agents).

Regattieri et al. (2007) proposed a general framework for a food traceability system, shown in Figure 2.7, which is based on four 'pillars'; product identification, data to trace, product routing and traceability tools. As the food product is highly sensitive to environmental factor (temperature, storage condition, etc), a traceability system for them has to be exceptionally complete. The framework in Figure 2.6 has developed by schematizing significant factors that influence the traceability problem, therefore, it can be used as a significant reference to develop an effective traceability system for food products.



Source: **Regattieri et al. (2007)**

Figure 2.7: Framework for a traceability system

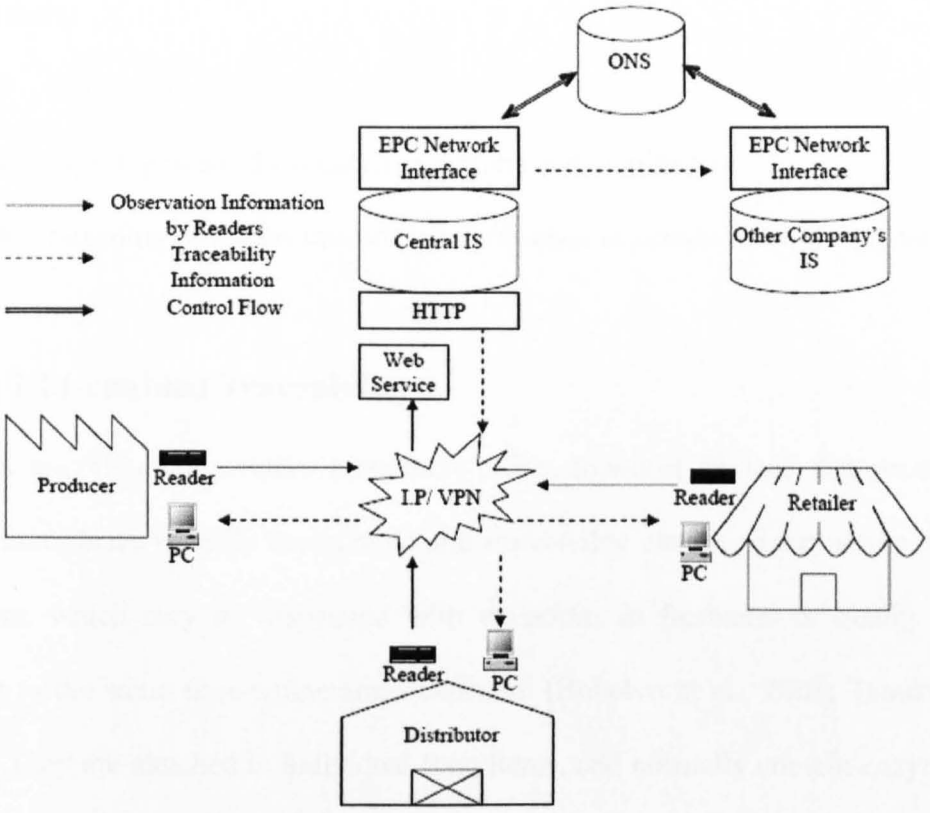
2.4.2. RFID-enabled Traceability

A group of recent studies has discussed the use of RFID as a data carrier in a food traceability system. RFID technology is introduced by studies of traceability (Jones et al., 2005; Kelepouris et al., 2007; Sellitto et al., 2007) as the next-generation barcode system, in that it has an exceptional ability to trace physical distribution automatically. According to Vijayraman and Osyk (2006), RFID is a promising technology with enormous potential in various retail industries.

RFID is the generic terminology for technologies that transfer data from the carrier to the reader and automatically identify and trace items by means of radio waves or a radio-

frequency carrier signal (Jones et al., 2005; Sellitto et al., 2007). Kumar et al. (2009) state that RFID systems are operated by three devices: a *tag* or transponder, which stores data that can be attached to an item to be identified and tracked; a *tag reader*, which communicates with the tag, to receive the data; and an *antenna*, a communication enabler between the tag and the reader.

Kelepouris et al (2007) proposed an information infrastructure of RFID-enabled traceability, which aims to present full and verifiable traceability in a cost-effective way. Shown in Figure 2.8, it follows a hybrid approach and a centralized information system, to which all partners in a supply chain can have access via a PC and a web browser. It is proposed that the centralized system is operated by the largest partner in the chain, or by an application service provider. Every partner in the chain has to install RFID readers, if the data are to be received and handled. The acronyms in the Figure stand for: ONS = object naming service; EPC = electronic product code, IS = information system; I.P /VPN = Internet or a virtual private network).



Source: **Kelepouris et al. (2007)**

Figure 2.8: Information infrastructure of RFID-enabled traceability

RFID technology has several advantages and benefits in use in the food industry, as summarised in particular by Jones et al. (2005); Karkkainen (2003); Kelepouris et al. (2007); Regattierri et al. (2007); and Sellitto et al. (2007). Those are:

- Improvement of accuracy in quality tracking and tracing
- Improvement of product-recall management
- Acceleration of physical flows
- Improved control in the supply chain, with respect to stock control and production monitoring
- Reduction of labour costs

To offset against those are the following potential disadvantages, identified by the same

five authors:

- Expensive tag costs
- Training needs for retailers, suppliers and distributors
- Scanning problems caused by interference in certain electromagnetic environments

2.4.3. TTI-enabled Traceability

TTIs are 'time-temperature integrators': tiny, low-cost devices that record a time-and-temperature history, easily measurable and irreversible change, for example in the colour of the item, which may be associated with variations in freshness or quality in food items subject to the same time-temperature exposure (Bobelyn et al., 2006; Taoukis and Labuza, 1998). They are attached to individual food items, and normally contain enzymes that reflect colour variations accompanying a decrease in the acidity levels of packaged food products in response to temperature variations (Giannakourou and Taoukis, 2003). Sahin et al. (2007, p. 107) described this process as the detection of a "mechanical, chemical, electrochemical, enzymatic or microbiological irreversible change usually expressed as a visible response in the form of a mechanical deformation, colour development or colour movement".

It is crucial to monitor and control the temperature of perishable foods, on account of their high sensitivity to temperature under storage condition (Fu et al., 1991). As sensory data carriers, Taoukis and Labuza (1998) stated that TTI can enhance the monitoring of time-temperature history, and can therefore be instrumental in assuring the right conditions for maintained freshness. The shelf-life of perishable foods needs to be modified by the time the products reach the retailers and end-users, to allow for the possibility of problems arising from varying storage conditions and other eventualities (Sahin et al., 2007).

Sahin et al. (2007) further defined the major benefits of TTI-enabled traceability as follows.

- More accurate identification of a food product's shelf-life; prevention of frauds in shelf-life information; cost reduction related to product quality inspection procedures; improvement of customer service quality; facilitation of a dynamic pricing strategy that matches the price with remaining shelf-life.
- Improvement of competitive advantage: enhancement of a food freshness monitoring system can augment the public image of a company and potentially generate increased sales or an increased market share.

2.4.4. Consumer Willingness to Pay for Improved Food Value Traceability

There are studies on consumer willingness to pay for improvements in various aspects of food safety. Higgins (2006) reported data evaluating consumers' willingness to pay for guaranteed freshness. That study noted that respondents reported that they throw away some food due to 'freshness betray' (spoilage before the listed expiry date; no respondents indicated "never" or "less than once a week") as follows:

Frequency:	*about once a week*	*more than once a week*	*once every two weeks*	*less than once a month*	*once a month*
Percentage of respondents:	18%	5%	24%	30%	23%

Consequently, respondents indicated how much additional they would be willing to pay for guaranteed freshness of a product costing $3.00 as follows:

Willing to pay:	*Nothing*	*$0.10*	*$0.25*	*$0.50*	*$0.75*	*$1.00*
Percentage of respondents:	29%	36%	22%	10%	1%	2%

Similarly, Hobbs et al. (2005) evaluated consumers' willingness to pay additional for traceability information, including, an assurance of extra food safety and information making it possible to trace Canadian beef and pork products to the farm of origin. They found that the following proportion of average consumers were willing to pay for information as follows:

Information:	*Assure food safety - beef*	*Assure food safety - pork*	*Trace to farm of origin - beef*	*Trace to farm of origin - pork*
Additional price:	40%	33%	7%	10%

The results of these studies indicate that improved food value traceability not only delivers the benefits described in sections 2.4.2 and 2.4.3, but also provides an opportunity for food retailers to increase the consumers' reservation price for perishable food products, which can reduce the concern over expensive implementation costs.

2.4.5. Improved Food Value Traceability and Dynamic Pricing

A study of Tsiros and Heilman (2005) found that as perishable foods approach to the expiry date, consumers' willingness to pay for them normally diminishes. This is due to the inverse relationship between perceived risk and willingness to pay, found by Eom (1994). As the end of the shelf-life of perishable foods, a perceived higher risk of reduced freshness leads to a decrease in willingness to pay. Indeed, the quality of perishable foods is dynamic, and decreases steadily up to the end of their shelf-lives. Therefore, food retailers need to implement an innovative pricing policy to match the price with actual quality of perishable

foods, as the short lifespan of perishable foods renders demand highly sensitive to price.

Studies by Li et al. (2006) and Liu et al. (2008) demonstrated the potential of dynamic pricing models with improved traceability systems to reduce consumers' concerns about the safety, freshness and price of perishable foods, simultaneously, and to boost retailers' profitability. Their conclusions were derived from simulated demand sensitive to price and perceived value, decreased value reducing demand over time and decreased price increasing demand, in which more accurate product values were detectable through advanced food traceability systems. Their dynamic pricing models were based on value-assessment results, estimated consumer demand depending on more accurately identified product value. The identified practical results are thus achieved by more dynamic alterations of the price, based on more accurate identification of variations in shelf life.

Improved food value traceability has made dynamic pricing models for perishable foods possible (Li et al., 2006; Liu et al., 2008), which are in turn expected to maximize the benefits obtained from improved accuracy in measuring food shelf-life achieved by advanced traceability systems. The expected benefits of dynamic pricing with improved value tracing are higher when consumers are more sensitive to value than to price (Li et al., 2006).

It is worth noting that an electronic plastic chip has been developed to provide more accurate expiry dates for display on the packaging of perishable food products, which measures elapsed time and temperature variations (http://www.polytaksys.com/42129.html).

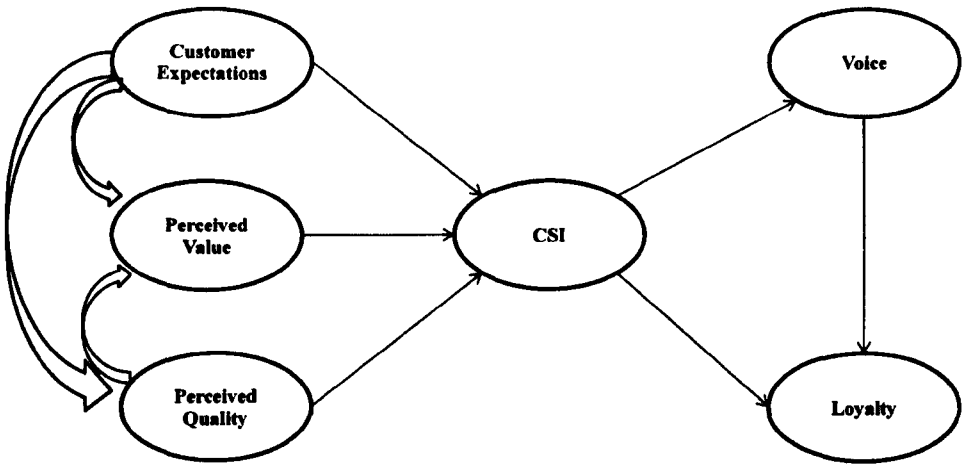
2.5. CUSTOMER SATISFACTION

According to Grigoroudis and Siskos (2010), there are many distinct approaches to the conceptualising of customer satisfaction. Churchill and Suprenant (1982, p.491) saw customer satisfaction as an outcome of purchase and use, defining it as, "a major outcome of marketing activity and serves to link processes culminating in purchase and consumption with postpurchase phenomena such as attitude change, repeat purchase, and brand loyalty". In the view of Tse and Wilton (1988), it is a process that evaluates the consumer's response to the perceived discrepancy between prior expectation and post-consumption of the product. Oliver (1997) defined customer satisfaction as in terms of pleasurable fulfilment, that "...the consumer's fulfilment response. It is a judgement that a product or service feature, or the product or service itself, provided (or is providing) a pleasurable level of consumption-related fulfilment, including level of under or overfulfilment...".

According to Foster (2004), customers speak about bad experiences twice as often as they share good experiences with others. It is thought that a customer who has a bad experience may express his or her dissatisfaction to between eight and ten people. This author asserts that up to 95% of businesses depend on repeat customers, and the cost of attracting a new customer can be up to six times higher than that of maintaining an existing one. With this in mind, it is clear that effective management of customer satisfaction is crucial for the improvement of business performance (Kristensen et al., 1999). It should therefore always be a top managerial concern, and every business needs to strive to meet the expectations of its customers consistently and effectively. The issue of customer satisfaction has become a central concept in marketing.

Figure 2.9 presents the CSI (Customer Satisfaction Index) model by Anderson and Fornell (2000), for a cumulative evaluation of the quality of products or services by customers who

have experience of consuming them. The CSI is a leading indicator of the performance of firms, industries, economic sectors and national economies (Anderson and Fornell, 2000; Fornell et al., 1996). Aggregation of individual firms' CSIs provides valuable information in terms of past, current and future economic performance of the firm (Anderson and Fornell, 2000).



***Source*: Adapted from Anderson and Fornell (2000)**
Figure 2.9: The CSI model

As the Figure shows, customer expectations, perceived value and perceived quality are the antecedents of customer satisfaction, which in turn influences customer loyalty and voice (e.g. word of mouth, complaints). Among the antecedents of customer satisfaction, expectations influence both perceived value and perceived quality, and perceived quality influences perceived value.

2.5.1. Antecedents of Customer Satisfaction

The commonly mentioned antecedents of customer satisfaction by studies of customer satisfaction, Anderson and Fornell (2000); Anderson and Sullivan (1993); Fornell et al.

(1996); Ravald and Gronroos (1996); Zeithaml (1988), are perceived quality, perceived value and customer expectations.

Ravald and Gronroos (1996) saw the difference between customer expectations and actual performance of a product or service as the most widely accepted definition of perceived quality. Zeithaml (1988) have defined perceived quality as an overall judgement about the product's superiority or excellence from the consumer's perspective, while emphasising the difference between objective and perceived quality of the product. Objective quality of a product is different from an individual's subjective judgment, which normally related to its technical performance (Hjorth-Anderson, 1984). According to Gabor and Granger (1966), it is generally accepted that price is an indicator of quality. Customers often link quality and prices in such a way that they equate higher prices with higher quality, and vice versa. Similarly, Lambert (1972) noted the general belief of some consumers that price is an indicator of quality. He found that consumers who chose a high-priced item were more confident in the direct positive relationship of quality to price than consumers who choose low-priced item. If the relationship is judged to be proportionate, customer satisfaction is the result. Gerstner (1985), by contrast, found the relationship between price and quality not to be so strong, on the evidence of data collected from a buyer's guide published by a non-profit consumer union, which evaluated the quality of competing brands. And Swan (1974) argued that the overall relationship between price and perceived quality is low, while Gardner (1971) also found that the relationship becomes weaker when other information cues such as brand name and store information are presented. Salvador et al. (2007) saw the consumers' subjective judgement of whether the product or service they receive is suitable for their individual needs and expectations as perceived quality. They noted that perceived quality relates to the individual evaluation and appraisal of product quality, which in turn influences

the satisfaction level. In addition, Ryu and Han (2010) found that the perceived quality of products is a significant predictor and determinant of customer satisfaction, and that in when consumers perceive the price of a product to be reasonable, their level of satisfaction can be improved. Similarly, Sumaedi et al. (2011) examined the impacts of perceived quality and perceived price on satisfaction. They found that perceived quality and price have a significant and positive influence on satisfaction level; moreover, perceived quality was found to exert a greater influence on customer satisfaction than perceived price.

The second antecedent of customer satisfaction is the perceived value of the product in relation to the price paid (Anderson and Fornell, 2000; Athanassopoulos, 1999; Fornell et al., 1996). Perceived value is defined by Monroe (1991) as the ratio between perceived benefits and perceived sacrifice. Zeithaml (1988, p.14) similarly conceptualised perceived value as, "the consumer's overall assessment of the utility of a product based on perceptions of what is received and what is given", but also mentioned that value is subjective therefore varies across consumers. Similarly, Ravald and Gronroos (1996, p.22) suggested that, "the customer-perceived value of an offering, seen through the eyes of the customer and related to his own value chain, must also be highly situation specific". Ulaga and Chacour (2001, p.527) saw it as, "a trade-off between benefits and sacrifices perceived by the customer in a supplier's offering". The former consist of a combination of physical attributes, service attributes and technical support available in relation to the particular use of the product, while the latter include purchase price, acquisition costs, transportation, installation, order handling, repairs and maintenance, risk of failure. In contrast to the definitions of perceived value by Monroe (1991) and Zeithaml (1988), Woodruff and Gardial (1996) defined it as a consumer's perception of what he or she would wish to happen when using a product or service to achieve a desired goal. In addition, Tam (2004, p.900) saw perceived value as "a result of

customers' evaluation of the service received against their perceptions of the costs of obtaining the service". According to Lin (2003), customers prefer to buy and obtain satisfaction from companies that offer the ideal perceived consumer value consistent with their demands, therefore the concept of value is of central importance in determining the purchasing and level of consumer satisfaction. As price is an important 'given' (Zeithaml, 1988) or 'sacrifice' (Monroe, 1991; Ulaga and Chacour, 2001), it must be true that it is an important factor influencing perceived value and consequently customer satisfaction. Dodds and Monroe (1985), Dodds et al. (1991) and Sweeney et al. (1999) found the negative association between price and perceived value. Similarly, Tam (2004) found a negative relationship between monetary costs and perceived value, and a positive relationship between perceived value and customer satisfaction. Hu et al. (2009) found that perceived value is positively related to customer satisfaction. Their findings also suggest that perceived value indirectly impacts corporate image via customer satisfaction. Hume and Mort (2011) also found a significant direct and positive relationship between perceived value for money and customer satisfaction, where consumers are satisfied when the product they receive is perceived to be worth the money they spent.

The third antecedent of customer satisfaction is customer expectation, which is determined both by past experience with a particular product shaping attitude towards the product, and by predicting the product's quality in the future, according to Fornell et al. (1996). The extent to which an item falls below a shopper's expectations weakens the level of satisfaction to be drawn from it. Vavra (1997) noted that consumers are highly influenced by pre-purchase information, which creates expectations that are tested against relevant past and present experience. Bearden and Teel (1983) and Oliver and Linda (1981) conducted empirical studies into expectation and satisfaction. They identified a positive association between

expectations and customer satisfaction. In addition, Szymanski and Henard (2001) found evidence that disconfirmation of expectations is a significant antecedent of customer satisfaction; they found that when the actual outcomes of experiencing products or services exceed expectation (positive disconfirmation), consumers are satisfied. Similarity, Hsu et al. (2006) found that consumers are satisfied when the actual experience of using products or services meets or surpasses pre-purchase expectations; this is confirmed by the results of a study conducted by Martinez-Tur et al. (2011), who also found that disconfirmation of expectations is a strong predictor of customer satisfaction.

2.5.2. Consequences of Customer Satisfaction: the Impact on Performance

This section discusses the importance of satisfying customers. Figure 2.9 posits that customer loyalty and voice are the two consequences of customer satisfaction. Many studies of customer satisfaction, for example: Anderson and Fornell (2000); Anderson and Sullivan (1993); Fornell (1992); Juhl et al. (2002). According to Bolton (1998) and Fornell (1992), have concluded that greater customer satisfaction leads to higher customer loyalty. The true loyalty of customers is significant to the success of business, since loyal and satisfied customers can secure future revenues. Customers are encouraged to purchase again if they are satisfied with a product or a service previously experienced (Bolton, 1998; Fornell, 1992). Positive attitudes resulting from customer satisfaction can strengthen the relationship between a customer and a seller, improving the level of customer retention (Anderson and Sullivan, 1993; Bolton, 1998; Fornell, 1992). Loyal customers can be encouraged to purchase more of the product, which enhances profitability. Bolton (1998) mentioned that the profit-maximising effect of loyalty is not limited to products or services already purchased but can encourage customers to try other offerings in the seller's portfolio. Higher levels of customer

satisfaction can improve the customer-retention rate and enhance consumption, thereby allowing companies to charge a premium or decrease costs (Jones and Sasser, 1995).

Szymanski and Henard (2001) studied the relationship between customer satisfaction and customer retention. They found that, when customers received what they had paid for but had a negative experience during the service transaction, many of them would be unlikely to purchase again. The customer-seller relationship would therefore be likely to be very short-lived, even if the product itself was excellent. For example, customers who suffer late delivery of a product or service are treated badly by the seller's staff will have a diminished desire to purchase it from that company again. This phenomenon forces the sellers to improve their offerings continuously, so as to satisfy more customers. Loyalty programmes and marketing promotions are examples of the tactics companies employ to encourage customer loyalty and repeat purchasing. Strategies to personalise customer relationships and emphasise service have been put in place in many businesses because of their significant effect on customer satisfaction and loyalty. Both customer satisfaction and loyalty are thus, in a sense, the indirect product of competition. Therefore, customer loyalty is a factor in profitability in many industries (Dick and Basu, 1994).

Fornell (1992), Reichheld and Sasser (1990) and Getty and Thompson (1994) pointed out that the satisfied and loyal customers can act as sources of indirect advertising and promotion to other potential customers, by sharing their positive experience with others and recruiting new customers. They do this through the horizontal relaying of positive word-of-mouth communication, according to Fornell (1992) and Gremler and Brown (1999). Also, increased loyalty can reduce price elasticities (Anderson, 1996), and increase the likelihood of resistance to the offerings of competitors (Gundlach et al., 1995).

It has also been observed by Juhl et al. (2002) that many customers are motivated to be loyal to sellers who offer their products or services at a lower price, especially in the case of groceries and supermarkets that pride themselves in undercutting the competition. However, the relationship between profit and customer loyalty can be misinterpreted, since cut-price retailers may achieve a higher level of customer loyalty but a lower return on assets. This does not necessarily suggest that customer loyalty will damages profits; it is simply that the decline in the return is the direct result of the lower prices (Juhl et al., 2002).

2.5.3. Price Perception and Customer Satisfaction

Perceived value, perceived quality and customer expectation are factors with a high propensity to affect satisfaction. Though low-quality products or services may generate little customer satisfaction, they are bought by customers who can, in practice, accept the quality delivered for the price paid: for example, cut-price airlines. Price is thus an important factor, influencing perception of the sacrifice and in turn affecting judgement of customer satisfaction (Ravald and Gronroos, 1996; Sweeney et al., 1999; Ulaga and Chacour, 2001).

This phenomenon has been demonstrated in a study by Salvador et al. (2007). Using data collected from users of university services, it found that consumers' assessment of their satisfaction was directly affected by the perception of price, consumers being satisfied with a transaction as long as what they paid was perceived to be appropriate for what they received. Customers exercise subjective judgment to judge quality on the basis of how well a product or service matches their own needs and expectations (Salvador et al., 2007). They will tend to buy a product or use a service if they expect it to be of good use to them, whatever the price

(within reason), but the price will nevertheless have a significant impact on their perceptions of value and quality.

Similarly, Hermann et al. (2007) surveyed car buyers, finding that when their perception of price was consistent with or exceeded their expectations, they were more likely to consider the price as fair. The perceived fairness of the price and the seller's pricing process (car buyers normally negotiating a final price from an initial one, often with complicated additions and subtractions of trade-in allowances, discounts and extras) have positive impacts on the level of customer satisfaction.

Huddleston et al. (2008) hypothesised that the impact of price on satisfaction differs among store formats: in food retailing as between specialty stores and conventional grocery stores, for example. Their study found that consumers were more satisfied with prices in the former than in the latter. This may be explained by willingness to pay more for better quality, given that products sold in specialty stores are generally perceived to be of higher quality. The study further found that customer service price, product assortment and perceived quality had a positive impact, in that order, on satisfaction in both types of store.

Matzler et al. (2006) conceptualised price satisfaction as a multidimensional construct, comprising: 'price transparency'; the 'price-quality ratio'; the 'relative price' by comparison with the competition; 'price reliability' (constant, with no hidden costs); and 'price fairness' (no price discrimination, nor abuse of market power to fix prices). They found that all five of those dimension were drivers of price satisfaction. The price-quality ratio was the most significant, followed by price fairness, relative price, price transparency and price reliability in that order.

The issue of customer satisfaction is an important concept as it significantly influences business performance. And price has an important influence on customer satisfaction; in turn, prior studies have explored the impacts of consumers' perception of price on their satisfaction. Those studies have not focused, however, on the impacts of the frequency of price variations that reflect the deterioration of perishable products as they approach the end of their shelf-life on customer satisfaction.

2.5.4. Customer Satisfaction and Interest in a Retailer

Jones and Reynolds (2006) defined 'retailer interest' as "the level of interest that a consumer has in a given retail store" (p.116), which is a cognitive state (Clore et al., 1987; Richins, 1997; Ortony and Turner, 1990). That being so, retailer interest may leads to positive or negative feelings towards the retailer (Clore et al., 1987; Richins, 1997; Ortony and Turner, 1990). Jones and Reynolds (2006) therefore considered it to be a motivational state, and define interest as a construct that "reflects an overall response to a given retailer beyond that which is reflected in a single store visit".

Jones and Reynolds (2006) found a positive relationship between consumer interest in the retailer and customer satisfaction. It is therefore one of the important factors affecting profitability. In addition, they found positive associations between interest in a retailer and:

- looking forward to visiting the store again;
- loyalty to the store;
- positive word of mouth; and

- a desire to learn more about the retailer.

For these reasons, retailers are strongly advised to make consumers interest, in order to augment the level of interest in their stores (Arnold and Reynolds, 2003). Although it has been noted that interest does not always indicate market validity (Tauber, 1973), the study by Jones and Reynolds (2006) showed that it does potentially influence business profitability.

2.6. PRICE AND BUYING BEHAVIOUR

'Price tolerance' is the willingness of the customer to pay for a product or a service at a given price (Anderson, 1996). Anderson (1996) found that consumers are motivated to tolerate a certain price if the product answers a relevant need and purpose and if useful information about the product is available to them prior to the transaction.

Dodds and Monroe (1985) studied the impacts of price and brand information on consumers' subjective evaluation of products. Their study found that the relationship between price and perceived quality did exist, though weaker in the case of a relatively high-price product, that price had a positive effect on quality perception but a negative impact on value perception and willingness to buy, and that brand information enhanced the effect of price. Dodds et al. (1991) later studied the effects of price, brand, and store information on consumer perceptions of product quality, value and willingness to buy. The findings were that price had a positive impact on perceived quality, but negatively influenced perceived value and willingness to buy. The inference is that, when price increases, perceived value and willingness to buy both decrease as a result of an increase in perceived sacrifice relating to perceived quality at that higher price. On the other hand, a favoured brand name and well

received store information will have a positive impact on willingness to buy.

Those findings were confirmed and extended by Sweeney et al. (1999), who added perceived risk as a mediator which they defined as "the subjective expectation of a loss". Earlier studies had focused on two components of risk, the probability of a loss and the importance of that loss, which was later expanded by the addition of financial, performance, physical, psychological, social and time losses (Peter and Tarpey, 1975). During the purchasing decision process, the components of perceived risk become a critical influence on the outcome (Brooker, 1984). The study by Sweeney et al. (1999) found that perceptions of price can have an impact on perceived quality, which in turn affects perceptions of risk, exerting a significant influence on perceptions of value for money, and thereby on willingness to buy.

Morariu (2008) argued that contemporary consumers become more knowledgeable and are hence able to assess the price appropriateness and the benefits of a product before purchasing. This implies that consumers rely on their evaluation of value attained against the price before purchasing. They would be expected to rely on the perceived fairness of the price as an important factor that is used as guidance to making the purchase decision (Morariu, 2008). This implies that consumers generally have an idea of how much a product of a specific value should cost them. In other words, the higher the perceived product value, the more the consumer would be willing to pay. Breidert (2006) held the opinion that, for the pricing strategy to affect the consumer's willingness to pay affirmatively, the sellers need to know the perceived value that consumers attach to the product.

Furthermore, previous studies have discussed how such price-related promotions as

discounting influence consumers' expectations and hence their purchasing attitude. In general, it is noted that the higher the discount, the lower the price and the higher the intention to purchase (Raghubir, 1998). It is widely believed that price-related promotions can increase sales performance. A study by Martinez-Ruiz et al. (2006) evaluated the sales effects of temporary retail price discounts, by analysing historical data gathered from a supermarket. The findings were that the tactic increased sales volume, more substantially in the case of a relatively high-price high-quality product than in that of a relatively low-price low-quality alternative.

Price-based sales promotion also has a number of potential disadvantages. A survey-based study by Raghubir and Corfman (1995) found that the perceived quality of a more frequently promoted brand is lower than that of one that is less frequently promoted. Hartley and Cross (1993) had earlier argued that price promotions can lead to the following negative impacts on a firm's performance:

- *Degrading the price*: repeated price-related promotions can reduce the lowest price that consumers wish to pay for the product.
- *Reducing perceived value*: repeated price-related promotions can lead to a reduction in the perceived value of the product
- *Cannibalising future sales*: price-related promotions can change the demand pattern (lead customers to forward buy, therefore borrow future sales).

Prior studies have explored the impacts of price variations and discounting on consumers' purchasing behaviour, however, they have not focused on the frequency of price variations and discounting that reflect the deterioration of perishable products as they approach the end of their shelf-life.

2.7. SUMMARY AND DISCUSSION

This chapter has reviewed the literature related to: the economists' pricing approach; practical pricing procedures commonly used by managers; dynamic pricing approaches for perishable products; and the pricing strategies based on the availability of advanced traceability systems designed for the management of the retailing of perishable foods. It has also investigated the implications for pricing strategy of the antecedents and consequences of customer satisfaction, the effects of price perception on customer satisfaction and willingness to buy, and the impact of price-related promotion on buying behaviour. The review has identified the following issues:

- From the perspective of economics, the quantities demanded by buyers and supplied by sellers are the major determinants of price. Since economists' pricing models were not developed as an executive tool, three other pricing approaches are typically adopted in practice, based on cost, competitors' prices, and customer value. The reviews of these traditional pricing strategies provide the basis of an understanding of pricing in practice. (See section 2.2)

- Given that the value of perishable products decreases as the end of a selling period or their expiry dates approach, numerous studies have proposed pricing models specifically applicable to perishable products. In general, those are based on continuous and dynamic variation of the price, to match the changes in perceived value to the customer and thereby maximise the profitability of perishable products. (See section 2.3)

- Numerous studies have proposed the implementation of an advanced traceability system, to reduce concerns associated with the retailing of perishable foods, including safety and freshness issues. Improved traceability system provides an opportunity to develop dynamic pricing models designed specifically for perishable foods offering consumers better trade-offs options between price and freshness. (See section 2.4)

- Noting that customer satisfaction has a significant influence on profitability, the literature emphasises the significance of understanding its antecedents (perceived quality, perceived value and customer expectations) and consequences (customer loyalty and voice). Consumers' interest in a retailer has a positive association with customer satisfaction, which can significant influence its overall performance. Price perception significantly affects customer satisfaction. Consumers are satisfied if the price they pay is perceived to be adequate for what they receive, and will pay more if the quality is high enough. On the other hand, satisfaction levels decrease when consumers have to pay more for an item that they perceive to be of the same quality as one at a lower price. (See section 2.5)

- Price significantly influences consumers' buying behaviour. Price perception also has an impact on willingness to buy. Price-led promotions, in the form of discount schemes, can affect consumers' purchasing behaviour in various ways. They can both improve sales performance, as intended, but also influence it negatively by degrading the price, reducing perceived value and cannibalising future sales. (See section 2.6)

The benefits of dynamic management of the pricing of perishable foods are reported in the literature, but from the retailers' point of view and under various determinative or stochastic demand assumptions. However, the potential changes of the consumer behaviour and demand patterns responding to the availability of the same food products with different prices for different remaining shelf-life at the same time, and the impact of these changes on the retail operations performance have rarely been considered, which should be taken into account in particular in any pricing model proposed for perishable food products. In addition, studies have rarely touched upon consumers' reaction to dynamic price management and the benefits they stand to derive from it.

Numerous reviewed studies focus on the issue of customer satisfaction, focusing on the antecedents and consequences of customer satisfaction, and the role of price perception in shaping them. However, satisfaction with pricing strategies has rarely been investigated, especially for perishable products. Dynamic pricing models are aimed at dynamic management of the prices of perishables, according to the changing perceptions of value over their shelf life, matching price to value and thereby offering customers better trade-offs options. The logical inference is that a more dynamic pricing strategy for perishable foods would improve satisfaction levels by comparison with those achieved by current pricing strategies, in practice. As the consumers' perceptions of freshness, price and value may vary as the expiry date approaches, in different ways from different product types, so will the impacts of these more dynamically managed pricing strategies. Yet consumers' perceptions of dynamic pricing models that continuously compensate for loss of value over time, and the influence of such models on customers' purchasing behaviour have rarely been studied. Existing studies of consumers' perception on price promotions have focused on temporary

discount policy rather than continuously altered pricing strategies. That is, from the point of view of this thesis, they have not evaluated consumers' perception of dynamic pricing strategies that are capable of offering trade-off options between price and remaining shelf-life.

To help fill the gap in the literature, this thesis will investigate consumers' responses to dynamic pricing strategies for perishable foods by surveying their satisfaction with and interest in the strategies as well as their purchasing behaviour in response to the strategies. This thesis will also investigate the impacts of dynamic pricing strategies on retailer performance considering customer demand in reaction to a situation where identical food products having different remaining shelf-life are available at the same time, but at different prices. This investigation will provide new insights into demand factors that should be considered in the design of perishable foods pricing approaches

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. INTRODUCTION

This chapter presents the methodological arguments for the studies in this thesis. It opens with a description of the research design. The research hypotheses to be tested by analysis of the survey data are next presented. The chapter then moves on to a discussion of the research strategy for obtaining a vital background understanding of the present business process of leading food retailers in South Korea, by individual in-depth interviews with fresh-food or branch managers, which would in turn inform the design of both the consumer-survey questionnaire and a simulation model of the general business environment of food retailing in the country. The research strategies for testing the hypotheses are then discussed. It closes with a discussion of the process of simulation modelling.

3.2. RESEARCH DESIGN

A research design is the framework or plan for a research providing a guidance to collect and analyze date (Churchill and Iacobucci, 2005). In other words, a research design is about structuring research activity in order to find answers for research questions (Easterby-Smith et al., 2002).

The extensive literature review in Chapter 2, has identified a gap in the body of knowledge. The purpose of the research design as discussed in this chapter is to fill that gap. The research design illustrated in Figure 3.1 shows the research process, starting with identification of the

research problems, then proceeding from the literature review, through the development of research questions and hypotheses, to formative in-depth interviewing of food-retailing managers, a field survey of consumers of perishable food products and a simulation model. The figure shows that the data collected during the process were then analysed, the hypotheses were tested, conclusions were drawn, and fruitful directions for future research were identified. This whole process took place within the context of South Korean food-retailing.

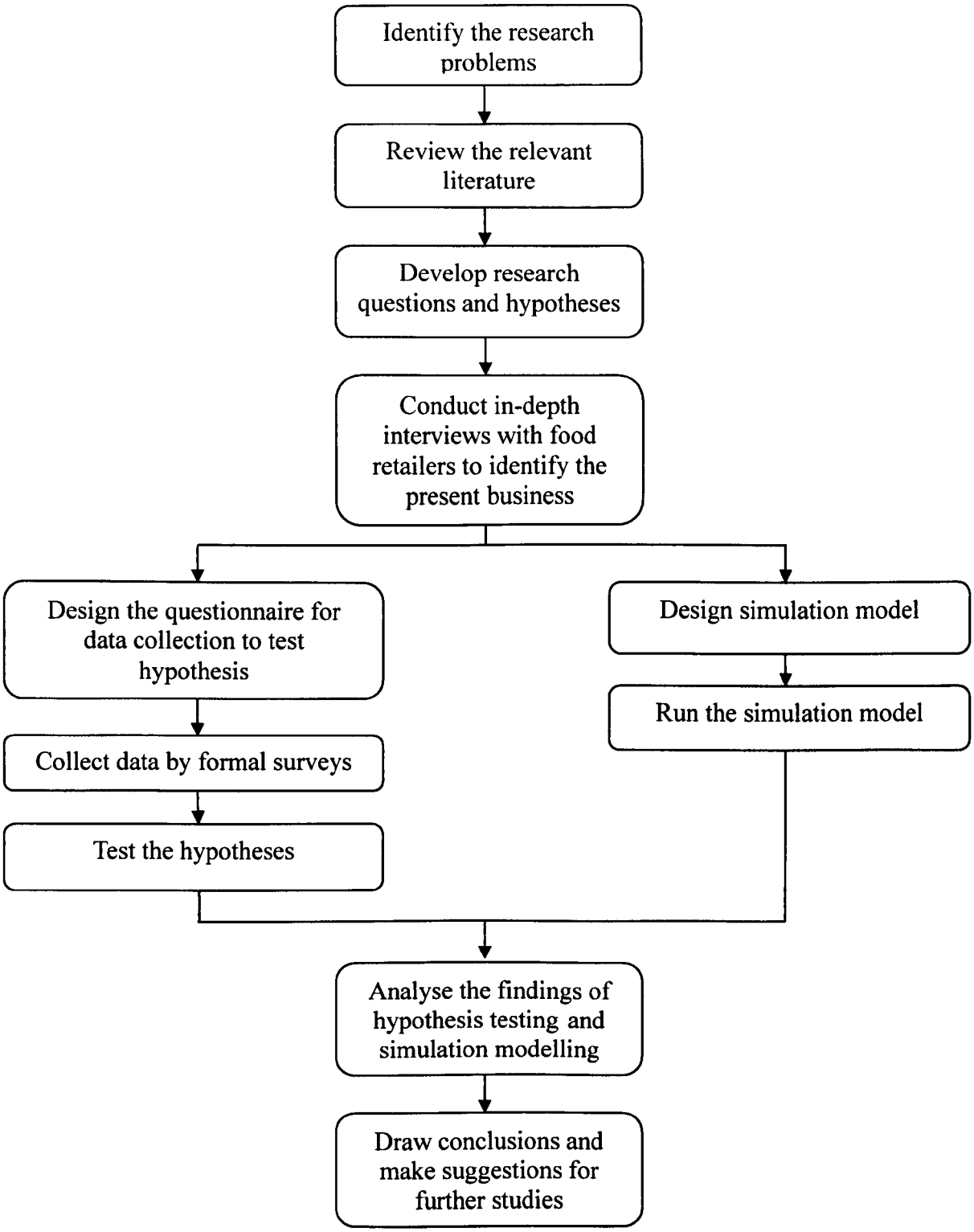


Figure 3.1: Research design

3.3. RESEARCH HYPOTHESES

A hypothesis is "an informed speculation, which is set up to be tested, about the possible relationship between two or more variables" (Bryman and Bell, 2003, p.570). Hypotheses should be developed to answer research questions and achieve research objectives. In this study, five hypotheses are proposed concerning consumers' perceptions of dynamic pricing strategies for perishable foods. The theoretical rationale of the hypotheses will be explained in Chapter 5, which presents the results of formal testing. They are:

Hypothesis 1: The level of customer satisfaction with a Multi-period Pricing Strategy for perishable foods is greater than the level of customer satisfaction with a Two-period Pricing Strategy.

Hypothesis 2: The level of customer satisfaction with a Two-period Pricing Strategy for perishable foods is lower in the case of a product category (or product type within a product category) in which the level of customer satisfaction with freshness is lower.

Hypothesis 3: The level of customer satisfaction with a Multi-period Pricing Strategy for perishable foods is higher in the case of a product category (or product type within a product category) in which the level of customer satisfaction with a Two-period strategy is lower.

Hypothesis 4: The level of interest in a Multi-period Pricing Strategy for perishable foods is higher in the case of a product category (or product type within a product category) in which (1) the level of customer satisfaction with a Multi-period Pricing Strategy is higher, and (2) the level of customer satisfaction with a Two-period strategy is lower.

Hypothesis 5: With a Multi-period Pricing Strategy, the level of consumer willingness to make economic trade-offs between price and remaining shelf-life is higher for a product category (or product type within a product category) in which (1) the level of customer satisfaction with and (2) the level of interest in a Multi-period Pricing Strategy are both higher, and (3) the level of customer satisfaction with a Two-period strategy is lower.

Two-period Pricing in which prices of perishable foods are discounted when the end of the selling period is judged to be imminent, was used as an example of present less dynamic pricing approach. Multi-period Pricing in which prices are more frequently adjusted as each day of remaining shelf-life passes, was used as an example of more dynamic approach to pricing. The detailed definitions of Two-period Pricing and Multi-period Pricing in this thesis are provided in Chapters 4 and 5, after identifying the present approach to pricing through in-depth interviews with food retailers in Chapter 4.

3.4. RESEARCH STRATEGIES FOR IN-DEPTH INTERVIEWS WITH FOOD RETAILERS

The purpose of in-depth interviews with food retailers is to obtain practical information about perishable food management, specifically helping to identify the current business process, which can in turn act as a key input to the design of the simulation model and the consumer survey with respect to the choice of sample product types and defining the present pricing strategies. They could also contribute to re-evaluation of research needs, from the retailers' point of view.

The formal questions around which these interviews were conducted were framed in Korean. The choice of product categories and types to be studied is an essential step in the testing of hypotheses, thus questions are needed to select sample product types. Since the display shelves are where customers actually purchase the items, further questions are needed to investigate how the interviewed retailers manage the display of perishable food products. In addition, the interviewer would ask about present approaches to the discounting of food products over the duration of their shelf-life. The interview questions are presented in appendix.

Thus, the in- depth interviews were expected to collect information that would contribute to the design of the customer survey questionnaire, generating data for the testing of the research hypotheses, and also to the construction of the simulation of actual events in the food retail stores.

The fresh-food managers or branch managers of leading food retailers in South Korea were contacted by telephone to request their participation, with the aim of collecting practical information about the management of perishable foods from one branch of each leading food retailers. The contact details were identified at their web-sites. In-depth face-to-face interviews were then conducted with those who agreed to participate; they are E-mart, Home Plus and Hanaro Mart, the largest, the second largest and the fourth largest food retailers in South Korea in terms of number of branches (see section 4.2.3 for more details of leading food retailers in South Korea). The main advantages of the face-to-face interview are that it enables the interviewer to adapt questions as necessary during the interview process, clarify participants' doubts about the meaning of a question, and ensure that all questions are fully understandable (Sekaran, 2003). As the interviews were based on a face-to face meeting, it

assisted researchers in obtaining valuable information that is directly relevant to the research.

3.5. RESEARCH STRATEGIES FOR TESTING THE HYPOTHESES

The aim of testing the five research hypotheses is to evaluate the potential impacts of Multi-period Pricing strategies from the consumers' point of view, in terms of customer satisfaction, willingness to make economic trade-offs between current price and remaining shelf-life, and the level of consumer interest in the approaches to pricing. These results will also cast light on the impact that Multi-period Pricing strategies have on consumption behaviour with respect to the different types and categories of food product investigated.

3.5.1. Source of Data

The methodological choice with respect to the sources of data is broadly between primary and secondary. Primary data is "originated by the researcher for the purpose of the immediate investigation at hand" (Churchill and Iacobucci, 2005, p167), which can lead to new insights, greater confidence for the outcomes (Easterby-Smith et al., 2002). Secondary data is the existing data and statistics, and therefore provides advantages over primary data in terms of cost and time (Churchill and Iacobucci, 2005). However, secondary data may have problems with the accuracy as the data was collected for other research purposes (Churchill and Iacobucci, 2005). The sources of data for testing hypotheses in this research were primary source in order to provide the most authoritative source.

Among the major methods available for collecting primary data: observation, interview and questionnaire, a questionnaire-based survey was chosen as the means of comparing consumer responses to more dynamic pricing strategies for perishable foods with those to

current practice, being an efficient way to collect responses from a large sample (Saunders et al., 2003).

3.5.2. Questionnaire Design

Kumar et al. (2002) have asserted that questionnaire design is "a very imperfect art" with no known processes capable of leading consistently to a "good" questionnaire. An effective design to achieve the objectives of research will follow a sequence of logical steps: "(1) plan what to measure, (2) formulate questions to obtain the needed information, (3) decide on the order and wording of questions and on the layout of the questionnaire, (4) using a small sample, test the questionnaire for omissions and ambiguity and (5) correct the problems and pretest again, if necessary" (Kumar et al., 2002, p.275).

The questions for inclusion in the consumer questionnaire were initially prepared in English and translated into Korean. Multi-period Pricing can discount the prices of perishable foods based either on a pre-defined unexpired shelf-life or, more accurately, on a remaining period determined by advanced traceability systems, as proposed in the dynamic pricing models for perishable foods proposed by Li et al. (2006) and Liu et al. (2008). The latter strategy adjusts the price according to an accurately measured remaining shelf-life, which is assumed to be stated explicitly at the point of purchase, whereas the former does so on the basis of an expiry date pre-set during the manufacturing process. The shelf-life of perishable foods, however it is defined, needs to be modified by the time the products reach the retailers and end-users, to allow for the possibility of problems arising from varying storage conditions and other eventualities (Sahin et al., 2007). Therefore, two different versions of the questionnaire were prepared, relating respectively to Multi-period Pricing strategy based on

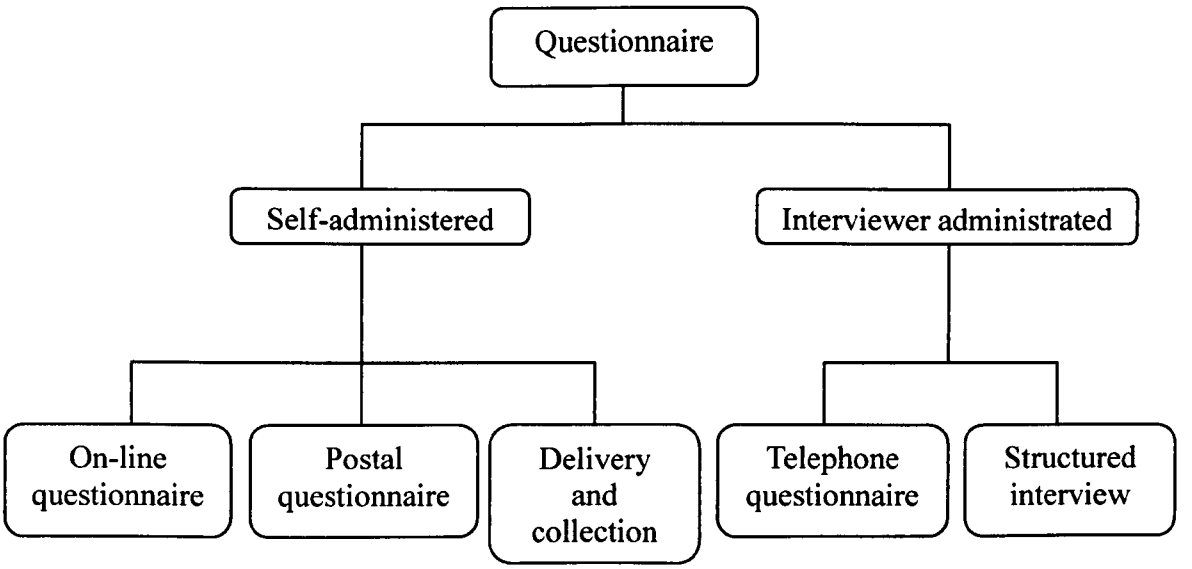
accurate and specific shelf-life data or Multi-period Pricing strategy based on a pre-defined expiry date, distinguished as *questionnaire version 1* and *questionnaire version 2*, respectively. The surveys in which they were administered are referred to as *Formal Survey 1* and *Formal Survey 2*, respectively.

There are 14 questions in the questionnaire which were grouped into five subject categories. The first, dealing with the respondent's satisfaction with the freshness of the food items, comprised three questions; the second, which assessed their satisfaction with the present pricing strategy, also consisted of three separate questions; the third was concerned with the expected level of satisfaction with a Multi-period Pricing strategy, and posed a further three separate questions; the two questions in the fourth group assessed the respondent's interest in a Multi-period Pricing strategy; and the three in the fifth group related to the degree of willingness to make economic trade-offs between price and remaining shelf-life, with a Multi-period Pricing strategy. Respondents rated the extent of their satisfaction, interest and willingness on five-point Likert scales, anchored at 'strongly disagree' and 'strongly agree', in response to fourteen questions. As Cooper and Schindler (2006, p.370) confirmed, this is "the most frequently used variation of the summated rating scale". All questions were framed in readily understandable terms, and a pre-test was conducted to ensure that they were comprehensible to the respondent without any uncertainty or confusion. Personal information was collected in a separate section. In the case of the three subject categories relating to satisfaction level, the measurement variables in the American Customer Satisfaction Index (ACSI), which measures overall satisfaction, expectancy disconfirmation, and performance versus the respondent's ideal product or service in the category (Fornell et al., 1996), was used. The fourteen questions are presented in Appendix.

Taking account of the fact that consumers' sensitivity to freshness and price is likely to vary among different types of perishable food products, nine types of sample products were selected based on the in-depth interviews with food retailers. The criteria for selection are explained in Chapter 4.

3.5.3. Data Collection Strategies

There are several available procedures for the collection of data in questionnaire-based survey research as illustrated in Figure 3.2. Table 3.1 summarises their key features.



***Source*: Saunders et al. (2003)**
Figure 3.2: Types of questionnaire

Attribute	*On line*	*Postal*	*Delivery and collection*	*Telephone*	*Structured interview*
Population characteristics for which suitable	Computer-literate individuals who can be contacted by email or internet	Literate individuals who can be contacted by post; selected by name, household, organisation etc.		Individuals who can be telephoned; selected by name, household, organisation etc.	Any; selected by name, household, organisation, in the street etc.
Confidence that right person has responded	High if using email	Low	Low but can be checked at collection	High	
Likelihood of contamination or distortion of respondent's answer	Low	May be contaminated by consultation with others		Occasionally distorted or invented by interview	Occasionally contaminated by consultation or distorted/invented by interviewer
Size of sample	Large, can be geographically dispersed		Dependent on number of field workers	Dependent on number of interviewers	
Likely response rate	Variable, 30% reasonable within organisations, internet 10% or lower	Variable, 30% reasonable	Moderately high, 30 to 50% reasonable	High, 50 to 70% reasonable	
Feasible length of questionnaire	Conflicting advice; however, fewer 'screens' probably better	6 to 8 A4 pages		Up to half an hour	Variable depending on location
Suitable types of question	Closed questions but not too complex, complicated sequencing fine if uses IT, must be of interest to respondent	Closed questions but not too complex, simple sequencing only, must be of interest to respondent		Open and closed questions, but only simple questions, complicated sequencing fine	Open and closed questions, including complicated questions, complicated sequencing fine
Time taken to complete collection	2 to 6 weeks from distribution (dependent on number of follow-ups)	4 to 8 weeks from posting (dependent on number of follow-ups)	Dependent on sample size, number of field workers etc.	Dependent on sample size, number of interviewers etc. but slower than self-administered for same sample size	
Main financial resource implications	World Wide Web page design	Outward and return postage, photocopying, clerical support, data entry	Field workers, travel, photocopying, clerical support, data entry	Interviewers, telephone calls, clerical support. Photocopying and data entry if not using CATI[c]. Programming, software and computers if using CATI	Interviewers, travel, clerical support. Photocopying and data entry if not using CAPI[d]. Programming, software and computers if not using CAPI.
Role of the interviewer/field worker	None		Delivery and collection of questionnaires, enhancing respondent participation	Enhancing respondent participation, guiding respondents through the questionnaire, answering respondents' questions	
Data input	May be automated	Closed questions can be designed so that responses may be entered using optical readers after questionnaire has been returned		Response to all questions entered at time of collection using CATI	Response to all questions can be entered at time of collection using CAPI

[c]Computer-aided telephone interviewing, [d]Computer-aided personal interviewing

Source: **Saunders et al. (2003)**

Table 3.1: Main attributes of questionnaire

Among these data collection options, the structured interview was chosen to be the data-collection vehicle. Administered in face-to-face street interviews, it permitted the interviewer to guide respondents through the questionnaire and deal with any procedural questions, as noted under 'Role of the interviewer/field worker' in Table 3.1. It was expected that some respondents would find it difficult to grasp the concept of Multi-period Pricing Strategies, for lack of first-hand knowledge and experience. Therefore, explanations of Multi-period Pricing, present discounting practices and advanced traceability systems (for *questionnaire version 1*) were provided before the interview, all in the context of perishable food products. Examples of Multi-period Pricing and present discounting practices were also provided to respondents.

The stages in selecting respondents for a methodologically sound sample are: "(1) examine the objective of the study, (2) define the people of interest, (3) find suitable source for the population members, (4) decide on the sampling type and approach, (5) decide on the sample size, (6) proceed with the fieldwork and (7) correct sampling errors ready for reporting" (Bradley, 2007, p. 164).

It is broadly true to say that everyone can be a 'consumer', in the food-retailing context. However, the population of interest here is those who regularly buy perishable food items. It is also generally true that the majority of consumers visiting retail food stores in South Korea are female (Lee and Park, 2004). The sampling location was Seoul, the capital city of South Korea. Seoul can broadly be divided by the Han River (locally called 'Hanhang') into the Gangbuk (north of the river, the older region) and the Gangnam (south of the river, a recently developed region). Therefore, surveys follow a stratified random sampling procedure. The aim of the sampling procedure was to obtain responses from mainly female shoppers and the same number of responses from the Gangbuk and Gangnam areas, respectively.

Sample size can be determined by calculation, by reference to industry-wide norms, by the budget available, or "by 'building' analysis cells" (Bradley, 2007). For this research, the last of those four options was chosen. It reasons backwards from the eventual result required, beginning with only one assumption: the minimum size of each sub-sample (or 'unit of analysis' or 'cell') that will be analysed separately, if the results are to be statistically valid. Expert opinion differs on that number; some researchers set it at a minimum of 50 respondents per cell while others prefer the level to be set at 100 (Bradley, 2007). Following the received wisdom that each cell in a sample should contain between 50 and 100 individuals, for analysis of the results to be statistically valid, the aim was to achieve 110 responses per cell, leaving a conservative margin error, for example to allow unusable questionnaires. Given that the number of cells is nine (three product types in each of three product categories), the target sample size was thus 990 for both *Formal Survey 1* and *Formal Survey 2.*

3.5.4. Data Analysis Strategies

This sub-section describes the statistical tools employed to test the research hypotheses on the basis of response data collected in *Formal Survey 1* and *Formal Survey 2.*

The first test was of the *reliability* of the data, defined by Churchill and Iacobucci (2005) as "the similarity or consistency of results provided by comparable measures of the same object or construct" (p. 283). Three distinct procedures are available: 'test-retest' in which the same test is conducted twice, with the same data sources, at an interval less than six months, in order to evaluate the stability of the results; alternative form, to test whether or not

alternative forms of the same measure produce the same or similar results; and internal consistency testing, to establish whether or not instrument items are homogeneous, and assess the consistency of responses to different items (Cooper and Schindler, 2006; Saunders et al., 2003).

Saunders et al. (2003) suggest that test-retest may present practical difficulties for the researcher, in that it may not be easy to arrange for respondents to complete the same questionnaire twice, and the time lapse between the two exercises may result in different responses to the same questions. They also identified the difficulty, in the case of the alternative form of ensuring that the original and alternative questions are substantially equivalent. The internal consistency testing was therefore chosen as the reliability test for the current study, by calculating the Cronbach's alpha coefficient. A resultant value greater than 0.7 is considered as an indicator of acceptable reliability (Field, 2005).

While reliability testing evaluates the consistency of the results, validity is concerned with "whether the findings are really about what they appear to be about" (Saunders et al., 2003, p. 101). It can be assessed in terms of content, criterion-related and construct validity.

Content validity measures whether or not "the content of the items adequately represents the concepts" (Cooper and Schindler, 2006, p. 349). Criterion-related validity can be determined by "the correlation between the measure and criterion" (Churchill and Iacobucci, 2005, p. 293). Construct validity can in turn be divided into convergent validity, which measures "the degree to which scores on one scale correlate with scores on other scales designed to assess the same construct", and discriminant validity, assessing "the degree to which scores on a scale do not correlate with scores from scales designed to measure a

different construct" (Cooper and Schindler, 2006, p. 351).

Content-validity testing was used as the means of ensuring that the design of the questionnaire had yielded a set of adequate and readily understandable questions. The initially formulated questions in English were discussed with colleagues with expertise in marketing research, before translation into Korean. A pilot test with a convenient sample of 20 respondents was then carried out in South Korea, to verify that respondents could readily comprehend the meaning of the questions; respondents were asked to comment on any aspects of the questionnaire and explanations. The result was the modification of certain key words, to make them more easily understood. The questionnaires used in gathering data for this thesis consisted of 14 main questions, grouped into five subject categories. The questions in each subject category asked the same concept in different words. Therefore, regarding the two methods of construct validity, convergent validity was tested using factor analysis to evaluate whether among 14 questions, the scores for questions in each subject category were highly correlated. Criterion-related validity, however, was not tested as the 'criterion' for the 'measure' was not available.

One of the key objectives of this study is to investigate the impact that better trade-off options between price and remaining shelf-life have on customer satisfaction, the level of consumer interest in the approaches and customers' willingness to make such trade-offs, for different categories or types of perishable food product. Therefore, it is essential for the testing of the research hypotheses to apply appropriate statistical procedures for *analysis of variance* among the mean scores obtained by the consumer questionnaire. The techniques available for that purpose are the t-test and ANOVA. The former is capable of testing the degree of difference between two sets of data; the latter can measure variation among three or

more (Saunders et al., 2003).

For this study, three product types within each of three product categories (dairy, meat and vegetable) were identified in the depth interviews with retail fresh food or branch managers. Details of the individual products are given in Section 5.3.1 of Chapter 5. Consumers' satisfaction with prices and freshness, their interest in Multi-period Pricing and willingness to balance price against unexpired shelf-life were measured on five-point numerical scales. The methodological decision was therefore to apply the t-test to Hypothesis 1, comparing current pricing strategy with the multi-period alternative, and to test the other four hypotheses by the ANOVA test.

The t-test exists in two forms. The 'independent' variant tests whether or not the mean scores of two different groups of people or conditions are significant; the 'paired samples' variant measures the difference between the mean scores for one group of people on separate occasions or under different conditions, or tests "the same person in terms of his/her response to two different questions" (Pallant, 2007). To test the Hypothesis 1, it was necessary to measure whether the dependent variable, customer satisfaction, is higher for a Multi-period Pricing strategy than for a current pricing strategy: that is, under the same person in response to two different questions. The paired-sample t-test was therefore chosen.

To test Hypotheses 2, 3, 4 and 5, the need was to assess variance, for different product categories and types within a product category, with respect to customer satisfaction with freshness and pricing, the level of interest in a Multi-period Pricing strategy, and willingness to make trade-offs between price and remaining shelf-life. The choice of test was therefore one-way between-groups ANOVA with post-hoc tests, given the existence of one dependent

variable and independent variable with three or more groups (Pallant, 2007). The ANOVA tests evaluates whether there are significant differences in the mean scores on the dependent variable against the three different groups (dairy, meat and vegetable products), and the post-hoc test shows where the differences exist. A probability of 0.05 (p-value) was chosen as the minimum level of significance in this thesis; researchers traditionally reject a null hypothesis if the p-value is smaller than 0.05 (Cooper and Schindler, 2006; Saunders et al., 2003).

3.6. Simulation

Hypotheses testing evaluates the outcomes of Multi-period Pricing strategy from the consumers' point of view. Given that a research objective is also to analyse the impacts of the more dynamically managed approach to pricing on consumers' behaviour and subsequent impact on retailers' performance, a simulation study was designed. Retailer performance can be evaluated using different measures, for example, market-based (e.g. sales or market share) and profitability-based measures (e.g. return on assets), according to Dunn et al. (1995). In this study, the impacts of dynamic pricing on retailer performance are evaluated in terms of profit (profitability-based), sales volume (market-based) and rate of disposal due to unsold products (a current major challenge in the food retailing industry).

Simulation has been defined as "the process of constructing a model of a system which contains a problem and conducting experiments with the model on a computer for a specific purpose of experimentation to solve the problem" (Balci, 1994, p.121). In other words, its purpose is to imitate "the operation of a real-world process or system over time [which is] an indispensable problem-solving methodology for the solution of many real-world problems" (Banks, 1998, p.3). The technique originated in the 1960s, has been widely used since the

1990s, and is considered to be an outstanding means of modelling and understanding social processes (Gilbert and Troitzsch, 2005).

Banks (1998) enumerates the key advantages and disadvantages of simulation studies. The advantages are said to be that it enables:

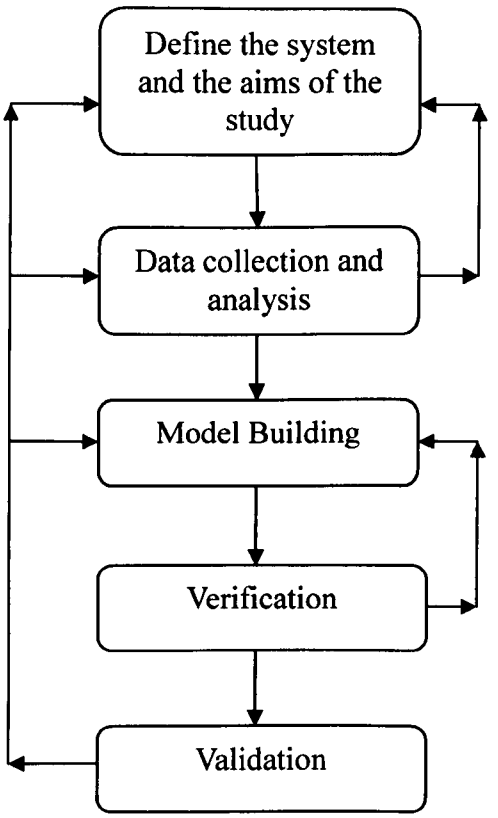
- the testing of proposed changes or additions without committing resources;
- the selective speeding up or slowing down of relevant events in the simulated situation, thereby helping the researcher to understand why a particular phenomenon occurs in the real system by examining and controlling it;
- the exploration of new strategies, operations or procedures without undertaking an expensive experiment with a real system;
- improved understanding and enhanced insights into a complex business process, helping to diagnose problems by examining interactions among constituent variables;
- the production of reliable results through appropriate modelling, testing and validating.

The disadvantages of simulation are identified as:

- the need for potentially time-consuming and expensive training in building a simulation model;
- difficulties in interpreting the results, since most input and output variables are random;
- improper implementation of the process; especially if other efficient methods are available.

3.6.1. Simulation Modelling

A simulation model needs to represent the reality in a simplified form. Failure to specify the boundaries of the system or set assumptions appropriately will result in inaccurate results; it is therefore important to continuously improve the model until the results can be said to have been verified and validated (Oakshott, 1997). The stages of the modelling cycle are illustrated in Figure 3. 3.



***Source*: Oakshott (1997)**
Figure 3.3: The modelling cycle

For the first stage of the modelling process in this study, the aim of the simulation was set; to evaluate the extent to which more dynamically managed pricing strategies influence retailer's performance comparing to the current practice, considering the consumer demand

responding to the availability of the same products with different prices and remaining shelf-life at the same time. At the second stage, the data for analysis were therefore collected by in-depth interviews with food retailers.

At the model-building stage of the process, account was taken of the cautionary advice offered by Oakshott (1997), that it is difficult in practice to build a complex model, which will have a greater chance of error than a simpler one, and that a simplified model may in fact achieve the intended purpose of the research more easily, with the potential for subsequent modification and improvement. The resultant simulation represents the actual and proposed business environment in retail food stores as closely as possible, but without undue complication, on the basis of interviewees' actual responses.

The model verification stage is a matter of evaluating "the accuracy of transforming a problem formulation into a model specification or the accuracy of converting a model representation in micro flowchart into an executable computer program" (Balci, 1994, p.123). The model validation stage is an important task to check that the simulation model has generated results consistent with those observed in the real operational environment, and hence that it is reliable (Oakshott, 1997). The purpose of model validation is to build the *right* model, whereas model verification is to ensure that the building process was the *right* one (Balci, 1994). The simulation model in this thesis was continuously modified and improved at the model development stage to ensure that the model reproduces the current business process in food retail stores. To verify the simulation model, the output of each process in the simulation (see Chapter 6, section 6.2) was separately checked to ensure whether they perform as intended; for example, it was checked that the price is actually decreased in the simulation as in Table 6.1, depending on the type of pricing and length of shelf-life. After

checking the outputs of each process in the simulation, it was checked whether the results of simulation (that is automatically calculated) conformed to the manually calculated results. For example, the simulation provides the annual profit as a result, but it was also manually calculated for confirmation. For the model validation, each business process in the simulation was built based on the current business process in food retail marts in South Korea that was identified by the interviews, and various different input variables were used to test whether the results of simulation are consistent with the expected outcomes that should happen in the real situation with the chosen input variables.

3.6.2. Building the Simulation Model

The available options for the construction of a model are a computer program package, a toolkit or a purpose-built program. Gilbert and Troitzsch (2005) identify the desirable features of a programming language for simulation as follows:

- it should "be well structured and allow for incremental refinement";
- it should "allow easy and rapid debugging"; and
- it should preferably be "familiar to the modeller and to researchers", so that it can be easily adopted and adapted.

They further note that, after the program has been written, "many hundreds of runs will be needed to carry out sensitivity analysis" to ensure the model is correctly specified.

According to Pidd (2003), there are various applications of dynamic simulation methods available that are constructed using Visual Interactive Modelling System (VIMS), including Stella/iThink, Vensim, and Powerism. Although VIMS simulators are widely used in operations researches, they are passive, and so only respond passively to user direction and

only operate in pre-programmed conditions (Hurrion, 1991).Therefore, among the variety of the simulation model, the simulation in this study used the middle-level computer programming language 'C language', with the assistance of an expert of computer programming. Advantages for choosing that language are: that it is easy to personalise and tailor to the specific needs of the study; that its readability, given that only 28 keywords have to be remembered, simplifies creation of the software; and (3) that it is portable, in the sense that one type of software can be easily adapted to others (Schildt, 1988). The main motivation for choosing C language as the vehicle to build the simulation model in this study is the ease with which it allows personalisation of the model to meet specific needs and the ease with which it allows model upgrade. This means that the model can be used and adapted in future studies.

The simulation model in this study imitates the current business environment in food retail stores in South Korea. The details of the current business environment in food retail stores are presented in Chapter 4; information given in the interviews with three leading food retailers in South Korea was used as the foundation of the design of the simulation model. To summarise, the simulation model consists of five main processes: (1) pricing strategies: a process to manage the price of perishable foods by employing either less dynamic pricing strategies or more dynamic pricing strategies, depending on the situation; (2) Inventory management: a process to control the inventory level from suppliers; (3) display shelf management: a process to manage the display at the consumer purchase point; (4) consumer behaviour: a process to simulate consumer purchasing behaviour, considering consumer demand in reaction to the situation where the display stock of a specific product has different values resulting in different prices; and (5) outcomes: a process to generate the profits, rate of disposal due to unsold products, sales volume, etc as results. These five processes are

intertwined in the simulation to reproduce the actual business environment in food retail stores as closely as possible. The details and assumptions of the five processes are presented in Chapter 6, section 6.2.

3.7. SUMMARY

This chapter has presented a discussion of the research methodology applied in this thesis. A schematic representation of the overall research design has shown the various steps in the research process in clear summary. The constituent elements of the process are in-depth interviews with food retail managers, two formal surveys of consumers, and a simulation study.

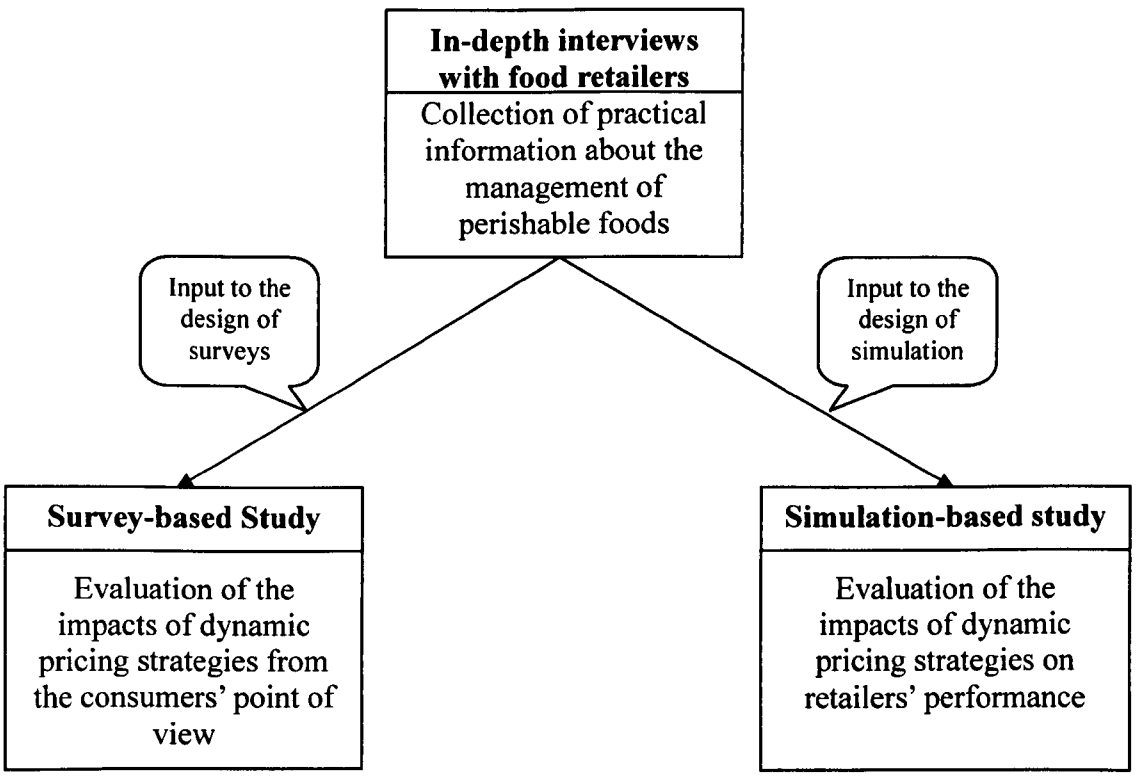


Figure 3.4: The three research process

As shown in Figure 3.4, through in-depth interviews with food retailers in South Korea,

practical information about perishable food management was collected. This information helps to: (1) determine sample product types among the variety of different types of perishable foods and identify present pricing strategies for conducting formal surveys and (2) identify present business processes to enable accurate simulation of actual events in food retail stores. Through conducting formal surveys, the consumers' perceptions of dynamic pricing strategies can be evaluated, and this information can be used to answer the first research question, outlined in Chapter 1, section 1.3. By conducting a simulation study, the potential impacts of dynamic pricing strategies on retailer performance can be evaluated, providing answers to the second research question outlined in Chapter 1, section 1.3. The associated research strategies have discussed in detail, including questionnaire design, data collection procedures, data analysis methods and computer-based simulation modelling.

CHAPTER FOUR

INTERVIEWS WITH FOOD RETAILERS IN SOUTH KOREA

4.1. INTRODUCTION

The purpose of this chapter is to present an overview of the management of perishable food retailing in South Korea. The practical details have been obtained by in-depth interviews with food retailers. Different countries may have different challenges and prevailing operations management approaches for perishable foods. The in-depth interviews have enabled the identification of the details of challenges in perishable foods management and detailed practical information for the research design focused on food retailing in South Korea, the sample market chosen for this thesis.

Section 4.2 describes the South Korean food retailing industry in terms of its total market value, and the market shares of the leading food retailers. The aim is both to provide the essential background and to guide the selection of a sample of food retailers for interview.

Section 4.3 presents the key findings of interviews with fresh food or branch managers in the food retail stores: practical information relating to their present pricing strategy, the wastage rate attributable to spoilage in transit from the supplier and unsold stock, and such aspects of their operations as display-shelf management and the replenishment of perishable stock. Interview responses furthermore identified the types of perishable food most strongly associated with the wastage problem, which could be chosen as the focus of formal surveys.

The practical information gathered from the food retailers was an important input to the design of formal consumer surveys, to collect data for the testing of the hypotheses, and to the specification of the simulation model to match the current business environment as closely as possible.

Section 4.4 presents the findings of the interviews with food retailers.

4.2. BACKGROUND TO FOOD RETAIL INDUSTRY IN SOUTH KOREA

4.2.1. Market Value of Food Retail Industry in South Korea

According to Datamonitor (2010), the total revenue generated by the South Korean food retail industry was 59,147 billion Korean Won in 2009. The compound annual growth rate of the South Korean food retail industry between 2005 and 2009 was 0.8%. Table 4.1 presents five-year statistics for the industry's economic market value over that five-year period: total annual revenue, year-on-year change, national population.

Year	Total revenue by food retailers in South Korea in billion Korean Won (KRW)	Growth in total revenue of food retailers in South Korea %	South Korea size of population (million)
2005	57,294.1		48.1
2006	57,823.1	0.9	48.2
2007	58,554.2	1.3	48.4
2008	58,850.7	0.5	48.6
2009	59,147.0	0.5	48.7
Average:	**58,333.8**	**0.8%**	**48.4**

Currency conversion rates by Korea Exchange Bank (30 August 2011):
1,000,000 KRW = 570.04 GBP

Source: adapted from Datamonitor (2010) and
The Bank of Korea Economic Statistics System (2010)
Table 4.1: Statistics of economic market value of food retailing in South Korea

4.2.2. Market Share by Type of Food Retailer

Datamonitor (2009) identifies the diversity of types of selling outlet in the food retailing business: "The food retail industry consists of the total revenues generated through food sales from supermarkets, hypermarkets, cooperatives, discounters, convenience stores, independent grocers, bakers, butchers, fishmongers and all other retailers of food and drink for off-the-premises consumption".

Type	2008	2007	2006	2005	2004
	% Market share by value				
Hypermarkets	16.6	16.6	16.6	16.5	16.4
Supermarkets	8.9	7.9	7.9	7.9	7.0
Discounters	5.2	4.0	4.0	3.9	3.6
Food Specialists	2.8	2.8	2.8	2.9	2.9
Others	66.5	68.7	68.7	68.7	70.0
Total	**100**	**100**	**100**	**100**	**100**

Source: Datamonitor (2005-2009)
Table 4.2: Market share by types of food retail mart

Table 4.2 shows that, among those in South Korea, hypermarkets collectively generate the largest amount of revenue, and have almost twice the market share of supermarkets. Those are followed by discounters and food specialists, in that order. The market-share ranking by type of outlet has not changed between 2004 and 2008.

4.2.3. Leading Food Retailers in South Korea

Rank	Retailer	Number of domestic branches	Number of overseas branches
1	E-mart	124	23
2	Home Plus	115	none
3	Lotte Mart	70	12
4	Hanaro Mart	27	none
5	Kim's Club Mart	17	none
6	GS Mart	13	none

Source: adapted from Korea Chainstores Association (2010)
Table 4.3: Number of branches of food retailers in South Korea

Table 4.3 ranks the leading players in food retailing in South Korea in terms of the number of branches each has. E-mart heads the table, with 147 branches of which 23 are overseas, and is fairly closely followed by the exclusively national Home Plus chain. Lotte Mart

occupies the middle of the table, with 70 home branches and 12 overseas. Hanaro Mart, Kim's Club Mart and GS Mart collectively operate 57 stores.

4.3. IN-DEPTH INTERVIEWS WITH LEADING FOOD RETAILERS

Face-to-face interviews were conducted with fresh-food retail managers at three of the leading retailers in Table 4.3, with the objective of collecting practical information relevant to the design of the subsequent consumer survey and simulation modelling. The two major issues to be addressed were operations management and operational efficiency, both in the specific context of perishable foods. Questioning followed a structured interview agenda, but was sufficiently open-ended to permit the interviewer to adapt questions as necessary, clarify respondents' doubts about any question, and ensure that all were fully understandable.

The fresh-food managers of the six retailers were identified at the companies' web sites, and telephoned to solicit their participation in this research. Though the aim was to collect the required information from one branch of each chain, it was ultimately E-mart, Home Plus and Hanaro Mart who were willing to collaborate, and with whose fresh-food or branch managers the interviews were conducted. The purposes of the study and the interview were explained before the process began. The next three sub-sections of this chapter summarize respondents' answers to the questions and topics covered by the interview agenda.

4.3.1. In-depth Interview 1

This interview was conducted on 28 June, 2008. Table 4.4 presents the key responses.

Question		**Answer**
1	Name	Byung-Ho Yoo

2	Job title	Fresh-food manager (Associate manager)
3	Store chain	E-mart
4	Branch	Suwon
5	Type	Supermarket
6	Total sales at branch in 2007	1.3 billion KRW
7	Current total number of employees	15
8	Percentage of perishable foods rejected or discarded on receipt from suppliers due to spoilage	Varies between products. On average, 2% of perishable foods rejected.
9	Perishable food products closely associated with wastage due to unsold by their expiry date	Bean sprouts, broccoli, beef, celery, cheese, chicken, chilli peppers, green pepper, milk, pork, yogurt.
10	Percentage of perishable foods disposed of because unsold by their expiry date	On average, 0 to 3%; can occasionally be up to 5%.
11	Profit margin	Initial profit-margin is between 20 and 40% for perishable foods (initial profit margin here corresponding to initial selling price minus purchasing cost divided by initial selling price times 100).
12	Discounting policy for perishable foods approaching their expiry dates	Pricing manager in the store has the authority to make decisions on the frequency and depth of discount, considering the present business circumstance. However, the pricing manager is not recommended to discount more than one time by the headquarters. Therefore, the prices of perishable foods are typically discounted by between 20 and 30%, (but up to 50%) during the last few days (one to four days remaining depending on the length of shelf-life) of the product's shelf-life. In addition, 1+1 offers (buy-one-get-one-free) are provided as an alternative to discounting (for purposes of new-product promotion), and suppliers occasionally require no discounts on some of their products, to avoid negative impacts of price discounting (see Chapter 2, section 2.6).
13	Display-shelf management	When the package of perishable food product is small, about 50 items are displayed for sale, and re-stocking from the warehouse is done when fewer than 15 products remain on display. For a product in medium-size package, about 30 items are displayed, and when fewer than 10 items are

		left on the shelf, the product is replenished. If the package for a product is large, the initial display includes about 10 items and is replenished when fewer than 3 or 4 remain. Products in the warehouse with the shortest remaining shelf-life are the first to be used for re-stocking shelves.
14	Replenishment management	The store sets target stock amount by considering the products' average daily sales volume. Perishable foods are replenished daily from distribution centre or suppliers up to the target stock amount.

Table 4.4: Interview at E-Mart

4.3.2. In-depth Interview 2

This interview was conducted on 3 July, 2008. Table 4.5 presents the key responses.

Question		**Answer**
1	Name	Anonymous
2	Job title	Branch manager
3	Store chain	Home Plus
4	Branch	Nam-Sung station
5	Type	Supermarket
6	Total sales at branch in 2007	Confidential
7	Current total number of employees	15
8	Percentage of perishable foods rejected or discarded on receipt from suppliers due to spoilage	On average, 1.5%.
9	Perishable food products closely associated with wastage due to unsold by their expiry date	Bean curd, beef, celery, cucumber, milk, pork, sausages, spring onions, yogurt, and 'young radish' salads.
10	Percentage of perishable foods disposed of because unsold by their expiry date	On average, 5% of perishable foods are disposed due to unsold by their expiry date. However, it can occasionally be up to 10% for some products if a serious problem affects food production (e.g. bird flu, foot-and-mouth disease).
11	Profit margin	Confidential.
12	Discounting policy for perishable foods approaching their expiry dates	The prices of perishable foods with relatively short shelf-life (e.g.2, 3 or 4-day shelf-life) are normally discounted on their expiry dates by between 20 to 50%. Those with relatively longer days of shelf-life are

		normally discounted by between 20 to 50% when two or three days of shelf-life remain. Suppliers occasionally require no discounts on some of their products.
13	Display-shelf management	For a perishable food product in small package, 40 to 50 items are initially displayed, and the product is replenished when 10 to 15 items remain. For a product in medium-sized package, 20 to 30 items are normally displayed on the shelf, and the display is restored when there are around 10 items left. For a perishable food in large package, only 10 items are initially displayed on the shelf, and the shelf-stock is replenished when 3 or 4 items remain.
14	Replenishment management	The store sets target stock amount by considering the products' average daily sales volume. Most products are replenished every day from distribution centre or suppliers up to the target stock amount; Quantity sold on a given day is replaced next day

Table 4.5: Interview at Home Plus

4.3.3. In-depth Interview 3

This interview was conducted on 5 July, 2008. Table 4.6 presents the key responses.

Question		**Answer**
1	Name	Jung-Ho Lee
2	Job title	Fresh food assistant manager
3	Store chain	Hanaro Mart
4	Branch	Chil-Gok Nong-Hyup
5	Type	Discounter
6	Total sales at branch in 2007	3.7 billion KRW
7	Current total number of employees	12
8	Percentage of perishable foods rejected or discarded on receipt from suppliers due to spoilage	On average, 1 to 3 %.
9	Perishable food products closely associated with wastage due to unsold by their expiry date	Bean sprouts, cabbage, carrot, cheese, chicken, chilli peppers, lettuce, milk, mushrooms, ready-to-eat salads.

10	Percentage of perishable foods disposed of because unsold by their expiry date	On average, 1 to 2%.
11	Profit margin	Varies according to product type. On average, initial profit-margin is between 20 and 40% for perishable foods (initial profit margin here corresponding to initial selling price minus purchasing cost divided by initial selling price times 100).
12	Discounting policy for perishable foods approaching their expiry dates	Initial price of all food products set to be lower than other leading food retailers in South Korea, therefore discount rate is also relatively lower. Perishable foods are normally discounted by 20% when 20 to 30% of remaining days of shelf-life remains, staying at that level until the expiry date.
13	Display-shelf management	Depending on package size, between 20 and 40 items are normally displayed on shelves, and the display is replenished when about 10 items remain Products with the shortest remaining shelf-life are normally displayed at the front of the shelf for efficiency.
14	Replenishment management	Every perishable food product is replenished every day from distribution centre or suppliers.

Table 4.6: Interview at Hanaro Mart

4.4. SUMMARY AND DISCUSSION

This chapter has reviewed the background of the food retailing industry in South Korea. It has also garnered practical information about the management of perishable foods by interviewing managers in retail food stores in South Korea. The key findings of the interviews can be summarized as follows:

- Stores generally reject 1 to 3% (2% by E-Mart, 1.5% by Home Plus, 1 to 3% by Hanaro Mart) of perishable foods on receipt from suppliers due to spoilage in

transit. A further 0 to 5 % (0 to 3% by E-Mart, 5% by Home Plus, 1 to 2% by Hanaro Mart) of perishable foods is disposed due to unsold. The interviewed managers were asked what product types they considered to be most strongly associated with the problems of wastage due to unsold stock, and hence to the inefficiency of the present discounting strategy. The following products in each category were suggested by at least two of the three managers and were therefore can be selected as sample product types for consumer surveys: cheese, milk and yogurt in the dairy category; beef, chicken and pork in the meat category; and bean sprouts, celery and chilli peppers in the vegetable category.

- Discounting policies with respect to perishable foods were similar across the three stores. In general, the prices of perishable foods are discounted during the last few days of the product's shelf-life; a procedure referred to as ***Two-period Pricing***, which is the most widely used pricing strategy at present. In general, E-Mart discounts the prices of perishable foods by between 20 to 50% during the last few days of the product's shelf-life. Home Plus discounts the prices of perishable foods by between 20 to 50% when the last or last two days of shelf-life remains. Hanaro Mart discounts the prices of perishable foods by 20% when 20 to 30% of remaining days of shelf-life remains. Two-period Pricing is applied to the majority of perishable foods including products within each selected sample product type. In some cases, however, retailers do not discount at all when suppliers ask them not to discount their products, a procedure referred to as ***Single-period Pricing***. As Two-period Pricing is the most prevailing pricing strategy for perishable foods, it was used as an example to represent the present less dynamic pricing for the consumer surveys. In addition, most perishable foods are replenished on a daily basis from a

distribution centre or by the suppliers, up to the target stock amount; the quantity sold on a given day is replaced the next day. The stores set the target stock amount by considering the products' average daily sales volume. The combination of the present discounting policies and daily replenishment often makes it difficult for retailers to avoid a situation in which the display stock of a particular item has the same price but different expiry dates. For instance, a specific item not sold on a certain day will be displayed alongside others replenished the next day with no price differential if neither expiry date is imminent. Then the "older" foods have a greater chance to be disposed due to the foods unsold at expiration. Therefore more dynamic pricing is needed for more effective management of the selling operation. This can stimulate consumers to purchase a product with fewer days of shelf-life remaining.

- The number of product items displayed on the shelf varies according to package size. In the case studies, E-mart displays 50, 30 and 10 items of a perishable food type on the shelf and re-stocks from the warehouse when fewer than 15, 10 and 3 or 4 items left for small and medium and large-size products, respectively. Home Plus displays 40-50, 20-30 and 10 items of a perishable food type on the shelf and re-stocks when 10-15, 10 and 3 items left for small and medium and large-size products, respectively. Hanaro Mart displays between 20-40 items of a perishable food type and replenishs when around 10 remain on display. Initial profit margin varies depending on product types. The respondents at E-Mart and Hanaro Mart explained that they aimed to set an initial profit margin of between 20 and 40% for perishable food products, but a fresh food manager in Home Plus refused to give a figure. These information alongside with the present discounting and stock

replenishment policies can be used as basis in developing the simulation model for this thesis.

- As an additional information, the interviewed managers suggest that majority of consumers visiting the stores are female; in general, female consumers account for 70-80% of overall consumers. This builds the ground that the consumer survey should obtain responses mainly from female consumers.

CHAPTER FIVE

HYPOTHESES TESTING

5.1. INTRODUCTION

The price for perishable products should be dynamically managed to balance the variations of product's value due to the deterioration in value over time (Elmaghraby and Keskinocak, 2003). The literature reports substantial benefits from the implementation of dynamic pricing strategies, published studies have examined those benefits from the retailers' point of view in mathematical terms. Consumer reactions to dynamic pricing strategies have rarely been studied as an aspect of marketing strategy and management. Therefore, this chapter will compare the reactions from a sample of food consumers to a more dynamic pricing strategy for perishable foods with their perceptions of a less dynamic Two-period Pricing Strategy, which evaluate the value of more dynamic pricing strategies from the consumers' point of view. As discussed in Chapter 4, more dynamic pricing for perishable foods is needed to reduce the concern for a situation where a particular perishable food item has different remaining shelf-life, but with the same price, therefore to stimulate consumers to choose to purchase a product with relatively less remaining shelf-life on display.

Accordingly, the main objective of this chapter is not to quantify the operational efficiencies to be achieved by dynamic pricing of perishable foods but rather to investigate the impact of those strategies on consumers' cognitive and affective responses. This is achieved by evaluating: (1) how customer satisfaction with the present less dynamic pricing is related to the level of satisfaction with freshness; (2) how customer satisfaction with more

dynamic pricing compared with that in relation to the present less dynamic pricing; and (3) how the impact of more dynamic pricing on customers' satisfaction level, the level of interest in such strategies and consumers' willingness to make trade-offs between price and remaining shelf-life varies across different products. This study will also examine the interactions among those variables.

This chapter contains four further sections. Section 5.2 defines more dynamic pricing strategies in this study and explains the theoretical rationale for the five research Hypotheses introduced in Chapter 3. Section 5.3 presents the results of *Formal Survey 1*, applying the data gathered by using questionnaire version 1, and section 5.4 presents the results of *Formal Survey 2*, applying the data gathered by using questionnaire version 2. Finally, section 5.5 summarizes the findings of both formal surveys and provides discussions.

5.2. DEFINITIONS OF PRICING STRATEGIES AND HYPOTHESES DEVELOPMENT

5.2.1. Defining Pricing Strategies

In this study, Multi-period Pricing is used as an example of more dynamic pricing strategies with which the present less dynamic Two-period Pricing is compared in the consumer surveys. With the two types of commonly used dynamic pricing approaches, announced fixed-discount strategy and contingent pricing strategy as introduced by Aviv and Pazgal (2008), an announced fixed-discount strategy is adopted as a case-in-point of dynamic pricing in this research based on the following grounds. If this study is to form a more accurate depiction of consumers' perceptions of dynamic pricing strategies for perishable foods, respondents have to be provided with a specific, readily understandable explanation of

what it is (Sekaran, 2003). With transparent and simpler price changes, consumer responses can be more precisely measured using a questionnaire-based survey. In addition, it permits the creation of a simplified and efficient simulation of the interactions between prices and purchasing decisions, capable of demonstrating the impact of dynamic pricing on retailer performance that will be investigated in Chapter 6.

Studies of dynamic models for the pricing of perishable products have suggested the sub-division of selling periods into a number of stages and reduction of the price as each one passes (Aviv and Pazgal, 2008; Dasu and Tong, 2010; Gallego and van Ryzin, 1994; Zhao and Zheng, 2000). Let a product's shelf-life (takes the day on receipt of the product as day one of its shelf-life) be the entire selling period m (days), and each day of that period as a separate selling stage. Therefore, the selling period of a perishable food can be divided into m stages or days. Let n_T be the remaining shelf-life on day T and d_T be the discount made to the price on day T, for $T = 1,2,3,...m$. Given that the price must be decreased as the end of the shelf-life draws nearer (Dasu and Tong, 2010), under the m-stage discount scheme (d_1, d_2, ... d_m), the discount can be $d_1 < d_2 \ldots < d_{m-1} < d_m$. d_1 represents when the product is at full value, and d_1 is therefore zero. If $d_2 = x$, then let $d_3 = 2x$, $d_4 = 3x$ .... $d_m = (m\text{-}1)x$ from the original price, or generally:

$$d_T = (m - n_T)x \tag{5-1}$$

Now, to compute x, the aggregation of a given daily discount over the total selling period is needed. Let d_s be the aggregate daily discount over the product's entire selling period. Therefore, $d_s = 0 + x + 2x \ldots + (m\text{-}1)x = x\sum_{T=1}^{m}(T - 1)$, then:

$$x = \frac{d_s}{\sum_{T=1}^{m}(T-1)} \tag{5-2}$$

Since T-1 = m–n_T, the announced fixed-discount version of more dynamic pricing, chosen for this thesis, is given by Equations (5-1) and (5-2), as follows:

$$d_T = \frac{d_s(m-n_T)}{\sum_{T=1}^{m}(m-n_T)} \tag{5-3}$$

Using equation (5-3), the discount on day T for each product, d_T, can be calculated. Each discount on day T is applied from the original price.

The fixed-discount calculation can be based either on a pre-defined remaining shelf-life or, more accurately measured remaining shelf-life enabled by advanced traceability systems, as proposed in the dynamic pricing models for perishable foods by Li et al. (2006) and Liu et al. (2008). The latter strategy adjusts the price according to an accurately measured remaining shelf-life, which is assumed to be stated explicitly at the point of purchase, whereas the former does so on the basis of an expiry date pre-set during the manufacturing process. For the sake of readability, the strategy that discounts the price on the basis of accurately measured remaining shelf-life will be referred to as '***Multi-period Pricing Strategy 1***', and that which discounts it by reference to a pre-defined expiry date will be referred to as '***Multi-period Pricing Strategy 2***'.

The interviews with retailers in South Korea identified that discounting policies with respect to perishable foods are similar across the three stores; the prices of perishables are

discounted during the last few days of the product's shelf-life. Respondents were shown examples of both strategies in tabular form, and therefore had a reasonable understanding of how retailers currently manage the price of a perishable food product (by Two-period Pricing) and how that practice might be changed (to Multi-period Pricing). The objective of this study is not to evaluate how consumer perceptions of pricing strategies vary depending on discount variations (higher or lower), but rather to investigate their perceptions of the different pricing approaches or methods of discounting perishable foods. Accordingly, d_s in Multi-period Pricing was set as equal to that with a Two-period Pricing Strategy.

For example, for a product type that has seven days of shelf-life, one possible pricing scenario with Two-period Pricing is to keep the initial price for the first 5 days and discounts the price by 20% and keeps the discount until the expiry date. Multi-period Pricing, by contrast, is shown to set the discounting structure by applying equation (5-3), with the aggregate daily discount over the product's shelf-life of 40%. The very different outcome is a sequence of increasing discounts, starting at the second day of the product's shelf-life. Table 5.1 is an example relating to one of the products they were to consider.

	Two-period Pricing	**Multi-period Pricing**
Days remaining	**Discount (%)**	**Discount (%)**
7	0	0
6	0	1.90
5	0	3.81
4	0	5.71
3	0	7.62
2	20	9.52
1 (expiry date)	20	11.43

Table 5.1: An example of Two-period Pricing and Multi-period Pricing provided to respondents

5.2.2. Hypotheses Development

Extant studies have revealed the direct impact of price on consumers' levels of satisfaction: when the price of products seems to have adequately taken into account the quality and value offered, consumers are more satisfied with the price they will have to pay (Hermann et al., 2007; Salvador et al., 2007). However, the present pricing strategies (i.e. Two-period Pricing Strategy) for perishable foods may not provide sufficient compensation for the tangible loss of value due to natural deterioration, as each day passes (Li et al., 2006). That will result in increased financial loss to the consumer, if the value does not adequately match the price (Dunn et al., 1986; Roselius, 1971). Perceived financial risk, as represented by the customer's assessment that the price has not been set at a level that reflects the actual condition of the product at the time of purchase (Dunn et al., 1986; Roselius, 1971), may be higher when the pricing of a perishable product is less dynamically managed.

Accordingly, it is postulated that Multi-period Pricing will augment the level of customer satisfaction with the discounting strategy implemented in a Two-period Pricing Strategy, in so far as it allows enriched trade-off options between price and remaining shelf-life, and more dynamically matches the price against the value of product.

It was expected that the level of their satisfaction with the latter strategy would be greater than that with the former. Thus:

Hypothesis 1: The level of customer satisfaction with a Multi-period Pricing Strategy for perishable foods is greater than the level of customer satisfaction with a Two-period Pricing

Strategy.

During the in-depth interviews with retailers in South Korea described in Chapter 4, it was noted that the current tactics for promoting the sale of perishable products approaching their expiry dates conformed to general practice across the food-retailing sector. However, each store offers slightly different discounts, reflecting individual circumstances. The rationale for measuring the level of customer satisfaction with Two-period and Multi-period Pricing in this study is to evaluate consumer satisfaction with the *methods* of discounting perishables due to value deterioration, rather than with the *level* of the resulting discounts.

It is logical to suppose that there is a greater chance of consumers being aware of unfair pricing if they check the prices of perishable products more frequently, giving themselves more opportunity to notice prices that are unreasonable. Tsiros and Heilman (2005) report that the average proportion of consumers who 'always' or 'usually' check expiry dates before purchasing is highest in the case of dairy products (milk 93%; yogurt 70%), next highest for meat products (chicken breast 74%; beef 59%), and below half for vegetable products (prepared lettuce 42%; prepared carrots: 29%). Thus, the perceived financial risk, represented by the customer's assessment that the price has not been set reasonably with the present pricing strategy for perishable foods (Dunn et al., 1986; Roselius, 1971), can be expected to be higher for a product category or type, that consumers check the expiry date more frequently.

The lower a customer's level of satisfaction with the freshness of a product category or type, the more likely it is that the expiry date will be checked before the purchase is made, leading to an increased probability of awareness that the present pricing strategy does not

actively manage the price in a way that is consistent with the period of shelf-life remaining. Given that freshness is a major component of the overall perception of the quality and value of a product, a shopper who is dissatisfied with that characteristic is also likely to be uneasy with the pricing strategy. Thus, it is to be expected that the level of customer satisfaction with Two-period Pricing will be low if satisfaction with freshness is low. Therefore:

Hypothesis 2: The level of customer satisfaction with a Two-period Pricing Strategy for perishable foods is lower in the case of a product category (or product type within a product category) in which the level of customer satisfaction with freshness is lower.

Consumers' expressions of dissatisfaction could be directly linked to their wish that retailers' would implement pricing strategies that were more customer-friendly. Therefore, the impact of Multi-period Pricing on customer satisfaction is expected to be more significant for a product category (or type) with a relatively lower level of satisfaction with Two-period Pricing, due to the higher demands for enriched trade-off options between price and remaining shelf-life. Therefore:

Hypothesis 3: The level of customer satisfaction with a Multi-period Pricing Strategy for perishable foods is higher in the case of a product category (or product type within a product category) in which the level of customer satisfaction with a Two-period strategy is lower.

Arnold and Reynolds (2003) have found that consumers' interest in a retailer and its operations is also an important influence on profitability. It is therefore important that expressions of greater satisfaction with a Multi-period Pricing Strategy are not taken as just that alone, in that they have a positive impact on consumers' interest in the approach.

Given that the level of consumer interest in a particular retailer is positively related to general satisfaction with the retailer (Jones and Reynolds, 2006), it can be postulated that there will be a positive association between the level of interest in aspects of a retailer's marketing strategies and satisfaction level with those strategies in narrower terms. In the context of this thesis, it is to be expected that the level of consumer interest in Multi-period Pricing will be higher for a product category or type with a higher level of satisfaction with Multi-period Pricing. As suggested in the discussion of Hypothesis 3, the level of satisfaction with Multi-period Pricing is expected to be relatively higher for a product with a relatively lower level of satisfaction with a Two-period Pricing Strategy. It is thus also expected that the level of interest will be higher for a product category (or type) with a lower satisfaction level with Two-period Pricing. Therefore:

Hypothesis 4: The level of interest in a Multi-period Pricing Strategy for perishable foods is higher in the case of a product category (or product type within a product category) in which (1) the level of customer satisfaction with a Multi-period Pricing Strategy is higher, and (2) the level of customer satisfaction with a Two-period strategy is lower.

Although a Multi-period Pricing Strategy may have a significantly positive impact on customer satisfaction with discounting tactics, it will not be effective if customers are not willing to make economic trade-offs between price and remaining shelf-life, and instead wait for the final reductions at the end of the shelf-life period. Therefore, Multi-period Pricing will not be a sensible strategic choice unless it gives consumers better control over purchasing by allowing them to make the necessary economic trade-offs between price and remaining shelf-life, based on their consumption needs.

It has also been noted that, as the perceived risk increases, consumers may also choose to make economic trade-offs by paying less in exchange for taking the risk (Huang, 1993; Tsiros and Heilman, 2005). Perceived risk is "the subjective expectation of a loss" (Sweeney et al., 1999, p.81), and consists of components distinguished as financial, performance-related, physical, psychological, social and related to lost time (Peter and Tarpey, 1975). Financial risk is a major factor in consumers' purchasing behaviour (Dunn et al., 1986). It is intuitively reasonable to assume that a product with a higher financial risk, occasioned by the perceived failure of the present price structure to match the price with the remaining shelf-life, will achieve a lower satisfaction rating. It is therefore postulated that, with Multi-period Pricing, consumers will exhibit greater willingness to make trade-offs between price and remaining shelf-life in the case of a product category or type with a relatively lower satisfaction level with respect to Two-period Pricing. It has already been hypothesised that the level of satisfaction with Multi-period Pricing is higher for a product category or type with respect to which the level of satisfaction with Two-period Pricing is lower and the level of interest in Multi-period Pricing is higher. Therefore, it is expected that consumers will express a higher willingness to make economic trade-offs between price and remaining shelf-life in the case of a product category or type with higher levels of satisfaction with and interest in Multi-period Pricing, and a lower level of satisfaction with Two-period Pricing. Thus:

Hypothesis 5: With a Multi-period Pricing Strategy, the level of consumer willingness to make economic trade-offs between price and remaining shelf-life is higher for a product category (or product type within a product category) in which (1) the level of customer satisfaction with and (2) the level of interest in a Multi-period Pricing Strategy are both

higher, and (3) the level of customer satisfaction with a Two-period strategy is lower.

5.3. RESEARCH STUDY 1

This section describes the Hypothesis-testing stage of the research in the context of a scenario in which a Multi-period Pricing Strategy based on more accurately measured shelf-life variation – that is Multi-period Pricing Strategy 1 – is taken as an example of more dynamic pricing strategies. The Hypotheses are tested with respect to both (1) product *categories* (using collective data gathered for product types within a product category to represent data for the product category) and (2) product *types* within each product category. The former method is used to evaluate which kind of products retailers may expect to have a higher positive impact as a result of more dynamic pricing from a broader perspective. The latter method assists in assessing the extent to which results are different when only product types within the same product category are involved. It evaluates whether difference in the impact of more dynamic pricing exists among the product types with similar characteristics (the same product category).

5.3.1. Selection of Sample Product Categories and Types

The in-depth interviews with managers of retail stores in South Korea, reported in Chapter 4, identified a number of product types closely associated with the waste resulting from unsold stock. Those types can be allocated to three product categories, collectively representing the wide range of perishable foods concerned: dairy products, meat products and vegetable products. Among the constituent types in each category, three that were mentioned as particular examples by at least two interviewed managers were selected as sample product types for the formal surveys to generate the data for Hypothesis testing. They are listed in

Table 5.2:

Product category	Product type
Dairy	Cheese
	Milk
	Yogurt
Meat	Beef
	Chicken
	Pork
Vegetable	Bean sprouts
	Celery
	Chilli peppers

Table 5.2: Sample product types in formal survey

5.3.2. Formal Survey 1

This survey was conducted from May to July 2009. The Two-period Pricing Strategy and Multi-period Pricing Strategy 1 were explained in detail to respondents before the embarked upon answering the questions.

A random sample of 990 consumers was recruited, with the aim of obtaining 110 valid responses for each product type in Table 5.1. Each respondent was randomly selected on the street and was asked to participate in this research by filling in the questionnaire. Each respondent filled in a questionnaire for only one product type. Since the completion of one questionnaire took 10 to 15 minutes on average, there were practical constraints that prevented asking respondents to fill in more than one questionnaire. After unusable responses had been rejected, 965 complete data sets were obtained.

5.3.3. Demographic Characteristics of Respondents

This section presents the demographic characteristics of the respondents in Formal Survey 1, by product type. They are summarised in Table 5.3. Given that the majority of shoppers at food retail stores in South Korea are female, as identified by the interviews with, the profile would be dominantly female.

In the event the female-to-male ratio was approximately 85% to 15%. The average age of selected respondents was 36, and the median monthly income was between 4,000,000 and 5,000,000 KRW.

	Product Type										
	Bean sprouts	Beef	Celery	Cheese	Chicken	Chilli peppers	Milk	Pork	Yoghurt	Total	
	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency	Valid %
Sex											
Female	90	82	93	92	88	88	99	90	99	821	85.43
Male	17	26	15	13	17	19	7	19	7	140	14.57
Total	107	108 (missing data = 1)	108	105 (missing data = 1)	105	107	106 (missing data = 1)	109	106 (missing data = 1)	961 (missing data = 4)	100
Age (Mean = 35.77)											
0-29	14	37	62	54	38	65	32	41	39	382	40.21
30-39	18	40	15	28	27	17	28	37	21	231	24.32
40-49	28	15	17	10	14	10	33	17	20	164	17.26
50-59	27	6	12	10	19	14	8	9	17	122	12.84
Over 60	20	9	2	2	5	1	3	1	8	51	5.37
Total	107	107 (missing data = 2)	108	104 (missing data = 2)	103 (missing data = 2)	107	104 (missing data = 3)	105 (missing data = 4)	105 (missing data = 2)	950 (missing data = 15)	100
Monthly Income (10,000KRW) (Median = 400-500)											
Under 50	1	5	0	2	1	2	1	0	1	13	1.41
50-100	4	6	1	0	3	1	3	1	2	21	2.27
100-200	8	17	2	5	3	4	6	4	5	54	5.84
200-300	28	29	22	12	24	14	18	23	12	182	19.68
300-400	25	22	18	19	22	23	17	15	25	186	20.11
400-500	17	16	8	16	14	14	16	18	16	135	14.59
500-600	8	2	13	18	11	19	20	20	13	124	13.41
600-700	4	0	12	12	8	10	9	6	11	72	7.78
700-800	1	3	11	6	3	2	3	3	6	38	4.11
800-900	1	3	4	1	1	3	1	2	3	19	2.05
900-1000	3	1	5	4	1	2	3	1	0	20	2.16
over 1000	3	0	8	8	10	7	7	10	8	61	6.59
Total	103 (missing data = 4)	104 (missing data = 5)	104 (missing data = 4)	103 (missing data = 3)	101 (missing data = 4)	101 (missing data = 6)	104 (missing data = 3)	103 (missing data = 6)	102 (missing data = 5)	925 (missing data = 40)	100

Table 5.3: Demographic characteristics of sample for Formal Survey 1

5.3.4. Reliability Analysis and Validity Test

Since each subject category in the questionnaire consisted of a set of two or three questions, a reliability analysis was carried out to check the consistency of responses. Table 5.4 shows that the Cronbach's alpha coefficients were all greater than 0.7, which is considered to indicate an acceptable level of reliability and consistency (Field, 2005).

Question	Cronbach's Alpha	Number of questions
Level of satisfaction with freshness	0.91	3
Level of satisfaction with Two-period Pricing	0.91	3
Level of satisfaction with Multi-period Pricing	0.84	3
Level of interest in Multi-period Pricing	0.80	2
Willingness to make trade-offs between price and remaining shelf-life	0.79	3

Table 5.4: Results of reliability analysis

Convergent validity was tested by factor analysis with varimax rotation. The results shown in Table 3 confirm that the scores for different questions in each subject category measuring the same concept were highly correlated, based on the suggestion by Fornell and Lacker (1981) that convergent validity exists when item factor loadings are greater than 0.7.

Question	Factor					Commonality
	1	2	3	4	5	
Level of satisfaction with Two-period Pricing (3)	***0.84***	0.35	-0.09	-0.06	-0.07	0.84
Level of satisfaction with Two-period Pricing (2)	***0.84***	0.37	-0.07	-0.09	-0.10	0.87
Level of satisfaction with Two-period Pricing (1)	***0.81***	0.38	-0.11	-0.10	-0.06	0.83
Level of satisfaction with freshness (1)	0.34	***0.85***	-0.09	-0.09	-0.06	0.86
Level of satisfaction with freshness (3)	0.44	***0.79***	-0.05	-0.10	-0.06	0.83
Level of satisfaction with freshness (2)	0.45	***0.79***	-0.10	-0.06	-0.05	0.84
Level of satisfaction with Multi-period Pricing (2)	-0.05	-0.10	***0.84***	0.21	0.19	0.80
Level of satisfaction with Multi-period Pricing (1)	-0.15	0.02	***0.84***	0.14	0.13	0.77
Level of satisfaction with Multi-period Pricing (3)	-0.04	-0.13	***0.79***	0.28	0.20	0.76
Willingness to make trade-offs (1)	-0.09	-0.08	0.16	***0.83***	0.02	0.73
Willingness to make trade-offs (2)	-0.04	-0.04	0.19	***0.83***	0.23	0.78
Willingness to make trade-offs (3)	-0.10	-0.10	0.28	***0.74***	0.26	0.71
Level of interest in Multi-period Pricing (1)	-0.08	-0.06	0.21	0.16	***0.87***	0.84
Level of interest in Multi-period Pricing (2)	-0.09	-0.05	0.26	0.25	***0.82***	0.81
Sum of squared loadings (eigenvalue)	2.64	2.44	2.31	2.20	1.68	
Percentage variance	18.88	17.44	16.50	15.73	12.01	

Table 5.5: Results of factor analysis

5.3.5. Findings Analyzed by Product Categories

This section reports SPSS analysis of survey responses relating to the groups of product types combined in the dairy products, meat products and vegetable products categories (see Table 5.1). Answers to each question in the questionnaire were scored on a five-point scale anchored at 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The total score for the questions in each subject category in the questionnaire was calculated for analysis.

To test **Hypothesis 1**, that the level of customer satisfaction with a Multi-period Pricing Strategy is greater than that with a Two-period Pricing Strategy, a paired-samples t-test was conducted to compare the overall mean scores for satisfaction with Multi-period Pricing and Two-period Pricing strategies. Table 5.6 compares the mean scores for satisfaction with Multi-period Pricing and Two-period Pricing by using all nine sample product types. The results presented in Table 5.6 support the Hypothesis, the overall mean score for satisfaction with Multi-period Pricing is significantly higher than that for satisfaction with Two-period Pricing.

Overall average level of satisfaction with Two-period Pricing		**Overall average level of satisfaction with Multi-period Pricing**		
M	**SD**	**M**	**SD**	**t**
8.67	2.55	11.84	1.89	**27.65****

** significant at $p < 0.01$
M = mean, SD = standard deviation

Table 5.6: Comparisons of mean scores for the level of overall satisfaction with Multi-period Pricing and Two-period Pricing

The difference of 3.2 between the mean scores is considered significant when the method of calculating the total scores is taken into account. The maximum total score achievable for satisfaction with Multi-period Pricing and Two-period Pricing is 15 (3 items at a score of 5 for "strongly agree"). Furthermore, if a mean score of 9 is equated to the state of being neutral (3 items at a score of 3, for "neither agree nor disagree"), the result for the overall mean score for satisfaction with Two-period Pricing is below neutral, whereas the overall mean score for satisfaction with Multi-period Pricing is close to satisfactory status (3 items at a score of 4 for "agree" = 12).

	Product Category						
	Dairy (N = 320)		Meat (N = 323)		Vegetable (N = 322)		
Variable	**M**	**SD**	**M**	**SD**	**M**	**SD**	**F**
Level of satisfaction with freshness	8.64	3.20	8.62	2.09	9.77	1.89	**6.54****
Level of satisfaction with Two-period Pricing	8.02	3.12	8.57	2.06	9.41	2.15	**8.97****
Level of satisfaction with Multi-period Pricing	12.25	2.19	11.82	1.70	11.44	1.64	**6.59****
Level of interest in Multi-period Pricing	8.19	1.66	7.93	1.33	7.47	1.37	**5.97****
Willingness to make trade-offs between pricing and remaining shelf-life	11.87	2.48	11.77	1.87	11.10	1.98	**5.92****

** significant at $p < 0.01$
N = sample size, M = mean, SD = standard deviation

Table 5.7: Comparisons of mean scores of variables by product category

To test the remaining four Hypotheses, ANOVA was used as was the main vehicle for comparative analysis of mean scores among the variables. The major descriptive statistics

presented in Table 5.7 partially support **Hypothesis 2**, that the level of customer satisfaction with a Two-period Pricing Strategy is lower for a product category in which the level of customer satisfaction with freshness is lower. The results of one-way ANOVA indicate a statistically significant difference in the mean score for satisfaction with freshness among product categories; lowest for the meat product category (M = 8.62, SD = 2.09), followed by the dairy product category (M = 8.64, SD = 3.20), and highest for the vegetable product category (M = 9.77, SD = 1.89). The mean score for satisfaction with Two-period Pricing is lowest for the dairy product category (M = 8.02, SD = 3.12), followed by the meat (M= 8.57, SD = 2.06) and vegetable (M = 9.41, SD = 2.15) product categories.

In addition, post-hoc comparisons using the Tukey HSD test show that the mean score for satisfaction with a Two-period Pricing Strategy for the dairy product category is significantly different from that for both meat and vegetable product categories, at $p< 0.05$ and $p< 0.01$ respectively, and is also different with respect to meat product category compared to vegetable product category, at $p< 0.01$. The same test shows that mean score for satisfaction with freshness in the case of dairy products is significantly different from vegetable products and differs between the meat and vegetable categories, at $p< 0.01$. It does not vary significantly, however, between the dairy and meat product categories, with $p = 0.99$. Thus, the fact that the vegetable product category exhibits the highest levels of customer satisfaction with freshness and with Two-period Pricing partially supports Hypothesis 2.

Hypothesis 3, that the level of customer satisfaction with a Multi-period Pricing Strategy for perishable foods is higher for a product category in which the level of customer satisfaction with a Two-period Pricing Strategy is lower, is supported. The results of the one-

way ANOVA show that the differences in mean scores with respect to customer satisfaction with Multi-period Pricing among different product categories were found; the mean score for satisfaction with Multi-period Pricing is the highest for the dairy product category (M = 12.25, SD = 2.19), followed by the meat (M = 11.82, SD = 1.70) and vegetable (M = 11.44, SD = 1.64) product categories. Therefore, the level of customer satisfaction with Multi-period Pricing is greater for a product category whose satisfaction level with Two-period Pricing is lower.

Post-hoc Tukey HSD tests show that the mean score for satisfaction with a Multi-period Pricing Strategy for the dairy products is significantly different from that for both the meat and vegetable product categories, at $p< 0.05$ and $p< 0.01$ respectively, and also differs between the meat products and vegetable products, at $p< 0.05$, further supporting Hypothesis 3.

Hypothesis 4 posits that the level of interest in a Multi-period Pricing Strategy will be higher for a product category in which the level of customer satisfaction with a Multi-period Pricing Strategy is higher, and the level of customer satisfaction with a Two-period Pricing Strategy is lower. The one-way ANOVA offers statistical evidence that the mean score for the level of interest varies among different product categories. Respondents' level of interest was strongest for the dairy products category (M = 8.19, SD = 1.66), followed by the meat (M = 7.93, SD = 1.33) and vegetable (M = 7.47, SD = 1.37) product categories, in that order. It is thus clear that the level of interest in Multi-period Pricing is higher for a product category whose satisfaction level is lower with respect to Two-period Pricing and higher with respect to Multi-period Pricing.

The results of the Tukey HSD test indicate that the mean score for the level of interest in Multi-period Pricing, with respect to the vegetable product category, is significantly different from that for the dairy and meat product categories, at $p< 0.01$, but the difference in mean scores between the dairy and meat product categories in this respect is insignificant, with $p = 0.06$. Therefore, Hypothesis 4 can be partially supported.

Hypothesis 5 predicts that, with a Multi-period Pricing Strategy, consumers' willingness to make economic trade-offs between price and remaining shelf-life is higher for a product category in which the levels of customer satisfaction with and interest in Multi-period Pricing are both higher and the level of customer satisfaction with Two-period Pricing is lower. The one-way ANOVA results suggest that the average consumers' willingness to make trade-offs between price and remaining shelf-life is highest for the dairy product category ($M = 11.87$, $SD = 2.48$), followed by the meat ($M = 11.77$, $SD = 1.87$) and vegetable ($M = 11.10$, $SD = 1.98$) product categories in that order. Therefore, consumers' willingness to make trade-offs is higher for a product category whose levels of satisfaction with and interest in Multi-period Pricing are higher, and for a product category whose level of satisfaction with Two-period Pricing is lower.

The Tukey HSD test found significant differences in the mean scores for consumers' willingness between the dairy and vegetable product categories, and between the meat and vegetable product categories, at $p< 0.01$. However, the difference in the mean scores of consumers' willingness between the dairy and meat products was insignificant, with $p = 0.82$. Hypothesis 5 is thus be partially supported.

5.3.6. Findings Analyzed by Product Types within Product Categories

This section reports SPSS analysis of survey responses relating to each of the three product types in the three categories: cheese, milk and yoghurt in the dairy category; beef, chicken and pork products in the meat category; and bean sprouts, celery and chilli peppers in the vegetable category.

To test **Hypothesis 1**, that the level of customer satisfaction with a Multi-period Pricing Strategy is greater than that with a Two-period Pricing Strategy, paired-samples t-tests were used to compare the overall mean scores for satisfaction with Multi-period Pricing and Two-period Pricing. Table 5.6 compares the mean scores for satisfaction with Multi-period Pricing and Two-period Pricing by using all nine sample product, while Table 5.8 refers only to product types within each product category, meaning that the figure is for the data collected for the three product types within each product category.

Product category	Average level of satisfaction with Two-period Pricing		Average level of satisfaction with Multi-period Pricing		t
	M	SD	M	SD	
Dairy	8.02	3.12	12.25	2.19	**-16.36****
Meat	8.57	2.06	11.82	1.7	**-20.62****
Vegetable	9.41	2.15	11.44	1.64	**-15.49****

** significant at $p< 0.01$
M = mean, SD = standard deviation

Table 5.8: Comparisons of mean scores for the level of satisfaction with Multi-period Pricing and Two-period Pricing Strategies

The results presented in Table 5.8 support the Hypothesis. The mean score for satisfaction with Multi-period Pricing is significantly higher than that with Two-period Pricing in all three cases.

To test the remaining four Hypotheses, ANOVA was used as the main vehicle to compare the mean scores among the variables. The major descriptive statistics are presented in Table 5.9.

	Dairy Products (N = 320)						
	Cheese (N = 106)		Milk (N = 107)		Yoghurt (N = 107)		
Variable	**M**	**SD**	**M**	**SD**	**M**	**SD**	**F**
Level of satisfaction with freshness	8.40	3.21	8.75	3.22	8.78	3.19	0.46
Level of satisfaction with Two-period Pricing	7.61	3.04	8.15	3.13	8.30	3.18	1.43
Level of satisfaction with Multi-period Pricing	12.51	1.87	12.46	1.71	11.78	2.78	**3.81***
Level of interest in Multi-period Pricing	7.99	2.00	8.37	1.41	8.20	1.50	1.43
Willingness to make trade-offs between pricing and remaining shelf-life	11.92	2.48	12.04	2.39	11.66	2.57	0.64
	Meat Products (N = 323)						
	Beef (N = 109)		**Chicken (N = 105)**		**Pork (N = 109)**		
	M	**SD**	**M**	**SD**	**M**	**SD**	**F**
Level of satisfaction with freshness	8.99	2.34	8.88	1.76	8.32	2.05	2.91
Level of satisfaction with Two-period Pricing	9.08	2.26	8.06	1.93	8.54	1.85	**6.89****
Level of satisfaction with Multi-period Pricing	11.40	1.70	11.81	1.87	12.25	1.44	**6.95****
Level of interest in Multi-period Pricing	8.05	1.43	7.88	1.29	7.86	1.25	0.64
Willingness to make trade-offs between pricing and remaining shelf-life	12.18	1.72	11.45	1.97	11.68	1.86	**4.46***
	Vegetable Products (N = 322)						
	Bean sprouts (N = 107)		**Celery (N = 108)**		**Chilli peppers (N = 107)**		
	M	**SD**	**M**	**SD**	**M**	**SD**	**F**
Level of satisfaction with freshness	9.71	2.02	9.65	1.86	9.94	1.79	0.73
Level of satisfaction with Two-period Pricing	9.72	1.86	8.94	2.32	9.59	2.18	**4.19***
Level of satisfaction with Multi-period Pricing	11.38	1.82	11.43	1.60	11.52	1.51	0.20
Level of interest in Multi-period Pricing	7.59	1.38	7.52	1.34	7.29	1.37	1.41
Willingness to make trade-offs between pricing and remaining shelf-life	10.69	2.05	10.93	1.94	11.69	1.98	**7.78****

*significant at $p < 0.05$
**significant at $p < 0.01$
N = sample size, M = mean, SD = standard deviation

Table 5.9: Comparisons of mean scores of variables among product types in each product category

The major descriptive statistics presented in Table 5.9 do not support **Hypothesis 2**, that

the level of customer satisfaction with a Two-period Pricing Strategy is lower for a product type in which the level of customer satisfaction with freshness is lower, in the case of any of the three product categories.

Within the dairy products category, the mean score for satisfaction with freshness was lowest for cheese product type ($M = 8.40$, $SD = 3.21$), followed by milk ($M = 8.75$, $SD = 3.22$) and yoghurt ($M = 8.78$, $SD = 3.19$) product types in that order. The mean scores for satisfaction with the Two-period Pricing Strategy are in exactly the same order; Cheese product type ($M = 7.61$, $SD = 3.04$), Milk product type ($M = 8.15$, $SD = 3.13$) and yoghurt product type ($M = 8.30$, $SD = 3.18$). However, one-way ANOVA found no significant difference in the mean scores with respect to satisfaction with either Two-period Pricing or freshness among the three product types in the category. Hypothesis 2 is therefore not supported.

In the meat products category, Hypothesis 2 again not supported. The mean level of respondents' satisfaction with freshness was lowest for pork product type ($M = 8.32$, $SD = 2.05$), followed by chicken ($M = 8.88$, $SD = 1.76$) and beef ($M = 8.99$ $SD = 2.34$) product types in that order. The average scores for satisfaction with Two-period Pricing was lowest for chicken product type ($M = 8.06$, $SD = 1.93$), followed by pork ($M = 8.54$, $SD = 1.85$) and beef products ($M = 9.08$, $SD = 2.26$) product types. The results of ANOVA indicate that there is significant difference in the mean satisfaction with Two-period Pricing among the product types in this product category. The Tukey HSD test show that the mean score for satisfaction with Two-period Pricing of chicken product type is significantly different from that for beef product type, at $p< 0.01$, however, the mean scores for pork product is not significantly

different from both chicken and beef product types, with $p = 0.19$ and $p = 0.12$ respectively. However, the results of ANOVA show that there is no significant difference in the mean satisfaction with freshness among the product types in this product category.

The finding is generally the same for the product types in the vegetable category. As Table 5.9 shows, the mean score for satisfaction with freshness is the lowest for celery product type ($M = 9.65$, $SD = 1.86$), followed by bean sprouts ($M = 9.71$, $SD = 2.02$) and chilli peppers ($M = 9.94$, $SD = 1.79$) product types. The mean score for satisfaction with Two-period Pricing is lowest for celery product type ($M = 8.94$, $SD = 2.32$) followed by chilli peppers ($M = 9.59$, $SD = 2.18$) and bean sprouts ($M = 9.72$, $SD = 1.86$) product types. One-way ANOVA found a significant difference in scores relating to satisfaction with Two-period Pricing among product types in this category. The results of post-hoc comparisons using the Tukey HSD test indicate that the mean score for satisfaction with Two-period Pricing of celery product type is significantly different from that for bean sprouts product type, at $p< 0.05$; however, the mean scores for chilli pepper product is not significantly different from both bean sprouts and celery product types, with $p = 0.89$ and $p = 0.06$ respectively. Furthermore, no significant difference in the mean scores for satisfaction with respect to freshness. Hypothesis 2 is again not supported.

Hypothesis 3, that the level of customer satisfaction with a Multi-period Pricing Strategy is higher for a product type in which the level of customer satisfaction with a Two-period Pricing Strategy is lower, is not supported by analysis of results relating to the product types in the dairy, meat or vegetable categories.

Table 5.9 shows that the mean score for satisfaction with Multi-period Pricing is highest for cheese product type (M = 12.51, SD = 1.87), followed by milk *(M = 12.46, SD = 1.71)* and yoghurt *(M = 11.78, SD = 2.78)* product types in that order. One-way ANOVA shows a significant difference in these scores among product types in the dairy product category. There is no significant difference, however, in the mean scores relating to Two-period Pricing.

In the case of the meat products category, one-way ANOVA results show that there is a significant difference in the mean scores for satisfaction with Multi-period Pricing across the different product types; highest for pork product type (M = 12.25, SD = 1.44), followed by chicken (M = 11.81, SD = 1.87) and beef (M = 11.40, SD = 1.70) product types in that order. The results of post-hoc comparisons using the Tukey HSD test indicate that the mean score for satisfaction with Multi-period Pricing of beef product type is significantly different from that for pork product type, at $p< 0.01$. However, the differences in the mean scores are insignificant between chicken product and both beef and pork product types, with p = 0.18 and p = 0.14 respectively. Also, the mean score for satisfaction with Two-period Pricing of pork product type is not the highest among the three different product types within the category.

Where product types within vegetable product category are concerned, the mean score for satisfaction with Multi-period Pricing Strategy is highest for chilli pepper product type (M = 11.52, SD = 1.51), followed by celery (M = 11.43, SD = 1.60) and bean sprouts (M = 11.38, SD = 1.82) product types in that order. However, one-way ANOVA shows that there is no significant difference in these mean scores among the different product types in the category.

Overall, therefore, Hypothesis 3 is not supported.

Hypothesis 4 posits that the level of consumers' interest in a Multi-period Pricing Strategy is higher for a product type in the case of which the level of customer satisfaction with a Multi-period Pricing Strategy is higher, and with a Two-period Pricing Strategy is lower. The results of one-way ANOVA did not offer statistical support for this Hypothesis.

In the dairy product category, the average level of interest is highest for milk product type ($M = 8.37$, $SD = 1.41$), followed by yoghurt ($M = 8.20$, $SD = 1.50$) and cheese ($M = 7.99$, $SD = 2.00$) product types in that order, but one-way ANOVA found no significant difference in these mean scores among product types. In the meat product category, the average level of interest is highest for beef product type ($M = 8.05$, $SD = 1.43$), followed by chicken ($M = 7.88$, $SD = 1.29$) and pork ($M = 11.68$, $SD = 1.86$) product types, but one-way ANOVA found that the variation of these scores among product types is insignificant. In the case of the vegetable product category, the average level of interest is highest for bean sprout product ($M = 7.59$, $SD = 1.38$), followed by celery ($M = 7.52$, $SD = 1.34$) and chilli peppers ($M = 7.29$, $SD = 1.37$) product types, but one-way ANOVA again found no significant difference in the average level of interest among product types.

Overall, therefore Hypothesis 4 is therefore not supported.

Hypothesis 5 predicts that with a Multi-period Pricing Strategy, consumers' willingness to make economic trade-offs between price and remaining shelf-life is higher for a product type in which the levels of customer satisfaction with and interest in a Multi-period Pricing

Strategy are higher, and for a product type in which the level of customer satisfaction with a Two-period Pricing Strategy is lower.

Though Table 5.9 indicates that respondents' willingness to make trade-offs is highest for milk product type (M = 12.04, SD = 2.39), followed by cheese (M = 11.92, SD = 2.48) and yoghurt (M = 11.66, SD = 2.57) product types in that order, one-way ANOVA found no statistical difference in the scores among different product types.

In the meat product category, one-way ANOVA result shows that statistically, willingness to make trade-offs is highest for beef product type (M = 12.18, SD = 1.72), followed by pork (M = 11.68, SD = 1.86) and chicken (M = 11.45, SD = 1.97) product types. The post-hoc Tukey HSD test found no significant differences in the mean scores of willingness between chicken and pork, and between beef and pork product types, with p = 0.63 and p = 0.11 respectively, but the mean scores of willingness between chicken and beef product types is significantly different at $p< 0.05$. Furthermore, the mean of scores for satisfaction with Multi-period Pricing and Two-period Pricing of beef product type were not the highest and lowest respectively.

Within the vegetable product category, one-way ANOVA found that respondents' willingness to make trade-offs between price and remaining shelf-life is highest for chilli pepper product type (M = 11.69, SD = 1.98), followed by celery (M = 10.98, SD = 1.94) and bean sprouts (M = 10.69, SD = 2.05) product types in that order. The Tukey HSD test found that the difference in the mean scores for willingness is significant between bean sprout and chilli peppers product types, and between chilli peppers and celery product types, at $p< 0.01$

and $p< 0.05$ respectively; no significant difference in the mean scores for willingness was found between bean sprouts and celery product types, with $p = 0.65$. Again, the result of ANOVA test found no significant differences in the mean scores for satisfaction with Multi-period Pricing or the level of interest in Multi-period Pricing among product types within this product category. Also, the mean score for satisfaction with Two-period Pricing for chilli pepper product type is not the lowest among the product types within the vegetable product category.

Overall, therefore, Hypothesis 5 is not supported.

5.4 RESESARCH STUDY 2

This section describes the Hypothesis-testing stage of the research in the context of a scenario in which a Multi-period Pricing Strategy based on pre-defined shelf-life – that is Multi-period Pricing Strategy 2 – is taken as an example of more dynamic pricing strategies. The Hypotheses are tested with respect to both product categories and product types within each product category.

5.4.1. Formal Survey 2

This survey was conducted from March to April 2010. The Two-period Pricing Strategy and Multi-period Pricing Strategy were explained in detail to respondents before the embarked upon answering the questions. A random sample of 990 consumers was recruited, with the aim of obtaining 110 valid responses for each product type in Table 5.1. Each respondent was again randomly selected on the street and was asked to participate in this survey by filling in the questionnaire. After unusable responses had been rejected, 912 usable

responses were obtained.

5.4.2. Demographic Characteristics of Respondents

This section provides the demographic characteristics of the respondents in Formal Survey 2, by product type. They are summarised in Table 5.10. As the majority of shoppers at retail food stores in South Korea are female, the aim of the sampling procedure was again to obtain responses mainly from female food shoppers. In the event the female-to-male ratio was approximately 84% to 16%. The average age of respondents was 34, and the median monthly income was between 3,000,000 and 4,000,000 KRW.

	Product Type										
	Bean sprouts	Beef	Celery	Cheese	Chicken	Chilli pepper	Milk	Pork	Yogurt	Total	
Characteristics	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency	Valid %
Sex											
Female	88	75	88	91	87	80	92	79	89	769	84.3
Male	14	27	15	10	14	20	10	22	11	143	15.7
Total	102	102	103	101	101	100	102	101	100	912	100
Age (Mean = 33.99)											
0-29	25	52	56	37	45	45	33	38	43	374	41.2
30-39	21	28	34	33	23	35	27	36	35	272	30.0
40-49	27	16	10	16	13	11	30	17	6	146	16.1
50-59	25	5	2	11	16	9	11	9	11	99	10.9
Over 60	4	0	0	2	4	0	1	1	4	16	1.8
Total	102	101 (missing data = 1)	102 (missing data = 1)	99 (missing data = 2)	101	100	102	101	99 (missing data = 1)	907	100
Monthly Income (10,000KRW) (Median = 300-400)											
Under 50	3	2	0	0	4	1	0	4	1	15	1.7
50-100	3	4	2	8	3	1	0	6	2	29	3.2
100-200	9	18	16	11	12	17	12	14	16	125	13.9
200-300	21	23	28	25	26	29	31	22	34	239	26.6
300-400	20	20	12	18	26	16	28	20	17	177	19.7
400-500	18	14	16	13	8	14	12	8	11	114	12.7
500-600	6	10	10	5	10	5	6	9	7	68	7.6
600-700	7	4	8	5	3	5	2	3	3	40	4.5
700-800	3	1	5	4	0	4	1	4	3	25	2.8
800-900	3	1	2	3	0	1	3	0	1	14	1.6
900-1000	4	0	1	6	2	1	3	4	0	21	2.3
over 1000	2	4	2	3	5	3	2	5	4	30	3.3
Total	99 (missing data = 3)	101 (missing data = 1)	102 (missing data = 1)	101	99 (missing data = 2)	97 (missing data = 3)	100 (missing data = 2)	99 (missing data = 2)	99 (missing data = 1)	897	100

Table 5.10: Demographic characteristics of sample for Formal Survey 2

5.4.3. Reliability Analysis and Validity Test

As questions in each subject category in the questionnaire consisted of a set of two or three questions, a reliability analysis was necessary to check the consistency of responses. Table 5.11 presents the results of reliability analysis.

Question	Cronbach's Alpha	Number of questions
Level of satisfaction with freshness	0.91	3
Level of satisfaction with Multi-period Pricing	0.90	3
Level of satisfaction with Two-period Pricing	0.88	3
Level of interest in Multi-period Pricing	0.84	2
Willingness to make trade-offs between price and remaining shelf-life	0.87	3

Table 5.11: Results of reliability analysis

The Cronbach's alpha coefficients were all greater than 0.7, which is an acceptable level of reliability and consistency (Field, 2005).

As shown in Table 5.12, the results of convergent validity test using factor analysis with varimax rotation indicating that the scores for different questions in each subject category measuring the same concept were highly correlated; factor loadings are 0.7 as suggested by Fornell and Lacker (1981)

Questions	Factor					Commonality
	1	2	3	4	5	
Level of satisfaction with Freshness (2)	***0.90***	0.01	0.26	0.00	-0.03	0.88
Level of satisfaction with Freshness (3)	***0.88***	0.02	0.27	0.00	0.02	0.85
Level of satisfaction with Freshness (1)	***0.87***	-0.02	0.28	-0.04	-0.04	0.84
Level of satisfaction with Multi-period Pricing (1)	0.01	***0.86***	0.02	0.20	0.17	0.81
Level of satisfaction with Multi-period Pricing (3)	0.03	***0.84***	-0.03	0.24	0.20	0.81
Level of satisfaction with Multi-period Pricing (2)	-0.02	***0.83***	0.04	0.23	0.24	0.80
Level of satisfaction with Two-period Pricing (3)	0.26	0.02	***0.88***	-0.01	0.03	0.84
Level of satisfaction with Two-period Pricing (2)	0.25	0.02	***0.87***	-0.02	-0.05	0.82
Level of satisfaction with Two-period Pricing (1)	0.29	-0.01	***0.86***	-0.04	-0.05	0.83
Willingness to make trade-offs (1)	-0.01	0.23	-0.03	***0.85***	0.07	0.78
Willingness to make trade-offs (2)	-0.01	0.19	-0.03	***0.85***	0.24	0.82
Willingness to make trade-offs (3)	-0.01	0.25	-0.02	***0.83***	0.24	0.81
Level of interest in Multi-period Pricing (1)	-0.01	0.36	-0.06	0.27	***0.82***	0.88
Level of interest in Multi-period Pricing (2)	-0.06	0.35	-0.02	0.35	***0.78***	0.86
Sum of squared loadings (eigenvalue)	2.54	2.53	2.49	2.47	1.54	
Percentage variance	18.16	18.07	17.81	17.67	10.98	

Table 5.12: Results of factor analysis

5.4.4. Findings Analyzed by Product Categories

This section reports SPSS analysis of survey responses relating to the groups of product types combined in the dairy products, meat products and vegetable products categories (see Table 5.1). Answers to each question in the questionnaire were scored on a five-point scale anchored at 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The total score for the questions in each subject category in the questionnaire was calculated for analysis.

To test **Hypothesis 1**, that the level of customer satisfaction level with a Multi-period pricing Strategy is greater than that with a Two-period pricing Strategy, a paired-samples t-test compared the overall mean scores for satisfaction with Multi-period Pricing and Two-period Pricing strategies, using all nine product types.

Overall average level of satisfaction with Two-period Pricing		**Overall average level of satisfaction with Multi-period Pricing**		
M	**SD**	**M**	**SD**	**t**
8.51	2.39	11.11	2.15	**24.52****

** significant at $p< 0.01$
M = mean, SD = standard deviation

Table 5.13: Comparisons of mean scores for the level of overall satisfaction with Multi-period Pricing and Two-period Pricing

The result presented in Table 5.13 supports the Hypothesis, the overall average satisfaction with Multi-period Pricing is significantly higher than the overall average satisfaction with Two-period Pricing. The mean difference of 2.6 is considered significant. The maximum total

score achievable for satisfaction level with Multi-period Pricing and Two-period Pricing is 15 (3 items at a score of 5 for "strongly agree"). If this is treated as the state of being completely satisfied with a strategy, the mean score of 8.51 for the overall average satisfaction with Two-period Pricing represents slightly below neutral satisfaction (3 items at a score of 3 for "neutral" = 9). By contrast, the mean of 11.11 for the overall average satisfaction with Multi-period Pricing is greater than neutral and slightly below the state of being satisfactory (3 items at a score of 4 for "agree" = 12).

To test Hypotheses 2 through 5, ANOVA was again used to compare the mean scores among the variables. The major descriptive statistics are presented in Table 5.14.

	Product Category						
	Dairy (N = 303)		**Meat (N = 304)**		**Vegetable (N = 305)**		
Variable	**M**	**SD**	**M**	**SD**	**M**	**SD**	**F**
Level of satisfaction with freshness	8.57	2.83	8.72	2.28	9.95	2.07	**30.15****
Level of satisfaction with Two-period Pricing	7.88	2.98	8.56	1.85	9.09	2.04	**20.45****
Level of satisfaction with Multi-period Pricing	11.67	2.22	11.08	1.85	10.57	2.21	**21.12****
Level of interest in Multi-period Pricing	7.83	1.55	7.54	1.34	7.01	1.60	**23.80****
Willingness to make trade-offs between pricing and remaining shelf-life	11.48	2.58	11.18	1.99	10.54	2.27	**13.23****

** significant at $p < 0.01$

N = sample size, M = mean, SD = standard deviation

Table 5.14: Comparisons of mean scores of variables by product category

Hypothesis 2 can be partially supported, that the level of customer satisfaction with a Two-period Pricing Strategy is lower for a product category in which the level of customer satisfaction with freshness is lower, based on the following statistical grounds. The results of one-way ANOVA indicate a statistically significant difference in the mean scores for satisfaction with freshness, lowest for the dairy product category (M = 8.57, SD = 2.83), followed by the meat product category (M = 8.72, SD = 2.28), and highest for the vegetable (M = 9.95, SD = 2.07) product category. The results of one-way ANOVA also suggest a statistically significant difference in the mean scores for satisfaction with Two-period Pricing, lowest for the dairy (M = 7.88, SD = 2.98), followed by the meat (M= 8.56, SD = 1.85) and vegetable (M = 9.09, SD = 2.04) product categories.

In addition, post-hoc comparisons using the Tukey HSD test show that the mean score of satisfaction with Two-period Pricing with respect to the dairy product category is significantly different from that for both the meat and vegetable product categories, at $p<$ 0.01, and is also different with respect to the meat compared to vegetable product categories, at $p<$ 0.05. The same test shows the mean satisfaction with freshness in the case of vegetable product category is significantly different from both the dairy and meat product categories, at $p<0.01$, however, the difference in mean scores for satisfaction with freshness between the dairy and meat product categories is not significant, with p = 0.73. Therefore, Hypothesis 2 can be partially supported.

Hypothesis 3, that the level of customer satisfaction with a Multi-period Pricing Strategy for perishable foods is higher for a product category in which the level of customer satisfaction with a Two-period Pricing Strategy is lower, can be supported. The results of the one-way ANOVA show that the difference in the mean scores with respect to satisfaction with

Multi-period Pricing among different product categories is significant; average satisfaction level with Multi-period Pricing is highest for the dairy product category (M = 11.67, SD = 2.22), followed by the meat (M = 11.08, SD = 1.85) and vegetable (M = 10.57, SD = 2.21) product categories.

The results of post-hoc comparisons using the Tukey HSD test show that the mean score for satisfaction with Multi-period Pricing with respect to the dairy product category is significantly different from that for both the meat and vegetable product categories, and also differs between the meat and vegetable product categories, at $p< 0.01$. Therefore, the mean score for satisfaction with Multi-period Pricing Strategy is higher for a product category in which the mean score for satisfaction with Two-period Pricing is lower.

Hypothesis 4, that the level of interest in a Multi-period Pricing Strategy is higher for a product category in which the level of customer satisfaction with a Multi-period Pricing Strategy satisfaction is also higher, and for a product category in which the level of customer satisfaction with a Two-period Pricing Strategy is lower, can be supported. The one-way ANOVA offers statistical evidence that the level of interest in Multi-period Pricing varies among different product categories; Respondents' level of interest is strongest for the dairy products category, (M = 7.83, SD = 1.55), followed by the meat (M = 7.54, SD = 1.34) and vegetable (M = 7.01, SD = 1.60) product categories in that sequence.

The results of the Tukey HSD test indicate that the mean score for the level of interest in Multi-period Pricing with respect to the vegetable product category is significantly different from those for the dairy and meat product categories, at $p< 0.01$, is also different with respect to the dairy compared to meat product categories, at $p< 0.05$. It is, therefore, the level of

interest in Multi-period Pricing is higher for a product category whose satisfaction level with Two-period Pricing is lower, and whose satisfaction level with Multi-period Pricing is higher.

Hypothesis 5 that, with a Multi-period Pricing Strategy, consumers' willingness to make economic trade-offs between price and remaining shelf-life is higher for a product category whose the levels of customer satisfaction with and interest in a Multi-period Pricing Strategy are both higher and whose the level of customer satisfaction with a Two-period Pricing Strategy is lower. The one-way ANOVA results indicate that average consumers' willingness to make trade-offs between price and remaining shelf-life is highest with respect to the dairy product category (M = 11.48, SD = 2.58), followed by the meat (M = 11.18, SD = 1.99) and vegetable (M = 10.54, SD = 2.27) product categories. Therefore, it is seen that consumers' willingness to make trade-offs is higher for a product category in which levels of satisfaction with and interest in Multi-period Pricing are higher, and for a product category whose satisfaction level with Two-period Pricing is lower.

The results of post-hoc comparisons using the Tukey HSD test indicate that consumers' willingness to make tradeoffs between price and remaining shelf-life in the case of the vegetable product category is significantly different from both the dairy and meat product categories, at $p< 0.01$. However, the difference in consumers' willingness between the dairy and meat product categories is not significant, with p = 0.25, thus Hypothesis 5 is partially supported.

5.4.5. Findings Analyzed by Product Types within Product Categories

This section reports SPSS analysis of survey responses relating to each of the three

product types in the three categories: cheese, milk and yogurt in the dairy category; beef, chicken and pork products in the meat category; and bean sprouts, celery and chilli peppers in the vegetable category.

Paired-samples t-tests compared the overall mean scores for satisfaction with Multi-period Pricing and Two-period Pricing, to test **Hypothesis 1**, that the level of customer satisfaction with a Multi-period Pricing is greater than the level of customer satisfaction with a Two-period Pricing Strategy.

Product category	Average level of satisfaction with Two-period Pricing		Average level of satisfaction with Multi-period Pricing		t
	M	SD	M	SD	
Dairy	7.88	2.98	11.67	2.22	**16.72****
Meat	8.56	1.85	11.08	1.85	**17.61****
Vegetable	9.09	2.04	10.57	2.21	**10.37****

** significant at $p< 0.01$
M = mean, SD = standard deviation

Table 5.15: Comparisons of mean scores for the level of satisfaction with Multi-period Pricing and Two-period Pricing Strategies

The results presented in Table 5.15 support the Hypothesis that, the overall mean score for satisfaction with Multi-period Pricing is significantly higher than the overall mean score for Two-period Pricing in all three cases.

To test the Hypotheses 2 through 5, ANOVA was mainly used to compare the mean scores among the variables. The major descriptive statistics are presented in Table 5.16.

	Dairy Products (N = 303)						
	Cheese (N = 101)		Milk (N = 102)		Yogurt (N = 100)		
Variable	**M**	**SD**	**M**	**SD**	**M**	**SD**	**F**
Level of satisfaction with freshness	8.48	3.04	8.49	3.05	8.74	2.37	0.27
Level of satisfaction with Two-period Pricing	7.61	3.30	7.68	3.16	8.35	2.34	1.90
Level of satisfaction with Multi-period Pricing	11.74	2.24	11.75	2.21	11.53	2.21	0.31
Level of interest in Multi-period Pricing	7.90	1.62	7.97	1.54	7.63	1.47	1.37
Willingness to make trade-offs between pricing and remaining shelf-life	11.79	2.50	11.83	2.70	10.80	2.41	**5.34****
	Meat Products (N = 305)						
	Beef (N = 102)		**Chicken (N = 101)**		**Pork (N = 101)**		
	M	**SD**	**M**	**SD**	**M**	**SD**	**F**
Level of satisfaction with freshness	8.72	2.51	8.77	1.99	8.67	2.31	0.05
Level of satisfaction with Two-period Pricing	8.57	1.99	8.47	1.75	8.65	1.81	0.26
Level of satisfaction with Multi-period Pricing	10.89	1.78	10.98	1.79	11.37	1.96	1.90
Level of interest in Multi-period Pricing	7.71	1.41	7.57	1.28	7.35	1.33	1.87
Willingness to make trade-offs between pricing and remaining shelf-life	11.75	1.84	10.74	2.01	11.06	2.01	**6.98****
	Vegetable Products (N = 305)						
	Bean sprouts (N = 102)		**Celery (N = 103)**		**Chilli pepper (N = 100)**		
	M	**SD**	**M**	**SD**	**M**	**SD**	**F**
Level of satisfaction with freshness	10.01	2.22	9.90	2.22	9.95	1.73	0.07
Level of satisfaction with Two-period Pricing	9.09	2.11	9.03	2.06	9.15	1.98	0.09
Level of satisfaction with Multi-period Pricing	10.45	2.39	10.56	2.20	10.69	2.06	0.29
Level of interest in Multi-period Pricing	6.99	1.56	7.19	1.65	6.83	1.60	1.32
Willingness to make trade-offs between pricing and remaining shelf-life	10.08	2.22	10.58	2.30	10.98	2.22	**4.09***

*significant at $p < 0.05$

**significant at $p < 0.01$

N = sample size, M = mean, SD = standard deviation

Table 5.16: Comparisons of the mean scores of variables among product types in each product category

Hypothesis 2, that the level of customer satisfaction with a Two-period Pricing Strategy is lower for a product type whose the level of customer satisfaction with freshness is lower,

cannot be supported in the case of any of the three categories.

Within the dairy product category, the mean score for satisfaction with freshness is lowest for cheese (M = 8.48, SD = 3.04), followed by milk (M = 8.49, SD = 3.05) and yogurt (M = 8.74, SD = 2.37) product types. The mean scores for satisfaction with Two-period Pricing are in exactly the same order; lowest for cheese (M = 7.61, SD = 3.30), followed by milk (M = 7.68, SD = 3.17) and yogurt (M = 8.35, SD = 2.34) product types. However, one-way ANOVA found no significant difference in the mean scores with respect to satisfaction with either Two-period Pricing or freshness among the three product types in the category. Hypothesis 2 is therefore not supported.

In the case of meat product category, the mean score for respondents' satisfaction with freshness is lowest for pork (M = 8.67, SD = 2.31), followed by beef (M = 8.72, SD = 2.51) and chicken (M = 8.77, SD = 1.99) products. On contrast, the average scores for satisfaction with Two-period Pricing is lowest for chicken (M = 8.47, SD = 1.75), followed by beef (M = 8.57, SD = 1.75) and pork (M = 8.65, SD = 1.81) product types in that sequence. And, the results of ANOVA show that there are no significant difference in the mean scores for satisfaction with freshness and Two-period pricing among the product types in this product category. Therefore, Hypothesis 2 is again not supported.

In the case of vegetable product category, the average level of satisfaction with freshness is lowest for celery product type (M = 9.90, SD = 2.22), followed by chilli pepper (M = 9.95, SD = 1.73) and bean sprouts (M = 10.01, SD = 2.22) product types. However, the mean score for satisfaction with Two-period Pricing is lowest for celery (M = 9.03, SD = 2.06), followed by bean sprouts (M = 9.09, SD = 2.11) and chilli pepper (M = 9.15, SD = 1.98) product types.

In addition, one-way ANOVA found no significant difference in the mean scores with respect to satisfaction with either Two-period Pricing Strategy or freshness among the three product types in the category. Hypothesis 2 is therefore not supported.

Hypothesis 3, that the level of customer satisfaction with a Multi-period Pricing Strategy is higher for a product type whose the level of customer satisfaction with a Two-period Pricing Strategy is lower, is not supported by analysis of statistical results relating to the product types in the dairy, meat or vegetable categories.

In the case of dairy product category, the mean score for satisfaction with Multi-period Pricing is highest for milk (M = 11.75, SD = 2.21) product type, followed by cheese (M = 11.74, SD = 2.24) and yogurt (M = 11.53, SD = 2.21) product types. However, one-way ANOVA shows that there is no significant difference in these mean scores among the different product types in this product category.

Where product types within the meat product category are concerned, the mean score for satisfaction with Multi-period Pricing is highest for pork (M = 11.37, SD = 1.96) product type, followed by chicken (M = 10.98, SD = 1.79) and beef (M = 10.89, SD = 1.78) product types. However, the result of one-way ANOVA indicates that there is no significant difference in these mean scores among product types in the meat product category.

Within the vegetable product category, the mean score for satisfaction with Multi-period Pricing is highest for chilli pepper (M = 10.69, SD = 2.06) product type, followed by celery (M = 10.56, SD = 2.20) and bean sprouts (M = 10.45, SD = 2.39) product types. However, One-way ANOVA shows that there is no significant difference in these mean scores among

the different product types in this category.

Overall, therefore, Hypothesis 3 is not supported.

Hypothesis 4, that the level of consumers' interest in a Multi-period Pricing Strategy for perishable foods is higher for a product type whose the level of customer satisfaction with a Multi-period Pricing Strategy is higher, and whose the level of customer satisfaction with a Two-period Pricing Strategy is lower, is not supported in the case of any of the three product categories.

In the dairy product category, the average level of interest in Multi-period Pricing is highest for milk ($M = 7.97$, $SD = 1.54$), followed by cheese ($M = 7.90$, $SD = 1.62$) and yogurt ($M = 7.63$, $SD = 1.47$) product types in that order, but one-way ANOVA found no significant difference in these scores. In the meat product category, the average level of interest is highest for beef ($M = 7.71$, $SD = 1.41$), followed by chicken ($M = 7.57$, $SD = 1.28$) and pork ($M = 7.35$, $SD = 1.33$) product types, but one-way ANOVA found that the difference in these mean scores among product types in this category is insignificant. In the case of vegetable product category, the average level of interest is highest for celery ($M = 7.19$, $SD = 1.65$) product type, followed by bean sprouts ($M = 6.99$, $SD = 1.56$) and chilli pepper ($M = 6.83$, $SD = 1.60$) product types. However, one-way ANOVA again found no significant difference in average level of interest in Multi-period Pricing among product types.

Overall, based on these statistical grounds, Hypothesis 4 is not supported.

Hypothesis 5 predicts that, with a Multi-period Pricing Strategy, consumers' willingness

to make economic trade-offs between price and remaining shelf-life is higher for a product type whose the levels of customer satisfaction with and interest in a Multi-period Pricing Strategy are higher and the level of customer satisfaction with a Two-period Pricing Strategy is lower.

The results of one-way ANOVA suggest that in the dairy product category, respondents' willingness to make trade-offs between price and remaining shelf-life with a Multi-period Pricing Strategy is statistically highest for milk product type (M = 11.83, SD = 2.70), followed by cheese (M = 11.79, SD = 2.50) and yogurt (M = 10.80, SD = 2.41) product types. The results of post-hoc comparisons using the Tukey HSD test indicate that respondents' willingness to make tradeoffs between price and remaining shelf-life in the case of yogurt product type is significantly different from both milk and cheese product types, at $p< 0.05$. However, the difference in respondents' willingness between milk and cheese product types is not significant, with $p = 0.98$.

In the meat product category, one-way ANOVA results suggest that statistically, respondents' willingness to make trade-offs between price and remaining shelf-life is highest for beef (M = 11.75, SD = 1.84), followed by pork (M = 11.06, SD = 2.01) and chicken (M = 10.74, SD = 2.01) product types. The post-hoc Tukey HSD test found that the mean score of respondents' willingness for beef product type is significantly different from both pork and chicken product types, at $p< 0.01$ and $p< 0.05$ respectively. However, the difference in respondents' willingness between pork and chicken product types is not significant, with p = 0.48.

Within the vegetable product category, the results of one-way ANOVA suggest that

respondents' willingness to make trade-offs between price and remaining shelf-life is statistically highest for chilli peppers (M = 10.98, SD = 2.22), followed by celery (M = 10.58, SD = 2.30) and bean sprouts (M = 10.08, SD = 2.22) product types. The post-hoc Tukey HSD test found that the mean score of respondents' willingness for chilli pepper product type is significantly different from bean sprouts product type, at $p< 0.05$. However, respondents' willingness in the case of celery product type is not significantly different from both chilli pepper and bean sprouts product types, with $p = 0.42$ and $p = 0.24$ respectively.

However, the results of one-way ANOVA indicate that the differences in the mean scores for satisfaction level with Multi-period Pricing and Two-period Pricing Strategy, and the level of interest in Multi-period Pricing are not significant among product types in any of three product categories. Overall, Hypothesis 5 is not supported.

5.5. SUMMARY AND DISCUSSION

5.5.1. Summary of Results

This chapter has presented the results of empirical studies which tested the research Hypotheses by statistical analysis of data collected by questionnaires in South Korea. The results offer an improved understanding of: the impact of Multi-period Pricing Strategies on customer satisfaction with the discounting of perishable food products as the shelf-life approaches expiry; the level of consumer interest in Multi-period Pricing Strategies for perishable products; and consumers' willingness to make trade-offs between price and remaining shelf-life, across different categories and types of food products. The main findings of Hypothesis testing are summarized in Table 5.17.

Hypotheses	Formal Survey 1				Formal Survey 2			
	By product category	By product type			By product category	By product type		
		Dairy	Meat	Vegetable		Dairy	Meat	Vegetable
	Hypothesis supported?							
Hypothesis 1: The level of customer satisfaction with a Multi-period Pricing Strategy for perishable foods is greater than the level of customer satisfaction with a Two-period Pricing Strategy.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hypothesis 2: The level of customer satisfaction with a Two-period Pricing Strategy for perishable foods is lower in the case of a product category (or product type within a product category) in which the level of customer satisfaction with freshness is lower.	Partly	No	No	No	Partly	No	No	No
Hypothesis 3: The level of customer satisfaction with a Multi-period Pricing Strategy for perishable foods is higher in the case of a product category (or product type within a product category) in which the level of customer satisfaction with a Two-period strategy is lower.	Yes	No	No	No	Yes	No	No	No
Hypothesis 4: The level of interest in a Multi-period Pricing Strategy for perishable foods is higher in the case of a product category (or product type within a product category) in which (1) the level of customer satisfaction with a Multi-period Pricing Strategy is higher, and (2) the level of customer satisfaction with a Two-period strategy is lower.	Partly	No	No	No	Yes	No	No	No
Hypothesis 5: With a Multi-period Pricing Strategy, the level of consumer willingness to make economic trade-offs between price and remaining shelf-life is higher for a product category (or product type within a product category) in which (1) the level of customer satisfaction with and (2) the level of interest in a Multi-period Pricing Strategy are both higher, and (3) the level of customer satisfaction with a Two-period strategy is lower.	Partly	No	No	No	Partly	No	No	No

Table 5.17: Summary of results of Hypothesis testing

Given that Hypothesis 1 was supported for every condition, it can be concluded that, although the aggregate daily discount over the product's shelf-life is the same as in the case of Two-period Pricing, consumers will be more satisfied by gradual compensation for the loss of value caused by approaching the expiry date: that is, a Multi-period Pricing Strategy. Hypotheses 2 to 5 were either fully or partially supported when the focus was on product categories.

The results of testing the Hypotheses by product *category* showed that, generally: (1) the level of customer satisfaction with Two-period Pricing is lower for a product category in which the level of customer satisfaction with freshness is lower; (2) the level of customer satisfaction with Multi-period Pricing will be higher for a product category in which the level of customer satisfaction with Two-period Pricing is lower; (3) the level of interest in Multi-period Pricing will be higher for a product category in which the levels of customer satisfaction with Two-period Pricing and Multi-period Pricing are respectively lower and higher; and (4) consumers' willingness to trade-off price against shelf-life, with Multi-period Pricing, will be higher for a product category in which the level of customer satisfaction with Two-period Pricing is lower, and both the levels of customer satisfaction with and interest in Multi-period Pricing are higher. The results of analysis by product category showed that value can be added by transforming a price management from the Two-period Pricing Strategy, into more dynamically managed approaches. These in-depth analyses, designed to assess the reality or feasibility of achieving the expected benefits from more dynamic and systematic management of price, have the potential to assist the food retail industry significantly in its quest to adopt and exploit an effective marketing strategy for the improvement of customer service and, ultimately, profitability.

Testing the Hypotheses by product *types* within each product category found differences in mean scores for some variables as shown in Tables 5.9 and 5.15. Although differences in mean scores were found for some variables, there were many others for which differences were not significant. Therefore, Hypotheses 2 to 5 were not be supported with respect to the product types within each product category. This implies that differences in mean scores of many variables used in this study are weaker among product types within a product category or with similar characteristics, but the differences are stronger among different product categories with different characteristics. In some instances, if different product types within each product category are taken as samples, the results may be different. For example, the characteristics of potato and onion product types in terms of consumers' consumption patterns may be different from the sample product types within the vegetable product category used in this study. They may be more likely to be purchased in a larger volume due to the likelihood of their constant (or daily) consumption, and relatively longer shelf-life compared to the sample vegetable product types chosen for this study. This may lead to the generation of slightly different results of hypotheses testing. However, the sample product types in this study were chosen based on the interviewed managers' recommendations, which are closely associated with wastage due to unsold product. Therefore the sample product types represent a group of perishable products that need to employ a more dynamic pricing approach. It is possible that if other products, that may not need more dynamic pricing, were chosen as sample products in this study, the results of hypotheses testing would be slightly different. On the other hand, the results of hypotheses testing in this chapter can be validated since the sample products in this study were chosen based on food retail managers' recommendations that might need to employ a more effective pricing approach.

5.5.2. Comparison of the Potential Impacts of Multi-period Pricing 1 and 2

Two examples of more dynamic pricing strategies in relation to the present less dynamic Two-period Pricing strategy were used for the surveys, which are Multi-period Pricing 1 and Multi-period Pricing 2, both of which envisage discounting the prices as each day of remaining shelf-life passes. The Multi-period Pricing Strategy 1 is to discount the price based more accurate shelf-life variations enabled by improved traceability systems, whereas Multi-period Pricing Strategy 2 simply operates on the basis of a pre-determined period of shelf-life. The same discount logic, that is to discount the price of perishable foods as each remaining day passes, is applied to Multi-period Pricing Strategies 1 and 2. Therefore, the consumer benefits that stem from these strategies may not be significantly different. Consequently, the results generated by the testing of the Hypotheses are almost the same for Multi-period Pricing Strategies 1 and 2. However, consumer confidence in freshness (or remaining shelf-life) may vary depending on the pricing strategy. For instance, consumers might be more confident in the remaining shelf-life and freshness of perishable foods with a Multi-period Pricing Strategy 1, as the price is discounted based on shelf-life information, which is measured with greater accuracy, rather than a pre-defined expiry date.

Table 5.18 shows the result of comparing the mean scores for overall satisfaction with Multi-period Pricing Strategy, level of interest in it and willingness to make trade-offs by consumers, as between Multi-period Pricing Strategy 1 and Multi-period Pricing Strategy 2, with an independent samples t-test.

Variable	Multi-period Pricing 1		Multi-period Pricing 2		t
	M	SD	M	SD	
Level of satisfaction with Multi-period Pricing	11.84	1.89	11.14	2.23	**8.45****
Level of interest in Multi-period Pricing	7.86	1.49	7.44	1.57	**6.08****
Willingness to make trade-offs between price and remaining shelf-life	11.58	2.15	11.01	2.34	**5.60****

** significant at $p < 0.01$
M = mean, SD = standard deviation

Table 5.18: Comparisons of mean scores for variables as between Multi-period Pricing 1 and Multi-period Pricing 2

The mean score for overall customer satisfaction with Multi-period Pricing is significantly higher when the strategy is based on more accurate measurement of remaining shelf-life than when it is based on a pre-defined shelf-life. The level of interest in the strategy is also significantly higher for Multi-period Pricing 1, than for Multi-period Pricing 2, as is customers' willingness to make trade-offs between price and remaining shelf-life. These results testify potential added-value, from the consumer's point of view, of more dynamic pricing management practices, specifically the implementation of the advanced food traceability systems that can more accurately measure shelf-life variations. Therefore, it can be seen that retailers may expect higher positive impacts when the pricing of perishable foods is more dynamically managed, in conjunction with advanced traceability systems.

As shown in Tables 5.3 and 5.10, the demographic characteristics of the sample for formal surveys 1 and 2 differ slightly, however, it may not affect the results of comparing mean

scores for variables between Multi-period Pricing Strategies 1 and 2, presented in Table 5.18, based on the following grounds. The mean age of samples for formal surveys 1 and 2 are 35.77 and 33.99, respectively. And the median income of samples for formal surveys 1 and 2 are 400-500 and 300-400 (10,000 KRW), respectively. These differences in the mean age and median income of samples are not too significant, and Chung and Li (2009) showed that the level of interest in a Multi-period Pricing Strategy and the impact of the strategy on consumers' purchasing behaviour do not vary according to age. The same study also showed that the impacts of a Multi-period Pricing Strategy on the level of interest and consumers' purchasing behaviour are likely to be higher for high income consumers. Given that the median income of the sample for formal survey 1 is higher than that for formal survey 2, it suggests that, if the income for formal survey 1 was lower (similar to that for formal survey 2), the mean scores for those variables may be even lower, which would not affect the results presented in Table 5.18.

The positive impacts of Multi-period Pricing 1 enabled by improved food traceability systems are not limited to what have discussed above; improved customer satisfaction is a significant factor that influences business performance. The generic benefits stemming from improved food traceability discussed in Chapter 2, sections 2.4.2 and 2.4.3, would also apply. The major concern in advanced traceability systems is expensive costs of implementation including expensive tag costs, training costs for retailers, suppliers and distributors. However, as discussed in Chapter 2, section 2.4.4, consumers showed willingness to pay more for improved food traceability (with increased reservation price), which will provides an opportunity to increase revenue by increasing initial price and sales, and reducing waste of perishable foods to compensate the expensive costs of implementation.

5.5.3. Managerial Implications

The practical implications of the findings in this chapter are significant. Retailers can expect an improvement of customer satisfaction, an important factor influencing business performance, if they implement more dynamic pricing strategies that compensate customers for the daily loss of value as the expiry date approaches. They can expect the impact of more dynamic pricing to be more positive when general satisfaction with the freshness of a product category and with the present less dynamic pricing are both lower (e.g. the dairy products in this case). Retailers might also consider applying more dynamic discounting to products that attract a higher number of complaints about price and freshness.

More dynamic pricing may not influence consumers' strategic buying behaviour that has received increasing attention in the literature of pricing. The reasons are as follows. For non-food perishable products, the value of identical products on display is the same, and the price is therefore reduced en bloc during the end of a selling period, permitting consumers to behave strategically. In the case of a specific type of perishable food product, however, the value of a given item on the shelf depends on how long it has been displayed and the printed expiry date. More dynamic management of pricing, by offering an earlier but smaller discount, will encourage shoppers to make a trade-off by deciding to buy an item with a shorter remaining shelf-life that is displayed alongside the same products at a higher price and a more distant expiry date. This could stimulate consumers to purchase a product with fewer days of shelf-life remaining, and further avert the last-day higher discount. Food retailers, who face difficulties in predicting the variation in daily sales of perishable products, and therefore often display items of a specific product type with different remaining shelf-life

simultaneously, may be encouraged by these conclusions to actively consider more dynamic management of prices and discounts.

CHAPTER SIX

THE RESULTS OF SIMULATION TESTS

6.1. INTRODUCTION

As discussed in Chapter 4, section 4.4, the combination of the present prevailing pricing and daily replenishment approaches for perishable foods may lead retailers to a situation in which the display stock of a particular perishable food item has the same price but different remaining shelf-life; a specific item not sold on a certain day will be displayed alongside others replenished the next day with the same price if the expiry date is not imminent. This provides the need for more dynamic pricing to encourage consumers to purchase a product with less remaining shelf-life in such a situation.

Using Multi-period Pricing as an example of more dynamic pricing strategies in relation to Two-period Pricing, the present prevailing less dynamic pricing approach, Chapter 5 presented the results of formal surveys investigating consumer perceptions of dynamic pricing strategies for perishable foods. The results reported in Chapter 5 showed the value of more dynamic pricing strategies which enables better trade-offs between price and the product's remaining shelf-life, from consumer perspectives. Chapter 5, however, could not show the value of more dynamic pricing strategies with respect to retailer performance, as a result of transformation of consumers' purchasing behaviour which may improve a retail operation's performance.

Studies reviewed and discussed in Chapter 2 have proposed dynamic pricing policies by

considering various demand assumptions, however, consumer demand in reaction to a situation where the display stock of a particular product has different values resulting in different prices available at the same time that is particularly applicable for perishable food products, has rarely been considered. Based on these grounds, this chapter will investigate the probable impacts of dynamic pricing strategies on retailer performance and provide an insight into the impact of frequency of discount during the product's selling period on retailer performance by considering the potential to transform consumers' purchasing behaviour and demand patterns in response to the availability at the same time of food products with different remaining shelf-life for different prices, which has not been considered in the prior studies on pricing perishable products.

6.2. SIMULATION MODEL ASSUMPTIONS

This section presents the method by which the simulation model was developed. On the basis of the interviews with managers of South Korean retail stores presented in Chapter 4, the business process characterising the current situation can be summarized as in Figure 6.1. Interviewed managers explained that their stores normally receive daily deliveries of perishable foods, directly from suppliers or through distribution centres, which are kept in in-store warehouses until being transferred to the display shelves for sale, and ultimately food are purchased from there by consumers.

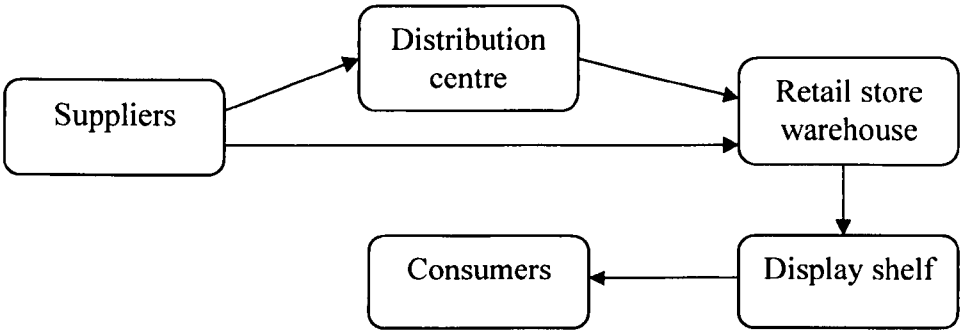


Figure 6.1: Typical business process for the management of perishable foods in retail stores in South Korea

The simulation model follows that typical sequence of events, in order to reproduce the current business environment as closely as possible. It was programmed using 'C language', the rational for the choice of which is explained in Chapter 3, and is represented visually in Figure 6.2.

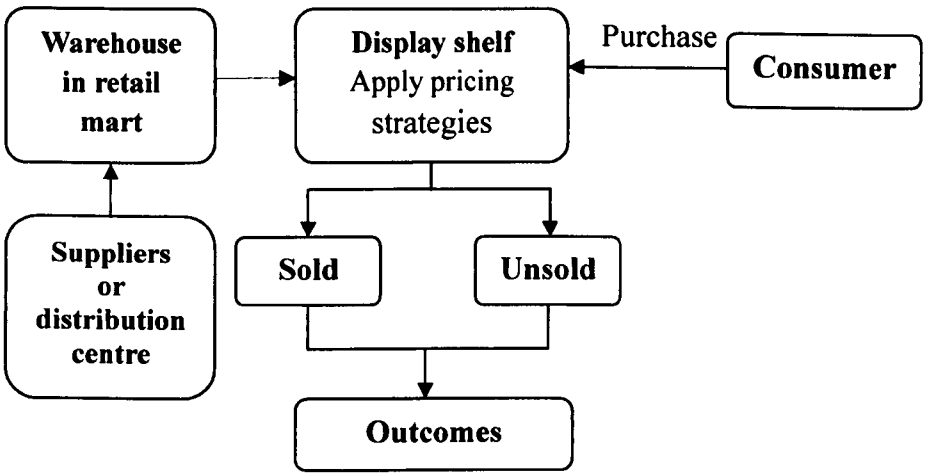


Figure 6.2: The business process in the simulation

The purpose of the simulation is to compare the performance of different pricing strategies, thus to permit evaluation of the effectiveness of more dynamic pricing approaches against the

present less dynamic pricing approaches for perishable foods in terms of retailer performance

6.2.1. Present Less Dynamic Pricing Strategies

Interviews with the managers of the retail stores in South Korea established that the present prevailing pricing policy for perishable foods is Two-period Pricing. And in some cases, retailers employ Single-period Pricing (i.e. no discount will be made). Let P_0 be the initial price and d be the discount made to the initial price P_0 when r remaining days of shelf-life remains, $1 \leq r < m$, m is the entire selling period (days) of a perishable food. If $P(T)$ is the price on day T for each product, T = 1,2,3,...m, n_T is the remaining shelf-life on day T, the Two-period Pricing equation can be expressed as:

$$P(T) = \begin{cases} P_0, n_T > r \\ P_0(1-d), n_T \leq r \end{cases} \tag{6-1}$$

For Single-period Pricing, $P(T)$ is always equal to P_0 since the price does not vary over time.

6.2.2. More Dynamic Pricing Strategies

In Chapter 5, a Multi-period Pricing Strategy that increases the discount at a constant rate as each remaining day passes was used as an example of more dynamic pricing strategies, which is adopted for the simulation. From Chapter 5, the discount made to the price on day T, d_T, was given by equation (5-3) in section 5.2.1, therefore, $P(T)$ can be expressed as:

$$P(T) = P_0 (1\text{-}d_T) \tag{6-2}$$

Equation (6-2) is a Multi-period Pricing Strategy that decreases the price at a constant rate as each remaining day of a perishable food passes. The simulation also considers one that decreases the price by increasing the discount at a constant rate at two-day intervals. Using equations (5-3), equation (6-4) to calculate the discount made to initial price on day T given by d_{T*} is as below (d_s is the aggregate daily discount over the product's shelf-life). Equation (6-4) follows the threshold function, (6-3), which is:

$$n_{T*} = \begin{cases} n_T, T = Odd\ numbers \\ n_T + 1, T = Even\ numbers \end{cases} \tag{6-3}$$

$$d_{T*} = \frac{d_s (m - n_{T*})}{\sum_{T=1}^{m} (m - n_{T*})} \tag{6-4}$$

Therefore, with Multi-period Pricing that decreases the price at a constant rate at two-day intervals, $P(T)$ can be expressed as:

$$P(T) = P_0 (1\text{-}d_{T*}) \tag{6-5}$$

The Multi-period Pricing Strategy given by equation (6-5) is defined as ***Multi-period Pricing Strategy 3***. The issue of improved traceability systems was not considered in the simulation. Implementation of improved traceability systems enables to identify more accurate remaining shelf-life information, therefore, the remaining shelf-life for each product

is dependent on an individual product's condition rather than a pre-determined expiry date. As a result, products that were produced and replenished on the same day would have a different remaining shelf-life. Inclusion of the improved traceability systems issue in the simulation may lead to greater complexity in designing the model. As this issue in no way poses an obstacle to achieving the objective of this chapter, only Multi-period Pricing given by equation (6-2) is used to decreases the price at a constant rate as each remaining day passes. The strategy is therefore Multi-period Pricing Strategy 2.

Perishable foods normally have short selling period. A Multi-period Pricing Strategy with long intervals between applying discounts is unreasonable for a product with a short selling period, which may only allow a single or Two-period Pricing policy. In summary, four different pricing possibilities are considered in the simulation (Single-period Pricing, Two-period Pricing, Multi-period Pricing 2 and 3) and which is sufficient to achieve this chapter's aim without loss of generality; to provide an insight into the impact of frequency of discount during the product's selling period on consumer purchasing behaviour and the subsequent impacts on retailer performance, rather than optimizing the structure of the discount.

To compare the performance among the different pricing approaches, the same initial price P_0 is applied, along with the same aggregate daily discount over a product's shelf-life were the product not sold until its expiry date, or d_s. In other words, d_s in equations (5-3) and (6-4) is set as being equal to ($d \times r$) from equation (6-1). Various possible values of m were considered, since each perishable food product type has a different length shelf-life. Therefore, a comparison was made of the performance of different pricing approaches when m is 7, 11 or 15. For the Two-period Pricing, (1) when $m = 7$, $d = 0.2$ and $r = 2$ were set, (2)

when m = 11, d = 0.2 and r = 3 were set, and (3) when m = 15, d = 0.2 and r = 4 were set. These values were inspired by the present pricing approach identified in the interviews conducted (discount can be 20~50% and here 20% is used as an example). d_s was set as being equal to ($d \times r$), d_s in equations (5-3) and (6-4) are 0.4, 0.6, and 0.8 when m is equal to 7, 11 or 15, respectively. From the interviews, it was identified that retailers target an initial profit margin of 20-40% (mean = 30%) when selling perishable food products. Therefore, P_0 in this study is set as 10, and the purchasing cost per product is determined as 7 for all simulations to generate an initial profit margin of 30%. By applying these parameters, each product's price in the simulation can be decreased, as shown in Table 6.1.

	P(T)											
	Single-period Pricing			Two-period Pricing			Multi-period Pricing 2			Multi-period Pricing 3		
T	m = 7	m = 11	m = 15	m = 7	m = 11	m = 15	m = 7	m = 11	m = 15	m = 7	m = 11	m = 15
1	10	10	10	10	10	10	10	10	10	10	10	10
2	10	10	10	10	10	10	9.81	9.89	9.91	10	10	10
3	10	10	10	10	10	10	9.62	9.78	9.83	9.56	9.76	9.82
4	10	10	10	10	10	10	9.43	9.67	9.74	9.56	9.76	9.82
5	10	10	10	10	10	10	9.24	9.56	9.66	9.11	9.52	9.63
6	10	10	10	8	10	10	9.05	9.45	9.57	9.11	9.52	9.63
7	10	10	10	8	10	10	8.86	9.34	9.49	8.67	9.28	9.45
8	*	10	10	*	10	10	*	9.23	9.40	*	9.28	9.45
9	*	10	10	*	8	10	*	9.12	9.31	*	9.04	9.27
10	*	10	10	*	8	10	*	9.01	9.23	*	9.04	9.27
11	*	10	10	*	8	10	*	8.90	9.14	*	8.80	9.08
12	*	*	10	*	*	8	*	*	9.06	*	*	9.08
13	*	*	10	*	*	8	*	*	8.97	*	*	8.90
14	*	*	10	*	*	8	*	*	8.89	*	*	8.90
15	*	*	10	*	*	8	*	*	8.80	*	*	8.71

Table 6.1: Pricing approaches in the simulation

6.2.3. Inventory

Let q be the target stock level in the retail store's warehouse. The interviews with retailers

in South Korea identified that the warehouse stock for perishable foods is replenished every morning by suppliers, up to the target stock level. In the simulation, the stock in the warehouse is replenished every morning up to the given q. Products with the shortest remaining shelf-life are the first to be taken from the warehouse to fill shelves. The target stock amount as an input parameter q is vital for the accuracy of the simulation test since the target stock levels influence a product's rate of disposal due to unsold stock. Therefore, the simulation was run to consider various possible values of q, which is spanned by $q \in \{10, 20, 30, 40, 50, 60, 70, 80, 90, 100\}$.

6.2.4. Consumer Behaviour

In the simulation, one year is selected as the sales horizon of length. In the simulation, the demand for a product at the retail store follows a Poisson process with the average of λ per day, as used in prior studies (e.g. Aviv and Pazgal, 2008; Bitran and Mondschein, 1997). The process is independent of the inventory availability level in the retail store.

Without loss of generality, and to simplify the analysis, $\lambda = 50$ is fixed for the entire simulation; as various possible values of q are considered, the fixed λ allows comparison of the performance of different pricing strategies under various instances where q is under- and over-targeted and nearly the optimal. This study considers $q \in \{10, 20, 30, 40\}$ as under-targeted, $q \in \{50, 60, 70\}$ as nearly the optimal and $q \in \{80, 90, 100\}$ as over-targeted stock level by taking $\lambda = 50$ into consideration reflecting the forecasted demand (where over-targeted and under-targeted imply the situations that the forecasted demand is higher and lower than the actual demand respectively).

This study considers consumers' individual consumption needs and rationality when making their purchases, rather than the strategic consumer waiting issue which has been discussed intensively in the literature of pricing for non-food products, for example Aviv and Pazgal (2008), Dasu and Tong (2010), Elmaghraby et al. (2008). In their researches, the objective value a specific non-food product on display is the same regardless of how long the product is displayed. Therefore, the price of non-food products is discounted en bloc when the end of pre-determined selling period is imminent, which enables consumers to either purchase at an earlier stage of selling period with a higher price or wait until the price is reduced in subsequent selling periods. On the other hand, with the printed expiry date on a food package, the value of the display stock of a specific type of perishable food product is different depending on how long an individual product is displayed. Therefore, the price of the specific type of perishable foods is discounted to match with an individual product's value (remaining shelf-life). This results in a situation that the specific product type with different remaining shelf-life and prices are available at the same time. It is expected that such situation will stimulate consumers to purchase a product with fewer remaining days left than is displayed a higher price and more remaining days if the product's remaining shelf-life fulfils their consumption needs.

Therefore, in the simulation, the purchasing behaviour, when consumer j attempts to purchase a unit of the product, is to follow the subsequent procedure. Consumer j requires c ($c \in 1, 2, 3..., m$) remaining days of shelf-life for a specific food product type to be purchased and therefore they check the expiry date. If the remaining days of shelf-life of all the products on the display shelf are less than c, then consumer j does not purchase the product. This also applies when the product is sold out. If there are the products with

remaining shelf-life that equals to or greater than c, consumer j purchases by choosing following conditions; (1) the cheapest price and (2) the longest remaining shelf-life, among the products with equals to or greater than c remaining days. This demand scenario is referred as ***need-driven demand***. These two conditions apply when Two-period Pricing and Multi-period Pricing 3 are employed, which consider products with different remaining shelf-life under the same price level. For Single-period Pricing, since the price does not change as the remaining days pass, only the latter condition applies. For Multi-period Pricing 2, since the price is discounted as each remaining day passes, only the former condition applies. Several different distribution possibilities are tested for c.

6.2.5. Display Shelf

In the simulation, products are transferred from the warehouse to the display shelf up to the given target quantity of products on the display shelf, as identified by the interviews with retailers. When the number of products on the shelf goes below the given minimum quantity required, the simulator automatically replenishes the products on the shelf from the warehouse until the target shelf quantity is reached. At the close of each day, the products' remaining shelf lives are reduced by one day and the products are disposed of if they have not been sold by the end of their shelf-life. The target and minimum quantities of the product on the shelf are set at 30 and 10 respectively (figures inspired from the interviews), to maintain consistency across all simulations.

6.2.6. Annual Profit and Rate of Disposal due to Unsold

The simulation generates the annual profit and rate of disposal due to unsold. Each run of the simulation represented one year, and the average results of 1,000 repetitions were

analyzed. The annual profit and annual rate of disposal due to unsold are calculated as:

- Profit = sales – [product purchasing cost × (number of product sold + unsold)]

- Rate of disposal due to unsold = [number of product unsold / (number of product sold + unsold)] × 100

Operational costs were ignored in the calculation of annual profits, though they might in practice be increased in Multi-period Pricing approaches by the possible need for more staff to implement them. Such costs would vary according to the size of the store under consideration and the business environment in which it was operating.

6.3. RESULTS OF SIMULATION WITH CONSUMER NEEDS FOLLOWING NORMAL DISTRIBUTION

Since several different distribution possibilities for c were to be tested, this section considers the cases in which c follows normal distribution; $c \sim N(\mu, \sigma^2)$. And $\mu = m/2$ is used to represent the individual consumption need distributed with a mean of the median shelf-life; with the expectation that the probability that consumers require the product with one remaining day and the full shelf-life is assumed to be lower, but this probability becomes higher as c approaches the median shelf-life of the product. Higher values for σ^2 are assigned in the simulation for longer m possibilities, to increase the spread of distribution for the possible c values.

For simplification of the simulation model, c is distributed by integers as shown in Figures 6.3 to 6.5 using cumulative distribution function. When consumer j arrives, the probability of c which equals to or less than 1, $F(c) = P(c \leq 1) = F(1)$, is considered to be the probability that consumer j requires a product with at least 1 day of remaining shelf-life. And in general, the probability of c that is greater than s - 1 and equal to or less than s, $F(c) = P(s\text{-}1 < c \leq s) = F(s) - F(s - 1)$ ($s = 2, 3, \ldots, m - 1$), is considered to be the probability of consumer j requiring a product with at least s days of the remaining shelf-life. Furthermore, the probability of c that is greater than $m - 1$, $F(c) = P(m - 1 < c) = 1 - F(m - 1)$, is the probability of consumer j requiring a product with the full (or m) remaining days. The cumulative normal distribution is symmetric by the median. For example, when $m = 7$, $\mu = 3.5$, $\sigma^2 = 1$, the probability of consumer j requiring a product with 3 remaining days is, $P(2 < c \leq 3) = P(c \leq 3) - P(2 < c)$ $= P(z \leq -0.5) - P(z < -1.5) = 0.3085\text{-}0.0668 = 0.2417$.And when $m = 7$, $\mu = 3.5$, $\sigma^2 = 1$, the probability of consumer j requiring a product with 5 remaining days is, $P(4 < c \leq 5) = P(c \leq 5) - P(4 < c) = P(z \leq 1.5) - P(z < 0.5) = 0.2417$. *Note*: according to Devore and Peck (1994, p.202), if $a < b$, $P(a \leq x \leq b) = P(a < x \leq b) = P(a \leq x < b) = P(a < x < b)$ when x is a continuous random variable, as "the area under a density curve and above a single value such as 3 or 7 is zero. The area above an interval of values therefore does not depend on whether either endpoint is included".

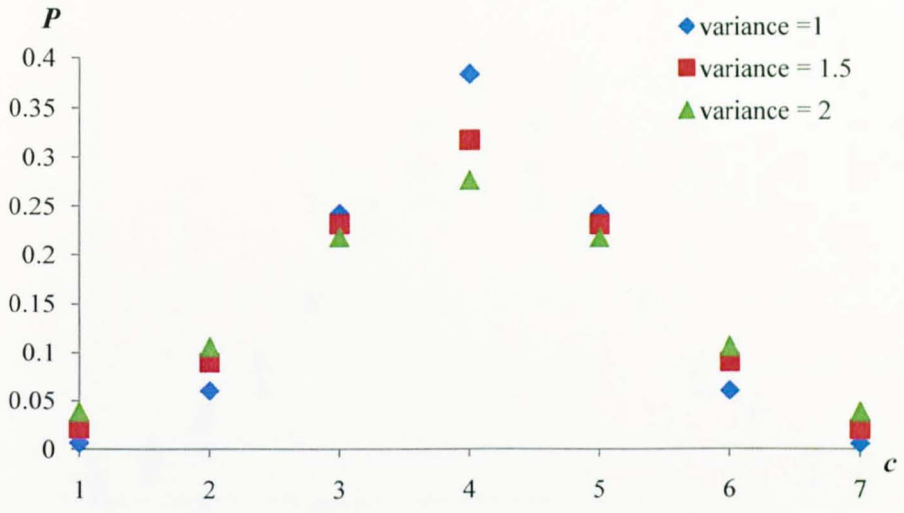


Figure 6.3: Consumer needs distribution, $m = 7$, $\mu = 3.5$

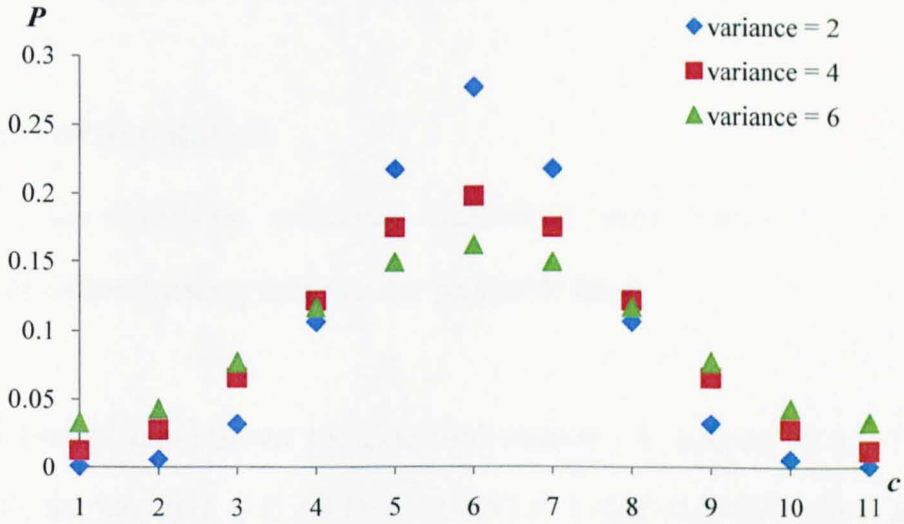


Figure 6.4: Consumer needs distribution, $m = 11$, $\mu = 5.5$

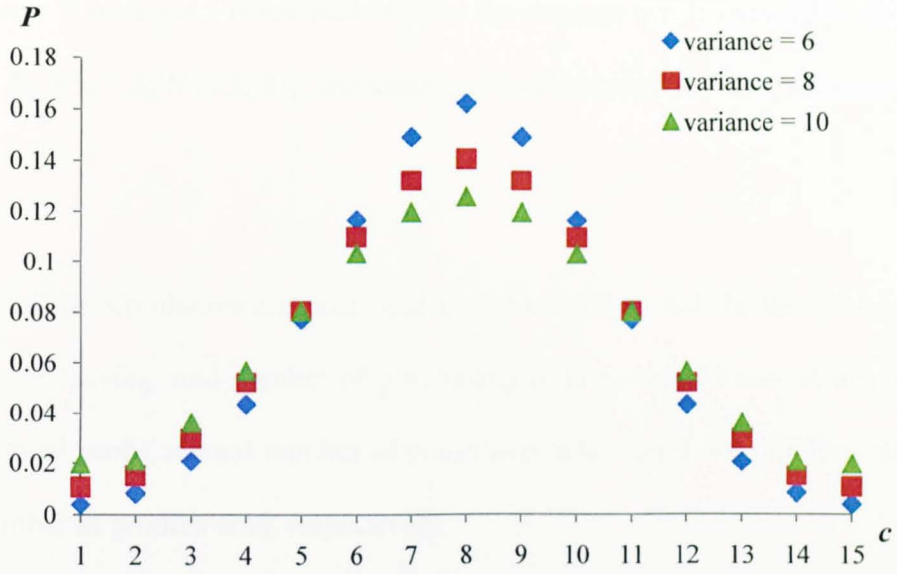


Figure 6.5: Consumer needs distribution, m = 15, μ = 7.5

6.3.1. Results of Simulation

Enabled by the simulation, numerical experiments were conducted to compare the performance of different pricing strategies for perishable foods.

Firstly, a subset of combinations was examined when m = 7, spanned by $q \in$ {10, 20, 30, 40, 50, 60, 70, 80, 90, 100}, $c \in \{N(3.5, 1), N(3.5, 1.5)\ N(3.5, 2)\}$, which provides 30 combinations. And when m = 11 and 15, a subset of combinations spanned with same q values, but with $c \in \{N(5.5, 2), N(5.5, 4)\ N(5.5, 6)\}$ and $c \in \{N(7.5, 6), N(7.5, 8)\ N(7.5, 10)\}$ was explored, respectively. Without loss of generality and to simplify the results to show the general trend of performance of the different pricing approaches depending on various q possibilities, the average results of the simulation under the same level of q are provided with three different σ^2 possibilities. Therefore, when m = 7, instance i is for the average results spanned by $q = i*10$ (i = 1, 2, ...10) and $c \in \{N(3.5, 1), N(3.5, 1.5)\ N(3.5, 2)\}$. In other

words, when m = 7, instance 1 is referred to draw the average result spanned by q = 10 and c $\in$ {N (3.5, 1), N (3.5, 1.5) N (3.5, 2)}.The same method was used to refer instances when m = 11 and 15.

The results of the simulation are presented in Tables 6.2 to 6.4. In the Tables, disposal, profit, number of leaving, and number of purchasing refer to annual rate of disposal due to unsold (%), annual profit, annual number of consumers who could not purchase the product, and annual number of product sold, respectively.

	Single-period Pricing				Two-period Pricing				Multi-period Pricing 2				Multi-period Pricing 3			
Instances	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing
1	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00
2	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.81	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94
3	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.13	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10
4	0.00	43,568.13	3,727.48	14,522.71	0.00	43,568.13	3,727.48	14,522.71	0.00	43,553.79	3,727.37	14,522.82	0.00	43,566.72	3,727.47	14,522.72
5	0.10	51,405.53	1,074.89	17,175.30	0.01	51,535.27	1,053.93	17,196.26	0.00	51,465.44	1,029.82	17,220.37	0.00	51,538.92	1,034.02	17,216.17
6	1.47	52,003.62	284.55	17,947.64	0.28	53,102.18	211.63	18,038.56	0.00	53,736.59	100.49	18,149.70	0.00	53,762.52	116.74	18,133.45
7	2.57	51,072.15	100.21	18,149.98	0.37	52,672.63	92.78	18,157.41	0.00	53,308.62	17.30	18,232.89	0.00	53,343.57	45.82	18,204.37
8	2.76	50,652.37	158.61	18,091.58	0.30	52,332.83	165.74	18,084.45	0.00	52,370.37	94.08	18,156.11	0.00	52,745.97	137.49	18,112.70
9	2.80	50,345.50	246.02	18,004.17	0.32	51,977.56	256.21	17,993.98	0.00	51,426.40	172.69	18,077.50	0.00	52,329.05	243.87	18,006.32
10	2.96	49,779.77	371.76	17,878.43	0.42	51,361.75	397.68	17,852.51	0.00	50,442.53	263.96	17,986.23	0.00	51,723.17	313.63	17,936.56

Table 6.2: The results of simulation, $m = 7$

	Single-period Pricing				Two-period Pricing				Multi-period Pricing 2				Multi-period Pricing 3			
Instances	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing
1	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00
2	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.81	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94
3	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.20	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10
4	0.00	43,568.24	3,727.44	14,522.75	0.00	43,568.24	3,727.44	14,522.75	0.00	43,560.06	3,727.37	14,522.82	0.00	43,567.45	3,727.45	14,522.74
5	0.01	51,610.77	1,042.74	17,207.45	0.00	51,624.31	1,040.26	17,209.93	0.00	51,549.08	1,029.81	17,220.38	0.00	51,593.52	1,032.72	17,217.47
6	0.77	53,023.50	247.83	18,002.36	0.15	53,646.41	198.61	18,051.58	0.00	54,041.32	100.39	18,149.80	0.00	54,071.59	111.84	18,138.35
7	1.62	52,397.52	80.69	18,169.50	0.26	53,436.60	73.03	18,177.16	0.00	53,917.09	12.62	18,237.57	0.00	53,969.39	32.30	18,217.89
8	1.76	52,120.98	113.95	18,136.24	0.22	53,239.78	117.44	18,132.75	0.00	53,355.43	65.56	18,184.63	0.00	53,607.33	94.92	18,155.27
9	1.78	51,925.57	172.23	18,077.96	0.22	53,034.86	176.77	18,073.42	0.00	52,785.92	121.05	18,129.14	0.00	53,328.35	170.99	18,079.20
10	1.84	51,653.26	237.98	18,012.21	0.25	52,775.31	244.26	18,005.93	0.00	52,194.00	183.82	18,066.37	0.00	52,979.93	219.48	18,030.71

Table 6.3: The results of simulation, $m = 11$

Instances	Single-period Pricing				Two-period Pricing				Multi-period Pricing 2				Multi-period Pricing 3			
	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing
1	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00
2	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94
3	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.23	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10
4	0.00	43,568.30	3,727.42	14,522.77	0.00	43,568.30	3,727.42	14,522.77	0.00	43,562.59	3,727.37	14,522.82	0.00	43,567.78	3,727.42	14,522.77
5	0.00	51,642.33	1,035.61	17,214.58	0.00	51,644.31	1,035.20	17,214.99	0.00	51,582.89	1,029.81	17,220.38	0.00	51,614.43	1,032.06	17,218.13
6	0.45	53,516.02	218.51	18,031.68	0.02	53,988.08	175.78	18,074.41	0.00	54,164.51	100.35	18,149.84	0.00	54,190.04	109.07	18,141.12
7	1.17	53,029.72	67.84	18,182.35	0.05	53,910.92	59.15	18,191.04	0.00	54,165.85	9.76	18,240.43	0.00	54,212.46	24.37	18,225.82
8	1.29	52,824.98	85.29	18,164.90	0.02	53,769.37	87.00	18,163.19	0.00	53,772.06	47.62	18,202.57	0.00	53,959.57	69.19	18,181.00
9	1.30	52,690.80	127.09	18,123.10	0.02	53,630.59	129.47	18,120.72	0.00	53,367.39	89.03	18,161.16	0.00	53,757.03	125.51	18,124.68
10	1.33	52,516.13	172.04	18,078.15	0.03	53,471.42	175.04	18,075.15	0.00	52,951.23	134.23	18,115.96	0.00	53,515.05	161.75	18,088.44

Table 6.4: The results of simulation, $m = 15$

6.3.2. Discussion of Results

As shown in Tables 6.2 through 6.4 and Figures 6.6 through 6.8 below, in terms of profitability, when m = 7, 11, every pricing strategy generates the highest annual profits under instance 6. When m = 15, Single-period Pricing and Two-period Pricing strategies generate the highest annual profits under instance 6, whereas Multi-period Pricing Strategies 2 and 3 generate the highest annual profits under instance 7.

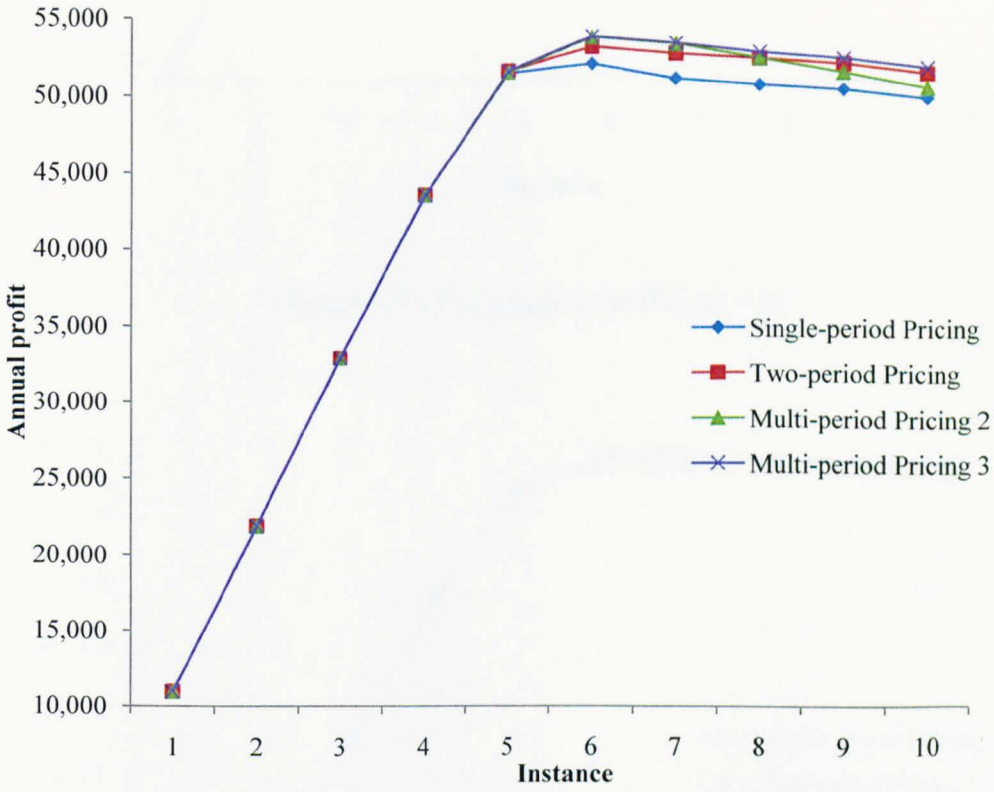


Figure 6.6: The annual profits, m = 7

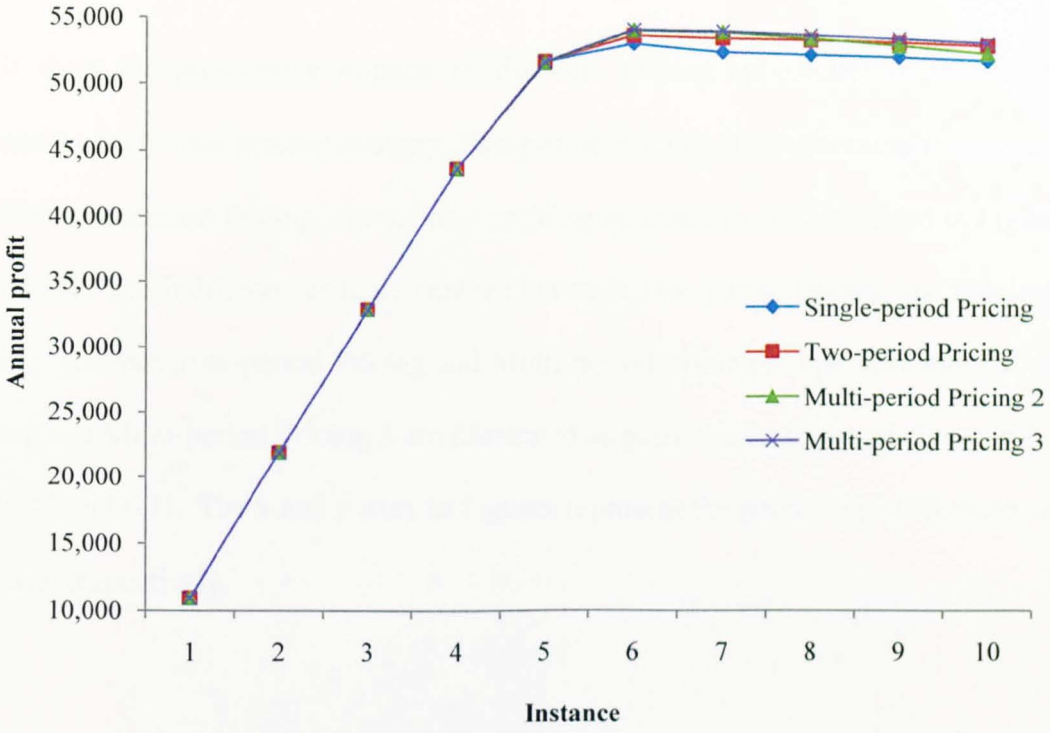


Figure 6.7: The annual profits, m = 11

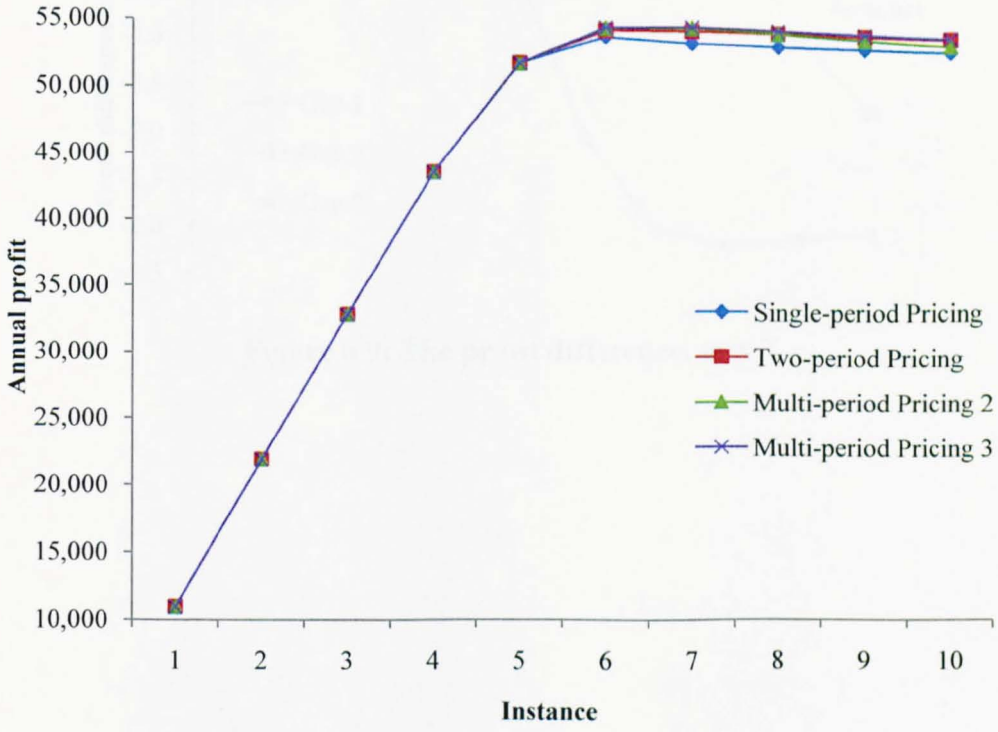


Figure 6.8: The annual profits, m = 15

To show the prospective impacts of different pricing approaches in relation to the presently widely used pricing strategy, Two-period Pricing, the differences in annual profit between Two-period Pricing and the other pricing approaches are illustrated in Figures 6.9 to 6.11. The profit differences in percentage between Two-period Pricing and Single-period Pricing, between Two-period Pricing and Multi-period Pricing 2, and between Two-period Pricing and Multi-period Pricing 3 are illustrated as gaps 1, 2 and 3 respectively in Figures 6.9, 6.10 and 6.11. The x and y axes in Figures represent the percentage difference and the instance, respectively.

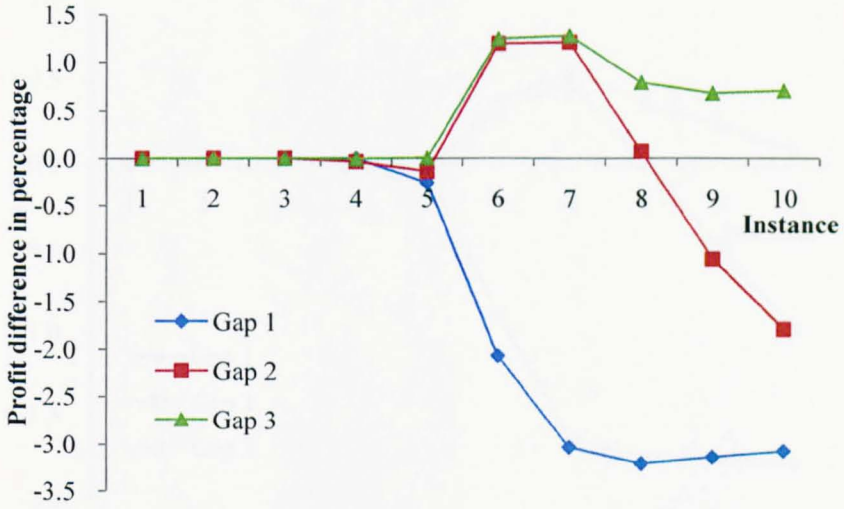


Figure 6.9: The profit difference, $m = 7$

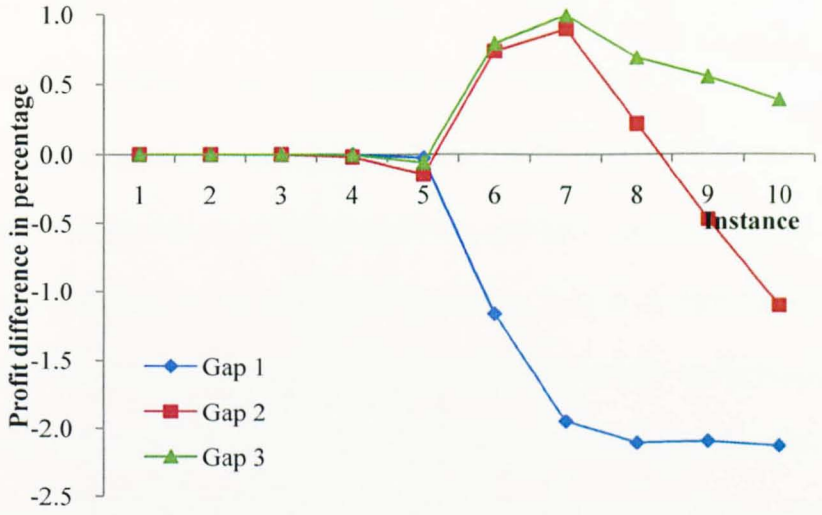


Figure 6.10: The profit difference, m = 11

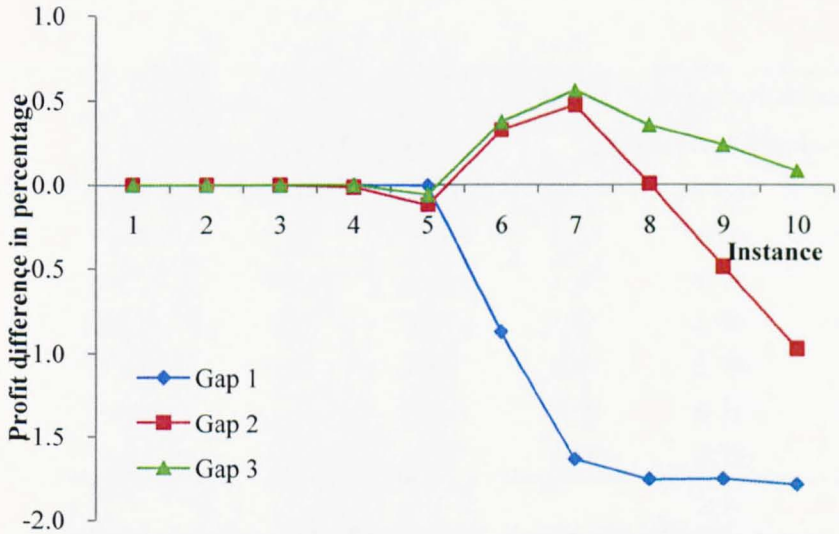


Figure 6.11: The profit difference, m = 15

As shown in Figures 6.9 to 6.11, when q is under-targeted ($q \in \{10, 20, 30, 40\}$), generally, it can be seen that the performance of different pricing strategies is similar. When q is nearly optimal ($q \in \{50, 60, 70\}$), Multi-period Pricing approaches are more beneficial in comparison to Two-period Pricing in many instances. When q is over-targeted

($q \in \{80, 90, 100\}$), Multi-period Pricing 2 is not beneficial comparing to Two-period Pricing in many instances, while Multi-period Pricing 3 is more beneficial in every instance. When q is nearly optimal and over-targeted, Single-period Pricing is seen as the least efficient strategy among different pricing strategies, generating the lowest annual profits in every instance, except instance 5 when $m = 11$ and 15, that the annual profit with Single-period Pricing is higher than that with Multi-period Pricing Strategies, but is lower than that with Two-period Pricing. The performance of Multi-period Pricing approaches comparing Two-period Pricing varies against different possible values of m and q. Table 6.5 shows the percentage increase in the retailer's annual profit by employing Multi-period Pricing approaches 2 and 3 over Two-period Pricing.

	% increase in the retailer's profit over Two-period Pricing					
	Multi-period Pricing 2			**Multi-period Pricing 3**		
Instance	$m = 7$	$m = 11$	$m = 15$	$m = 7$	$m = 11$	$m = 15$
5	*-0.14*	*-0.15*	*-0.12*	0.01	*-0.06*	*-0.06*
6	1.19	0.74	0.33	1.24	0.79	0.37
7	1.21	0.90	0.47	1.27	1.00	0.56
8	0.07	0.22	0.01	0.79	0.69	0.35
9	*-1.06*	*-0.47*	*-0.49*	0.68	0.55	0.24
10	*-1.79*	*-1.10*	*-0.97*	0.70	0.39	0.08

Table 6.5: Percentage increase in profit by employing Multi-period Pricing approaches over Two-period Pricing

The results in Table 6.5 imply that, between Multi-period Pricing approaches, Multi-period Pricing approach 3 outperforms Multi-period Pricing approach 2 in most instances. Additionally, it is expected that the positive impact of adopting Multi-period Pricing approaches on retailer profitability against Two-period Pricing is stronger for a product type that has a relatively shorter shelf-life.

The profitability is very sensitive to such parameters as d_s, d and r. If d_s for Multi-period Pricing approaches was set higher than $(d \times r)$, or vice versa, the results presented in this study will vary. However, by setting d_s as equal to $(d \times r)$, this study reveals that more dynamic price management, compared to the present forms of perishable foods pricing, may be beneficial. It is also worth to note that, as shown in Tables 6.2 through 6.4 and Figures 6.12 through 6.14, the number of products sold with Multi-period Pricing 2 is generally the highest.

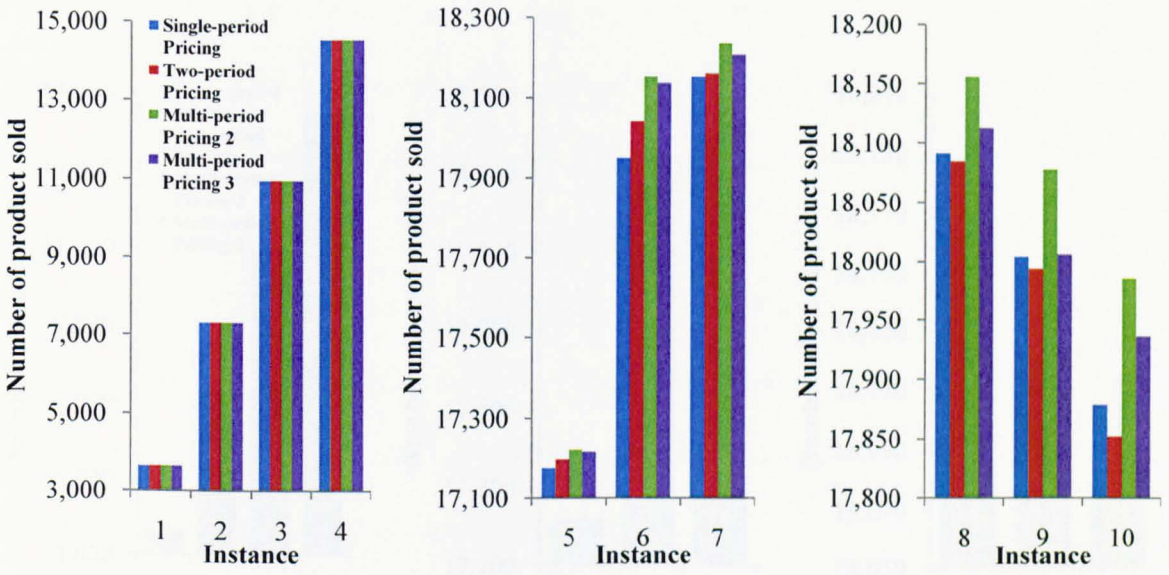


Figure 6.12: Annual number of product sold, $m = 7$

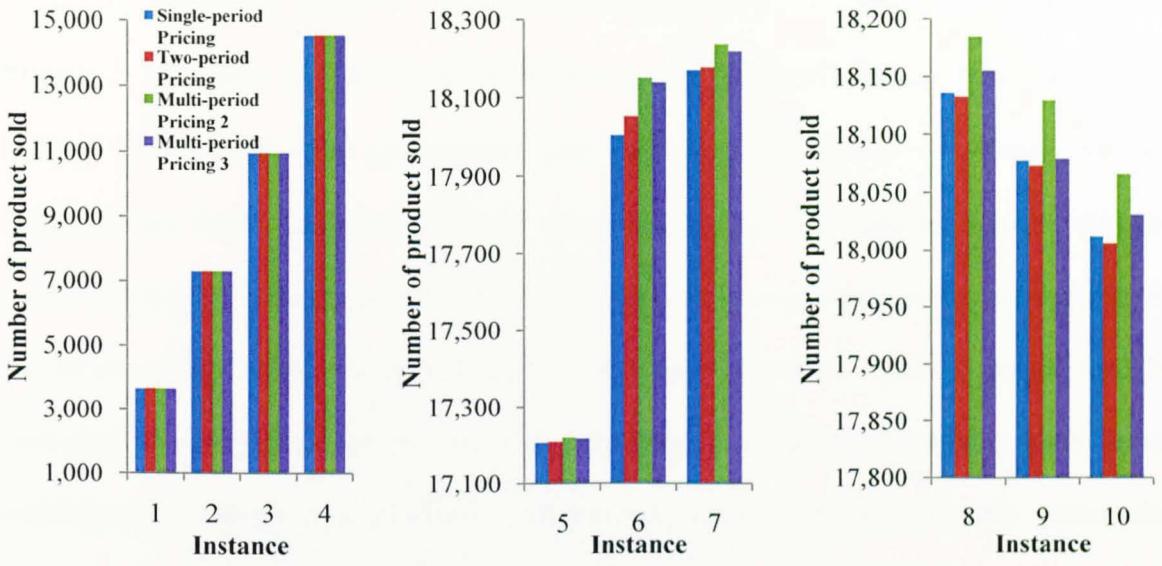


Figure 6.13: Annual number of product sold, $m = 11$

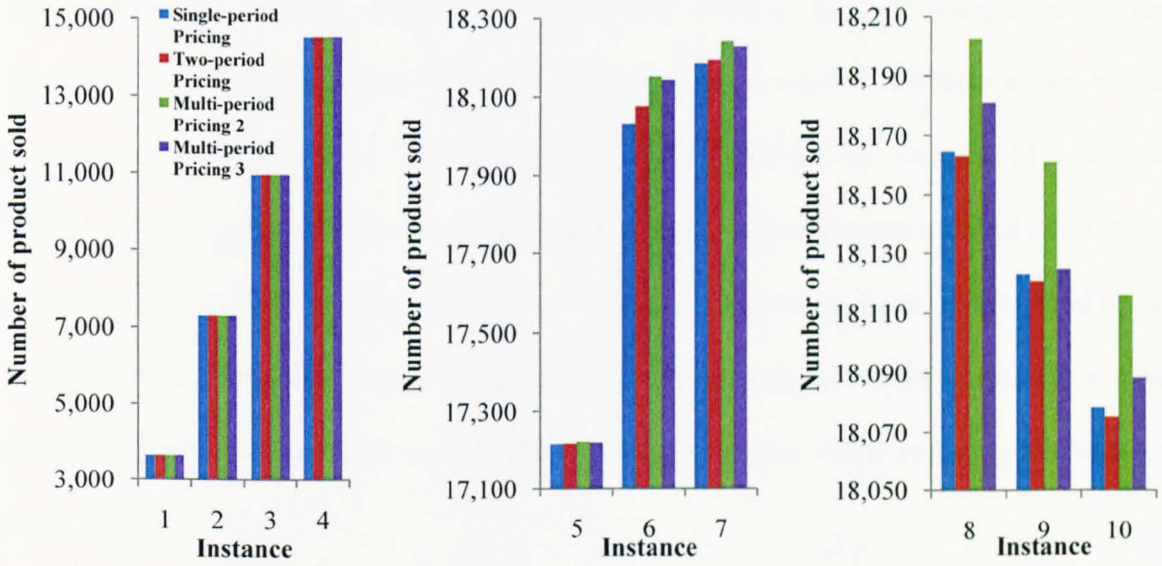


Figure 6.14: Annual number of product sold, $m = 15$

Figures 6.12 through 6.14 show that when q is under-targeted ($q \in \{10, 20, 30, 40\}$), the annual numbers of products sold by employing different pricing strategies are generally similar. When q is nearly optimal ($q \in \{50, 60, 70\}$), the number of products sold is generally the highest with Multi-period Pricing 2, followed by Multi-period Pricing 3, Two-period Pricing and Single-period Pricing, in that order. When q is over-targeted (q

$\in$ {80, 90, 100}), the number of products sold is generally the highest with Multi-period Pricing 2, followed by Multi-period Pricing 3, Single-period Pricing and Two-period Pricing, in that order. The performance with respect to the number of product sold by Single-period Pricing can be improved more when q is over-targeted because Single-period Pricing generated a larger volume of wastage due to unsold products, comparing to the other pricing strategies (see Tables 6.2 through 6.4). This wastage would lead to increased number of orders placed with suppliers to replenish the target stock level, making more fresh products available on the display shelf. More fresh produce enables the retailer to enhance the operational efficiency to fulfil c, thus selling more of the product using the Single-period Pricing strategy than with Two-period Pricing. This does not imply that Single-period Pricing outperforms Two-period Pricing, since Single-period Pricing generates a significantly higher volume of wastage due to unsold products which would lead to an increased number of orders placed with suppliers. In contrast, Multi-period Pricing approaches 2 and 3 generate the highest and the second highest number of products sold, respectively, and produces the lowest wastage. In general, these results lead to the expectation that when the prices of perishable foods are adjusted more frequently during its selling period, the retailer's sales volume can be increased, while reducing the wastage due to unsold.

	% increase in the number of product sold over Two-period Pricing					
	Multi-period Pricing 2			Multi-period Pricing 3		
Instance	$m = 7$	$m = 11$	$m = 15$	$m = 7$	$m = 11$	$m = 15$
5	0.14	0.06	0.03	0.12	0.04	0.02
6	0.62	0.54	0.42	0.53	0.48	0.37
7	0.42	0.33	0.27	0.26	0.22	0.19
8	0.40	0.29	0.22	0.16	0.12	0.10
9	0.46	0.31	0.22	0.07	0.03	0.02
10	0.75	0.34	0.23	0.47	0.14	0.07

Table 6.6: Percentage increase in sales volume by employing Multi-period Pricing over Two-period Pricing

In addition, as shown in Table 6.6, generally, the positive impact of employing Multi-period Pricing approaches on retailer sales volume, comparing with the present most widely practiced Two-period Pricing is expected to be stronger for a product type that has a relatively shorter shelf-life.

To compare the effectiveness of different pricing approaches in terms of waste due to unsold products, Figures 6.15 to 6.17 illustrate the differences in annual rate of disposal due to unsold. Differences in annual rate of disposal due to unsold (annual rate of disposal due to unsold of Two-period Pricing minus annual rate of disposal due to unsold of the another pricing approach) between Two-period Pricing and Single-period Pricing, between Two-period Pricing and Multi-period Pricing 2, and between Two-period Pricing and Multi-period Pricing 3 are referred to as gaps 1, 2 and 3 respectively.

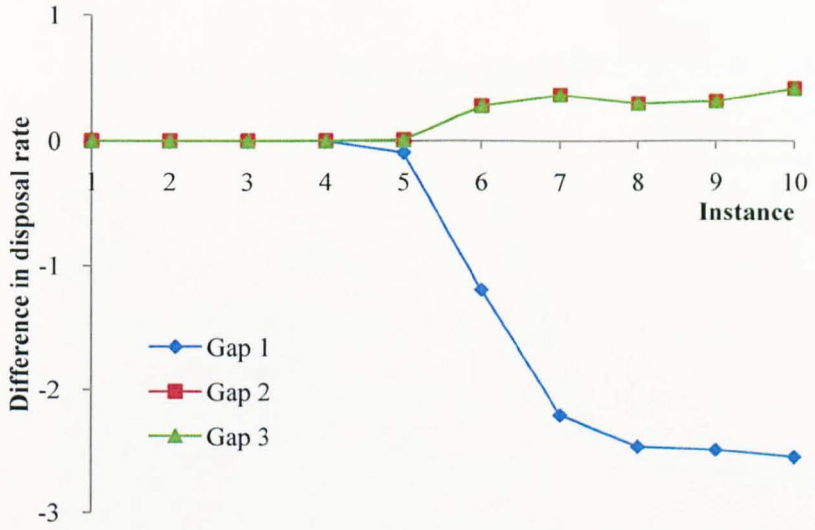


Figure 6.15: The disposal gaps, $m = 7$

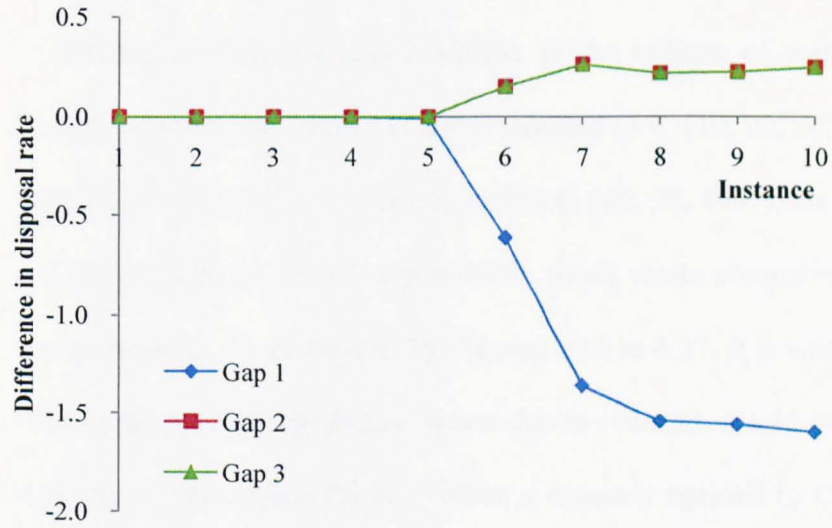


Figure 6.16: The disposal gaps, $m = 11$

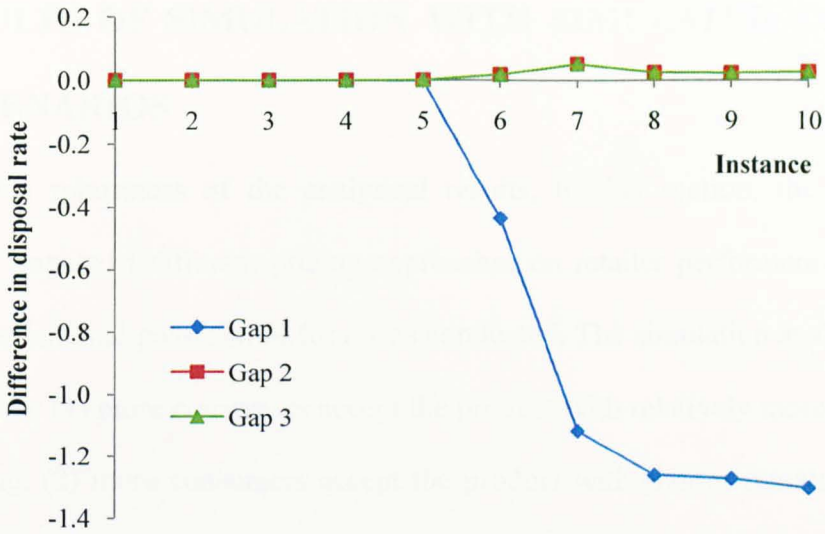


Figure 6.17: The disposal gaps, $m = 11$

As shown in Figures 6.15 to 6.17 and Tables 6.2 to 6.4, generally, it can be seen that the performance of different pricing strategies is similar in the volume of waste which is a result of unsold expired products, when q is under-targeted ($q \in \{10, 20, 30, 40\}$). When q is nearly optimal ($q \in \{50, 60, 70\}$) or over-targeted ($q \in \{80, 90, 100\}$), the Single-period Pricing policy is not efficient in reducing perishable foods waste comparing Two-period Pricing under every instance. As illustrated by Figures 6.15 to 6.17, it is worth to note that Multi-period Pricing approaches can reduce waste due to reduced unsold products due to expiration, comparing to Two-period Pricing. When q is nearly optimal ($q \in \{50, 60, 70\}$) and over-targeted ($q \in \{80, 90, 100\}$), Two-period Pricing generates less than 0.5% annual rate of disposal due to unsold, while Multi-period Pricing 2 and 3 generate 0% annual disposal in our case context, as presented in Tables 6.2 to 6.4. This leads to the expectation that, by more frequently adjust the price of perishable foods, waste due to unsold products can be reduced.

6.4. RESULTS OF SIMULATION WITH SIMULATED CONSUMER NEED SCENARIOS

To improve robustness of the analytical results, in this section, the simulation to compare the impact of different pricing approaches on retailer performance with several different distributional possibilities for c was conducted. The simulation analysis considers three situations: (1) more consumers accept the product with relatively more days of shelf-life remaining, (2) more consumers accept the product with shorter remaining shelf life, and (3) such needs/demands follow uniform distribution. The results are shown in Figures 6.18 to 6.20, which again relate to three possible values of m: 7, 11 and 15.

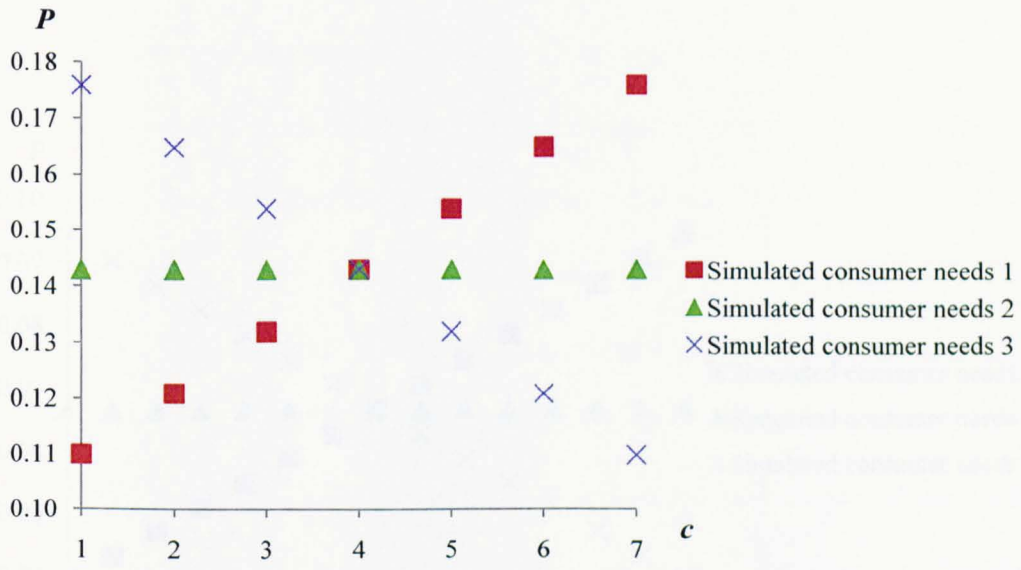


Figure 6.18: Simulated consumer needs, $m = 7$

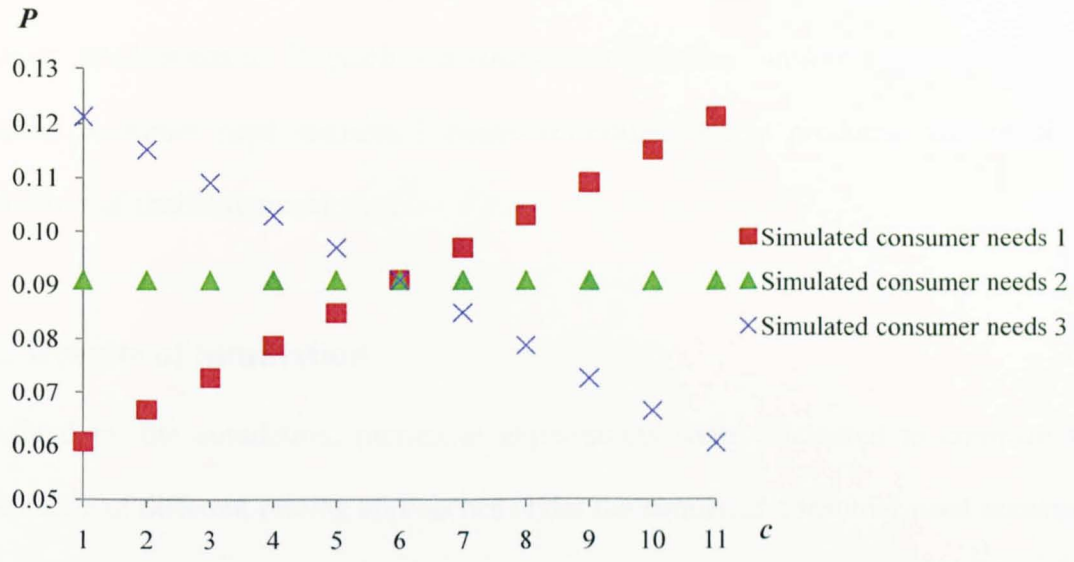


Figure 6.19: Simulated consumer needs, $m = 11$

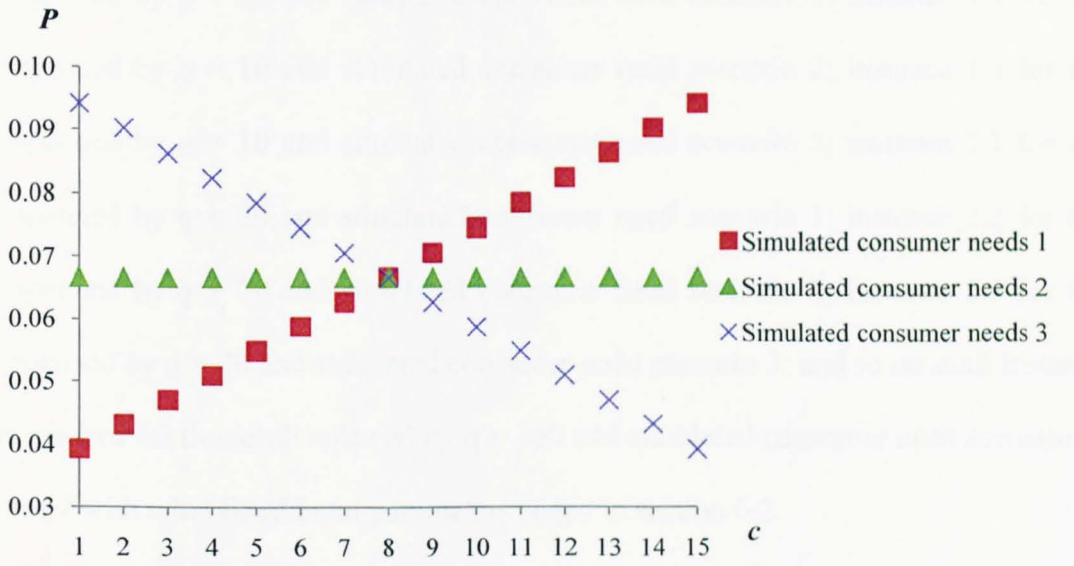


Figure 6.20: Simulated consumer needs, m =15

The Figures 6.18 through 6.20 show three different consumer need scenarios which were not considered in the previous section; simulated consumer need scenario 1(more

consumers accept products with relatively more days of shelf-life remaining), simulated consumer need scenario 2 (such consumer needs follow uniform distribution) and simulated consumer need scenario 3 (more consumers accept products with relatively shorter days of shelf-life remaining).

6.4.1. Results of Simulation

Enabled by the simulation, numerical experiments were conducted to compare the performance of different pricing approaches under the simulated consumer need scenarios. When m = 7, a subset of combinations is considered, spanned by $q \in$ {10, 20, 30, 40, 50, 60, 70, 80, 90, 100}, $c \in$ {simulated consumer need scenarios 1, 2 3} as illustrated in Figure 6.18, which provides 30 combinations. These are referred as : instance 1.1 for the result spanned by q = 10 and simulated consumer need scenario 1; instance 1.2 for the result spanned by q = 10 and simulated consumer need scenario 2; instance 1.3 for the result spanned by q = 10 and simulated consumer need scenario 3; instance 2.1 for the result spanned by q = 20 and simulated consumer need scenario 1; instance 2.2 for the result spanned by q = 20 and simulated consumer need scenario 2; instance 2.3 for the result spanned by q = 20 and simulated consumer need scenario 3; and so on until instance 10.3 is reached for the result spanned by q = 100 and simulated consumer need scenario 3, when m =7 with other fixed input parameters stated in section 6.2.

When m = 11, a subset of combinations is considered, spanned by $q \in$ {10, 20, 30, 40, 50, 60, 70, 80, 90, 100}, $c \in$ {simulated consumer need scenarios 1, 2 3} as illustrated in Figure 6.19, which shows 30 combinations. When m = 15, a subset of combinations is considered, spanned by $q \in$ {10, 20, 30, 40, 50, 60, 70, 80, 90, 100}, $c \in$ {simulated

consumer need scenarios 1, 2 3} as illustrated in Figure 6.20, which provides combinations. The individual instances were specified by the same method as when m was set equal to 7. The results of the simulation are presented in Tables 6.7 to 6.9. In the Tables, disposal, profit, number of leaving, and number of purchasing refer to annual rate of disposal due to unsold (%), annual profit, annual number of consumers who could not purchase the product, and annual number of product sold, respectively.

	Single-period Pricing				Two-period Pricing				Multi-period Pricing 2				Multi-period Pricing 3			
Instances	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing
1.1	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00
1.2	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00
1.3	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00
2.1	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.81	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94
2.2	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.81	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94
2.3	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.81	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94
3.1	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.13	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10
3.2	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.13	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10
3.3	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.13	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10
4.1	0.00	43,565.19	3,728.46	14,521.73	0.00	43,565.21	3,728.44	14,521.75	0.00	43,553.79	3,727.37	14,522.82	0.00	43,563.91	3,728.29	14,521.90
4.2	0.00	43,565.82	3,728.25	14,521.94	0.00	43,565.83	3,728.24	14,521.95	0.00	43,553.79	3,727.37	14,522.82	0.00	43,564.53	3,728.11	14,522.08
4.3	0.00	43,566.75	3,727.94	14,522.25	0.00	43,566.75	3,727.94	14,522.25	0.00	43,553.79	3,727.37	14,522.82	0.00	43,565.39	3,727.86	14,522.33
5.1	0.10	51,227.40	1,132.46	17,117.73	0.00	51,342.73	1,112.84	17,137.35	0.00	51,465.14	1,029.92	17,220.27	0.00	51,417.85	1,069.32	17,180.87
5.2	0.07	51,345.34	1,105.63	17,144.56	0.00	51,416.40	1,092.55	17,157.64	0.00	51,465.23	1,029.89	17,220.30	0.00	51,448.71	1,060.31	17,189.88
5.3	0.05	51,426.34	1,085.91	17,164.28	0.00	51,473.73	1,076.32	17,173.87	0.00	51,465.30	1,029.87	17,220.32	0.00	51,474.46	1,052.80	17,197.39
6.1	1.64	51,117.48	513.48	17,736.71	0.00	52,433.41	452.59	17,797.60	0.00	53,716.13	106.90	18,143.29	0.00	53,306.66	253.68	17,996.51
6.2	1.54	51,466.81	438.92	17,811.27	0.00	52,697.90	379.86	17,870.33	0.00	53,725.19	104.06	18,146.13	0.00	53,421.25	219.10	18,031.09
6.3	1.44	51,790.43	371.53	17,878.66	0.00	52,941.26	314.59	17,935.60	0.00	53,730.01	102.55	18,147.64	0.00	53,521.29	189.03	18,061.16
7.1	2.76	48,580.99	892.45	17,357.74	0.00	50,297.88	920.47	17,329.72	0.00	52,513.02	266.69	17,983.50	0.00	51,741.43	554.67	17,695.52
7.2	2.70	49,292.19	665.79	17,584.40	0.00	51,040.78	675.83	17,574.36	0.00	52,786.14	181.07	18,069.12	0.00	52,246.45	393.52	17,856.67
7.3	2.65	49,889.40	478.06	17,772.13	0.00	51,648.21	477.96	17,772.23	0.00	52,987.22	118.04	18,132.15	0.00	52,628.78	271.92	17,978.27
8.1	3.09	45,570.04	1,825.33	16,424.86	0.00	47,109.31	1,926.84	16,323.35	0.00	48,768.09	1,223.36	17,026.83	0.00	47,777.27	1,749.20	16,500.99
8.2	2.97	47,045.61	1,343.81	16,906.38	0.00	48,658.95	1,416.73	16,833.46	0.00	49,839.77	887.38	17,362.81	0.00	49,256.83	1,272.63	16,977.56
8.3	2.89	48,249.03	949.95	17,300.24	0.00	49,925.72	999.20	17,250.99	0.00	50,710.16	614.53	17,635.66	0.00	50,463.57	881.67	17,368.52
9.1	9.30	42,356.13	2,832.91	15,417.28	0.00	43,806.91	2,964.69	15,285.50	0.00	45,182.46	2,130.34	16,119.85	0.00	44,662.75	2,648.36	15,601.83
9.2	3.22	44,733.17	2,067.98	16,182.21	0.00	46,312.33	2,155.36	16,094.83	0.00	47,052.30	1,544.05	16,706.14	0.00	46,746.45	2,012.65	16,237.54
9.3	3.07	46,607.81	1,462.84	16,787.35	0.00	48,263.14	1,522.93	16,727.26	0.00	48,553.11	1,073.52	17,176.67	0.00	48,537.58	1,455.24	16,794.95
10.1	4.06	38,173.89	4,110.86	14,139.33	0.00	39,041.61	4,407.87	13,842.32	0.00	40,871.71	3,265.13	14,985.06	0.00	41,042.77	3,422.55	14,827.64
10.2	3.63	41,937.42	2,899.12	15,351.07	0.00	43,365.08	3,032.74	15,217.45	0.00	43,897.67	2,316.22	15,933.97	0.00	44,357.52	2,480.41	15,769.78
10.3	3.38	44,676.87	2,014.81	16,235.38	0.00	46,307.01	2,086.34	16,163.85	0.00	46,122.71	1,618.52	16,631.67	0.00	46,786.52	1,782.02	16,468.17

Table 6.7: The results of simulation, $m = 7$

Instances	Single-period Pricing				Two-period Pricing				Multi-period Pricing 2				Multi-period Pricing 3			
	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing
1.1	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00
1.2	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00
1.3	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00
2.1	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.81	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94
2.2	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.81	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94
2.3	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.81	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94
3.1	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.20	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10
3.2	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.20	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10
3.3	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.20	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10
4.1	0.00	43,566.57	3,728.00	14,522.19	0.00	43,566.57	3,728.00	14,522.19	0.00	43,560.06	3,727.37	14,522.82	0.00	43,565.96	3,727.91	14,522.28
4.2	0.00	43,566.90	3,727.89	14,522.30	0.00	43,566.90	3,727.89	14,522.30	0.00	43,560.06	3,727.37	14,522.82	0.00	43,566.26	3,727.82	14,522.37
4.3	0.00	43,567.53	3,727.68	14,522.51	0.00	43,567.53	3,727.68	14,522.51	0.00	43,560.06	3,727.37	14,522.82	0.00	43,566.81	3,727.65	14,522.54
5.1	0.01	51,470.30	1,088.36	17,161.83	0.00	51,486.54	1,084.61	17,165.58	0.00	51,548.90	1,029.87	17,220.32	0.00	51,521.11	1,055.12	17,195.07
5.2	0.01	51,533.19	1,069.80	17,180.39	0.00	51,540.20	1,067.95	17,182.24	0.00	51,548.93	1,029.86	17,220.33	0.00	51,543.49	1,048.20	17,201.99
5.3	0.00	51,581.81	1,055.04	17,195.15	0.00	51,583.25	1,054.40	17,195.79	0.00	51,548.96	1,029.85	17,220.34	0.00	51,564.46	1,041.71	17,208.48
6.1	0.89	52,306.71	434.80	17,815.39	0.00	53,105.38	387.09	17,863.10	0.00	54,033.18	103.01	18,147.18	0.00	53,794.83	198.80	18,051.39
6.2	0.80	52,662.59	357.80	17,892.39	0.00	53,365.48	315.25	17,934.94	0.00	54,036.60	101.91	18,148.28	0.00	53,876.88	172.99	18,077.20
6.3	0.70	53,001.60	285.00	17,965.19	0.00	53,612.53	247.02	18,003.17	0.00	54,039.22	101.07	18,149.12	0.00	53,959.02	147.16	18,103.03
7.1	1.71	50,862.73	570.14	17,680.05	0.00	52,053.12	580.17	17,670.02	0.00	53,529.34	137.34	18,112.85	0.00	53,118.68	307.92	17,942.27
7.2	1.68	51,384.03	405.31	17,844.88	0.00	52,579.31	406.78	17,843.41	0.00	53,679.22	89.13	18,161.06	0.00	53,415.30	211.67	18,038.52
7.3	1.64	51,856.24	257.66	17,992.53	0.00	53,043.70	255.13	17,995.06	0.00	53,794.41	52.08	18,198.11	0.00	53,666.07	130.41	18,119.78
8.1	1.86	49,110.07	1,111.45	17,138.74	0.00	50,270.75	1,149.40	17,100.79	0.00	51,377.27	701.87	17,548.32	0.00	50,846.12	1,004.11	17,246.08
8.2	1.82	50,135.62	772.05	17,478.14	0.00	51,329.28	796.99	17,453.20	0.00	52,071.06	478.70	17,771.49	0.00	51,817.60	684.73	17,565.46
8.3	1.79	51,023.27	478.01	17,772.18	0.00	52,242.83	493.10	17,757.09	0.00	52,661.83	288.67	17,961.52	0.00	52,642.03	413.20	17,836.99
9.1	1.97	47,324.93	1,690.00	16,560.19	0.00	48,472.67	1,736.20	16,513.99	0.00	49,361.27	1,222.71	17,027.48	0.00	48,820.66	1,637.79	16,612.40
9.2	1.90	48,900.66	1,171.50	17,078.69	0.00	50,079.18	1,204.59	17,045.60	0.00	50,551.20	839.92	17,410.27	0.00	50,316.00	1,154.79	17,095.40
9.3	1.84	50,249.94	726.22	17,523.97	0.00	51,465.97	745.34	17,504.85	0.00	51,562.34	514.65	17,735.54	0.00	51,652.26	720.11	17,530.08
10.1	2.13	45,345.04	2,313.75	15,936.44	0.00	46,467.02	2,378.79	15,871.40	0.00	47,089.83	1,825.92	16,424.27	0.00	47,308.90	1,992.03	16,258.16
10.2	2.03	47,552.10	1,586.44	16,663.75	0.00	48,748.08	1,624.31	16,625.88	0.00	48,829.16	1,266.34	16,983.85	0.00	49,163.28	1,418.94	16,831.25
10.3	1.94	49,389.85	982.21	17,267.98	0.00	50,626.84	1,003.75	17,246.44	0.00	50,333.13	782.47	17,467.72	0.00	50,818.68	902.13	17,348.06

Table 6.8: The results of simulation, $m = 11$

Instances	Single-period Pricing				Two-period Pricing				Multi-period Pricing 2				Multi-period Pricing 3			
	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing	Disposal	Profit	No. leaving	No. purchasing
1.1	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00
1.2	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00
1.3	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00	0.00	10,950.00	14,600.19	3,650.00
2.1	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94
2.2	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94
2.3	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94	0.00	21,899.82	10,950.25	7,299.94
3.1	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.23	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10
3.2	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.23	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10
3.3	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10	0.00	32,847.23	7,301.09	10,949.10	0.00	32,847.30	7,301.09	10,949.10
4.1	0.00	43,566.84	3,727.91	14,522.28	0.00	43,566.84	3,727.91	14,522.28	0.00	43,562.59	3,727.37	14,522.82	0.00	43,566.50	3,727.83	14,522.36
4.2	0.00	43,567.41	3,727.72	14,522.47	0.00	43,567.41	3,727.72	14,522.47	0.00	43,562.59	3,727.37	14,522.82	0.00	43,566.94	3,727.69	14,522.50
4.3	0.00	43,567.95	3,727.54	14,522.65	0.00	43,567.95	3,727.54	14,522.65	0.00	43,562.59	3,727.37	14,522.82	0.00	43,567.41	3,727.54	14,522.65
5.1	0.00	51,539.23	1,069.70	17,180.49	0.00	51,541.68	1,069.11	17,181.08	0.00	51,582.69	1,029.87	17,220.32	0.00	51,561.41	1,048.85	17,201.34
5.2	0.00	51,581.59	1,055.93	17,194.26	0.00	51,582.95	1,055.62	17,194.57	0.00	51,582.76	1,029.85	17,220.34	0.00	51,580.42	1,042.83	17,207.36
5.3	0.00	51,614.56	1,045.08	17,205.11	0.00	51,615.38	1,044.89	17,205.30	0.00	51,582.85	1,029.82	17,220.37	0.00	51,597.14	1,037.54	17,212.65
6.1	0.56	52,885.69	384.91	17,865.28	0.00	53,414.67	347.96	17,902.23	0.00	54,159.32	102.04	18,148.15	0.00	53,982.90	175.36	18,074.83
6.2	0.46	53,251.29	303.76	17,946.43	0.00	53,678.39	273.38	17,976.81	0.00	54,161.91	101.20	18,148.99	0.00	54,056.97	151.63	18,098.56
6.3	0.38	53,564.46	233.32	18,016.87	0.00	53,908.84	208.37	18,041.82	0.00	54,163.48	100.69	18,149.50	0.00	54,126.14	129.51	18,120.68
7.1	1.23	51,885.16	433.31	17,816.88	0.00	52,779.25	436.89	17,813.30	0.00	53,908.52	93.41	18,156.78	0.00	53,613.29	220.15	18,030.04
7.2	1.20	52,335.47	291.91	17,958.28	0.00	53,223.12	290.99	17,959.20	0.00	54,016.34	58.36	18,191.83	0.00	53,847.97	143.40	18,106.79
7.3	1.17	52,731.45	169.53	18,080.66	0.00	53,609.05	165.74	18,084.45	0.00	54,101.58	30.65	18,219.54	0.00	54,045.82	78.74	18,171.45
8.1	1.34	50,636.08	813.55	17,436.64	0.00	51,536.04	832.49	17,417.70	0.00	52,383.83	498.93	17,751.26	0.00	52,013.61	712.81	17,537.38
8.2	1.32	51,477.31	534.05	17,716.14	0.00	52,391.35	546.80	17,703.39	0.00	52,934.89	319.78	17,930.41	0.00	52,787.05	457.14	17,793.05
8.3	1.30	52,195.06	295.15	17,955.04	0.00	53,124.99	302.36	17,947.83	0.00	53,388.76	172.23	18,077.96	0.00	53,421.89	247.12	18,003.07
9.1	1.39	49,361.88	1,231.68	17,018.51	0.00	50,255.10	1,255.53	16,994.66	0.00	50,951.48	874.47	17,375.72	0.00	50,487.78	1,200.07	17,050.12
9.2	1.35	50,637.88	808.82	17,441.37	0.00	51,553.16	824.27	17,425.92	0.00	51,890.07	569.32	17,680.87	0.00	51,725.46	794.55	17,455.64
9.3	1.32	51,720.66	449.62	17,800.57	0.00	52,652.39	458.78	17,791.41	0.00	52,681.62	311.98	17,938.21	0.00	52,793.02	443.56	17,806.63
10.1	1.47	48,004.67	1,666.21	16,583.98	0.00	48,896.15	1,697.15	16,553.04	0.00	49,315.23	1,316.42	16,933.77	0.00	49,422.16	1,471.80	16,778.39
10.2	1.41	49,744.83	1,089.68	17,160.51	0.00	50,670.17	1,107.36	17,142.83	0.00	50,705.68	864.32	17,385.87	0.00	50,930.30	991.66	17,258.53
10.3	1.37	51,200.17	607.46	17,642.73	0.00	52,146.83	617.40	17,632.79	0.00	51,896.65	477.10	17,773.09	0.00	52,269.42	562.87	17,687.32

Table 6.9: The results of simulation, $m = 15$

6.4.2. Discussion of Results

Figures 6.21 to 6.23 illustrate the relationship between annual profits and instances in which m was set at 7, 11 and 15, to show the general trend in the effect of q and simulated consumer needs on the retailers' profitability.

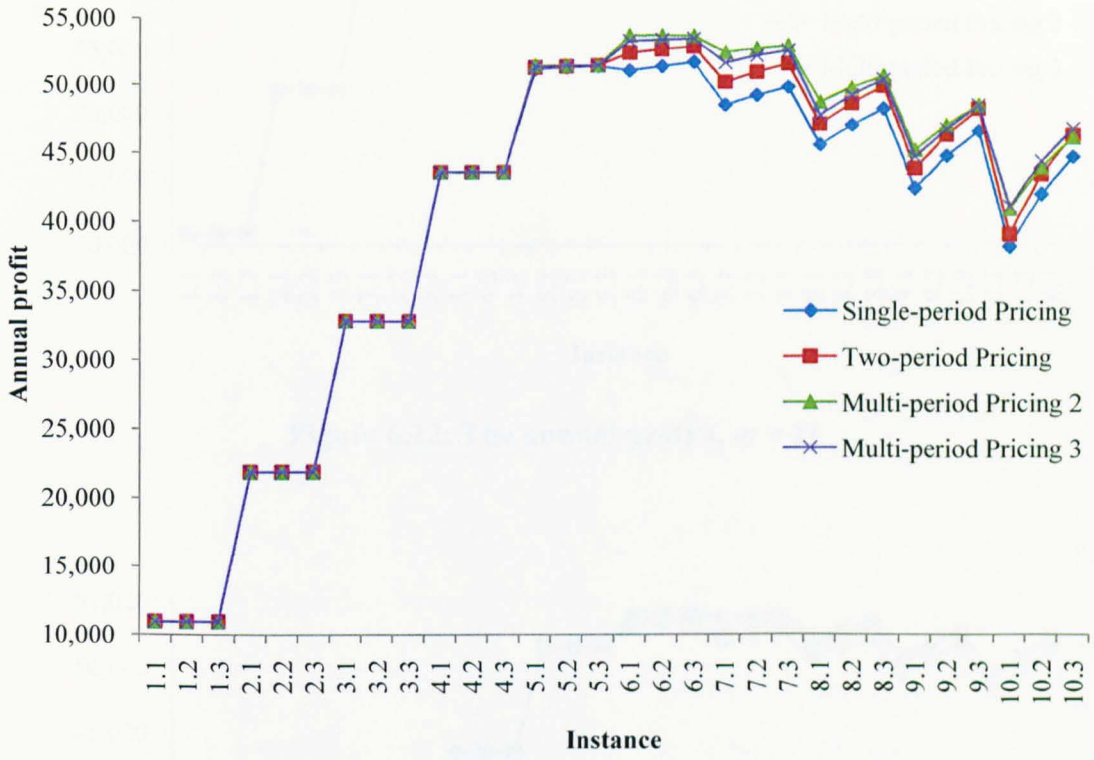


Figure 6.21: The annual profits, m = 7

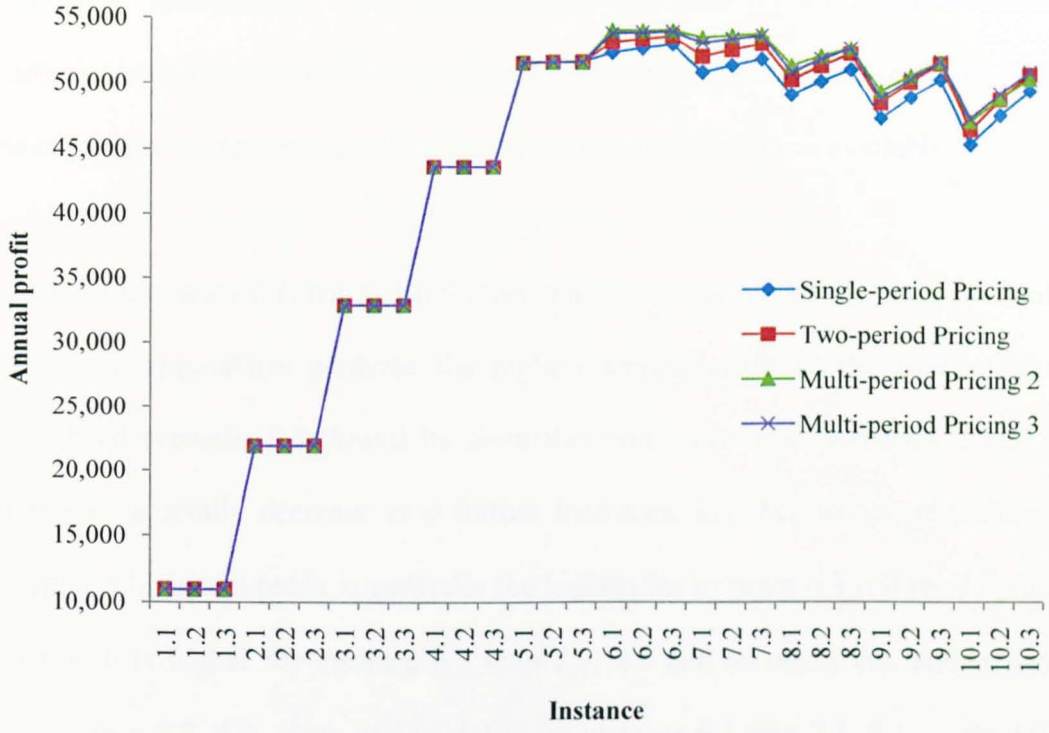


Figure 6.22: The annual profits, $m = 11$

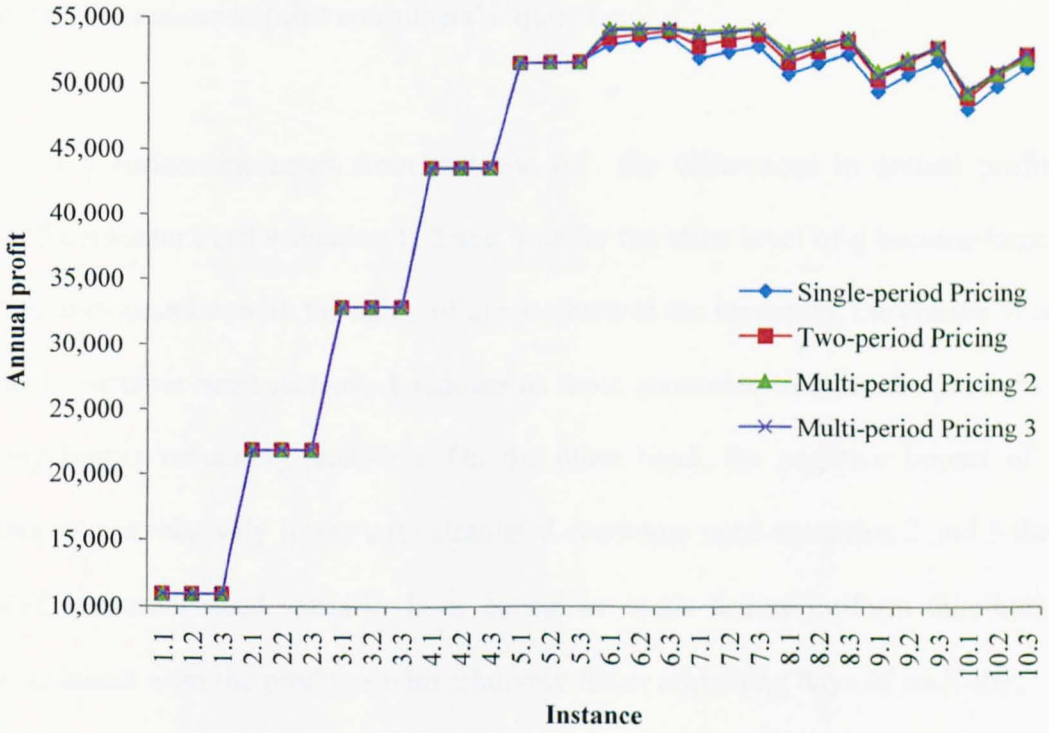


Figure 6.23: The annual profits, $m = 15$

Figures 6.21 through 6.23 show that the effect is similar for the different values of m. Generally, for instances 1.1 to 5.3, annual profits increase as q increases, due to an increased volume of purchasing associated with the greater number of products available.

Results for instances 6.1, 6.2 and 6.3 show that, generally, under the same level of q, the chosen pricing approaches generate the highest annual profit in the case of simulated consumer need scenario *3* followed by simulated consumer need scenarios 2 and 1. And annual profits generally decrease as q further increases. In other words, regardless of the pricing approach, annual profit is generally the highest for instance 6.3 followed by instances 6.2 and 6.1. It is higher for instance 6.3 than 7.3, 8.3 and so on..., etc. and is higher for instance 6.2 than 7.2, 8.2..., etc. and is higher for instance 6.1 than 7.1, 8.1..., etc. Likewise, annual profits are envisaged to be higher when more consumers accept the products with a relatively shorter remaining shelf-life, associated with significantly increased purchasing as there are more chances to fulfil consumers' required c.

And as q further increases from instance 6.1, the differences in annual profits with simulated consumer need scenarios 1, 2 and 3 under the same level of q become larger. As q increases in association with the aging of the products in the inventory, the chance of meeting simulated consumer need scenario 1 reduces as more consumers require the products with a relatively longer remaining shelf-life. On the other hand, the negative impact of further increases in q is relatively lower with simulated consumer need scenarios 2 and 3 than with simulated consumer need scenario 1, as consumer needs follow uniform distribution and more consumers want the products with relatively fewer remaining days of shelf-life.

To show the prospective impacts of different pricing approaches in relation to the present

prevailing pricing strategy, two-period pricing, the differences in annual profit between two-period pricing and the other pricing approaches are illustrated in Figures 6.24 to 6.26. The profit differences in percentage between Two-period pricing and Single-period pricing, between Two-period Pricing and Multi-period Pricing 2, and between Two-period Pricing and Multi-period Pricing 3 are referred to as gaps 1, 2 and 3 respectively in Figures 6.24 through 6.26. The x and y axes in Figures represent the percentage difference and the instance, respectively.

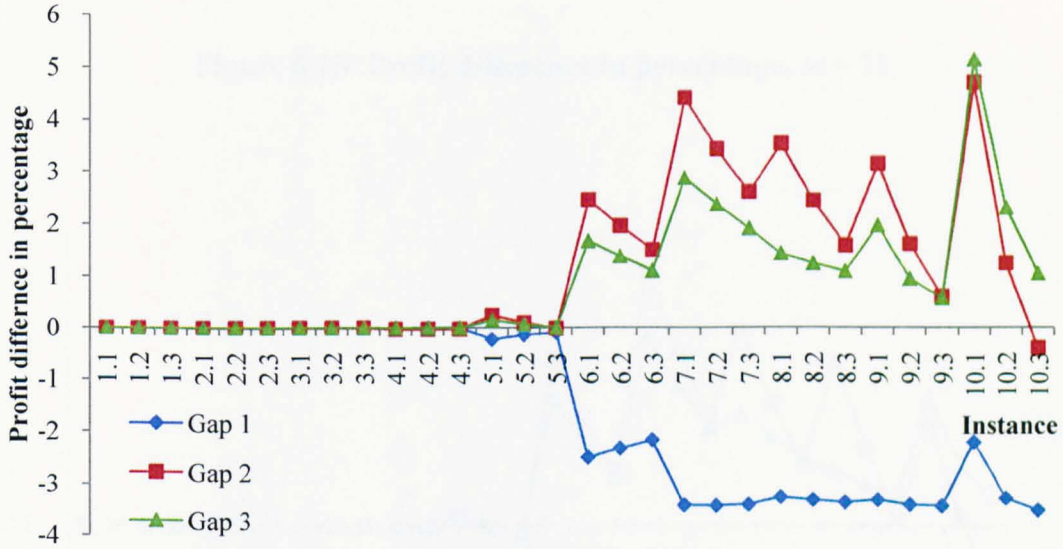


Figure 6.24: Profit difference in percentage, $m = 7$

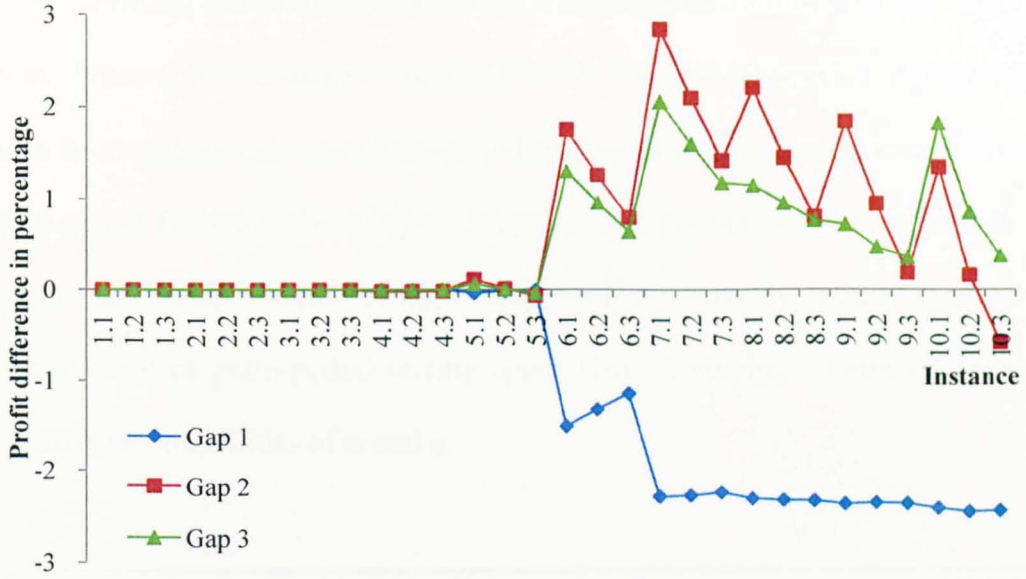


Figure 6.25: Profit difference in percentage, m = 11

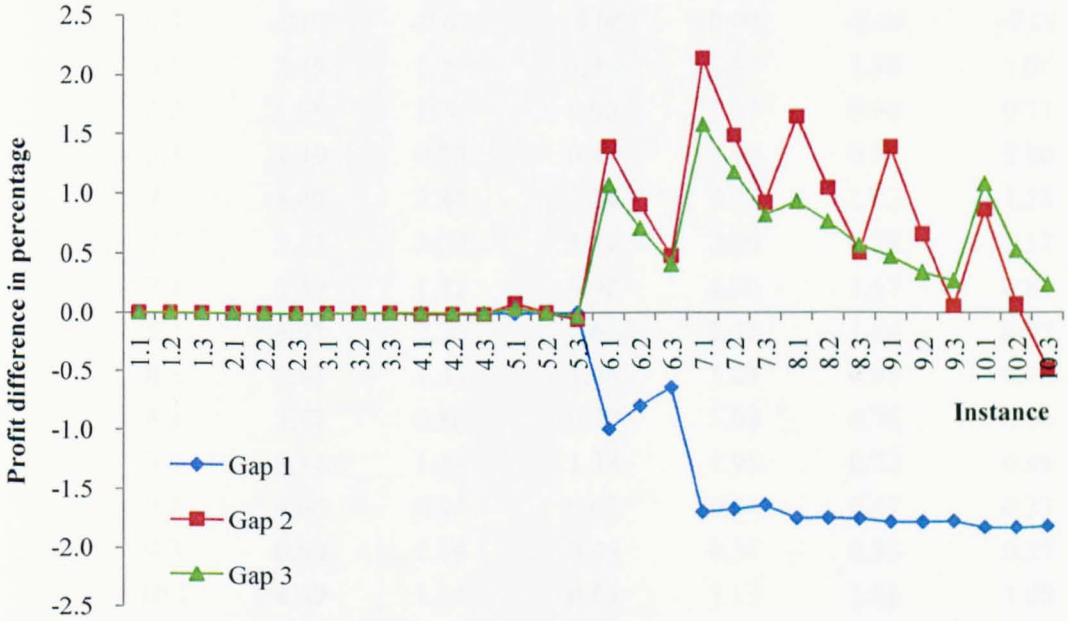


Figure 6.26: Profit difference in percentage, m = 15

In terms of profitability, when q is under-targeted ($q \in \{10, 20, 30, 40\}$), generally, it can be seen that the performance of different pricing strategies is similar. When q is nearly optimal ($q \in \{50, 60, 70\}$), Multi-period Pricing approaches generally perform better than

Two-period Pricing, and Multi-period Pricing 2 outperforms Multi-period Pricing 3 in many instances. When q is over-targeted ($q \in \{80, 90, 100\}$), Multi-period Pricing approaches appear to be more beneficial than Two-period Pricing in every instance, except instance 10.3 for Multi-period Pricing 2 for every m. Single-period Pricing is not beneficial in terms of profitability comparing to other pricing strategies when q is nearly optimal and over-targeted. The performance of multi-period pricing approaches comparing two-period pricing varies against different possibilities of m and q.

	% increase in the retailer's profit over Two-period Pricing					
	Multi-period Pricing 2			**Multi-period Pricing 3**		
Instance	$m = 7$	$m = 11$	$m = 15$	$m = 7$	$m = 11$	$m = 15$
5.1	0.24	0.12	0.08	0.15	0.07	0.04
5.2	0.09	0.02	0.00	0.06	0.01	0.00
5.3	*-0.02*	*-0.07*	*-0.06*	0.00	*-0.04*	*-0.04*
6.1	2.45	1.75	1.39	1.67	1.30	1.06
6.2	1.95	1.26	0.90	1.37	0.94	0.71
6.3	1.49	0.80	0.47	1.10	0.65	0.40
7.1	4.40	2.84	2.14	2.87	2.05	1.58
7.2	3.42	2.09	1.49	2.36	1.59	1.17
7.3	2.59	1.42	0.92	1.90	1.17	0.81
8.1	3.52	2.20	1.65	1.42	1.14	0.93
8.2	2.43	1.45	1.04	1.23	0.95	0.76
8.3	1.57	0.80	0.50	1.08	0.76	0.56
9.1	3.14	1.83	1.39	1.95	0.72	0.46
9.2	1.60	0.94	0.65	0.94	0.47	0.33
9.3	0.60	0.19	0.06	0.57	0.36	0.27
10.1	4.69	1.34	0.86	5.13	1.81	1.08
10.2	1.23	0.17	0.07	2.29	0.85	0.51
10.3	*-0.40*	*-0.58*	*-0.48*	1.04	0.38	0.24

Table 6.10: Percentage increase in profit by employing Multi-period Pricing approaches over Two-period Pricing

These results in Table 6.10 imply that, between Multi-period Pricing approaches, Multi-

period Pricing 2 outperforms Multi-period Pricing 3 in many instances. Furthermore, it is seen that the positive impacts of adopting Multi-period Pricing approaches on retailer profitability are stronger for a product type that has a relatively shorter shelf-life, and when more consumers accept products with relatively longer remaining shelf-life.

In addition, Figures 6.27 through 6.29 illustrate that the Multi-period Pricing 2 strategy generally sells highest number of products.

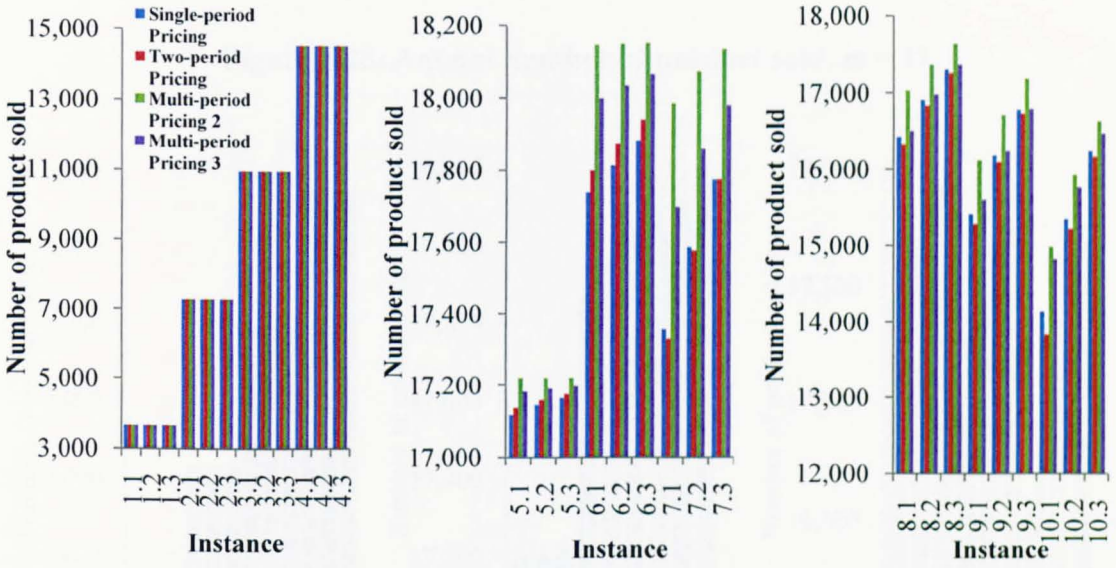


Figure 6.27: Annual number of product sold, $m = 7$

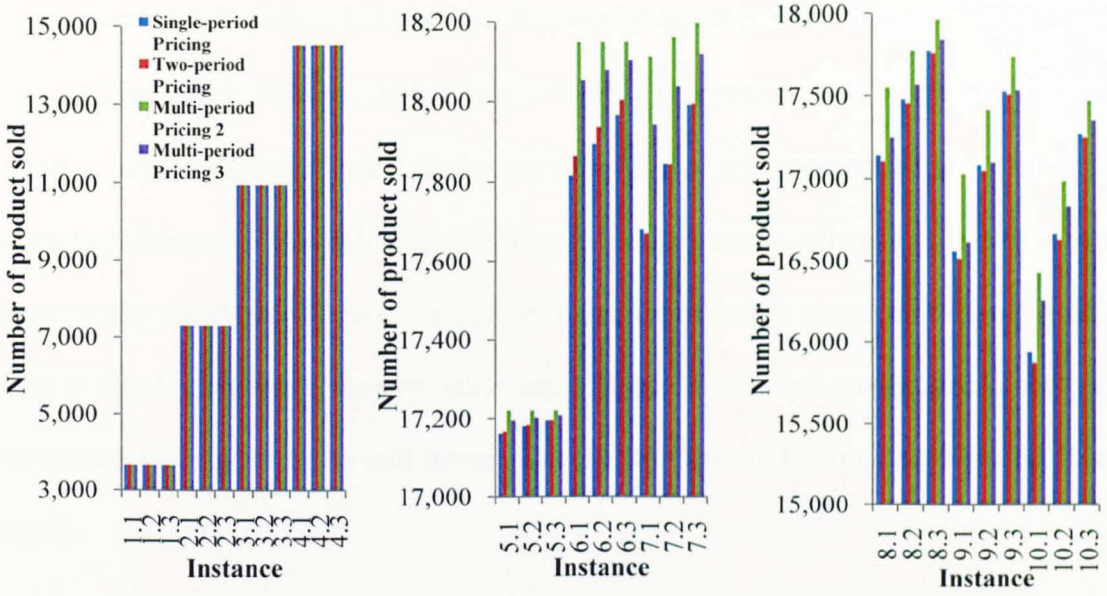


Figure 6.28: Annual number of product sold, $m = 11$

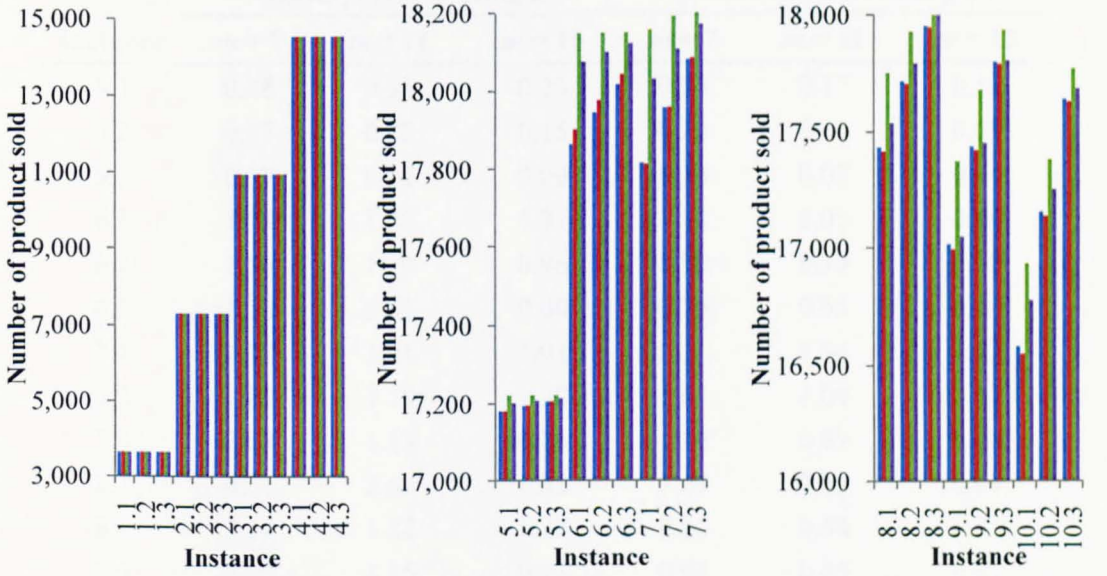


Figure 6.29: Annual number of product sold, $m = 15$

When, q is under-targeted ($q \in \{10, 20, 30, 40\}$), the different pricing strategies generally produce a similar number of products sold annually. When q is nearly optimal ($q \in \{50, 60, 70\}$), the number of product sold is generally the highest with Multi-period Pricing 2, followed by Multi-period Pricing 3, Two-period Pricing and Single-period Pricing, in that order. When q is over-targeted ($q \in \{80, 90, 100\}$), the number of products sold is generally

the highest with Multi-period Pricing 2, followed by Multi-period Pricing 3, Single-period Pricing and Two-period Pricing, in that order. When q is over-targeted, Single-period Pricing generated a large volume of wastage due to unsold products, comparing to other pricing strategies (see Tables 6.7 through 6.9), resulting in an increased number of orders to suppliers to replenish the target stock level. As before, these extra orders made more fresh products available at the display shelf, thereby achieving a higher number of products sold comparing to Two-period Pricing, but it is still lower than the number sold using Multi-period Pricing Strategies.

	% increase in the number of product sold over Two-period Pricing					
	Multi-period Pricing 2			**Multi-period Pricing 3**		
Instance	$m = 7$	$m = 11$	$m = 15$	$m = 7$	$m = 11$	$m = 15$
5.1	0.48	0.32	0.23	0.25	0.17	0.12
5.2	0.37	0.22	0.15	0.19	0.11	0.07
5.3	0.27	0.14	0.09	0.14	0.07	0.04
6.1	1.94	1.59	1.37	1.12	1.05	0.96
6.2	1.54	1.19	0.96	0.90	0.79	0.68
6.3	1.18	0.81	0.60	0.70	0.55	0.44
7.1	3.77	2.51	1.93	2.11	1.54	1.22
7.2	2.82	1.78	1.30	1.61	1.09	0.82
7.3	2.03	1.13	0.75	1.16	0.69	0.48
8.1	4.31	2.62	1.92	1.09	0.85	0.69
8.2	3.14	1.82	1.28	0.86	0.64	0.51
8.3	2.23	1.15	0.73	0.68	0.45	0.31
9.1	5.46	3.11	2.24	2.07	0.60	0.33
9.2	3.80	2.14	1.46	0.89	0.29	0.17
9.3	2.69	1.32	0.83	0.40	0.14	0.09
10.1	8.26	3.48	2.30	7.12	2.44	1.36
10.2	4.71	2.15	1.42	3.63	1.24	0.67
10.3	2.89	1.28	0.80	1.88	0.59	0.31

Table 6.11: Percentage increase in sales volume by employing Multi-period Pricing over Two-period Pricing

As shown in Table 6.11, it is worthy to notify that the positive impact of adopting Multi-

period Pricing approaches on retailer sales volume is expected to be stronger than that of Two-period Pricing for a product type that has a relatively shorter shelf-life, and when more consumers accept products with relatively longer remaining shelf-life.

To show the expected impacts of different pricing approaches in relation to the most widely used strategy, Two-period Pricing, on wastage due to unsold products, Figure 6.30 to 6.32 show the differences in annual rate of disposal due to unsold. Differences in annual rate of disposal due to unsold products (annual rate of disposal due to unsold of Two-period Pricing minus annual rate of disposal due to unsold of the another pricing approach) between Two-period Pricing and Single-period Pricing, between Two-period Pricing and Multi-period Pricing 2, and between Two-period Pricing and Multi-period Pricing 3 are referred to as gaps 1, 2 and 3 respectively in the Figures. The x and y axes represent the difference in annual rate of disposal due to unsold and the instance.

Figure 6.30: The disposal gaps, $m = 7$

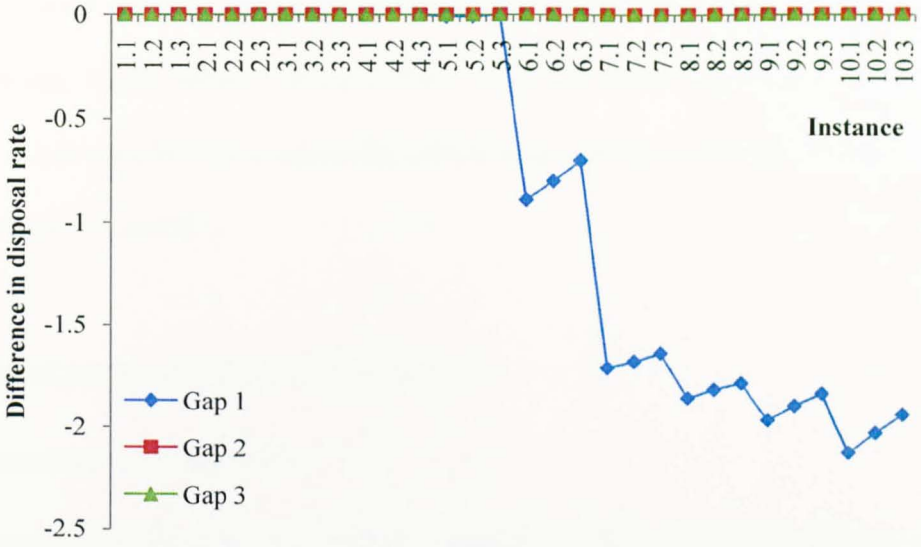


Figure 6.31: The disposal gaps, *m* =11

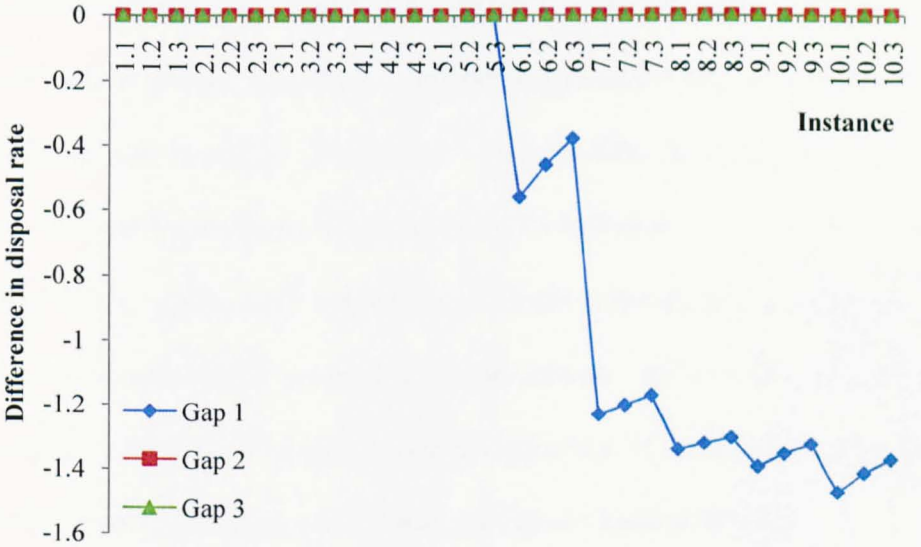


Figure 6.32: The disposal gaps, *m* =15

The results show that when q is under-targeted ($q \in \{10, 20, 30, 40\}$), it can be seen that the performance of different pricing strategies is similar in the volume of waste which is a result of unsold expired products. When q is nearly optimal ($q \in \{50, 60, 70\}$) or over-targeted ($q \in \{80, 90, 100\}$), the Single-period Pricing policy is not efficient in reducing

perishable foods waste comparing Two-period Pricing under every instance. Since, Two-period Pricing, Multi-period Pricing 2 and 3 generate equal annual rate of disposal due to unsold, it is not possible to compare the effectiveness of those pricing strategies with respect to wastage due to unsold.

6.5. SUMMARY AND DISCUSSION

6.5.1. Summary of Results

This chapter has explored the probable impacts of different pricing strategies on retailer performance, which enabled to compare the performance of more dynamic pricing to that of the present less dynamic pricing. A simulation model was designed and executed to evaluate the comparative effects on retailer performance of single and Two-period Pricing, as examples of present pricing approaches, and Multi-period Pricing approaches as examples of the more dynamically managed alternatives. In modelling the simulation, an assumption of need-driven demand was made, which expects to introduce a new insight into consumer demand that will be particularly applicable to future research into the pricing of perishable foods. The analytical results presented in this chapter provide answers to the research questions stated in Chapter 1 relating to the effectiveness of more dynamic pricing compared with the present less dynamic practice, from the retailer's point of view.

The findings from the simulation can be summarised as follows. When consumer needs followed normal distribution, Single-period Pricing was generally the least efficient among the various pricing approaches evaluated in this thesis, in terms of profitability and wastage due to unsold stock, when the target stock level was nearly optimal and over-targeted. When the target stock level was under-targeted considering the forecasted average daily demand, the performance of different pricing strategies was similar. When the target stock level was

nearly optimal, generally, Multi-period Pricing approaches were more profitable in comparison to Two-period Pricing in many instances; Multi-period Pricing 3 outperformed Multi-period Pricing 2 in most instances. In addition, the positive impacts of adopting Multi-period Pricing approaches on retailer profitability were stronger for a product type that has a relatively shorter shelf-life. With respect to the annual rate of disposal due to unsold, Multi-period Pricing approaches were expected to reduce wastage more effectively than Two-period Pricing.

When consumer needs were simulated under the three given conditions, generally Single-period Pricing was the least efficient strategy, when the target stock level was nearly optimal and over-targeted, among other pricing strategies in this thesis. The three conditions were that more consumers sought products with relatively more shelf-life left, that more sought those with relatively less, and that such needs follow uniform distribution. When the target stock level was under-targeted considering the forecasted average daily demand, the performance of different pricing strategies was similar. When the target stock level was under-targeted or over-targeted, generally, it could be seen that Multi-period Pricing approaches appeared to be more profitable in comparison to Two-period Pricing. Between the two Multi-period Pricing approaches, version 2 outperformed version 3 in many instances. With respect to the annual rate of wastage due to unsold, Single-period Pricing was not efficient in reducing wastage comparing to Two-period Pricing. And the performance of Two-period Pricing and Multi-period Pricing approaches in terms of wastage was not comparable since those pricing strategies generate equal annual rate of disposal due to unsold.

When the target stock level was under-targeted, the performance of different pricing strategies was similar with regards to the annual number of product sold. When the target

stock level was nearly optimal, the annual number of product sold was generally the highest with Multi-period Pricing 2, followed by Multi-period Pricing 3, Two-period Pricing and Single-period Pricing. And, when the target stock level was over-targeted, the number of product sold was generally the highest with Multi-period Pricing 2, followed by Multi-period Pricing 3, Single-period Pricing and Two-period Pricing.

6.5.2. Managerial Implications

The findings in this study provide important practical implications for food retailers, as follows: when the retailer under-estimates the target stock level, considering the average number of consumers expected to visit the store, the retailer's performance using any of the pricing strategies is similar in terms of profitability, wastage due to unsold products, and sales volume. This finding suggests that more dynamic discounting for perishables may not need to be considered for (1) small retail stores (e.g., convenience stores, and small retail food stores in the city centre) who keep relatively small amounts of perishable foods in stock comparing to the number of consumers expected to visit, or (2) such specific perishable foods that are so popular that demand normally exceeds the amount of stock in retail stores. However, the less dynamic pricing strategy may not be beneficial for retailers when the stock level, considering the anticipated demand, is nearly optimal or over-targeted.

For food retailers who predict the demand for their perishable foods more accurately and thereby keep the stock level nearly optimal, more dynamic pricing strategies for perishable foods may improve their business performance. The simulation results reported in this chapter shows that more dynamic pricing strategies, as compared to the present less-dynamic Single-period Pricing or Two-period Pricing, may improve the profitability for perishable foods when the target stock level is close to optimal in terms of customer demand. For the

products that more consumers requiring the product with at least the median number of days of the product's full shelf-life remaining before expiration, decreasing the price at two-day intervals may improve the profitability more than decreasing it as each remaining day passes. For the three types of products it may improve profitability more to decrease the price as each remaining day passes, rather than decrease the price at two-day intervals: (1) products that more consumers demand relatively more days of shelf-life remaining (e.g. large package size products), (2) products that more consumers accept fewer days of shelf-life remaining (e.g. small package size products that should be consumed immediately), and (3) products that consumers uniformly demand regardless of the remaining shelf-life,. Therefore, retailers should let their particular business circumstances determine whether to decrease the price as each remaining day passes until the expiry date, or to decrease it at two-remaining day intervals. The positive impacts of employing Multi-period Pricing Strategies on retailer profitability are stronger for a product type that has a relatively shorter shelf-life.

For food retailers who frequently fail to predict demand for perishable foods accurately and whose stock level is relatively over-targeted, more dynamic pricing strategies may or may not increase their profitability. For products that more consumers requiring the product with at least the median number of days of the product's full shelf-life remaining, decreasing the price as each remaining day passes is likely not beneficial, while decreasing the price at two-day intervals may improve performance comparing the present less dynamic pricing that discounts the price of product only one time when its expiry date is imminent. For the products that (1) more consumers accept for a product with relatively more days remaining on their shelf-life, (2) with fewer remaining days, and (3) consumers uniformly demand regardless of the remaining shelf-life, decreasing the price at two-day intervals over the shelf-life may be more beneficial than decreasing the price as each remaining day passes. Both

strategies outperform the present less-dynamic Single-period Pricing and Two-period Pricing, and the positive impacts of employing Multi-period Pricing Strategies are stronger for a product type that has a relatively shorter shelf-life and when more consumers accept products with relatively longer remaining shelf-life

The profitability is highly sensitive to the actual discount rate. Therefore the results reported in this chapter might vary with different discounts. Food retailers, however, can expect an increase in the number of product sold when they more frequently adjust (decrease) the price during the product's shelf-life, where the stock level is nearly optimal or the perishable stock is over-targeted against the demand. It is also expected that the positive impacts of employing Multi-period Pricing Strategies, in terms of number of product sold, are stronger when a product type has a relatively shorter shelf-life and consumers accept products relatively longer remaining shelf-life

In terms of reducing wastage due to unsold products, the results in this study suggest that employing more dynamic pricing strategies, food retailers may expect a lower level or at least the same level of wastage, in relation to the present pricing strategies. Unfortunately, the results in this chapter could not clearly identify the impact of more dynamic pricing on wastage due to unsold products, because with the simulated consumer need scenarios, Two-period Pricing and Multi-period Pricing Strategies 2 and 3 generated no wastage due to unsold products. However, the probable impact of the frequency of decreasing price during the product's shelf-life on wastage due to unsold can be anticipated by reviewing more detailed results of a particular instance as an example.

Remaining days of shelf-life at the point of purchase	Annual Number of product sold		
	Two-period Pricing	Multi-period Pricing 2	Multi-period Pricing 3
7	15,950	14,396	15,643
6	1,172	3,745	816
5	109	0	1,536
4	58	0	0
3	27	0	0
2	471	0	0
1	6	0	0

Table 6.12: Annual number of product sold against remaining days of shelf-life at the point of purchase, $m = 7$, $q = 60$, simulated consumer need scenario 1

Table 6.12 presents information about how many products were sold against different remaining days of shelf-life at the point of purchase, where $m = 7$ and $q = 60$ under simulated consumer need scenario 1 in the simulation. The results indicate that with Multi-period Pricing 2, all of the products were sold with 7 or 6 remaining days of shelf-life, which indicates that products only experienced two days of aging before consumers purchased them. With Multi-period Pricing 3, all of the products were sold with 5 or more remaining days of shelf-life, whereas with Two-period Pricing, products were sold with up to 1 remaining day of shelf-life. Therefore, it can be said that more dynamic pricing helps to mitigate aging of the inventory, by virtue of the more efficient selling process under the given demand assumptions. The lowest level of inventory aging is experienced with Multi-period Pricing 2, followed by Multi-period Pricing 3 and Two-period Pricing. This leads to the expectation that decreasing the prices of perishable foods more frequently until the expiry date, may reduce the food retailers' wastage due to the unsold products.

In addition, based on Table 6.12, the annual number of products sold is the largest with Multi-period Pricing 2, followed by Multi-period Pricing 3 and then Two-period Pricing at

18,141, 17,995 and 17,793, respectively. With the pricing rules outlined in Table 6.1, the calculated revenue achieved by Multi-period Pricing 2 is [(14,396 × 10) + (3,745 × 9.81)] = 180,698.5; that generated by Multi-period Pricing 3 is [(15,643 + 816) × 10 + (1,536 × 9.56)] = 179,274.2; and that generated by Two-period Pricing is [(15,950 + 1,172 + 109 + 58 + 27) × 10 + (471 + 6) × 8] = 176,976. These result in generating the highest profit with Multi-period Pricing 2, followed by Multi-period Pricing 3 and Two-period Pricing, as shown in Table 6.7. The profitability is very sensitive to discounts, therefore these results may vary if different discounts were applied, however by setting d_s as equal to ($d \times r$), this study reveals that adopting a more dynamic price management can be beneficial as this is associated with higher sales volumes.

CHAPTER SEVEN

CONCLUSIONS

7.1. INTRODUCTION

This chapter draws overall conclusions of this thesis by discussing the findings and contributions of the studies, and the strategic advantages and disadvantages of implementing more dynamically managed pricing methods, from the perspectives of retailers, consumers and food suppliers. It lastly discusses the limitations and recommends directions for future research.

7.2. CONTRIBUTION TO KNOWLEDGE

The main purpose of this thesis is to assess the probable impacts on consumers' perceptions and retailers' performance of employing more-dynamic pricing strategies for perishable foods, compared with the present less-dynamic pricing strategies. As discussed in Chapter 2, the literature suggests numerous dynamic pricing strategies to maximize the performance of retailers in selling perishable products under various demand assumptions. These studies have not, however, considered the impacts of dynamic pricing strategies from the consumers' point of view and consumer demand responding to a situation where identical food products having different remaining shelf-lives available at the same time and are offered at different prices.

The present management practice for perishable food retailing in South Korea was identified in Chapter 4, through conducting in-depth interviews with food retailers. Chapter 4 started by presenting the background of the food retail industry in South Korea, and in-depth

interviews with food retailers assisted in collecting practical information relevant to the design of consumer survey and simulation modelling to achieve the objectives of this thesis.

In Chapter 5, five hypotheses were developed to explain the potential benefits of more dynamic pricing strategies comparing to the present less dynamic pricing for food retailers from the consumers' point of view. Two examples of such more dynamic approaches were designated 'Multi-period Pricing 1' and 'Multi-period Pricing 2', both of which envisage discounting the prices as each day of shelf-life passes. The Multi-period Pricing Strategy 1 is to alter the price on the basis of the more accurate enumeration of the number remaining days made possible by improved traceability systems, whereas Multi-period Pricing 2 simply operates on the basis of a pre-determined period of shelf-life. 'Two-period Pricing', in which prices are discounted when the end of the selling period is judged to be imminent, was used as an example of the less dynamic present pricing approach.

Table 5.15 presented the summary results of hypotheses testing, which demonstrated that the five research hypotheses can be partially or fully supported when they are tested with respect to product categories. On the other hand, all but Hypothesis 1 are not supported when they are tested with respect to product types within each category. The results of hypotheses testing demonstrated that the level of satisfaction with Multi-period Pricing is significantly higher than the level of satisfaction with Two-period Pricing, implying that retailers can expect greater customer satisfaction as a result of dynamically managed pricing strategies that more systematically compensate the loss of value as each remaining day of shelf-life passes. Also, consumers showed greater interest in and satisfaction with Multi-period Pricing 1 than Multi-period Pricing 2, since it provides more accurate shelf-life information, which potentially reduces concerns regarding the freshness and safety of perishable foods and

thereby enhances the level of willingness to make trade-offs between price and remaining shelf-life.

In general, the results described in Chapter 5 indicate that, generally:) (i) the level of satisfaction with Two-period Pricing will be higher for a product category in which the level of satisfaction with freshness lower; (ii) the level of satisfaction with Multi-period Pricing will be higher for a product category in which satisfaction with Two-period Pricing is lower; (iii) the level of interest in Multi-period Pricing will be higher for a product category in which levels of satisfaction with Two-period Pricing and Multi-period Pricing are respectively lower and higher; and (iv) customers' willingness to trade-off price against shelf-life will be higher for a product category in which satisfaction with Two-period Pricing is lower, and both satisfaction with and interest in Multi-period Pricing are higher. These identified relationships among those variables have the potential to provide retailers with an opportunity to evaluate how the impact of Multi-period Pricing varies across different product categories.

The findings of the field interviews with three fresh-food retail managers and 1,980 shoppers, reported in Chapter 5, are expected to be useful as guidelines for retailers aiming to implement a more dynamically managed pricing strategy, helping them to identify product categories that would be particularly amenable to such an approach, and to better understand its impact on consumers' interest in pricing, their willingness to trade-off price against remaining shelf-life, and their satisfaction. The findings are the first step in measuring the value of more dynamically managed pricing strategies, from the consumer perspective. This study provides a new insight into the influence of a discounting policy on selling the relevant category of perishable products.

The results of the simulation study, presented in Chapter 6, compare the effectiveness of more dynamically managed pricing approaches with less dynamic present pricing approaches, from the retailer's point of view with particular respect to profitability, wastage and number of product sold. Multi-period Pricing 2 and 3 represented the more dynamic options, Multi-period Pricing 3 discounting the prices of the perishable foods at two-day intervals. Both Two-period Pricing and Single-period Pricing (a strategy that does not change the price at all during the selling period) represented the present approaches. The simulation model was built on data collected by interview from the retail managers, to model the actual and proposed business process in the retail food stores.

The findings suggest that, generally, when the target stock level is under-targeted considering the forecasted average daily demand, the performance of different pricing strategies is similar. Single-period Pricing is the least efficient pricing approach among the different pricing approaches examined in this thesis, for retailer performance,

When consumer needs follow normal distributions, Multi-period Pricing 3 generally produced the highest profits, followed by Multi-period Pricing 2, Two-period Pricing and Single-period Pricing, so long as the target stock level is nearly optimal against the forecasted average daily demand. When the target stock level is over-targeted against the average daily demand, Multi-period Pricing 3 again generally produced the highest profits, followed by Two-period Pricing, Multi-period Pricing 2 and Single-period Pricing. In contrast, Multi-period Pricing 2 generally produced the highest profits, followed by Multi-period Pricing 3, Two-period Pricing and Single-period Pricing when (1) more consumers wanted the products with relatively more days of shelf-life remaining, (2) more consumers wanted the products with relatively fewer days left, and (3) consumer needs follow uniform distributions, when

the target stock level is nearly optimal. And it is expected that the positive impacts of employing Multi-period Pricing are relatively stronger for a product type that has a relatively shorter shelf-life, and more consumers accept products with relatively longer remaining shelf-life for purchasing. In a general view of the above findings, the results indicate that decreasing the price more frequently (in a way that consumers can recognise significant trade-off benefits from the price differentiation) as the product approaches its expiry date can increase the sales volume. In terms of the waste due to unsold products, Multi-period Pricing produces a lower level of wastage, or at least the same level of wastage, compared to Two-period Pricing.

This thesis compares the performance of different pricing strategies under conditions of need-driven consumer demand, in which identical products having different values and, consequently, different prices exist simultaneously. This pricing scenario has rarely been considered in the literature; therefore this study provides a new insight into a demand scenario that should be considered in management of the pricing of perishable foods.

7.3. RELATIONSHIPS OF THE FINDINGS AND IMPLICATIONS AMONG INTERVIEWS, FORMAL SURVEYS AND SIMULATION

In-depth interviews with three food retailers in South Korea provided the detailed practical information about the management of perishable foods. The key findings from the interviews indicate that discounting policies for perishable foods are similar, which in general discount the prices of perishable foods during the last few days of the product's shelf-life, and the findings also indicate that most perishable foods are replenished on a daily basis. The combination of the present discounting policies and daily replenishment of perishable foods may often make it difficult for retailers to avoid a situation in which the display stock of a

particular item has the same price but different expiry date. As a result, the interviewed managers stated that up to 5% of perishable foods are disposed as a result of being unsold by their expiry date, which indicates the need for employing more dynamic pricing approaches.

The interviewed managers provided valuable information that was used as input into the design of the formal surveys and simulation model. Identification of perishable foods closely related to wastage due to being unsold by their expiry date and the discounting policy for perishable foods assisted in selecting the sample product types for questionnaires and these were used to provide survey respondents as an example of the present less dynamic pricing. In addition, the practical information about the present discounting policy, profit margin, display-shelf management and inventory replenishment management for perishable foods was used as a basis for building the simulation model to imitate the present business processes in food retail stores.

The findings from formal surveys testing the hypotheses provide significant implications. Food retailers can enhance customer satisfaction, an important factor influencing business performance, by offering an earlier but smaller discount. They can furthermore expect the impacts of more dynamic pricing strategies to be more positive when general satisfaction with freshness of a product category and with the present discounting strategy are both lower. Retailers might also usefully consider applying more dynamic discounting to products that attract a higher number of complaints about price and freshness. The findings from formal surveys provide showed the value of more dynamic pricing strategies, from consumers' perspective. However, they could not show the value of the strategies in terms of retailer performance by taking into account the possible transformation of consumers' purchasing behaviour enabled by providing better trade-off options between price and remaining shelf-

life.

Accordingly, a simulation study was conducted to show how more dynamic pricing strategies affect the retail operation's performance. The simulation-based study in this thesis provides the evaluation of the impacts of more dynamic pricing strategies on retailers' performance, which have not been examined by a survey-based study. The findings imply that more dynamic pricing strategies may improve the profitability, increase sales volume and reduce wastage due to unsold products for perishable foods, compared with the present less dynamic pricing strategies.

7.4. ADVANTAGES AND DISADVANTAGES OF MORE DYNAMIC PRICING APPROACHES

In this section, the generic potential advantages and disadvantages of employing Multi-period Pricing approaches are discussed, on the basis of the literature review and findings of the fieldwork, mainly from the retailer's perspective, but also from those of consumers and food suppliers.

7.4.1. Advantages for Retailers

The results reported in Chapter 5 suggest that customer satisfaction with Multi-period Pricing is greater than their satisfaction with Two-period Pricing, where perishable food products are concerned. As greater satisfaction lead to greater productivity (Anderson and Sullivan 1993; Bolton 1998; Fornell 1992; Jones and Reynolds 2006; Juhl et al. 2002), the potential value added by Multi-period Pricing would be significant. The potential value added would be particularly significant if Multi-period Pricing 1 were applied, since the satisfaction level was found to be statistically greater than with Multi-period Pricing 2. Retailers can

expect higher positive impact of Multi-period Pricing for a product category where satisfaction with freshness and the present markdown strategy is lower. Retailers may need to consider using more dynamic price management for products that receive a higher number of complaints regarding pricing and freshness.

The results in Chapter 5 also suggest that Multi-period Pricing is expected to ameliorate customer' attitudes with respect to perishable food products, and thereby attract more customers into a store. This would provide the conditions for increased sales of non-perishables and other grocery goods as well, when consumers visiting a retail store to buy the perishable items take the opportunity to shop for other needs.

The simulation tests reported in Chapter 6 suggest that the multi-period option is expected to be more likely to reduce the wastage of unsold stock than the most widely practised pricing approach for perishable foods. In terms of profitability, under the given need-driven demand assumptions, Multi-period Pricing approaches would be beneficial when retailers could accurately estimate daily sales volumes, since it has been found that Multi-period Pricing approaches generate higher annual profits in many instances when the amount of stock held is nearly optimal and over-targeted.

It is also noteworthy that every tonne of food waste generates 4.5 tonnes of CO_2 (Wrap 2008). The reduced volume of disposal achieved by Multi-period Pricing thus not only has the potential to increase profitability in certain circumstances, but can also contribute to a positive corporate image by demonstrating a reduction in a retailer's carbon footprint.

Furthermore, the advanced traceability system described in Chapter 2 offers considerable

opportunities for Multi-period Pricing 1 to further improve business performance, by: reducing waste due to spoilage in transit to the retailer by closer collaboration with suppliers; reducing labour costs; improving the accuracy of quality tracking; and improving the management of product recall (Jansen-Vullers et al. 2003; Karkkainen 2003; Kelepouris et al. 2007; Koutsoumanis et al. 2005; Regattieri et al. 2007; Sahin et al. 2007). The benefits deliverable by a traceability system are affected by a number of factors, leading Golan et al. (2004, p.11) to enumerate the following six propositions to be taken into account when planning and using such a system: "the higher the value of coordination along the supply chain, the larger the benefits of traceability for supply-side management; the larger the market, the larger the benefits of traceability for supply side management, safety and quality control; the higher the value of the food product, the larger the benefits of traceability for safety and quality control; the higher the likelihood of safety and quality failures, the larger the benefits of reducing the extent of failure with traceability systems for safety and quality control; the higher the penalty for safety or quality failures, where penalties include loss of market, legal expenses, or government-mandated fines, the greater the benefits of reducing the extent of safety or quality failures with traceability".

To sum up, the general potential advantages of adopting Multi-period Pricing are the expectation of achieving higher annual profits, increase in sales volume and lower wastage, compared with a present two-period or single-period pricing approach, as well as positive consumer attitudes, and the potential added value achieved by the advanced traceability systems for Multi-period Pricing 1.

7.4.2. Disadvantages for Retailers

The major weakness of the Multi-period Pricing approaches can be the costs of

implementation. First of those might be the potentially increased operating costs of hiring additional sales staff and producing the number of price labels required to cater for alteration of the price of perishables at daily or two-day intervals. The latter would of course depend on the size and daily inventory turnover, and each retailer needs to find an efficient way to reduce the specific cost implications of frequent price changes.

Retailers need to consider the costs of implementing an advanced traceability system for Multi-period Pricing 1. It is nevertheless difficult to measure the costs of a traceability system accurately. Golan et al. (2004, p.11) identify six factors significantly influencing the costs of implementation: "breadth of traceability; depth and the number of transactions; degree of precision; degree of product transformation; number of new segregation or identity preservation activities; degree of difficulties of tracking".

Given that 58% of consumers in the USA are willing to pay a 3 to 8 percent price premium for guaranteed freshness (Higgins 2006), there is an opportunity to recover the costs of a traceability system, partially or fully, by increasing the initial price of a perishable food product.

7.4.3. Advantages for Consumers

Multi-period Pricing will give consumers better control over their purchases. Consider, for example, a food product that has three days of shelf-life left and is planned to be discounted by 30% on the last day. When Multi-period Pricing is employed, the discounts might typically be 0, 10, and 20 per cent for remaining shelf-life of three days, two days, and one day, respectively. Therefore, customers can make better trade-offs between price and remaining shelf-life based on their consumption needs. Furthermore, when the Multi-period

Pricing 1 is employed, the concerns about freshness and safety of perishable foods can be also reduced.

7.4.4. Disadvantages for Consumers

For purchasers who always tend to purchase the product at the discounted price under Two-period Pricing, Multi-period Pricing would not deliver significant benefit.

7.4.5. Advantages for Food Suppliers

It is argued that food suppliers in South Korea are responsible for the costs of unsold products, in cases where they consign their products to food retailers (Lee 2007). Therefore, if a Multi-period Pricing strategy can reduce the volume unsold, food suppliers can expect improved profitability. They may also benefit from the adoption of Multi-period Pricing 1, due to improved value tracing.

7.4.6. Disadvantages for Food Suppliers

An issue for food suppliers dealing with retailers implementing Multi-period Pricing 1 is the costs associated with the traceability system, which has been raised previously by suppliers to Wal-Mart (Gaudin 2008). Although the price of the RFID tags required for the tracing system studied in this thesis has reduced to less than $0.10, Webster (2008) has argued that RFID would not be beneficial, for some suppliers, until the cost of tags fell to two cents.

7.5. LIMITATIONS AND FUTURE RESEARCH

7.5.1. Survey Study

The limitations of the survey study in this thesis lie in the number of product types selected for inclusion in the questionnaire, as consumers' perceptions and sensitivities may vary across the full range of perishable food products with respect to freshness and price. And also, this study conducted the consumer surveys in South Korea only. Their counterparts in different countries might express different perceptions of possibly different generally prevailing discounting strategies versus more dynamic approaches.

Therefore, further studies are required, covering more than nine types of perishable foods in three categories, to yield more generalized knowledge of consumers' perceptions in relation to the proposed variations in retail food discounting strategies. Moreover, the fieldwork was restricted to South Korea. In order to move towards a universally effective dynamic pricing strategy, further studies need to generate more generic understanding of consumers' perceptions of alternative retail food pricing strategies. In addition, this study only showed the influence of general satisfaction with freshness of perishable foods on dynamic pricing strategies. Evaluation of general customer satisfaction with freshness had to rely on the respondents' experience. This study could not reveal a clear association between consumers' perceptions of the importance of freshness or the perceived risk in freshness and satisfaction with dynamic pricing strategies, which may show a clearer influence of freshness of perishable foods has on pricing approaches. Therefore, further studies should consider this issue to clarify the nature of the interaction between freshness and pricing approaches for perishable foods.

7.5.2. Simulation Study

The simulation study in this thesis did not consider changes in management costs resulting from adopting different pricing approaches. There might be potentially increased operating

costs of hiring additional sales staff and producing the number of price labels required to cater for alteration of the price of perishables more frequently. Furthermore, this study did not focus on finding the optimal dynamic pricing structures, but compared the general performance of four different pricing scenarios that cover a wide range of the frequency of discount possibilities. It only investigated dynamic pricing approaches with the frequency which is convenient to implement in practice, e.g. once a day, once in two days. In addition, the need-driven demand assumptions considered purchasing among products that had a remaining number of days of shelf-life equal to or greater than each consumer's demanded number. However, in reality and in some situations, consumers may be likely to purchase products with remaining shelf-life less than their demanded number of days of by making economic-trade-offs between price and time remaining. In addition, consumer demand patterns may change on each visit that is made to food retail stores. Moreover, for some consumers, price variations may not affect their purchases. For example, some consumers may always prefer to purchase the product with the longest remaining shelf-life, and some consumers may not check the expiry date and price at all, instead tending to purchase randomly. Therefore, further studies investigating the optimal frequency and amount of discount, by taking operational costs and more possibilities of such consumer demand in conjunction with the current need-driven demand into consideration may produce further insight into the way to design the best dynamic pricing policies for perishable foods.

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Appendix A

Interview Questions for Food Retailers in South Korea

(1) English Version

1. What is the name of your store including your branch name? And what type of store is it?

2. What is your name and job title?

3. How much sales income did your branch earn last year?

4. How many full-time staffs does your branch employ?

5. What is the average percentage of perishable foods that your branch has to reject or discard on receipt from suppliers due to spoilage?

6. What kind of perishable food types are closely associated with wastage due to unsold stock?

7. What is the average percentage of perishable foods that remain unsold by their expiry date at your branch?

8. What is the average initial profit margin for perishable foods?

9. Please explain the prevailing price discount strategies for perishable foods to promote the sales of these products as they are approaching their expiry date.

10. How many units of perishable foods are normally displayed? And please explain the method used to replenish and maintain stock for displaying.

11. Please explain the stock replenishment method for perishable foods from suppliers.

(2) Korean Version

1. 귀사의 상호와 매장의 지점명은 무엇입니까? 그리고 지점의 종류는 무엇입니까?

2. 귀하의 성함과 직책은 무엇입니까?

3. 작년 매출액은 얼마입니까?

4. 현재 본 매장의 상시 근무하는 종업원의 몇 명입니까?

5. 공급자로부터 공급받은 전체 변질성 식품 중, 공급과 동시에 식품의 부패 등으로 인해 폐기 혹은 반품 처리되는 식품의 평균비율은 몇 % 입니까?

6. 변질성 식품 중, 유통기한 내에 팔리지 않아서 다량 폐기되는 제품들은 어떤 제품들이 있습니까?

7. 평균적으로 대략 몇 % 정도의 변질성 식품들이 유통기한이 경과되어 폐기됩니까?

8. 변질성 식품들의 가격 할인 전 평균 마진율은 몇 % 입니까?

9. 통상적으로 변질성 식품의 경우에는 날짜가 경과함에 따라 가격 할인전략을 사용하여 소비자의 구매를 유도하고 있습니다. 변질성 식품들의 일반적인 평균 가격 할인 전략을 설명해 주십시오.

10. 통상적으로 판매를 위해 진열되는 변질성 식품의 평균 진열수량은 몇 개입니까? 또한 그 진열수량을 보충, 유지하는 방법을 구체적으로 설명해 주십시오.

11. 변질성 식품의 공급자로부터의 재고보충 관리방법을 구체적으로 설명해 주십시오.

Appendix B

Questions in Questionnaire-version 1

(1) English Version

*'X' for product types

To evaluate the level of customer satisfaction with regard to freshness

1. I am satisfied with the freshness of product X (generic) that I buy at retail stores.

2. The freshness of product X (generic) that I buy from retail stores lives up to my expectations.

3. The freshness of product X (generic) that I buy from retail stores is ideal, in terms of quality assurance.

To evaluate the level of customer satisfaction with the commonly prevailing discount strategy

1. I am satisfied with the present discounting strategies of product X (generic) that I buy from retail stores.

2. The present discounting strategy of product X (generic) that I buy from retail stores lives up to my expectations.

3. The present discounting strategy of product X (generic) that I buy from retail stores is the ideal offer.

To evaluate the level of customer satisfaction with a Multi-period Pricing Strategy 1

1. If the price of product X (generic) in retail stores was gradually reduced on the basis of the

more accurately measured remaining shelf-life, I would be satisfied with the discounting strategy.

2. If the price of product X (generic) in retail stores was gradually reduced on the basis of the more accurately measured remaining shelf-life, the discounting strategy would live up to my expectations.

3. It would be the ideal discounting strategy if the price of product X (generic) in retail stores was gradually reduced on the basis of the more accurately measured remaining shelf-life.

To evaluate the level of interest in a Multi-period Pricing Strategy 1

1. I am interested in the discounting strategy that gradually reduces the price of product X (generic) in retail stores on the basis of the more accurately measured remaining shelf-life.

2. I am intrigued in the discounting strategy that gradually reduces the price of product X (generic) in retail stores on the basis of the more accurately measured remaining shelf-life.

To evaluate the level of consumers' willingness to make economic trade-offs between price and remaining shelf-life, on the basis of their consumption needs, a Multi-period Pricing Strategy 1

1. If the price of product X (generic) in retail stores is gradually reduced on the basis of the more accurately measured remaining shelf-life, that would help me to make rational purchasing decisions, since I could base my buying on my planned consumption of the product. For example, I would make an economic trade-off by buying product X to be consumed within the next four days that showed an expiry date four days ahead, for a relatively lower price, rather than buying more expensive product X with a longer remaining shelf-life.

2. Enabling better trade-off options between paying more for product X (generic) with a longer remaining shelf-life (more accurately measured) and paying less for product X (generic) with a shorter remaining shelf-life (more accurately measured) would help me to control my purchasing decisions, considering my product X consumption plan.

3. I would like to be able to make better economic trade-offs between paying more for product X (generic) with a longer remaining shelf-life (more accurately measured) and paying less for product X (generic) with a shorter remaining shelf-life (more accurately measured), in order to control my purchasing effectively on the basis of my planned consumption

(2) Korean Version

*** 다음 질문들은 신선도에 대한 현재의 만족도를 측정하기 위한 것 입니다.**

1. 나는 마트에서 구입하는 X 제품의 신선도에 만족한다.

2. 마트에서 구입하는 X 제품의 신선도는 그 품질 면에 있어서 내 기대치에 미친다.

3. 마트에서 구입하는 X 제품의 신선도는 그 품질 면에 있어서 이상적이다.

*** 다음 질문들은 판촉전략에 대한 현재의 만족도를 측정하기 위한 것 입니다.**

1. 나는 마트에서 구입하는 X 제품의 판촉전략에 만족한다.

2. 마트에서 구입하는 X 제품의 판촉전략은 그 적정성에 있어 내 기대치 에 미친다.

3. 마트에서 구입하는 X 제품의 판촉전략은 그 적정성에 있어서 이상적이다.

*** 다음의 질문들은 "단계적 가격인하 제도"가 시행되었을 때에 예상되는 만족도를 조사하기 위한 설문입니다.**

1. 조금 더 정확한 측정방법으로 유통기한의 변화에 따라 마트에서 구입하게 되는 X 제품의 가격을 단계적으로 인하한다면, 이와 같은 단계적 가격인하제도에 만족할 것이다.

2. 조금 더 정확한 측정방법으로 유통기한의 변화에 따라 마트에서 구입하게 되는 X 제품의 가격

을 단계적으로 인하한다면, 이와 같은 단계적 가격인하제도는 그 적정성에 있어서 내 기대치 이상일 것이다.

3. 조금 더 정확한 측정방법으로 유통기한의 변화에 따라 마트에서 구입하게 되는 X 제품의 가격을 단계적으로 인하한다면, 마트에서 구입하게 되는 X 제품의 단계적 가격인하제도는 그 적정성에 있어서 이상적일 것이다.

*** 다음 질문들은 단계적 가격인하제도에 대한 관심도를 측정하기 위한 설문입니다.**

1. 나는 조금 더 정확한 측정으로 유통기한의 변화에 따른 X 제품의 단계적 가격인하제도에 관심이 있다.

2. 조금 더 정확한 측정으로 유통기한의 변화에 따른 X 제품의 단계적 가격인하제도는 나의 소비를 더 흥미롭게 할 것이다.

*** 다음 질문들은 가격을 단계적으로 인하하는 제도가 시행될 경우, 당신의 소비패턴의 변화에 미칠 영향력을 측정하기 위한 설문입니다.**

1. 조금 더 정확한 측정에 따른 유통기한의 변화에 따라 마트에서 구입하게 되는 X 제품의 가격을 단계적으로 인하하게 된다면, 나의 소비계획에 따른 합리적인 구매가 이루어 질 수 있도록 도와줄 것이다. (예: X 제품을 4일 안에 먹을 계획이라면, 유통기한이 4일 이상 남은 X 제품보다 유통기한이 4일만 남은 더 할인 된 X 제품을 구입할 것이다)

2. 위와 같은 단계적 가격인하 제도는, 합리적인 소비계획에 따라 유통기한까지 날짜가 더 많이 남은 X 제품을 더 비싼 가격에 구매하거나, 유통기한까지 날짜가 적게 남은 X 제품을 더 싼 가격에 구매할 수 있게 되므로, 이는 나의 합리적인 구매활동에 도움이 될 것이다.

3. 위와 같은 단계적 가격인하 제도는, 합리적인 소비계획에 따라 유통기한까지 날짜가 더 많이 남은 X 제품을 더 비싼 가격에 구매하거나, 혹은 유통기한까지 날짜가 적게 남은 X 제품을 더 싼 가격에 구매함으로써, 가격과 신선도간의 절충을 도모할 것이다.

Appendix C

Questions in Questionnaire-version 2

(1) English Version

*'X' for product types

To evaluate the level of customer satisfaction with regard to freshness

1. I am satisfied with the freshness of product X (generic) that I buy at retail stores.

2. The freshness of product X (generic) that I buy from retail stores lives up to my expectations.

3. The freshness of product X (generic) that I buy from retail stores is ideal, in terms of quality assurance.

To evaluate the level of customer satisfaction with the commonly prevailing discount strategy

1. I am satisfied with the present discounting strategies of product X (generic) that I buy from retail stores.

2. The present discounting strategy of product X (generic) that I buy from retail stores lives up to my expectations.

3. The present discounting strategy of product X (generic) that I buy from retail stores is the ideal offer.

To evaluate the level of customer satisfaction with a more dynamic pricing approach

1. If the price of product X (generic) in retail stores was gradually reduced on the basis of the

remaining shelf-life, I would be satisfied with the discounting strategy.

2. If the price of product X (generic) in retail stores was gradually reduced on the basis of the remaining shelf-life, the discounting strategy would live up to my expectations.

3. It would be the ideal discounting strategy if the price of product X (generic) in retail stores was gradually reduced on the basis of the remaining shelf-life.

To evaluate the level of interest in a more dynamic pricing approach to pricing

1. I am interested in the discounting strategy that gradually reduces the price of product X (generic) in retail stores on the basis of the remaining shelf-life.

2. I am intrigued in the discounting strategy that gradually reduces the price of product X (generic) in retail stores on the basis of the remaining shelf-life.

To evaluate the level of consumers' willingness to make economic trade-offs between price and remaining shelf-life, on the basis of their consumption needs, with a multi-period pricing strategy

1. If the price of product X (generic) in retail stores is gradually reduced on the basis of the remaining shelf-life, that would help me to make rational purchasing decisions, since I could base my buying on my planned consumption of the product. For example, I would make an economic trade-off by buying product X to be drunk within the next four days that showed an expiry date four days ahead, for a relatively lower price, rather than buying more expensive product X with a longer remaining shelf-life.

2. Enabling better trade-off options between paying more for product X (generic) with a longer remaining shelf-life and paying less for product X (generic) with a shorter remaining shelf-life would help me to control my purchasing decisions, considering my product X consumption plan.

3. I would like to be able to make better economic trade-offs between paying more for product X (generic) with a longer remaining shelf-life and paying less for product X (generic)

with a shorter remaining shelf-life, in order to control my purchasing effectively on the basis of my planned consumption

(2) Korean Version

*** 다음 질문들은 신선도에 대한 현재의 만족도를 측정하기 위한 것 입니다.**

1. 나는 마트에서 구입하는 X 제품의 신선도에 만족한다.

2. 마트에서 구입하는 X 제품의 신선도는 그 품질 면에 있어서 내 기대치에 미친다.

3. 마트에서 구입하는 X 제품의 신선도는 그 품질 면에 있어서 이상적이다.

*** 다음 질문들은 판촉전략에 대한 현재의 만족도를 측정하기 위한 것 입니다.**

1. 나는 마트에서 구입하는 X 제품의 판촉전략에 만족한다.

2. 마트에서 구입하는 X 제품의 판촉전략은 그 적정성에 있어 내 기대치 에 미친다.

3. 마트에서 구입하는 X 제품의 판촉전략은 그 적정성에 있어서 이상적이다.

*** 다음의 질문들은 "단계적 가격인하 제도"가 시행되었을 때에 예상되는 만족도를 조사하기 위한 설문입니다.**

1. 마트에서 구입하게 되는 X 제품의 가격을 유통기한이 다가옴에 따라 단계적으로 인하한다면, 이와 같은 단계적 가격인하제도에 만족할 것이다.

2. 마트에서 구입하게 되는 X 제품의 가격을 유통기한이 다가옴에 따라 단계적으로 인하한다면, 이와 같은 단계적 가격인하제도는 그 적정성에 있어서 내 기대치에 미칠것이다.

3. 마트에서 구입하게 되는 X 제품의 가격을 단계적으로 인하한다면, 마트에서 구입하게 되는 X 제품의 단계적 가격인하제도는 그 적정성에 있어서 이상적일 것이다.

*** 다음 질문들은 단계적 가격인하제도에 대한 관심도를 측정하기 위한 설문입니다.**

1. X 제품의 단계적 가격인하제도에 관심이 있다.

2. X 제품의 단계적 가격인하제도는 나의 소비를 더 흥미롭게 할 것이다.

*** 다음 질문들은 가격을 단계적으로 인하하는 제도가 시행될 경우, 당신의 소비패턴의 변화에 미칠 영향력을 측정하기 위한 설문입니다.**

1. 마트에서 구입하게 되는 X 제품의 가격을 단계적으로 인하하게 된다면, 나의 소비계획에 따른 합리적인 구매가 이루어 질 수 있도록 도와줄 것이다. (예: X 제품의 4일 안에 다 먹을 계획이라면, 유통기한이 4일 이상 남은 X 제품보다 유통기한이 4일만 남은 더 할인 된 X 제품을 구입할 것이다)

2. 위와 같은 단계적 가격인하 제도는, 합리적인 소비계획에 따라 유통기한까지 날짜가 더 많이 남은 X 제품을 더 비싼 가격에 구매하거나, 유통기한까지 날짜가 적게 남은 X 제품을 더 싼 가격에 구매할 수 있게 되므로, 이는 나의 합리적인 구매활동에 도움이 될 것이다.

3. 위와 같은 단계적 가격인하 제도는, 합리적인 소비계획에 따라 유통기한까지 날짜가 더 많이 남은 X 제품을 더 비싼 가격에 구매하거나, 혹은 유통기한까지 날짜가 적게 남은 X 제품을 더 싼 가격에 구매함으로써, 가격과 신선도간의 절충을 도모할 것이다.

Appendix D

Examples of Present Pricing and More Dynamic Pricing, as Provided to Respondents

	Present prevailing pricing	More dynamic pricing
Days remaining	**Discount (%)**	**Discount (%)**
3	0	0
2	0	6.67 (10)
1	20 (30)	13.33 (20)

	Present prevailing pricing	More dynamic pricing
Days remaining	**Discount (%)**	**Discount (%)**
7	0	0
6	0	1.90 (2.86)
5	0	3.81 (5.71)
4	0	5.71 (8.57)
3	0	7.62 (11.43)
2	20 (30)	9.52 (14.29)
1	20 (30)	11.43 (17.14)

	Present prevailing pricing	More dynamic pricing
Days remaining	**Discount (%)**	**Discount (%)**
11	0	0
10	0	1.09 (1.64)
9	0	2.18 (3.27)
8	0	3.27 (4.91)
7	0	4.36 (6.55)
6	0	5.45 (8.18)
5	0	6.55 (9.82)
4	0	7.64 (11.45)
3	20 (30)	8.73 (13.09)
2	20 (30)	9.82 (14.73)
1	20 (30)	10.91 (16.36)

	Present prevailing pricing	More dynamic pricing
Days remaining	**Discount (%)**	**Discount (%)**
15	0	0
14	0	0.76 (1.14)
13	0	1.52 (2.29)
12	0	2.29 (3.43)
11	0	3.05 (4.57)
10	0	3.81 (5.71)
9	0	4.57 (6.86)
8	0	5.33 (8.00)
7	0	6.10 (9.14)
6	0	6.86 (10.29)
5	0	7.62 (11.43)
4	20 (30)	8.38 (12.57)
3	20 (30)	9.14 (13.71)
2	20 (30)	9.90 (14.86)
1	20 (30)	10.67 (16.00)

	Present prevailing pricing	More dynamic pricing
Days remaining	**Discount (%)**	**Discount (%)**
19	0	0
18	0	0.70 (1.05)
17	0	1.40 (2.11)
16	0	2.11 (3.16)
15	0	2.81 (4.21)
14	0	3.51 (5.26)
13	0	4.21 (6.32)
12	0	4.91 (7.37)
11	0	5.61 (8.42)
10	0	6.32 (9.47)
9	0	7.02 (10.53)
8	0	7.72 (11.58)
7	0	8.42 (12.63)
6	20 (30)	9.12 (13.68)
5	20 (30)	9.82 (14.74)
4	20 (30)	10.53 (15.79)
3	20 (30)	11.23 (16.84)
2	20 (30)	11.93 (17.89)
1	20 (30)	12.63 (18.95)