

ECONOMIC FACTORS INFLUENCING FRESH FRUIT AND VEGETABLE  
EXPENDITURES IN SOUTH KOREAN HOUSEHOLDS

by

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(Under the Direction of Wojciech J. Florkowski)

ABSTRACT

This study identifies consumer and household characteristics, geographical locations and opinions and views of the respondents that influence the expenditure on fresh fruit and vegetable, using a survey data collected from 1,100 female residents of seven urban centers in the Republic of Korea. Two separate equations for fresh fruit and vegetable expenditures were estimated using the OLS after determining that the Heckman's procedure was not applicable. Results provide insights for the formulation of profiles for consumers according to their expenditures. Calculated elasticities for household income, education, age and number of adults in the case of fresh vegetable expenditure are 0.21, 0.32, 0.39 and 0.31, respectively. Elasticities for income, education and number of adults in the case of fresh fruit expenditure are 0.30, 0.30 and 0.16, respectively. Knowledge from this study is useful for fresh produce strategies by food manufacturers and for public health education led by the government agencies.

INDEX WORDS: Expenditure on Fresh Fruit and Vegetable, Korea, Double Log, Socioeconomic and Demographic factors, Location, BMI, Elasticity, Heckman's Procedure

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B.S., Kerala Agricultural University, India, 1991

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment  
of the Requirements for the Degree

MASTER OF SCIENCE

ATHENS, GEORGIA

2010

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August 2010

## **DEDICATION**

Dedicated to my parents who are the reason for my existence and who are watching me from above, and to my wife, Shaku for her inspiration throughout my life.

## **ACKNOWLEDGEMENTS**

As I reach this final phase of my Masters Degree in Agricultural Economics, I remember the path that brought me here and all the people who have been instrumental in making me what I am today.

First and foremost I want to place on record my sincere gratitude to my major professor Dr. Wojciech J. Florkowski. Thank you Sir, for agreeing to be my advisor. I had struggled long and hard getting admission in a foreign university, dealing with immigration issues and finally leaving home, and also obtaining funding for my studies. Your acceptance came at a time when I was beginning to wonder whether my struggle would be in vain after all. It gave me renewed hope and encouragement. I can never thank you enough for your concern about my academic performance as well as my general well being and health. I cannot express in words, how much I appreciate your patience to read through each and every word of my writing which, I know, was never of a scientific or academic nature before and hence has taken up so much of your time to correct and edit. Your advice helped me to improve this very important skill and I hope I can rise to your standards some day. Your constant guidance and support during preparation of my thesis has been the strongest reason that I am completing this work on time. I shall always cherish and value the time I spent with you and I hope that our association will last forever.

Dr. Michael Wetzstein is one person who has truly seen me all the way from India till UGA. My contact with him started in 2005, during my admissions process and since then he has always supported and encouraged me. Never once have I been disappointed after talking to him. Thank you Sir, for agreeing to serve on my committee. Your excellent classes have left a

permanent imprint on my mind, and your warm and cheerful nature have a special place in my heart. Your suggestions and opinions regarding my thesis work have helped me greatly and I shall always value your advice. Thank you for all your help and support.

I am sincerely thankful to Dr Charlie Huang, my teacher and also member of my advisory committee. Thank you Sir, for agreeing to serve on my committee. Your classes have been extremely challenging and helped me to sharpen my thinking and analytical skills, two factors that have been very influential in my academic excellence. I am also grateful for all your suggestions and guidance during the preparation of my thesis, as well as during my course work. Thank you for always being ready to help me whenever I asked.

My heartfelt thanks are due to my Department and all the faculty members and staff whom I have had the chance to interact with. I would especially like to mention Dr Octavio Ramirez, Head of the Department. I have been fortunate to attend his classes and benefit from his excellent teaching, as well as his cordial and approachable nature. I cannot but mention Ms JoAnne Norris, without whom I would never have felt so much at home in this Department. I greatly appreciate her efficiency at work and her warm and friendly nature that endears her to one and all. I also thank Ms Karina and Ms Laura for their whole hearted help. I cannot exclude Ms Marilyn Slocum from the Griffin campus from this list, since she was always very helpful to me in tackling the word processor.

I also take this opportunity to thank the Rural Development Administration (RDA) of the Republic of Korea and Dr Dong-Kyun Suh of the RDA for permitting me to use the data set for this empirical analysis.

I could never have finished this program without the help of so many of my colleagues and friends in the Department as well as outside. Thank you Ruohong, Wesley, Kavita, Nzaku,

Clarisse, Florence, Jack, Doris, Ya Wu, Shanshan, Cheng, Andrew, Veronica, Douglas, Xiaofei , Huiting, Ramesh, Dawit, Ajita and Rebati for all the good times we spent together.

Special thanks to Finto for always being there to help, whether with a statistics question or with his car. Thanks are also due to Samar for always challenging my intelligence (do I have it?). I also remember Sandeep and his pleasant and helpful nature with gratitude. Thanks to Teneema and Shimat and also Ms Andrea Montlick from the grad school for helping me with the thesis format, an important part of the successful graduation. Mollychechi and John, you are very special to me. Special thanks to Sini, Assa, Aswathi, Sereena and Leena for always providing delicious food and good company. Thanks are also to my numerous friends, Sandeep, Vijay, Vikram, Kamal, Ranjith, Jaison, Madhu, Sethu just to mention a few, whose names are all close to my heart.

At this time I remember my parents who had to leave for their heavenly abode a few years ago, but who always live in my heart and support me and everything I do in their own special way.

I am thankful for the support and love I have received from my sisters and other family members, my in-laws and my friends and well-wishers back home in India. I know that their wishes and prayers have played a great role in bringing me to where I am today.

Lastly, I just wanted to hug my wife, Shaku for her unrelenting support throughout my life. I could not have even imagined such an academic resurrection had I not married her. Thank you my dear, for everything you have been doing for me.



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## **CHAPTER 1**

### **INTRODUCTION**

Increasing incomes and a growing awareness about the relationship between health and diet are among the important factors that have changed food consumption patterns across the world. According to Schmidhuber (2004), urbanization with expansion in marketing channels, globalization and trade liberalization also contributed to changing consumption patterns. The changed food consumption pattern resulted in the increased incidences of non-communicable diseases (Schmidhuber, 2004) including certain cancers, cardiovascular diseases (cvd), type 2 diabetes and stroke.

#### **Influence of Fruit and Vegetable Consumption on Human Health**

Numerous scientific studies and epidemiological reports emphasize the relationship between fruit and vegetable consumption and the occurrences of non-communicable diseases. Low consumption of fruit and vegetables is reported to be the reason of about 31% ischemic heart disease cases, 19% cases of gastrointestinal cancers and 11% of strokes globally (WHO/FAO, 2003). Three other independent studies find that 3.5%, 2.8% and 2.4% of the burden of disease in the European Union (Diderichsen, Dahlgren and Vagero 1997), Australia (Mathers et al., 2001) and New Zealand (Tobias et al., 2001), respectively, can be attributed to the low consumption of fruit and vegetables.

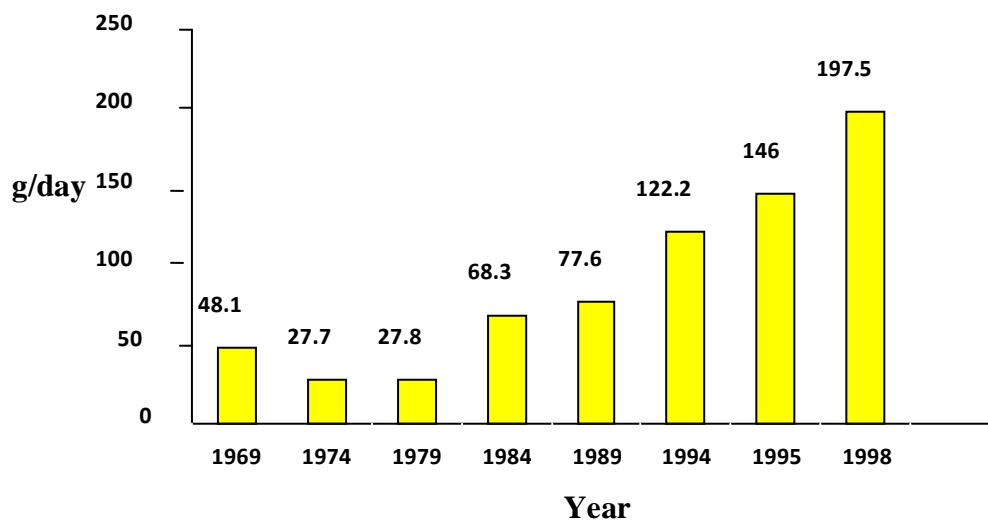
The WHO estimates that about 2.7 million deaths occurring globally each year can be avoided by consuming sufficient amount of fruit and vegetables. An increased consumption of fresh fruit and vegetable is believed to protect against certain types of cancers and the coronary heart disease (WCRF/AICR, 1997; Hu, 2003; IARC, 2003). A number of studies link a high

fruit and vegetable intake to a low incidence of certain cancers (e.g., Pavia et al., 2006; Linseisen et al., 2007). Rigorous case control studies (Riboli and Norat, 2003) support the relationship between high consumption of fruit and vegetables and low incidences of cancers of the esophagus, lung, stomach and colorectum and negative associations of fruit consumption with bladder cancer and vegetable consumption with breast cancer. Pavia et al. (2006) conclude that fruit and vegetable intake decreased the incidence of oral cancer and Linseisen et al. (2007) find a significant inverse relationship between fruit consumption and lung cancer risk. According to Van Duyn and Pivonka (2000), the scientific evidence also supports the role of fruit and vegetables in controlling other diseases like cataract formation, chronic obstructive pulmonary disease, diverticulosis and, probably, hypertension. Thus, increased fruit and vegetable consumption has a significant role in reducing the incidences of non-communicable diseases (Lock et al., 2005). Fortunately, dissemination of such information about the link between health and diet has positively affected the consumption of fruit and vegetables worldwide.

The general relation between the vegetable and fruit intake and the diseases incidence likely varies across countries. Societies differ in their per capita consumption of fruits and vegetables (Pomerleau et al., 2004). Among countries with some of the highest fruit and vegetable consumption is the Republic of Korea. A number of studies address the association of fruit and vegetable intake and certain non-communicable diseases in the Republic of Korea. For example, Choi-Kwon and Kim (1998) report that low intake of vegetables is one of the risk factors for cerebral infarction in men. Another study on victims of the first stroke finds that young patients consumed fruit and vegetables a fewer number of times than elderly patients (Park et al., 2001). In a separate study, Kim et al. (2001) find an association between increased consumption of fruits and vegetables and reduction in the risk of gastric cancer. Lee, Popkin and

Kim (2004) conclude that increased consumption of green vegetables may be related to decreased incidence of breast cancer in Korean women, while Do et al. (2007) attribute this reduction to increased consumption of fruits, vegetables and soy foods.

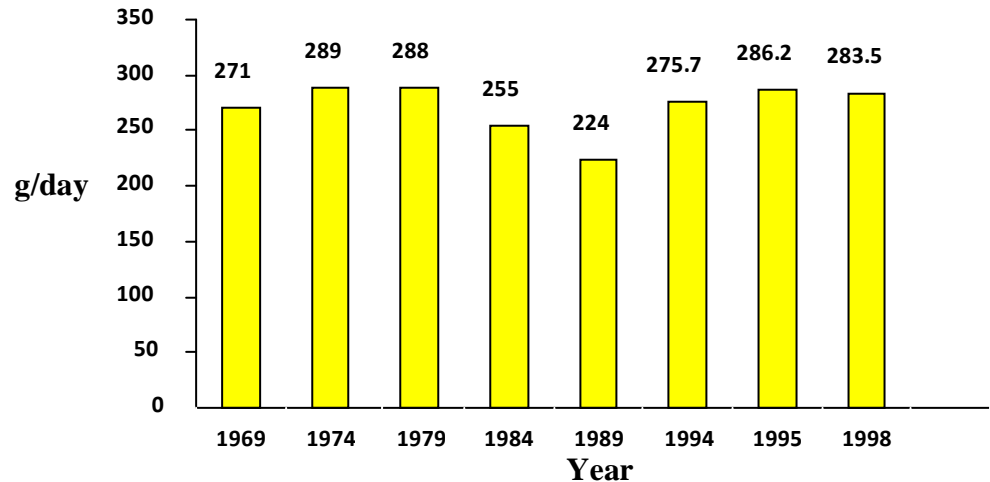
An increasing number of Koreans adopts a western lifestyle, a possible result of years of economic growth. The modified lifestyle is reflected in eating more foods of animal origin, fats and oils than in the traditional Korean diet, but, Koreans also consume an increasing volume of fruits and vegetables (Son, 2003). The per capita fruit consumption increased from 48.1 g per day in 1969 to 197.5 g per day in 1998 (Figure 1), a remarkable 400 percent increase. During the



**Figure 1: Per capita fruit consumption in South Korea** (Source: The Ministry of Health and Welfare (1999), Republic of Korea, 1998 National Health and Nutrition Survey)

same period the vegetable consumption remained high and amounted to 283.5 g per day in 1998 (Figure 2) (Ministry of Health and Welfare, 1999). The per capita vegetable consumption level is one of the highest in Asia (Lee, Popkin and Kim, 2002) and the world. The total consumption of fruits and vegetables is in line with the recommendation by WHO/FAO (2003) of a minimum of

400 g per day. According to Son (2003) the high fruit and vegetable consumption allows



**Figure 2: Per capita vegetable consumption in South Korea** (Source: The Ministry of Health and Welfare (1999), Republic of Korea, 1998 National Health and Nutrition Survey)

Koreans to maintain the ideal proportion of energy derivation from carbohydrates, protein and fat (66%, 15% and 19%, respectively, in 1998).

Despite such a desirable diet, the 1998 National Health and Nutrition Survey discover the increase in the rate of growth of both obese and overweight individuals (Lee, Popkin and Kim, 2002). The reported rate of obesity was 1.7% and 3.0% (BMI of  $\geq 30.0 \text{ Kg/m}^2$ ) and the rate of overweight 24.3% and 23.5% (BMI of  $25.0\text{-}29.99 \text{ Kg/m}^2$ ) among adult men and adult women, respectively. Consequently, to combat the potential health problems government agencies, nutrition specialists and private organizations have been educating the society at large about the traditional Korean diet rich in vegetables (Lee, Popkin and Kim, 2002).

From the empirical standpoint, the question of what drives changes in fruit and vegetable expenditure is of utmost relevance. Consumption functions that use income and prices to explain



expenditures assume that tastes of consumers, income distribution and socioeconomic characteristics of the population do not change (Agarwala and Drinkwater, 1972). However, though in short run such changes may not be significant, in medium and long term analyses one needs to incorporate socioeconomic factors into the analysis and should consider the effect of these factors on expenditure patterns (Agarwala and Drinkwater, 1972). Studies that include various socioeconomic and demographic factors at individual household level provide better perceptions about the behavior of different groups within the population (Yen and Huang, 2002). An increase in fruit and vegetable consumption offers farmers and food distributors' opportunities to earn additional revenue. To target their education and marketing efforts public and private decision makers need to learn the characteristics of consumers and their influence on fresh fruit and vegetable expenditures. Government decision-makers depend on information about consumer profiles to formulate policies relevant to food consumption. Knowledge about the consumer preferences through the effects of socioeconomic and demographic variables, and consumer views help the government to re-direct research on various aspects of the cultivation and post-harvest handling of fruits and vegetables. Food retailers seek information about consumers and expenditures on fresh fruit and vegetable for planning their marketing efforts to increase the volume of business.

The establishment of consumer profiles requires the identification of the relationship between various socio-economic and demographic factors that influence expenditures on fresh fruit and vegetable in Korean households. Socioeconomic and demographic factors, household location and opinions and views of consumers delineate consumer characteristics influencing the expenditures. The planning and marketing program implementation improves due to knowledge of consumer profiles. Government decision-makers formulate policies targeting population

segments that benefit from an increased produce consumption leading to an overall healthier society and health care savings. In addition, a study like this provides insights for the development a model applicable in forecasting the fresh fruit and vegetable expenditures once the projections of explanatory variables become available (Nayga, 1995). Such models help farmers and marketers in preparing practical fruit and vegetable production and marketing plans.

## **Objectives**

This study examines the Korean consumer expenditure on fruit and vegetables. It presupposes that consumers' spending on fruits and vegetables reflects preference for these two food categories. Particular objectives of this study are to:

- 1) quantify the effects of socioeconomic factors including household income, respondent's education and employment status, demographic factors counting respondent's age, household size and its composition, and household location;
- 2) investigate the association between the expenditure on fruit and vegetables and the respondent's body mass index (BMI) to provide insights about the importance of weight management among Korean people;
- 3) scrutinize the relationship between the Korean consumers' expenditure on fruit and vegetables and their opinions and views about the link between health and diet, food attributes, sources of information on food quality, agricultural and food technology development, and food processing methods.

## **Methods**

Weekly expenditures on fresh fruit and vegetable are the dependent variables in two separate analytical equations. The application of regression techniques quantifies effects of the

socioeconomic, demographic and location variables on the dependent variables. The association between the respondent BMI, opinions and views of consumers and fruit or vegetable expenditures is also explored using regression methods. The analysis focuses on factors that influence the changes in expenditures of fresh fruit and vegetable. The double-log functional form is applied to the specified empirical equations. Estimated coefficients are elasticities and allow a straightforward interpretation of practical implications of results. The study uses cross sectional data obtained through a survey.

A comparison between two different modeling approaches is also undertaken in this study: the ordinary least squares (OLS) method and the Heckman sample selection model. The OLS is the most widely used method in analytical estimations, because of its simplicity. However, in household expenditure studies, Heckman's two-step procedure is used to overcome the zero expenditure problems. In this study, the estimations are done using both the approaches and the results are compared.

## **Review of Literature**

This section reviews the previous studies that dealt with similar topics. The purpose of this review is to examine the variety of selected methodological approaches including the reasoning applied to the selection of various explanatory variables. Therefore, the discussion in this section focuses on major categories of factors relevant to expenditures on fruits and vegetables.

### ***Socioeconomic and Demographic Factors and Household Location***

Several studies have concluded that socioeconomic and demographic factors determine the pattern of expenditures on fresh fruit and vegetable. Most of these studies (Price and West, 1980; Capps and Love, 1983; Nayga, 1995) focus on American consumers, while rigorous

empirical studies of consumers in other countries are less frequent. Generally, socioeconomic factors include household income, education and occupation. The positive effect of household income on the expenditures on fresh fruit and vegetable is confirmed in case of American consumers (Capps and Love, 1983; Nayga, 1995). The effect of income has been studied in several ways. Many studies (Capps and Love, 1983; He, Huang and Houston, 1995; Nayga, 1995) have investigated the effect of household income directly and included a measure of income as an explanatory variable of fruit and vegetable expenditure. The purpose of those studies has been the calculation of income elasticities. Another way of capturing the effect of income is to compare low and high income households. However, this approach results from the specific objective to consider differences in fruit and vegetable consumption between households reporting markedly different incomes, so the results can be applied to the formulation of specific policies addressing any undesired outcomes. Some studies use total expenditure instead of income as an explanatory variable to study the variations in fruits and vegetable expenditure, because it is easier to get an accurate measure of total expenditure than household income.

The literature includes several studies that examine the direct effect of household income on fruit and vegetable expenditure. Using Bureau of Labor Statistics Consumer Expenditure Diary Survey (BLSCEDS) data consisting of the US households for the period from July 1973 to June 1974, Capps and Love (1983) conclude that the expenditure on fresh vegetables increases with increase in household income reaching a saturation level beyond which an increase in income does not have an effect on it. Nayga (1995), using a different data published in 1992 by the same source, finds that household income positively influences the expenditures on fresh fruit and vegetable. In an estimation of disaggregated fresh fruits, employing 1987-88 US Department of Agriculture Nationwide Food Consumption Survey Data, He, Huang and Houston

(1995) observe that a significant positive relationship exists between income and most of the fresh fruits consumed by the US households. The objective of Blisard et al. (2002) has been the projection of food expenditures in America for 2020. They first quantify the effect of income growth and various demographic variables on per capita food expenditures and food quantities consumed and then convert these results into projections for 2020 based on projected changes in the variables. Data sources were BLSCEDS and USDA's Continuing Survey of Food Intakes by Individuals. One of the predictions has been that an increase in household income likely would increase fruit and vegetable consumption. The predictions have been made for the use of the participants in the food production and marketing system.

Some studies from other countries also support the positive relationship between the household income and the fruit and vegetable expenditure. For Norwegian consumers income is an important factor influencing fruit consumption (Wandel, 1995). In a study of ten sub-Saharan African countries based on the household expenditure survey data, Ruel, Minot and Smith (2005) conclude that an increase in income triggers an increase in the consumption of fruit and vegetables. The effects of income have been subject of studies referring to the economies of Asia. A food consumption pattern study by Han and Wahl (1998), applying data from National Rural Household Survey conducted in China, leads to the conclusion that an increase in income would increase the demand for fruits and vegetables in rural China. A study based on cross-sectional data (Bittencourt, Teratanavat and Chern, 2002) has concluded that an income raise probably will have a considerable positive impact on vegetable consumption in Japanese households.

The studies that compare the behavior of low-income and high-income households relating to fruit and vegetable consumption are mostly done in developed countries. While

analyzing the challenges and opportunities in the US fresh produce industry, Cook (1990) observes that families earning more income spend more on fresh fruit and vegetable than those earning less income. Stewart, Blisard and Jolliffe (2003) use BLSCEDS data for 2000 from the US Department of Labor expenditure pattern of fruits and vegetables by low-income households and conclude that such households spend less on fruits and vegetables than other households. The above study also finds that low-income households do not increase their consumption of fruits and vegetables in response to an increase in household income. This result is supported by Blisard, Stewart and Jolliffe (2004), who also observe that an additional increase in income of low-income households will result in an additional allocation to the expenditure on other foods or nonfood items perceived more important than fruits and vegetables. A study conducted by Kirkpatrick and Tarasuk (2007) on the expenditure patterns of low-income households in Canada finds that low-income households purchased fewer servings of fruits and vegetables than did high-income households. Another study from Scotland (Mainland, 1998), that uses data from the National Food Survey for the period from 1976 to 1995, also confirms that higher income groups consumed more fruits and vegetables than did lower income groups.

Total household expenditure has been used as a proxy for household income in household expenditure studies. Reynolds (1990) uses total food expenditures in place of household income in his analysis of fresh vegetable consumption by American households using BLSCEDS data for 1984 from the US Department of Labor. He finds a statistically significant, positive association between the proxy variable and the decision whether and how much fresh vegetables to purchase. The use of the proxy variable has been fairly common in studies of expenditures on other goods or services. Parker and Wong (1997), for their study on the determinants of health care expenditures in Mexico, use total household expenditures as a proxy for household income.

They consider that total household expenditure give a more accurate account of permanent income than the current income, and follow a suggestion by Russo and Herrin (1993) that in developing countries there is a tendency among respondents to report expenditures more accurately than household income. To study the association between household income and social capital in rural Tanzania, Narayan and Pritchett (1999) also use household expenditures instead of household income for two reasons. They find it very hard to measure the income of self employed, rural population, which comprise the majority of their sample. The second reason they provide is that from a theoretical point of view current expenditures give a better idea of permanent income than do the current incomes, because current income will also have to account for saving and dissaving.

Consumer educational attainment level influences consumption behavior. Earlier studies show that there is a relationship between fruit and vegetable expenditure and education level. Moreover, the reports distinguish, given data availability, between the education of household head and a person with the primary responsibility for the shopping and preparation of food at home. According to Reynolds (1990), the probabilities for the decisions on whether to purchase and how much to purchase fresh vegetables in the US households were higher in the case of high school graduates than nongraduates. Nayga (1995) in his study of the determinants of the US household expenditures on fruits and vegetables finds that a household with at least a college degree spends more on the weekly expenditures of fresh fruit and vegetable than the one with a high school degree. Serdula et al. (1995) report that persons with less education are found to consume less fruits and vegetables than those with more education among residents of 16 states in the US. Blisard et al. (2002) project that increased education levels will increase fruit and vegetable consumption in the US.

Studies done in other countries also support the positive association between the education attainment level and fruit and vegetable consumption. A study conducted by Hansen (2008) in Denmark shows that fruit and vegetable consumption increases with an increase in education across all income groups. He attributes this relationship to the increased capacity of people with increased education levels to understand the essence of health campaigns. Bertail and Caillavet (2008) in a study of fruit and vegetable consumption pattern in France opine that education can be seen as a point of entry for providing nutritional information in the programs aimed at developing fruit and vegetable consumption.

The review of studies that have used the information on the education of women in the households is also relevant here, because respondents in the applied survey data are women. Some studies relate this aspect to the fruit and vegetable consumption. Price and West (1980), in their study of fruit and vegetable expenditure in the US households, observe that an increase in the education of the adult female has a statistically significant positive impact on the consumption of fresh tree fruits, number of fruits served, consumption of fruit salads and consumption of common fresh vegetables. Another study by Dutta-Bergman (2005) also concludes that an increase in education probably leads to an increased intake of fruits and vegetables among American women. A Swedish study (Simunaniemi, Andersson and Nydahl, 2009) finds a positive correlation between education of women and fruit and vegetable consumption.

Besides income and education another characteristic relevant to the current study is employment status. Occupation expands person's knowledge, broadens experience, but foremost influences time allocation among many competing tasks associated with work or leisure. Occupation sways expenditures on fresh fruit and vegetable. Capps and Love (1983) find that



unemployment increases the vegetable expenditure, which they recognize results from time available for shopping and food preparation. Cook (1990) mentions that as more and more women take up jobs, the time available for food preparation at home decreases leading to the purchase of convenience foods that take less preparation time than fresh produce. The unemployed have no job obligations. The study conducted by Ruel, Minot and Smith (2005) reports that household members responsible for the food preparation working outside jobs, have less time for food preparation. The resulting need for time allocation leads to an increase in the processed food consumption because they require less preparation time than fresh vegetables.

A number of food expenditure studies consider demographic factors and include age, household size, its composition, and household location. Age is found to be an important determinant of fruit and vegetable expenditure in studies conducted across the world. A study by Cook (1990) finds that people tend to consume more fresh fruit and vegetable as they age. According to another study conducted by Reynolds (1990) age of the household head has a positive relationship with the decision on how much vegetables should be purchased. Households headed by an older person spend more on fresh fruit and vegetable than those headed by a younger person (Nayga, 1995), while He, Huang and Houston (1995) report that number of adults in the age group of 18-64 years plays an important role in the consumption of fresh fruits. A study by Serdula et al. (1995) reveals that fruit and vegetable intake is lower among youth than older people. Bittencourt, Teratanavat and Chern (2002) support such result and report that older people consume more fruits and vegetables than their younger counterparts. A food consumption projection study undertaken by Blisard et al. (2002) in the US observes that older age groups eat more fruits and vegetables than the young groups. There may be gender differences in terms of fruit and vegetable consumption. Dutta-Bergman (2005) finds that as age

increases women tend to eat more fruits and vegetables and Simunaniemi, Andersson and Nydahl (2009) conclude that middle aged and older women consume more fresh fruits.

Household size and composition is found to influence the fruit and vegetable expenditure in many studies. According to Price and West (1980) households with a large number of members purchase a greater variety of fruits and vegetables than those with fewer members. Capps and Love (1983) report that as the number of adult males in a household increases, the household tends to purchase a larger volume of fresh vegetables. Nayga (1995) concludes that larger households spend more on fresh fruit and vegetable than smaller households, a result supported by Han and Wahl (1998) who find that the consumption of vegetables increases when the number of household members increases. Reynolds (1990) reports that the household size is positively related to the decision to purchase fresh vegetables, but negatively related to the decision on how much to purchase, while McCracken (1992) indicates a negative correlation between household size and vegetable expenditure. Ruel, Minot and Smith (2005) in their review of studies also conclude that household size is inversely related to the purchase of fruits and vegetables.

Many studies have included variables to account for the regional differences in the expenditure on fruits and vegetables (e.g., Price and West, 1980; Capps and Love, 1983; Reynolds, 1990; Nayga, 1995; Han and Wahl, 1998; Ruel, Minot and Smith, 2005). Capps and Love (1983) include region in their studies to account for disparities in prices, distribution costs, general availability, and cultural habits. Results justify that inclusion. Reynolds (1990) also finds significant geographical variations in fresh vegetable expenditure in the US. According to Nayga (1995) regional differences can account, partly, for price differences faced by households

at different locations. Differences in availability of fruits and vegetables can also be reflected in the regional variations (Ruel, Minot and Smith, 2005).

### ***The Body Mass Index (BMI)***

The body mass index (BMI) is a measure of the comparison between a person's height and body weight. This index was first described by Adolphe Quetelet in 1932 and was known as the Quetelet index (Eknoyan, 2007). Quetelet was very much interested in probability calculus with applications in the study of human physical characteristics and social aptitudes. Many measures that relate height and weight were available during that period. However, after the Second World War, a growing concern about the link between body weight and mortality, especially due to cardiac disease and diabetes, initiated a search for a reliable and practical measure. The search identified the Quetelet index that gives the ratio of body weight in kilograms to the square of height in meters (Eknoyan, 2007). Keys et al. (1972) found that this index is the best proxy for body fat percentage among the ratios of body weight and height and named it the BMI. According to the WHO international classification, persons with BMI of less than  $18.5 \text{ kg/m}^2$  are classified as underweight, while those with BMI between 18.5 and 24.99 are regarded as having normal weight and those with BMI of more than 30 are considered obese.

According to the WHO (2002), the BMI represents the relationship between health and body weight. The BMI indicates body fat percentage that in turn relates to a person's health condition. The index is included in many food consumption studies that are concerned with obesity. Studies by Jeffery and French (1998), Bowman et al. (2004) and Duffey et al. (2007) use BMI as a proxy for obesity measure and find that fast food consumption is positively associated with BMI. Some other studies (Lahti-Koski et al., 2002; Olivares et al., 2004) link the increase in BMI, and therefore the obesity, to the high consumption of dairy products.

Association between the BMI and expenditures on fruits and vegetables has also been examined in several studies. Kahn et al. (1997) conclude a negative association between vegetable intake and the ten year change in the BMI. According to Williams et al. (1999) a low BMI is associated with a regular consumption of vegetables throughout the year and another study by Bazzano et al. (2002) supports such association by finding that a more frequent intake of fruits and vegetables considerably reduced the BMI. Lin and Morrison (2002) report men with a lower BMI had more servings of fruits per day than those with a higher BMI, while Flood et al. (2002) state that an intake of more servings of fruit and vegetables decreases BMI. Tohill (2005), in his review of studies, concludes that a high vegetable consumption helps in body weight management.

### ***Opinions and Views of Consumers***

The history of food culture of Koreans provides important insights into the selection of variables included in the empirical model of fruit and vegetable expenditures. Koreans follow an oriental approach towards health that is deeply rooted in philosophical principles. The knowledge about the link between health in the Korean society and diet is centuries old (Lee, 2005). Consumers' knowledge about health and nutrition is only occasionally considered in studies related to the expenditure on fruits and vegetables. According to Capps and Schmitz (1991) American consumers consider nutrition and health issues very important in purchasing decisions. They include consumer attitudes and knowledge about health and nutrition in their study. In another study, Wandel (1995) finds that consumers, who pay attention to their health, are likely to have increased fruit and vegetable consumption. Her finding is supported by the 2000 Food Marketing Institute survey which reveals that American food shoppers, who think that their diet could be healthier, opine that increasing fruit and vegetable consumption can

improve the healthfulness of the diet. Dutta-Bergman (2005) also concludes that a person's health orientation is a predictor of attitude favoring fruit and vegetable consumption. Echoing such attitudes among consumers, many food marketers put various health claims on food labels (Cook, 1990).

## CHAPTER 2

### THEORY AND METHODS

#### Theoretical Framework

Generally, the analysis of household expenditures, based on cross sectional data, highlights the Engel curve specification. An Engel curve describes the variations in the purchases of a good like food by a consumer according to the variations in the total resources such as income or total expenditure. Apart from the household income, other socioeconomic and demographic factors also cause consumer preferences to vary (Nayga, 1995), and, in turn, shift the utility function. Given that the utility function is not directly observable, the variation in fresh fruit and vegetable expenditures results from differences in socioeconomic and demographic factors. By considering fresh vegetables or fresh fruits as one good and all other goods as another single good, we can express the utility function of the consumers as follows (Deaton and Muellbauer, 1980):

$$U = f(F, X; T),$$

where  $F$  = fresh vegetables or fruits, and  $X$  = all other goods consumed. This utility is maximized subject to the budget constraint which is,

$$I = P_F * F + P_X * X,$$

where  $I$  = household income,  $P_F$  = price of fresh vegetables or fruits and  $P_X$  = price of all other goods. The utility maximization leads to the demand function of the form,

$$Q_F = f(P_F, P_X, I; T),$$

where  $Q_F$  = quantity of fresh vegetables or fruits demanded and  $T$  = tastes and preferences of the consumers. Socioeconomic and demographic variables represent the tastes and preferences

(Buse and Salathe, 1978). If the quantity demanded is known, the expenditure function is calculated as follows:

$$E_F = P_F Q_F = f(P_F, P_X, I, T),$$

where  $E_F$  = expenditure on fresh vegetables or fruits. In studies applying cross-sectional data prices are assumed constant across households and the expenditure function becomes

$E_F = f(I, T)$ . Tastes and preferences are believed to vary across different socioeconomic and demographic classes of consumers.

### **Empirical Specification**

The empirical model can be expressed as follows.

$$EXP = b_0 + \sum_i b_i S_i + \sum_j b_j R_j, \quad i = 1, \dots, 7; \quad j = 1, \dots, 6$$

where  $EXP$  is the expenditure on fresh vegetables or fresh fruits.  $S_i$  refers to the group of socioeconomic and demographic variables and  $R_j$  indicates the location variables.

Socioeconomic variables include household income, and education and employment status of consumers. Consumer's age, the number of adults, presence of children and the respondent's BMI are among demographic characteristics. An important variable that is generally included in demand analyses is the price of the commodity under study. However, as in most of the cross sectional data analyses (e.g., Price and West, 1980; Capps and Love, 1983; Cox, Ziemer and Chavas, 1984; Nayga, 1995), price is not available in the data set applied in this study. But, the price is assumed to be constant across all urban centers selected for the study.

The applied functional form in this analysis is the double log form. This functional form requires that values of all continuous variables including the dependent variable are converted into their natural logarithmic form. The conversion provides this functional form its important feature useful in applied economics, i.e., the slope coefficient becomes the elasticity and

quantifies the effect of an independent variable with respect to the dependent variable (Gujarati and Porter, 2009).

Besides the continuous variables, studies involving tastes and preferences commonly use binary variables. Because this class of variables assumes the value of 0 or 1, their natural logarithm values do not exist. Therefore, the estimate for a binary variable needs to be translated in to an interpretable form. Halvorsen and Palmquist (1980) offer a procedure for such transformation. The procedure calls first for the subtraction the value of 1 from the antilog of a coefficient of a particular binary variable and, then, its multiplication by 100. The obtained value is the percentage change in the dependent variable in response to the change of binary variable value from 0 to 1. For example, if  $C$  is a coefficient of a binary variable, then  $(\exp(C) - 1)$  is the relative effect of the binary variable on the dependent variable. Therefore,  $(\exp(C) - 1) * 100$  is the percentage change in the dependent variable when a binary variable switches from 0 to 1. Elasticities permit the calculation of changes in response variables resulting from marketing or policy decisions made by private or public entities. This feature is useful for interpreting the parameters from an economic point of view.

Two separate equations are used to estimate the expenditures on fresh fruit and vegetable, respectively, as a function of the set of explanatory variables. The expanded model is:

$$\ln EXP_{ki} = b_0 + b_1 \ln income + b_2 \ln age + b_3 \ln educ + b_4 \text{child} + b_5 \ln adult + b_6 \ln BMI + b_7 \text{employ} + b_8 \text{Incheon} + b_9 \text{Daejeon} + b_{10} \text{Daegu} + b_{11} \text{Ulsan} + b_{12} \text{Busan} + b_{13} \text{Gwangju},$$

where  $\ln EXP_{ki}$  is the log of weekly expenditure on fresh fruits or vegetables by the  $i^{\text{th}}$  household,  $\ln income$  is log of annual household income,  $\ln age$  is log of respondent's age in years,  $\ln educ$  is log of respondent's education in years,  $\text{child}$  indicates the presence of children in a household,  $\ln adult$  is the log of number of adults in a household,  $\ln BMI$  is the log of body mass



index of the respondent, employ is the employment status of the respondent and Incheon, Daejeon, Daegu, Ulsan, Busan, and Gwangju indicate household location in urban areas (Figure 3). In addition, some variables constructed from the opinions and views of consumers are also included in the model.

### ***Zero Expenditure Problems***

The observation of zero expenditure on a particular good or class of goods in household expenditure data is not uncommon (Capps and Love, 1983; He, Huang and Houston, 1995; Nayga, 1995). The observed zero expenditure can be due to sufficient household inventory at the time of data collection, response to market prices and non-preferences of the consumers toward a particular commodity (Capps and Love, 1983). Maddala (1986) suggests that if the analysis uses ordinary least square procedure, the omission of such observations would yield inconsistent parameter estimates. Heckman (1979) provides a two stage procedure to overcome this problem. The same procedure has been employed in previous such studies (e.g., Cheng and Capps, 1988; Jensen, Kesavan and Johnson, 1992; Nayga, 1995). In the current study, the zero expenditure on fruits or vegetables is encountered only sporadically. The share of zero observations is only about 0.3 percent in the case of expenditures on fresh vegetables and about 2.5 percent in the case of fresh fruits. The dataset contains the weekly expenditures and it is possible that a household carried a sufficient inventory to avoid any purchase. The frequent purchase of fresh fruit and vegetable by Korean households may reflect the fact that the total consumption of fresh fruit and vegetable in Korea is more than the WHO recommendation. Adherence to the traditional Korean diet, rich in vegetables, likely contributed to the insignificance of the zero expenditure problem. Though insignificant, only the actual application of the Heckman's procedure verifies the presence of any measurable impact.



**Figure 3: Map of the Korean Peninsula and the Republic of Korea showing the household locations**

### *Heckman's Procedure*

Heckman developed a two-step procedure to circumvent the zero expenditure problems and the associated sample selection bias. The first step employs all observations in a data set

including those with zero expenditure and uses a probit regression for estimation. The dependent variable in the first step equation is a binary variable with a value of one if the household makes a purchase, and a value of zero otherwise. Let  $I_{hi}$  be the variable indicating the purchase of fresh fruits or vegetables (i) by  $h^{th}$  household. Then, the probabilities of the purchase and its absence are (Saha, Capps and Byrne, 1997):

$$\Pr \{I_{hi}=1\} = \Phi(R_h C_t) \text{ and}$$

$$\Pr \{I_{hi}=0\} = 1 - \Phi(R_h C_t) \quad t = 1, \dots, n; h = 1, \dots, H; i = 1, 2$$

where  $\Phi$  is the cumulative distribution function (CDF),  $R_h$  is the vector of explanatory variables that influence the purchasing decision and  $C_t$  is the vector of estimates. This first step analysis also provides estimates of the inverse of Mills ratio ( $IMR_{hi}$ ) that are considered a proxy for sample selection bias (Heckman, 1979). Mathematically,  $IMR_{hi}$  can be expressed as

$$IMR_{hi} = \frac{\phi(R_h \widehat{C}_t)}{\Phi(R_h \widehat{C}_t)} \quad \text{for } I_{hi} = 1 \text{ and}$$

$$IMR_{hi} = \frac{-\phi(R_h \widehat{C}_t)}{1 - \Phi(R_h \widehat{C}_t)} \quad \text{for } I_{hi} = 0$$

where  $-\phi$  is the normal density function.

The second step of the procedure uses the ordinary least squares method (OLS) to estimate the actual expenditure made by the purchasing households. This step includes only observations which have non-zero expenditure. But, the inverse Mills ratio ( $IMR_{hi}$ ) is included as an additional regressor. The mathematical representation of the second stage equation is

$$\begin{aligned} E(Y_{hi} | I_{hi}=1) &= X_h \beta_t + \gamma_t \frac{\phi(R_h \widehat{C}_t)}{\Phi(R_h \widehat{C}_t)} \\ &= X_h \beta_t + \gamma_t \widehat{IMR}_{hi} \end{aligned}$$

where  $X_h$  is the vector of regressors used in the second stage,  $\beta_t$  is the vector of coefficients and

$\gamma_i$  is the coefficient of the inverse Mills ratio. The use of Heckman's procedure in this study is justified by the use of a different set of explanatory variables in each of the two steps. The Heckman sample selection model is less restrictive than the Tobit model, because it can have different set of explanatory variables in each step, i.e., selection and magnitude. The Tobit model consists of a single equation and considers same explanatory variables influence both the probability and the magnitude of purchase.

## **CHAPTER 3**

### **DATA AND VARIABLE SELECTION**

#### **The Data**

The study uses the cross sectional data from a survey conducted by a commercial market research company in the Republic of Korea in September 2007. Data were collected from seven urban centers, i.e., Seoul, Daejeon, Daegu, Busan, Ulsan, Incheon and Gwangju. Respondents were 1,100 women with the primary responsibility for food purchase and preparation in their respective households. Details regarding the various variables used in this study were collected by providing a comprehensive questionnaire to each of these participants. As in other survey studies, here also some participants did not respond to some of the questions, especially to those questions that related to the opinions and views of the respondents. Such observations were deleted. After the deletion, 896 observations were used for analytical purposes in the case of expenditure equation for vegetables and 916 observations in the expenditure equation for fruits.

#### **The Descriptive Statistics of Variables**

The dependent or the response variables are the weekly expenditures on fresh fruit and vegetable in Korean won as reported by respondents. Consumption, in general, is measured in terms of expenditures (Tomek, 1977). However, sometimes it is also measured in terms of physical quantities. The easy availability and the accurate measurement make expenditures a commonly used measure of consumption rather than physical quantities. Tomek (1977) suggests that if the product price does not vary during the sample period, then, it would not make any difference whether expenditure or quantity is used for the consumption study.

The independent variables include various socio-economic and demographic characteristics of the respondent and household locations. Respondents' BMI and opinions and views regarding various food attributes and technologies are also included to learn the direction of their association with the expenditures on fresh fruit and vegetable. Descriptive statistics, definitions of these variables and units of measurements are presented in Table 1. The mean of the expenditure on fresh fruits is higher than that on fresh vegetables. The average annual household income is 40,541,719.54 Korean won. The exchange rate was 928.60 South Korean Won for 1 US dollar at the time of conducting the survey (Federal Reserve Statistical Release, October 1, 2007). Respondents received an average of 13 years of education and the average age was 41.5 years. The average number of adults was 2.6 and sixty six percent of the households had children. Fifty nine percent of the interviewed females were employed. The respondent's BMI is not a commonly used variable in household expenditure studies. First, because data needed to calculate the BMI have not been collected and, second, because the need to consider the BMI has become urgent as the obesity has become a problem. This study considers the association between the expenditure and BMI. The average BMI is 21.603 and suggests the normal weight.

Around 80 percent of the total population in the Republic of Korea lives in urban cities. The surveyed households were located in seven major urban areas of the Republic of Korea, i.e., Incheon, Daejeon, Daegu, Ulsan, Busan, Gwangju and Seoul. About a quarter of the total population of the country resides within Seoul metropolitan area (CIA, 2008) making it the most densely populated urban center. Moreover, because it is the capital city, its residents also dictate the country's consumption pattern. Therefore, in this study Seoul has been omitted from the specified model and the comparison of expenditures in other urban centers is made in relation to

**Table 1. Descriptive statistics of variables**

Variable name	Units of measurement/variable description	Mean	Std dev	Expected sign	
				Vegetables	Fruits
<i>Dependent variables</i>					
Expenditure on Fresh Vegetables*	Expenditure in Korean won in the week preceding the survey	103902.24	87861.40		
Expenditure on Fresh Fruits*	Expenditure in Korean won in the week preceding the survey	141698.72	145800.57		
<i>Independent variables</i>					
<b><i>Socio-economic factors</i></b>					
Income*	Annual household income in Korean won	40541719.54	12939948.14	+	+
Educ*	Education of the respondent in years	13.0235	2.1369	+	+
Employ	=1 if the respondent is employed, 0 otherwise	0.5884	0.4924	-	?
<b><i>Demographic factors</i></b>					
Age*	Age of the respondent in years	41.4477	8.2468	+	+
Adult*	Number of adults in the household (more than 18 years old)	2.5812	0.8943	+	+
BMI*	The calculated Body Mass Index of the respondent	21.6352	2.4369	-	-
Child	=1 if children in the household, 0 otherwise	0.6645	0.4724	+	-
<b><i>Household location</i></b>					
Incheon**	=1 if the household is located in Incheon, 0 otherwise	0.1218	0.3272	?	?
Daejeon	=1 if the household is located in Daejeon, 0 otherwise	0.0684	0.2525	?	?
Daegu	=1 if the household is located in Daegu, 0 otherwise	0.1089	0.3118	?	?
Ulsan	=1 if the household is located in Ulsan, 0 otherwise	0.0524	0.2229	?	?
Busan	=1 if the household is located in Busan, 0 otherwise	0.1346	0.3415	?	?
Gwangju	=1 if the household is located in Gwangju, 0 otherwise	0.0716	0.2579	?	?
<b><i>Opinions and views</i></b>					
Responses to the following questions:					
Imfresh	How important is it to you that food be fresh? <sup>a</sup>	2.9551	0.2659	?	?
Rtapp	How important is it to you that food be have right appearance? <sup>a</sup>	2.8985	0.3662	?	?
Vitamin	How important is it to you that food be have vitamins? <sup>a</sup>	2.5609	0.7049	?	?

**Table 1. cont.**

Variable name	Units of measurement/variable description	Mean	Std dev	Expected sign	
				Vegetables	Fruits
Pestallow	How important is it to you that food be have pesticide residue within allowable limits? <sup>a</sup>	2.6571	0.6613	?	?
Contam	How important is it to you is the reduction of the possibility of food poisoning from contamination of fresh vegetables or fresh fruits by, for example, harmful microorganisms <sup>a</sup>	2.8024	0.5358	?	?
Ingred	Do you support or oppose the use of genetic modification in fruits or vegetables to increase the content of beneficial ingredients other than vitamins? <sup>b</sup>	1.7393	0.8643	?	?
Spoil	Do you support or oppose the use of genetic modification in fruits or vegetables to lengthen storage to decrease the spoilage? <sup>b</sup>	1.4786	0.7540	?	?
Refresh	Agreement with the statement that new agricultural and food technologies should focus on preserving freshness of foods <sup>c</sup>	2.7436	0.6087	?	?
Pestneed	Agreement with the statement that new agricultural and food technologies should focus on reducing the amount of pesticide used in production <sup>c</sup>	1.6015	0.8366	?	?
Manuf	How much trust do you have in food manufacturers when they make claims about food quality? <sup>d</sup>	2.0299	0.8371	?	?
Kfda	How much trust do you have in the KFDA when they make claims about food quality? <sup>d</sup>	2.4925	0.7443	?	?
Cab	Do you process cabbage at your home? <sup>e</sup>	0.7842	0.4116	+	NA
Other	Do you process vegetables other than pickle cabbage at your home? <sup>e</sup>	0.7949	0.4040	+	NA
Willfiber	Are you willing to pay more for foods that contain more dietary fiber? <sup>e</sup>	0.6368	0.4812	+	+
Willvitamin	Are you willing to pay more for foods that contain more vitamins? <sup>e</sup>	0.6368	0.4812	+	+
Willprotein	Are you willing to pay more for foods that contain more protein? <sup>e</sup>	0.5705	0.4953	?	?
Willlessfat	Are you willing to pay more for foods that contain less saturated fat? <sup>e</sup>	0.4776	0.4998	?	?

\* Logarithmic transformation is used. \*\* Seoul is the reference variable for the household location.

Responses: <sup>a</sup> 1=unimportant; 2=neutral; 3=important. <sup>b</sup> 1=oppose; 2=neutral; 3=support. <sup>c</sup> 1=disagree; 2=neutral; 3=agree.

<sup>d</sup> 1=no trust; 2=neutral; 3=trust. <sup>e</sup> 1=yes; 0=no.



that reported by respondents from Seoul. The location of a household in the remaining six urban centers is depicted by dummy variables.

Variables under the section ‘opinions and views’ are the responses to certain questions that are related to the attitudes and views of the respondents about food attributes, home processing of foods, willingness to pay more for foods with certain attributes, the aims of new agricultural and food technologies and sources of information about food quality (Table 1). Responses to the variables Imfresh, Rtapp, Vitamin, Pestallow, Contam, Ingred, Spoil, Refresh, Pestneed, Manuf and Kfda were originally scored on a seven-point scale with 1 representing ‘not important at all’ or ‘strongly oppose’ or ‘strongly disagree’ or ‘no trust at all’ and 7 representing ‘very important’ or ‘strongly favor’ or ‘strongly agree’ or ‘trust very much’. The middle number 4 was considered ‘neutral’. Since many of the categories have only very few observations, they were reclassified to a three-point scale with 1 representing ‘not important’ or ‘oppose’ or ‘disagree’ or ‘no trust’, 3 representing ‘important’ or ‘support’ or ‘agree’ or ‘trust’ and 2 representing ‘neutral’.

The variables Imfresh, Rtapp, Vitamin and Pestallow are the constructs based on responses to the questions ‘how important to you is it that food be: fresh, foods have right appearance, foods have vitamins, and foods have pesticide residues within allowable limits’, respectively. Contam is based on the response to indicate the importance of the issue of reducing the possibility of food poisoning from contamination of fresh vegetables by harmful microorganisms. Average scores were 2.96, 2.90, 2.56, 2.66 and 2.80 for Imfresh, Rtapp, Vitamin, Pestallow and Contam, respectively. Ingred and Spoil were created to analyze the responses to the questions ‘do you support or oppose the use of genetic modification in vegetables to increase the beneficial ingredients other than vitamins and in fruits to lengthen

storage to decrease the spoilage?’ The average values for these two variables were 1.74 and 1.48, respectively. Two other variables were constructed to obtain the respondent’s level of agreement with the aims of new agricultural and food technologies to focus on preserving freshness and reducing the amount of pesticides used in production. These were Refresh and Pestneed with mean levels of 2.74 and 1.60, respectively. Manuf (mean score: 2.03) and Kfda (mean score: 2.49) were related to the question ‘how much trust do you have in food manufacturers and the Korean Food and Drug Administration (KFDA) when they make claims about food quality’.

The remaining six variables are binary variables. Cab with a share of 0.79 and Other with a share of 0.78 related the home processing of pickle cabbage and vegetables other than cabbage, respectively. If a respondent reported the processing then the variable assumed a value of 1 and 0 otherwise. The willingness to pay more for foods that contain more dietary fiber, more vitamins, more protein and less saturated fat was represented through the variables Willfiber, Willvitamin, Willprotein, and Willlessfat with shares of 0.64, 0.64, 0.57 and 0.48, respectively. If a respondent is willing to pay more, then the concerned variable was given a value of 1 and 0 otherwise.

## **Variable Selection**

Among the different factors that are used as explanatory variables in this analysis, household income is perhaps the only variable, inclusion of, which is supported by the “traditional” economic theory (Reynolds, 1990). An increase in income is hypothesized to increase the expenditure on normal goods and to decrease the expenditure on inferior goods. Fresh fruit and vegetable are considered normal goods and, therefore, the expenditure on them is expected to increase in response to rising household income. Normal goods have an income

elasticity of more than zero. If the elasticity is more than one, the commodities are considered luxury goods, and if it is between zero and one, they are classified as necessities. Fruits and vegetables are generally considered necessities.

Reynolds (1990) maintains that economic theory has only a limited role in justifying the other variables. Rather, previous studies support their inclusion. The educational attainment level of a respondent is hypothesized to boost fresh fruit and vegetable expenditure and consumption. Earlier studies (Reynolds, 1990; Nayga, 1995; Blisard et al., 2002; Dutta-Bergman, 2005) report a positive influence of education on fruit and vegetable consumption and expenditures. The result is plausible because an increase in education level likely exposes a person to more information about the health benefits of fruit and vegetable consumption and knowledge gains influence food choices.

Employment status of a respondent is expected to have a negative effect on the fresh fruit and vegetable expenditure given the results of past studies (Capps and Love, 1983; Cook, 1990; Ruel, Minot and Smith, 2005). Employment status is a proxy variable that measures the allocation of time and presupposes that the employment indicates if a person spends a good portion of a day working outside the household. Indeed, the share of women having a job has been increasing in the United States (US). According to the US Bureau of Labor Statistics (2009), percentage of employed mothers with children under the age of 18 increased from 45% to 73% for the period from March 1975 to March 2000. In the Republic of Korea the employment also increased from 42.8% to 50% during the last three decades (Li, 2009) as a result of the export oriented rapid industrialization. Job demands limit the amount of time left for household chores including shopping for food and meal preparation. Earlier studies (Capps and Love, 1983; Cook, 1990) unanimously state that a person responsible for meal preparation,

who has a job and has less time for shopping and food preparation purchases foods that require less preparation time. Fresh produce preparation can be time consuming. In the US such explanation is supported by the fast growing demand for fresh-cut vegetables and fruits. The sales of fresh-cut fruit and vegetables have reached \$12 billion annually contributing to 15% of all the produce sales (Gorny, 2001). However, the behavior of consumers in other parts of the world, even though well off as consumers in the Republic of Korea, may be different, and the effect of employment has to be empirically verified.

Homemakers usually engage in home centered activities (McCall, 1977) and always feel more responsible for their family's health than working wives (Jackson et al., 1985). Therefore, nonworking wives devote more time to shopping and food preparation than their working counterparts. Homemakers consider food preparation efforts a major activity to win the admiration of family members (Jackson et al., 1985). Redman (1980) reports that nonworking wives purchase prepared foods less often than do working wives. It is quite plausible that the expenditures on fresh fruit and vegetable in households that have a homemaker would exceed similar expenditures of households with a working wife. Because this study examines expenditures on fresh fruit and vegetable, the ultimate effect of employment may vary between the two product categories. It is plausible that fresh fruit is eaten with little handling at home; vegetables may be used differently and may require more preparation time.

Studies of American consumers suggest that as a person ages, she becomes more health conscious and tries to increase the consumption of fruits and vegetables (Reynolds, 1990; Nayga, 1995; Serdula et al., 1995). The aging consumers are most likely motivated to eat more fruits and vegetables by epidemiological evidence that links a high consumption volume of fruits and vegetables and the reduction of the incidences of heart disease, certain cancers and stroke (Hu,

2003; Pavia et al., 2006). Korea's ageing population is affecting the consumer market trends. Ageing consumers are more interested in healthy eating and exercising than the younger counterparts because of the increased health awareness (Chennell and Ridley, 2009). The increased health awareness may be translated into an increased intake of fruits and vegetables by older people, since cancer and cardiovascular diseases are the major causes of deaths in South Korea (Chennell and Ridley, 2009). The variable age is expected to be positively associated with fresh fruit and vegetable expenditure. Results of past studies support this hypothesis.

An increase in the number of adults in the household is anticipated to increase fresh fruit and vegetable expenditure. A study by Capps and Love (1983) shows that this can happen with the fresh vegetable expenditure in the US households and a separate study by He, Huang and Houston (1995) report a similar outcome in the case of fresh fruits. An increase in the number of adults can also increase the expenditure on fruits and vegetables indirectly through the increase in the total members in the household. Such effects by the household size are validated by previous studies (Price and West, 1980; Nayga, 1995; Han and Wahl, 1998). The presence of children (less than 19 years old) in the households is expected to have a positive relationship with the expenditure on fresh vegetables. This is supported by Han and Wahl (1998) in their study on China's rural household demand for fruits and vegetables. At the same time, presence of children has shown a negative relationship with the fresh fruit expenditure in a study by Nayga (1995) about the US household expenditures on fruit and vegetables.

A household location variable is included to account for the regional differences. Availability of fresh fruit and vegetable may cause variation in expenditures among different regions. Several studies done in the US have examined the regional differences in the expenditure on fruit and vegetables (e.g., Price and West, 1980; Capps and Love, 1983;

Reynolds, 1990; He, Huang and Houston, 1995; Nayga, 1995) and in all these studies it has been found that geographical locations do influence the fruit and vegetable expenditure. A study conducted in South Korea by Onyango et al. (2006) on the consumer acceptance of genetically modified foods, finds that geographical differences affects the acceptance. In a separate study done in a neighboring country, China, by Ma et al. (2004) on animal product consumption in the 1990s, it is emphasized that the non inclusion of regional dummy variables can produce different expenditure and price parameters. Seven different urban locations, i.e., Incheon, Daejeon, Daegu, Ulsan, Busan, Gwangju and Seoul, are included in this study.

The BMI is a measure of the comparison between a person's height and his body weight, which represents body fat percentage that in turn will relate to a person's health condition. Therefore, this measure is generally included in studies related to obesity and is connected to the fruit and vegetable consumption. The increased consumption of fruits and vegetables which are lower in energy density may decrease the body weight of a person and at the same time makes him feel satiated also: because the BMI of a person is the proportion between his height and weight. Consequently, several studies have examined the relationship between the BMI and fruit and vegetable intake (e.g., Kahn et al., 1997; Williams et al., 1999; Bazzano et al., 2002; Flood et al., 2002; Lin and Morrison, 2002). These studies find that there is an inverse relationship between the BMI and fruit and vegetable consumption.

Besides the above, associations between opinions and views of the respondents and the fruit and vegetable expenditure are also examined in this study. Study by Capps and Schmitz (1991) points to the importance of nutrition and health issues in food purchasing decisions. Koreans are also becoming more and more concerned about health and quality of food (Chennell and Ridley, 2009). Therefore, in this study, respondent's knowledge about health and nutrition is

assessed using the responses to certain questions. Fresh vegetable equation has all the opinion variables included in the study, while fresh fruit equation excludes two variables, namely other and Cab. The results from this analysis may be used to create consumer profiles that can improve the marketing efforts by the food industry.

Some of the questions were on the importance of the freshness (Imfresh), right appearance (Rtapp) and vitamin content (Vitamin) of foods. Opinions about the importance of reducing the contamination from harmful micro-organisms (Contam) and the importance of having the pesticide residue within allowable limits (Pestallow) were also recorded. The levels of agreement/disagreement with the aims of new agricultural and food technologies to preserve freshness (Refresh) and to reduce the pesticide application (Pestneed) in food were measured. Another set of variables indicate the responses to the questions related to the support/opposition to the use of genetically modified methods to increase ingredients other than vitamins (Ingred) and to lengthen the storage to avoid spoilage (Spoil). Respondents' sources of food quality information such as food manufacturers (Manuf) and the KFDA (Kfda) are also included as variables. Sources of nutrition information are found to have dissimilar effects on the consumption of most of the fresh fruits included in a study by He, Huang and Houston (1995). The associations between the preparation of fermented cabbage (Cab) and other vegetables (Other), and the fresh fruit and vegetable expenditure are also considered. The fermented cabbage is called *kimchi* which is an essential ingredient of a Korean meal. *Kimchi* has a 1500 year old tradition and is consumed by Koreans at the rate of 90g per day per person (Park and Rhee, 2005). Other variables included in the category of opinions and views are the willingness of the respondent to pay more for foods that contain more dietary fiber (Willfiber), more vitamins (Willvitamin), more protein (Willprotein) and less saturated fat (Willlessfat).

Fruit and vegetables are generally rich in fiber and vitamins and are poor in fat content. Some of the vegetables provide protein as well.

To summarize, this study hypothesizes that an increase in household income, education level or age increases, while employment, other than being a homemaker, decreases the expenditure on fruits and vegetables. The household size has been reported to yield conflicting results and no a priori expectations with regard to the directional effect are formed. The BMI is expected to have an inverse association with fruit and vegetable expenditure. Respondents with more knowledge about health and nutrition are expected to spend more on fruits and vegetables, than those with less knowledge.



## **CHAPTER 4**

### **ESTIMATION RESULTS**

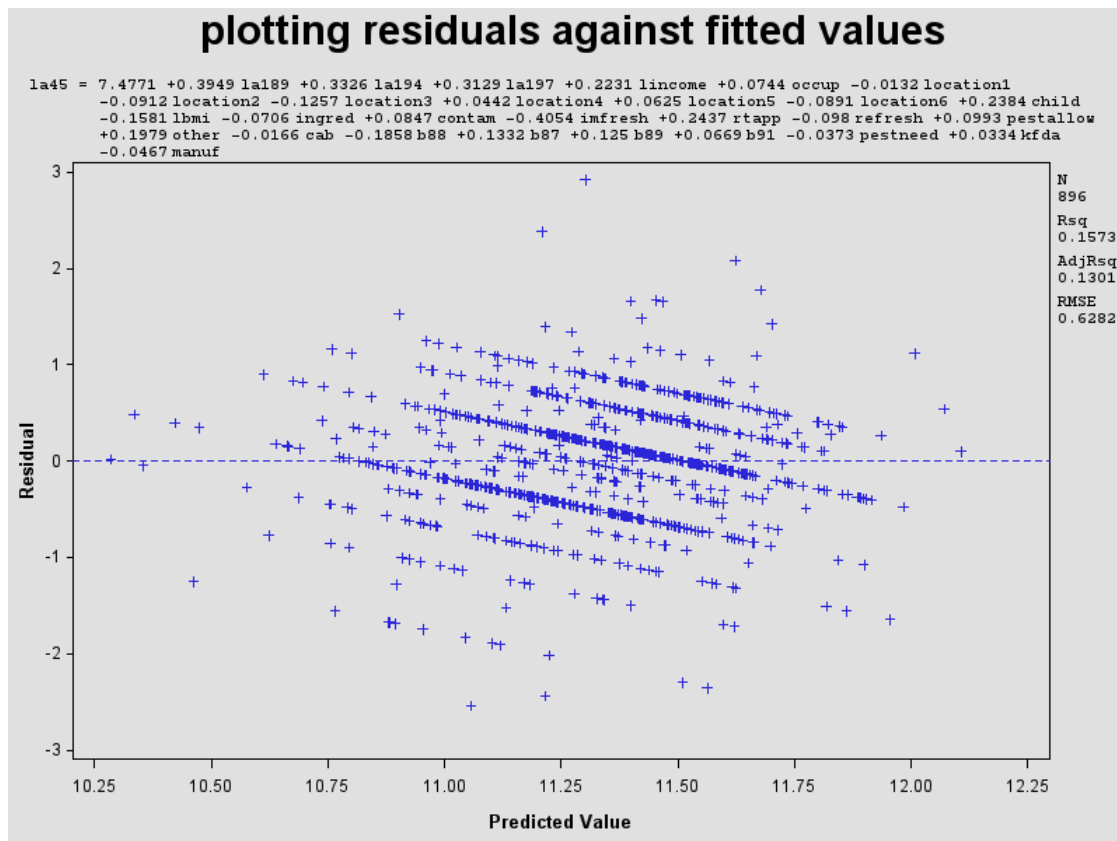
Estimation results are discussed separately for each equation, i.e., expenditures on fresh fruit and vegetable. All the selected variables were included in the fresh vegetable equation, but two opinion variables, namely Other and Cab, were excluded from the fresh fruit equation. For the Heckman's procedure, a different set of explanatory variables was used in each of the two stages. In the selection stage of the procedure all the socioeconomic and demographic variables, household location variables, the BMI and some of the opinion variables (Vitamin, Other and Cab for expenditure on vegetables and Vitamin for expenditure on fruits) were used. In the second stage, apart from the above, all the remaining opinion variables were also included. Heckman procedure was executed using SAS (qlim procedure) and STATA (Heckman selection model) softwares. The results from all procedures including the OLS were found to be quite similar (see the Appendix A and B). The similarity was expected, since the percentages of zero expenditure observations were very low in fresh vegetable as well as in fresh fruit expenditures. In the case of fresh vegetable equation the percentage of zero expenditure was so low that the Heckman procedure did not converge, while in fresh fruit equation, the coefficient of the inverse Mills ratio ( $MR_{hi}$ ) was not significant. The  $MR_{hi}$  is considered a proxy for the sample selection bias, therefore it can be concluded that there is no significant sample selection bias that affects the accuracy of the estimates. Because there are no threats of biased estimators and the results from the OLS method and the Heckman's procedure are similar, only the OLS results are discussed here.

## **Expenditure on Fresh Vegetables**

The model used to analyze the expenditure on fresh vegetables is found to be globally significant with an F value of 5.50 and the corresponding probability of less than 0.0001. The test value implies that the model has good predictive capabilities. The  $R^2$  and the adjusted  $R^2$  for the equation are about 0.16 and 0.13, respectively. Two major problems that are found to be associated with the analysis of cross-sectional data are heteroscedasticity (heterogeneity of variance) and multicollinearity. Homogeneity of variance (homoscedasticity) is one of the main assumptions in ordinary least square regressions (OLS). Heteroscedasticity or the non-constant variance can cause the OLS standard error estimates to be biased and, therefore, lead to inefficient OLS parameter estimates. Severe multicollinearity can inflate the standard error estimates.

Several tests are available for detecting the above problems. Both graphical and non-graphical methods are used to find whether there is any problem of heteroscedasticity. The graphical method is a plot of residuals against the fitted or predicted values. The resulting graph does not show any serious problem of heteroscedasticity (Figure 4) in this study. The White test is used to detect the problem non-graphically. In this test, the squared OLS residual is used as the dependent variable regressed against the explanatory variables in the original equation, and squares and cross products of these explanatory variables. The ‘/spec’ command in SAS<sup>®</sup> is used. Results show that the null hypothesis of no heteroscedasticity is not rejected ( $\text{Pr} > \text{ChiSq}$  is 0.1888), reinforcing the graphic results. The presence of multicollinearity is tested using the Variance Inflation Factor (VIF) method. The VIF is calculated as  $\text{VIF}_i = 1/(1-R_i^2)$ , where  $R_i^2$  is the  $R^2$  of the regression with the  $i^{\text{th}}$  independent variable as the dependent variable and all other independent variables as the explanatory variables. Results of this test (Table 2) show that there

are no serious multicollinearity problems, as all the VIF values are less than 4, a value of 10 being the critical limit above which multicollinearity is considered a serious problem that



**Figure 4.** The plot of residuals against predicted values of expenditure on fresh vegetables obtained using proc reg procedure` in SAS

**Table 2.** The VIF values for the continuous explanatory variables used in the fresh vegetable equation

Name of the variable	VIF value
Age	1.5
Education	1.4
Number of adults	1.7
Annual household income	1.3
BMI	1.2

interferes with the estimation of standard errors. Pearson correlation coefficients and the scatter plot matrix of these five continuous variables are provided in the Appendices C and D, respectively. Pearson correlation coefficients calculated for the independent variables range from 0.04 to 0.42. The highest correlation coefficients were between the age and number of adults (0.42), the age and level of education (0.35), the level of education and the BMI (0.30), household income and education (0.29). Although these values do not reveal a serious problem of multicollinearity, there could be a degree of multicollinearity problem that is overlooked in this analysis.

Table 3 shows estimation results of the equation for expenditure on fresh vegetables. Among the socioeconomic factors, annual household income has a highly significant and positive effect on fresh vegetables expenditure. The result is consistent with several previous studies (e.g. Capps and Love, 1983; Nayga, 1995; Blisard et al., 2002) and the expectation that fresh vegetables are normal goods. The positive relationship between the household income and fresh vegetable expenditure indicates that the Koreans always want to increase their vegetable intake whenever there is a possibility to do so. Traditional Korean diet rich in vegetables supports this suggestion. Another socioeconomic variable that also has a statistically significant and positive influence on the expenditure on fresh vegetables is the education of the respondent. The result is similar to those obtained by Price and West (1980), He, Huang and Houston (1995) and Nayga (1995). As a person becomes more educated, it is likely she becomes increasingly aware of the health benefits of consuming fresh vegetables. Capps and Love (1983) also agree that the educational attainment level of the household manager indicates the level of awareness of the importance of vegetables in the diet. Those with more education will be able to comprehend the content and the essence of health and other campaigns more easily than those

with less education. The third and the last socioeconomic variable used is the employment status

**Table 3. Parameters estimated for the expenditure on fresh vegetables**

Variable name	Parameter estimate	t statistics
Intercept	7.59877	7.71
<i>Socioeconomic factors</i>		
Household income	0.21312***	2.98
Education	0.32490**	2.33
Employment	-0.07525*	-1.68
<i>Demographic factors</i>		
Age	0.39048***	3.12
No: of adults	0.30936***	3.61
Presence of children	0.23205***	4.25
BMI	-0.15027	-0.71
<i>Location of the household</i>		
Incheon	-0.00882	-0.12
Daejeon	-0.07805	-0.77
Daegu	-0.13277*	-1.76
Ulsan	0.03676	0.37
Busan	0.06212	0.86
Gwangju	-0.07580	-0.85
<i>Opinions and views</i>		
Imfresh	-0.42420***	-4.20
Rtapp	0.23993***	3.29
Vitamin	0.05858	1.51
Pestallow	0.06544*	1.69
Contam	0.08932**	2.14
Ingred	-0.05335*	1.68
Spoil	-0.03275	-0.89
Refresh	-0.09543**	-2.51
Pestneed	-0.03610	-1.34
Manuf	-0.04637	-1.44
Kfda	0.02711	0.80
Cab	-0.01530	-0.22
Other	0.19620***	2.88
Willfiber	0.12337	1.49
Willvitamin	-0.18279*	-1.92
Willprotein	0.12067*	1.70
Willlessfat	0.07185	1.36

Note: \*, \*\* and \*\*\* denote significant at 10%, 5%, and 1% levels, respectively

F-statistic: 5.5; P-value: <0.0001;  $R^2$ : 0.16; Adjusted  $R^2$ : 0.13

of the respondent. Employment other than that of a homemaker is found to decrease the expenditure on fresh vegetables. This statistically significant result can be linked to the availability of less time for food preparation by a respondent who works outside, as compared to a homemaker. The opportunity cost of meal preparation increases with the employment (Capps and Love, 1983) and, therefore, the expenditure on fresh vegetables, which normally require more time for preparation, may decrease in households with main food preparer working outside. Such households may choose convenience foods more often than the households with homemakers.

Among the demographic factors, age of the respondent is found to have a positive and statistically highly significant relationship with the highest estimate value (elasticity) among all the estimates of the continuous variables. The result is consistent with the previous studies (e.g., Reynolds, 1990; Simunaniemi, Andersson and Nydahl, 2009). When people become older, they become more concerned about their health resulting in the higher consumption of fresh vegetables. Older people may also influence the food pattern of the household leading to the increased purchase of fruits and vegetables. Nayga (1995) report that older Americans are shifting to diets rich in fruits and vegetables in order to prevent heart disease and cancer. In the Republic Korea, cardiovascular diseases and cancer are the major fatal causes (Chennell and Ridley, 2009). Therefore, it is possible that older Koreans will tend to eat more vegetables than their younger counterparts. Another demographic household characteristic, the number of adults in the household, also has a statistically significant effect on the expenditure on fresh vegetables. This effect is positive and has been reported in earlier studies (Capps and Love, 1983; He, Huang and Houston, 1995). There can be many reasons for the positive influence. An increase in the total number of members in the household may require increased purchase of fresh vegetables.

Also, the increase in the number of adults may contribute more to the total household income resulting in the increased expenditure on fresh vegetables. The presence of children also has a highly significant positive effect on fresh vegetable expenditure. Larger households usually spend more on fresh vegetables than smaller households (Nayga, 1995). The parents may also want their children to have sufficient nutrients through the fresh vegetable intake. Another interesting result is the association between the BMI and the expenditure on fresh vegetables. The variable is not statistically significant, but its directional effect suggests an inverse relationship with the expenditure on fresh vegetables. Previous studies support this kind of relationship (Kahn et al, 1997; Bazzano et al, 2002; Tohill, 2005). The inverse relationship suggests that an increased expenditure on fresh vegetables is associated with a reduced BMI value. Fresh vegetables which are lower in energy density may decrease the body weight of a person, thereby reducing the BMI value.

Households located in Daegu spend less on fresh vegetables compared to the households in the reference location of Seoul. Although the Korean society is highly urbanized, many urban residents have migrated to cities relatively recently and have strong family ties to relatives living in rural Korea. So, there is high possibility that households in Daegu have easier access (especially at the time of the survey implementation) to fresh fruit and vegetable during the peak harvest season through relatives and friends engaged in farming. They may not have to spend money for fresh vegetables and fruits. Decreased availability of fresh vegetables when compared to Seoul may also have played a role in the lesser expenditure observed in households in Daegu than those in Seoul.

Nine out of seventeen variables used to indicate the opinions and views of the respondents are found to be statistically significant. These associations are usually helpful to

refine the profile of the respondents who have a particular opinion or view about some attributes and/or certain issues mentioned earlier. Respondents who consider it important that the food be fresh (Imfresh) spend less on fresh vegetables than those who have a neutral opinion and those who regard the issue as unimportant. Consumers tend to emphasize freshness as a highly important attribute food attribute and fresh vegetables, considered in this study as a category, include various types of vegetables ranging from leafy to root vegetables. Maintaining the visually appealing freshness of many vegetables is a challenge and any sign of deteriorating vegetable condition may discourage purchase, which is captured by the estimation result. Importance of the right appearance of the foods (Rtapp) has a positive relationship with the fresh vegetable expenditure, which means that the households with respondents for whom this issue is important spend more on fresh vegetables than those for whom this is unimportant or those who have no opinion in that matter. Similarly, the importance that foods should have pesticide residues within allowable limits (Pestallow) and the importance of the issue of reducing the possibility of food poisoning from contamination of fresh vegetables by harmful microorganism (Contam) also have positive relationship with the fresh vegetable expenditure. Households with respondents who support the genetic modification in vegetables to increase the beneficial ingredients other than vitamins (Ingred) are found to spend less on fresh vegetables than those with a neutral opinion or those who oppose such a practice. The respondents who support the above practice might have considered fresh vegetables a primary source of vitamins and expected foods other than fresh vegetables to provide additional benefits. Similarly, respondents who agree with the aim of new technologies to preserve the freshness of food (Refresh) spend less on fresh vegetables than those who disagree or do not have an opinion on this issue. Respondents who support such technology development might not have been satisfied with the



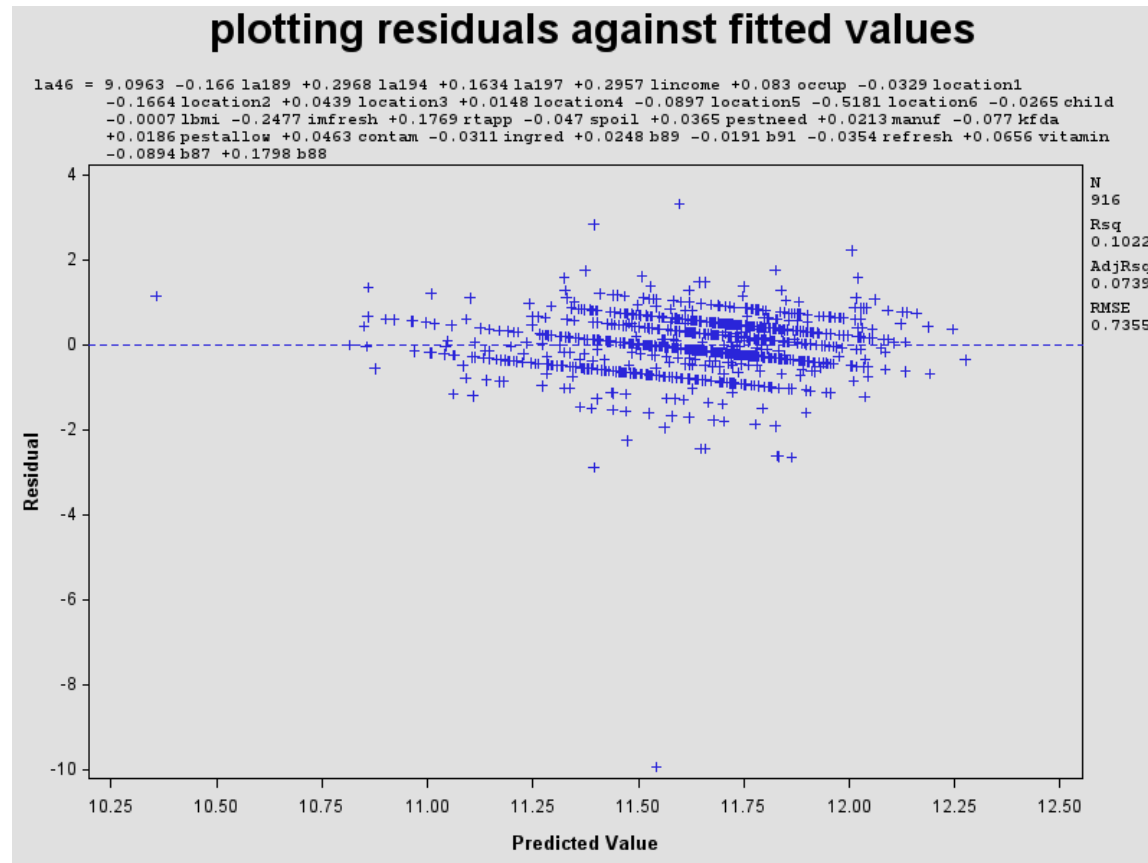
fresh vegetables available in the markets and search for a permanent technical solution to freshness. Households in which vegetables other than cabbage are processed (Other) spend more on fresh vegetables than those in which no processing has been reported. This result is quite reasonable, because those households which process vegetables may require their additional volume. The households where respondents are willing to pay more for foods with more vitamins (Willvitamin) spend less on fresh vegetables than households which report high expenditure. The respondents who are willing to pay more for foods with increased vitamin content possibly prefer to obtain vitamins from other foods because the Korean diet is already rich in vegetables. Respondents willing to pay more for foods with increased protein content (Willprotein) spend more on fresh vegetables than respondents who are unwilling to pay more for such foods. The respondents who are willing to pay more for additional proteins might have been well informed about the high protein vegetables such as beans, peas, broccoli and soybeans, and consequently made larger purchases of these kinds of vegetables.

### **Expenditure on Fresh Fruits**

The null hypothesis that all the estimated parameters are not significantly different from zero is rejected with an F value of 3.61 and the probability value of less than 0.0001, leading to the conclusion that the model can predict fresh fruit expenditure from the values of the explanatory variables used in the estimation. The  $R^2$  and the adjusted  $R^2$  for the equation are 0.1 and 0.07, respectively. These low values are not unusual in cross sectional data analyses. Results of both the graphical technique (Figure 5) and the White test ( $Pr > ChiSq$  is 0.9773) employed to detect heteroscedasticity indicate the absence of serious problem with the constant variance. Table 4 provides the VIF values that measure the multicollinearity problems. All the VIF values

are substantially smaller than the critical value of 10 indicating that multicollinearity is not a serious problem. Here also the problem that may still persist is overlooked.

Table 5 shows the estimation results for the equation modeling expenditure on fresh fruits. Among the socioeconomic factors, household income has a significant and positive effect on fresh fruit expenditure. The result is consistent with the results of previous studies (e.g. Cook,



**Figure 5. Plot of residuals against predicted values of expenditure on fresh fruits obtained using proc reg procedure in SAS**

**Table 4. The VIF values for the continuous explanatory variables used in the fresh fruit equation**

Name of the variable	VIF value
Age	1.5
Education	1.3
Number of adults	1.7
Annual household income	1.3
BMI	1.2

1990; He, Huang and Houston, 1995; Nayga, 1995). The positive relationship is expected because fresh fruits are considered normal goods. The education of the respondent has a positive and statistically significant influence on the expenditure on fresh fruits. More educated persons usually are more exposed to information about the health benefits of consuming fresh fruits than their less educated counterparts. Such adult persons usually influence the diet pattern of the households by trying to include more fresh fruits in the diet. Therefore, an increased level of education attainment brings about an increase in the fresh fruit expenditure. This is a good sign for the Republic of Korea because the country has one of the highest education-participation rates in the world (Chon-sun, 2007). The third and last socioeconomic variable, employment of the respondent also has a statistically significant negative effect on the fresh fruit expenditure indicating that households with respondents who are employed spend less on fresh fruits than those with homemakers. The result may be attributed to the time pressure experienced by the working wives. They may not have enough time to shop frequently and, therefore, may purchase less fresh fruits than their non-working counterparts. On the other hand, homemakers will have sufficient time to consider the effects of several factors, including the consideration of health, on household members, while food shopping. The health concerns are a plausible consideration prompting them to purchase a larger variety and quantity of fruits.

Among the demographic variables only the number of adults in the household has a statistically significant effect. The effect of the number of adults is positive. The result is tenable because as the number of adults increases, the requirement for fresh fruits may increase and, consequently, the fresh fruit expenditure. Although the other three demographic variables, i.e., age of the respondent, the presence of children in the household, and the BMI of the respondent are not statistically significant, but the signs of the estimates are consistent with

expectations. Age of the respondent has a negative sign suggesting that as a person ages, she spends less on fresh fruits. On the other hand, the presence of children has a negative influence on fresh fruit expenditure. Nayga (1995) suggested that children usually prefer sweetened or

**Table 5. Parameters estimated for the expenditure on fresh fruits**

Variable name	Parameter	t statistics
Intercept	9.09632	8.02
<i>Socioeconomic factors</i>		
Household income	0.29571***	3.56
Education	0.29678*	1.82
Employment	-0.08302*	-1.67
<i>Demographic factors</i>		
Age	-0.16598	-1.16
No: of adults	0.16337*	1.68
Presence of children	-0.02653	-0.42
BMI	-0.00074	-0.20
<i>Location of the household</i>		
Incheon	-0.03294	-0.39
Daejeon	-0.16645	-1.42
Daegu	0.04394	0.51
Ulsan	0.01479	0.13
Busan	-0.08969	-1.10
Gwangju	-0.51806***	-4.86
<i>Opinions and views</i>		
Imfresh	-0.24765**	-2.12
Rtapp	0.17687**	2.09
Vitamin	0.06561*	1.65
Pestallow	0.01858	0.40
Contam	0.04633	0.88
Ingred	-0.03113	-0.84
Spoil	-0.04695	-1.13
Refresh	-0.03543	-0.84
Pestneed	0.03646	1.17
Manuf	0.02126	0.58
Kfda	-0.07700**	-1.97
Willfiber	-0.08943	-0.96
Willvitamin	0.17979*	1.66
Willprotein	0.02478	0.31
Willlessfat	-0.01914	-0.32

Note: \*, \*\* and \*\*\* denote significant at 10%, 5%, and 1% levels, respectively

F-statistic: 3.61; P-value: <0.0001;  $R^2$ : 0.1; Adjusted  $R^2$ : 0.07

processed fruits over fresh fruits. The inverse relationship between the BMI and the fresh fruit expenditure indicates that fresh fruits which are lower in energy density can decrease the body weight of a person leading to the reduction in the BMI value.

The households located in Gwangju spend less on fresh fruits than those located in Seoul. It is plausible that the difference in the availability of fresh fruits across cities results from closer ties with families living in rural areas. A relatively easy access to fresh fruits during peak harvest season may have contributed to this reduction in expenditure on fresh fruits in September 2007, the time of the survey implementation. The relationship is highly statistically significant and has the largest magnitude among all variables.

Five out of fifteen variables used to indicate the opinions and views of the respondents are found to be statistically significant. Households where respondents consider it important that the food be fresh (Imfresh) spend less on fresh fruits than those who have a neutral opinion or those who regard the issue as unimportant. The respondents who attach importance to the freshness of foods might have been very selective while purchasing the fresh fruits leading to the lesser expenditure on fresh fruits than those who do not consider the freshness of foods important. Importance of the right appearance of the foods (Rtapp) has a positive association with the fresh fruit expenditure. Appearance of fruit is a known factor encouraging fruit purchase and a visually appealing fruit will increase fruit expenditure in a household. The importance that foods should have vitamins (Vitamin) also positively influences the fresh fruit expenditure. This result is plausible because the fresh fruits are a major source of vitamins essential for human wellbeing. The effect of the variable Kfda, related to the trust respondents place in the Korean Food and Drug Administration (KFDA) regarding the claims about food quality is unexpected. According to the results, respondents who trust KFDA claims about food

quality, spend less on fresh fruits than those with respondents who do not trust or do not have an opinion. This may mean that KFDA is not promoting the consumption of fresh fruits as expected, because of the concerns about the quality of fresh fruits being sold in Korean markets. The households with respondents who are willing to pay more for foods containing additional vitamins (Willvitamin) spend more on fresh fruits than those with respondents who are not willing to pay more for these foods.

### **The Elasticities**

The elasticities provide an easy way to understand the impact of explanatory variables on the dependent variable. Estimates of continuous independent variables are elasticities because of the applied functional form. The income elasticity of expenditure on fresh vegetables is 0.21. A 10% increase in the annual household income will bring about 2.1% increase in the household weekly expenditure on fresh vegetables. The income elasticity value confirms that the fresh vegetables are normal and necessary goods. Similarly, the education elasticity is 0.32, which implies that a 10% increase in the length of formal education respondent has received causes a 3.2% increase in the weekly fresh vegetable expenditure. Age elasticity of 0.39 translates into an increase of 39% in the expenditure on fresh vegetables for every 10% increase in the age of a respondent. An increase of 3.1% in the fresh vegetable expenditure for a 10% increase in the number of adults in the household is suggested by the adult elasticity of 0.31.

The interpretation of percentage changes due to the binary variables is slightly different from those due to the continuous variables. Percentage changes resulting from the statistically significant binary variables, calculated using Halvorsen and Palmquist (1980) procedure, are shown in Table 6. These changes occur when a binary variable changes its value from 0 to 1. Presence of children in the household is the most influential variable in the fresh vegetable

expenditure equation. A household that reports having children is expected to increase the weekly fresh vegetable expenditure by 26.1%. A household located in Daegu spends 12.4% less per week on fresh vegetables than a household located in Seoul. Employment has the least effect

**Table 6. Estimated percentage changes in the expenditures on fresh fruit and vegetable in the case of statistically significant binary variables**

Variable name	Expenditure on Fresh Vegetables	Expenditure on Fresh Fruit
Employment	-7.8	-8.7
Presence of children	26.1	NS
Daegu	-12.4	NS
Gwangju	NS	-40.4

NS: statistically not significant

with an absolute value of 7.8. This value suggests that a household with a working wife spends 7.8% less on fresh vegetables than a household with a homemaker.

Elasticities have been calculated using the estimation results from the fresh fruit expenditure equation. The income and the education of the respondent are associated with the largest magnitude of elasticities. Both characteristics have an elasticity of 0.30 each. The income elasticity implies that a 10% increase in the household income increases the weekly fresh fruit expenditure by 3%. The magnitude of the income elasticity implies that the fresh fruits are normal and necessary goods. A 10% increase in the number of years of schooling received by a respondent, or about 1.5 year of additional, formal education increases the fresh fruit expenditure by 3%. The elasticity associated with the number of adults in the household is 0.16 and indicates that an addition of one adult to a household will increase the fresh fruit expenditure by about 6.4%.

Table 6 shows elasticities calculated for two statistically significant binary variables. A 8.7% decrease in the fresh fruit expenditure occurs in households with working wives as

compared to households with homemakers. A household located in Gwangju spends a whopping 40.4% less than a household in Seoul on fresh fruit. The difference is quite large and may result from a combination of factors including the timing of the survey implementation during the typical month when many fruits are being harvested and the pricing differences between the two urban areas. The sizable difference supports the need to account for location differences when examining expenditures on fresh fruit.

The income elasticity of expenditure for fresh fruits (0.30) is higher than that for fresh vegetables (0.21). Consequently, a one percentage increase in income will result in a higher percentage increase in the expenditure on fresh fruit than that on fresh vegetables. Figures 1 and 2 also support the identified difference in the elasticities. The per capita fruit consumption showed a growing tendency between 1969 and 1998 (Figure 1), while the per capita vegetable consumption was fairly steady during the same period (Figure 2). Therefore, fresh fruit expenditure is more responsive to a change in income than the fresh vegetable expenditure. Another notable difference is the magnitude of adult elasticity associated with the number of adults in the household. A change in the number of adults has almost twice the impact on fresh vegetable expenditure, 0.31, than on fresh fruit expenditure, 0.16. The result is consistent with the observed diet high in vegetables despite the observed influence of western dietary pattern. The education and employment have elasticities of almost the same magnitude in case of both fresh fruit and vegetable expenditures. Such results suggest that the importance of both characteristics for the expenditure on the two categories has to consider their relative effect and account for the absolute expenditure amount on either fruit or vegetables.

The examples showing the elasticity interpretation illustrate their practical importance. If a household with an annual income of 40541719 won (\$43687) receives an additional 10%



revenue of 4054172 won (\$4369) annually, then the expenditure on fresh fruits will increase by 3% (4251 won or \$4.6) per week against an increase of 2.1% (2182 won or \$2.4) in the case of fresh vegetable expenditure. The education elasticity values indicate that one percentage change in education will bring about a larger percentage increase in expenditure on fresh vegetables than that on fresh fruits. For example, if a woman with 13 years of education studies for one more year (about 8% increase), the weekly expenditure on fresh vegetables will increase by about 2.6% (2701 won or \$2.9) and the weekly expenditure on fresh fruits will increase by 1.28% (1814 won or \$2). The elasticity associated with age in case of fresh vegetable expenditure is 0.39, and suggests that a 44 year old woman will spend 4% (4156 won or \$4.5) more on fresh vegetables per week, compared to a 40 year old female respondent. The calculated elasticities indicate that if a household adds an adult member (about 40% increase in the number of adults), there will be about 12.4% (12884 won or \$13.9 per week) as opposed to only 6.4% (9069 won or \$9.8) increase in the fresh fruit expenditure, amounting to a difference of 3815 won (\$4.1) between the increases in fresh vegetable and fruit expenditures.

## **CHAPTER 5**

### **CONCLUSIONS**

This study focused on the estimation of expenditures on fresh fruit and vegetable by urban Korean households. A number of studies indicate that high consumption of fresh fruit and vegetable can lower the incidences of certain non-communicable diseases such as cardiovascular diseases, cancers and strokes, and thereby prevent deaths associated with these diseases. Unfortunately, in South Korea, various forms of cancer and cardiovascular diseases are the major fatal causes (Chennell and Ridley, 2009). According to UBS (2008) South Korea is among the ten fastest ageing countries in the world. An increase in the rate of incidences of such diseases among the increasing elderly population is likely. In 2007 alone, cardiovascular diseases accounted for 23.5% of all deaths in the Republic of Korea (Chennell and Ridley, 2009). An increased consumption of fresh fruit and vegetable may bring down this alarming rate in the coming years. In this context, this analysis of the determinants of the expenditures on fresh fruit and vegetable in South Korean households assume much importance, especially for the farm sector, food marketers and the government agencies.

Given the traditional division of household responsibilities only women were interviewed with regard to household eating habits, consumption preferences and food expenditures. The results provide insights about similarities and differences in the set of factors influencing expenditures on fresh fruit and fresh vegetables and allow various participants of the supply chain and public and private decision-makers to shape their marketing strategies or public education efforts intended to increase the consumption of fresh produce. On the whole,

results of this analysis seem to be consistent with the previous studies, however, they also provide insights specific to Korean consumers and support the observed food preferences. The results are summarized below.

### **Summary of Results**

The annual household income has a positive effect on both fresh fruit and vegetable expenditures. Expenditure on fresh fruits is more responsive to a change in income than that on fresh vegetables given the calculated higher income elasticity for fresh fruits. Both commodity groups are normal (positive elasticity) and necessary (elasticity values are less than one) goods. Any increase in income in Korean urban households is more relevant to the increased expenditure on fruit offering opportunities to market additional fresh fruit volume although additional vegetable volume will also be purchased. The differences in fresh fruit and vegetable income elasticities offer opportunities for growers, distributors and retailers. Using this information and the identified regional differences and differences in other consumer characteristics marketing and merchandising efforts can become more effective in encouraging spending on fresh produce, which generates relatively higher margins than processed produce. Overall, the observed income effect is in line with the objectives of public health policy aiming at increased fresh produce consumption, while the identified consumer profiles are helpful in modifying educational messages addressed to various population groups.

The education of the respondent also has a positive impact on expenditures of fresh fruit and vegetable and the magnitude of the elasticities is almost the same for both. Educated consumers can be motivated to increase fresh produce expenditures and are likely receptive to messages stressing the health benefits of fresh produce consumption. The employment status of the respondent is negatively related to the expenditures on fresh fruit and vegetable and,

similarly to the effect of education, the size of the effect differs little between fresh fruit and vegetable expenditures. However, the marketers and public policy makers may have to focus their efforts on encouraging greater expenditure on fresh produce by working urban women in South Korea. It appears that the difference in expenditures on fresh produce may reflect the shift in the dietary pattern away from the traditional Korean diet to westernized diet with its emphasis on convenience.

The age of the respondent has a positive influence on the fresh vegetable expenditure. This is a desired outcome from the public health standpoint if the expenditures translate into an increased volume of consumed fresh vegetables. Because vegetables are a major source of several vitamins and minerals (including calcium), the observed age effect on expenditures is a positive phenomenon.

The number of adults in the household has positive effects on both fresh fruit and vegetable expenditure. However, the magnitudes of elasticity vary dramatically (0.31 against 0.16). The large differences in elasticities are of primary interest to fresh produce marketers who are offered a chance to differentiate their message targeting sales of two fresh produce categories. The presence of children in the household has a positive influence on the fresh vegetable expenditure. The households with children spend 26% more on fresh vegetables per week than the households without children. This large difference is a signal for food distributors in marketing fresh vegetables. But, at the same time, the use of expenditure as the measure in this study could, however, imply that women from households with children select more expensive (presumably higher quality) vegetables than women from households without children. A future study may re-examine this relationship.

In terms of the household location, only the location in Daegu has a statistically significant effect on the fresh vegetable expenditure. This effect is negative indicating that the households located there spend less on fresh vegetables than those located in Seoul. It is plausible that the respondents from Daegu might have access to fresh vegetables from their farming friends and relatives. Price differences might also have played a role in such variations in the expenditures. The expenditure on fresh fruits is less in households in Gwangju than those located in Seoul, the capital city of the Republic of Korea. The accessibility and price differences may have been the reasons, but future study which would include prices would more definitely provide an answer. The expenditure in the current study are for a period of week and were collected during the month when many fruits and vegetables are harvested

Influence of the opinions and views of the respondents was more prominent in the case of fresh vegetable expenditure than the fresh fruit expenditure. Three variables that are significant in both cases are about the importance of the freshness (Imfresh) and right appearance (Rtapp) of the foods, and about the willingness to pay more for foods that contain additional amount of vitamins (Willvitamin). Imfresh has a negative influence on both fresh fruit and vegetable expenditures, while the Rtapp has a positive influence. The variable Willvitamin has a positive relationship with fresh fruit expenditure, whereas it has a negative relationship with fresh vegetable expenditure. Other opinion variables that are statistically significant in the fresh vegetable equation are about the importance of having pesticide residue within allowable limits (Pestallow), reducing the contamination from microorganisms (Contam), genetic modification in vegetables for increasing some beneficial ingredients (Ingred), agreement with the new technology aim to preserve the freshness of foods (Refresh), willingness to pay for foods that contain additional amount of protein (Willprotein), and the home processing of vegetables other

than the pickled cabbage (Other). All the above listed variables except Ingrid and Refresh have a positive relationship with fresh vegetable expenditure. The variable about the importance of vitamins in foods (Vitamin) and that about the trust in the KFDA (Kfda) regarding the claims about food quality have a positive and negative relationship with fresh fruit expenditure, respectively.

### **Implications**

The impacts and the directional effects of the explanatory variables used in this study on fresh fruit and vegetable expenditure provide insights for food marketers and the government policy makers in formulating their future plans and making decisions. Overall an average Korean already consumes the recommended volume of fruits and vegetables. However, the incidence of diseases commonly associated with the western-style diet has been increasing. Moreover, although the majority of Koreans maintain their weight in the healthy range, the share of overweight people increases. For example, the food marketers will be able to focus on the segment of the population that is likely to spend more on fresh fruit and vegetable. The government policy makers are able to identify the categories of consumers, whose diet could include additional amount of fresh fruit and vegetable based on the knowledge provided by this study. The majority of the households with respondents not older than 40 years of age, having less than 13 years of education and with respondents who work spend less on fresh vegetables than the calculated average weekly amount. Similarly, households with respondents who work, respondents having less than 13 years of education, and with an annual household income of less than 45,000,000 Korean won are more likely to spend less on fresh fruits than the calculated average weekly expenditure. Both food marketers and government agencies may consider coordinating their efforts to increase fresh produce expenditures in households falling into the

above mentioned categories by addressing the convenience of fresh produce and specific health benefits. Given that the working women are likely to be educated and education was positively influencing expenditures on fresh produce, a suitable message may target that segment of consumers.

The quantification of the effects of the explanatory variables and elasticities enable the forecast of future changes in fresh and vegetable expenditures in the Republic of Korea. The effect of anticipated changes in income, age, household compositions and size, and education on fresh produce expenditure can be calculated and used in making farm decisions, food distribution and retailing. The information about the observed expenditures on fresh fruit and vegetable helps to modify the future consumer educational programs and production programs by public health officials and agricultural policy makers, respectively.

The regional variations in the expenditures on fresh produce usually provide food marketers an opportunity to redirect the distribution of fresh produce and to earn additional revenue. In this study, it is found that households located in Daegu spent less on fresh vegetables than those located in Seoul and households located in Gwangju spent markedly less than those located in Seoul. The food distributors and the government agencies may be able to increase the fresh produce consumption in Daegu and Gwangju by directing their marketing and education efforts. However, it is difficult to provide the exact reasons for the decreased expenditure, because the prices were not available for this study. Both accessibility and price differences might have lead to this decrease. Accounting for the price differences and availability of fresh produce in urban centers as well as in rural areas may be able to provide much more clear directions to food marketers and the government agencies. The lack of easy

accessibility may hinder the adequate fruit and vegetable consumption especially by households with limited resources.

The profiles of consumers, who are prone to spend more on fresh vegetables and fruits, based on the results of this study may help food distributors and retailers in formulating their marketing strategies. For example, households with high annual income, elderly members, children, a large number of adults, highly educated members, a homemaker rather than a working female, and with locations at Daegu may be targeted for marketing fresh vegetables. Similarly, households with high income, consisting mostly of adults, run by a homemaker rather than a female working outside the household, with highly educated members, and located at Gwangju can be a focus of fresh fruit marketing efforts.

The statistically significant relationship between various opinion variables used in this study and fresh fruit and vegetable expenditure may be used for refining consumer profiles useful for both the food distributors and the government agencies. Respondents whose age ranges from 40 to 50 years and who have at least 12 years of schooling are willing to pay more for foods containing additional amounts of vitamins. The percentage of respondents who regard the right appearance of foods as important for them is relatively more in Seoul and Gwangju cities than other cities considered in this study. Since the households with these respondents spend more on fresh fruit and vegetable, the locations mentioned above can be targeted for marketing the fresh produce. Another opinion variable that has a significant influence in fresh fruit and vegetable expenditures is the importance of food freshness (Imfresh). This variable is inversely related to both fresh fruit and vegetable expenditures indicating that the respondents who consider the freshness of foods important spent less on both fruits and vegetables. Efforts to ensure the freshness of fresh fruit and vegetable currently being distributed in the Republic of



Korea may require additional care on the part of distributors and retailers if they would like to increase the sales value. The directions of the effects of opinion variables on fresh produce expenditures provide specific information to food marketers and allow to effectively target selected consumer groups.

The BMI is not statistically significant. It appears that despite growing concerns in Korea about the weight management issues, the BMI has yet to show to matter in the study on fresh produce expenditure. A possible shift in the diet could have important health consequences. A future study exploring the relationship between the BMI and food expenditure of various food groups' consumption seems worthwhile. A study will require new data collection effort.

### **Limitations of this Study**

Though the study is able to provide some useful results for the food marketers and the government agencies in the Republic of Korea, it still has some limitations. A major limitation is that all the respondents interviewed were urban women. Therefore, a generalization to the population of the South Korea as a whole could be misleading. Another limitation is omission of prices in this study. Such omission, assumes that the prices are constant across the surveyed households and, is common in cross sectional studies. In reality, prices faced by households may vary. Tomek (1977) noted that the omission of prices may affect the income elasticities, which are used to quantify the effects of specific factors on fresh fruit or fresh vegetable.

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# APPENDIX A:

## COMPARISON OF THE RESULTS FROM THE OLS AND THE HECKMAN'S PROCEDURE FOR FRESH VEGETABLE EQUATION

Variable	Values of parameters estimated from		
	OLS	PROC QLIM(SAS)	STATA
Household income	0.21312***	0.21575***	0.21894
Education	0.32490**	0.28285**	0.22778
Employment	-0.07525*	-0.07060*	-0.06223
Age	0.39048***	0.37921***	0.34896
No: of adults	0.30936***	0.30824***	0.30296*
Presence of children	0.23205***	0.22956***	0.21683*
BMI	-0.15027	-0.14696	-0.14603
Incheon	-0.00882	-0.01247	-0.02133
Daejeon	-0.07805	-0.06243	-0.04349
Daegu	-0.13277*	-0.13741*	-0.14741
Ulsan	0.03676	0.03148	0.02269
Busan	0.06212	0.05970	0.05255
Gwangju	-0.07580	-0.07785	-0.08072
Imfresh	-0.42420***	-0.42299***	-0.43157**
Rtapp	0.23993***	0.24066***	0.23701
Vitamin	0.05858	0.05803	0.05699
Pestallow	0.06544*	0.06551	0.07079
Contam	0.08932**	0.08707	0.08969
Ingred	-0.05335*	-0.05381	-0.05600
Spoil	-0.03275	-0.02993	-0.03166
Refresh	-0.09543**	-0.09548	-0.09493
Pestneed	-0.03610	-0.03891	-0.03923
Manuf	-0.04637	-0.04639	-0.04775
Kfda	0.02711	0.02682	0.02698
Cab	-0.01530	-0.01679	-0.01892
Other	0.19620***	0.19375	0.18256
Willfiber	0.12337	0.12583	0.13095
Willvitamin	-0.18279*	-0.18585	-0.18393
Willprotein	0.12067*	0.11914	0.11488
Willlessfat	0.07185	0.07036	0.06826
Convergence status	NA	Not converged	Converged; p-value for IMR is 0.373

Note: \*, \*\* and \*\*\* denote significant at 10%, 5%, and 1% levels, respectively  
IMR: Inverse Mills Ratio

# APPENDIX B:

## COMPARISON OF THE RESULTS FROM THE OLS AND THE HECKMAN'S PROCEDURE FOR FRESH FRUIT EQUATION

Variable	Values of parameters estimated from		
	OLS	PROC QLIM(SAS)	STATA
Household income	0.29571***	0.29833***	0.29833***
Education	0.29678*	0.30883*	0.30882
Employment	-0.08302*	-0.08419*	-0.08419*
Age	-0.16598	-0.17093	-0.17093
No: of adults	0.16337*	0.16734*	0.16734*
Presence of children	-0.02653	-0.02188	-0.02188
BMI	-0.00074	-0.01134	-0.01135
Incheon	-0.03294	-0.03168	-0.03167
Daejeon	-0.16645	-0.16828	-0.16829
Daegu	0.04394	0.04698	0.04698
Ulsan	0.01479	0.01742	0.01743
Busan	-0.08969	-0.08586	-0.08585
Gwangju	-0.51806***	-0.52328***	-0.52328***
Imfresh	-0.24765**	-0.24759**	-0.24759*
Rtapp	0.17687**	0.17677**	0.17677**
Vitamin	0.06561*	0.06753*	0.06753*
Pestallow	0.01858	0.01823	0.01823
Contam	0.04633	0.04635	0.04635
Ingred	-0.03113	-0.03100	-0.03100
Spoil	-0.04695	-0.04689	-0.04689
Refresh	-0.03543	-0.03518	-0.03518
Pestneed	0.03646	0.03670	0.03670
Manuf	0.02126	0.02139	0.02139
Kfda	-0.07700**	-0.07724**	-0.07724**
Willfiber	-0.08943	-0.08929	-0.08929
Willvitamin	0.17979*	0.17981	0.17981*
Willprotein	0.02478	0.02533	0.02533
Willlessfat	-0.01914	-0.01910	-0.01910
Convergence status	NA	Converged; p-value for Rho is 0.5498	Converged; p-value for the IMR is 0.177

Note: \*, \*\* and \*\*\* denote significant at 10%, 5%, and 1% levels, respectively  
IMR: Inverse Mills Ratio

# APPENDIX C:

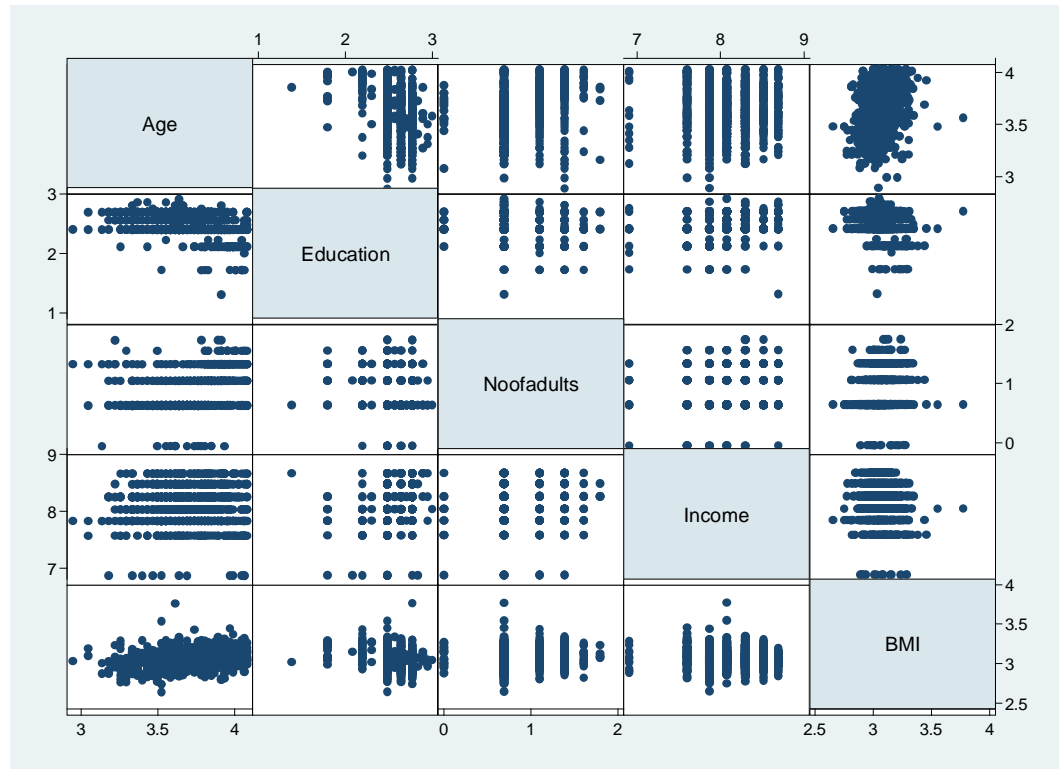
## THE PEARSON CORRELATION COEFFICIENT OF THE FIVE CONTINUOUS EXPLANATORY VARIABLES

<b>Pearson Correlation Coefficients, N = 896</b> <b>Prob &gt;  r  under H0: Rho=0</b>					
	<b>Age</b>	<b>Education</b>	<b>No of adults</b>	<b>income</b>	<b>bmi</b>
<b>Age</b>	1.00000	-0.34676 <.0001	0.42339 <.0001	0.04160 0.2135	0.29944 <.0001
<b>Education</b>	-0.34676 <.0001	1.00000	-0.21613 <.0001	0.28888 <.0001	-0.24214 <.0001
<b>No of adults</b>	0.42339 <.0001	-0.21613 <.0001	1.00000	0.07758 0.0202	0.16545 <.0001
<b>income</b>	0.04160 0.2135	0.28888 <.0001	0.07758 0.0202	1.00000	-0.06865 0.0399
<b>bmi</b>	0.29944 <.0001	-0.24214 <.0001	0.16545 <.0001	-0.06865 0.0399	1.00000

(Obtained using the proc corr procedure in SAS)

# APPENDIX D:

## THE SCATTERPLOT MATRIX OF THE FIVE CONTINUOUS EXPLANATORY EXPLANATORY VARIABLES



(Obtained using the procedure in STATA software)



## APPENDIX E:

### THE FULL SURVEY INSTRUMENT DEVELOPED FOR DATA COLLECTION

The data used in this study were collected by the commercial survey company in the Republic of Korea using the survey instrument developed by Drs Wojciech J. Florkowski, University of Georgia, and Dong-Kyun Suh, Rural Development Administration (RDA). The survey was implemented under the project focused on agricultural technology and consumer food choices supported by a grant to the University of Georgia from the RDA. The full survey instrument used to collect data is shown below.

### RDA/UGA SURVEY, 2007

1. Are you the primary food shopper in your household? ☐ Yes ☐ No

If you are the primary food shopper, do you take into account food preferences of your household members when buying food?

☐ Almost never ☐ Seldom ☐ Neither often nor seldom ☐ Often ☐ Very often

2. How often do you select foods when you buy them with this in mind:

	Almost never ----- Almost always						
Food	1	2	3	4	5	6	7
Sodium (salt) content							
Sugar content							
Total fat content							
Saturated fat content							
Protein content							
Total calories (energy) content							
Fiber content							

3. How important to you is it that food be:

Importance	Not important at all	Not important	Neither important nor unimportant	Important	Very important
Fresh					
Have right appearance					
Have a brand name					
Have vitamins					
Have pesticide residue within allowable limits					
Be pesticide free					
Be of Korean origin					
Be inexpensive					
Organic produce					
Hydroponically grown vegetables					

4. Is it important to you to know how the food you eat was produced

At the farm ☐ Yes ☐ No ☐ Don't know  
 By a food processor ☐ Yes ☐ No ☐ Don't know  
 By a manufacturer ☐ Yes ☐ No ☐ Don't know

5. In your view how much risk is involved by eating foods that:

	A lot of risk	Some risk	May have some risk, but may be ok	No risk	Definitely no risk	Don't know
contain allowable amount of pesticide residue						
have been irradiated to prevent spoilage						
have been irradiated						
have been pasturized						
have been modified through breeding to increase vitamin content						
have been treated with harmless chemicals to improve appearance						
have been fumigated to kill insects						
have been contaminated by rodents						
have been washed in chlorinated water						
have been sprayed with sanitizing solution						
raw fruits or vegetables that contain soil particles						

6. I prefer to eat food produced

Preference	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
Using conventional production practices					
Using modified practices where pesticides are used only when needed					
Using unconventional production practices without synthetic pesticides					
Using unconventional production methods based on the latest technological developments					

7. Do you remember how much approximately did you spend last month on:  
 All food eaten at home (exclude meals eaten outside your home) \_\_\_\_\_ won  
 All food eaten away from home \_\_\_\_\_ won  
 Fresh vegetables eaten at home \_\_\_\_\_ won  
 Fresh fruit eaten at home \_\_\_\_\_ won

8. Do you think that the amount spent last week was:

	Less than normal	About normal	More than normal
On food at home			
On food away from home			
On fresh vegetables			
On fresh fruit			

9. Approximately how much of your typical food expenditures is spent on fresh fruits and vegetables? Please indicate either the amount in won \_\_\_\_\_ or as the percentage of the typical food expenditures \_\_\_\_\_ percent.

10. Have you heard of genetically modified food?

☐ Yes      ☐ No      ☐ Don't know

11. If yes, how much have you heard about GM foods:

☐ Very little      ☐ Little      ☐ Some      ☐ A lot/great deal

12. Do you favor or oppose the introduction of GM products in the food supply in Korea?

☐ Strongly oppose      ☐ Strongly favor      ☐ Neutral

13. Do you think foods containing GM plant ingredients are in supermarkets?

☐ Yes      ☐ No      ☐ Don't know

14. Reasons for buying or not buying GM foods

Would buy GM foods if :	Definitely	Probably	Probably not	Definitely not	Don't know
Healthier					
Contained less pesticide residues					
More environmentally friendly					
Approved by relevant authorities					
Cheaper					

15.

Do you support or oppose the use of genetic modification in <b>fruits</b> to:	Strongly oppose ----- Strongly favor				
	1	2	3	4	5
Improve appearance, such as color					
Lengthen storage to decrease the spoilage					
Change the content of vitamins by lowering content fo some, but increasing the content of others					
Increase the content of beneficial ingredients other than vitamins					
Change the taste, for example, increase sweetness					

16.

Do you support or oppose the use of genetic modification in <b>vegetables</b> to:	Strongly oppose ----- -Strongly favor				
	1	2	3	4	5
Improve appearance, such as color					
Lengthen storage to decrease the spoilage					
Change the content of vitamins by lowering content fo some, but increasing the content of others					
Increase the content of beneficial ingredients other than vitamins					
Change the taste, for example, increase sweetness					

17. Are you willing to pay more for foods that have been improved through agricultural technology and substantially change their attributes so:

Foods contain more dietary fiber	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Foods contain more vitamins	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Foods contain more protein	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Foods contain more fat	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Foods contain less saturated fat	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Foods contain more disease fighting anticarcinogens	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Foods are less expensive	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Foods have nicer appearance	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Foods store longer	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Foods taste sweeter	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
The typical taste of food is stronger	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Functional foods	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know

18. How much more would you be willing to pay above the retail price you paid for the unimproved food product?

	Percent										
Foods that	0	1 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 - 100
Contain more dietary fiber											
Contain more vitamins											
Contain more protein											
Contain more fat											
Contain less saturated fat											
Contain more disease fighting anticarcinogens											
Are less expensive											
Have nicer appearance											
Store longer											
Taste sweeter											
Have stronger flavor											
Are functional											

19. Do you support research on:

	Strongly oppose	Oppose	Neither support nor oppose	Support	Strongly Support
Rice production					
Grains other than rice					
Fruit production					
Vegetable production					
Livestock raised for meat					
Livestock producing milk and dairy products					

20. When a new food production technology is applied on farms, I expect that it has been approved by:

KFDA ☐ Yes ☐ No ☐ Don't know  
 Food manufacturing industry ☐ Yes ☐ No ☐ Don't know  
 Supermarket chains ☐ Yes ☐ No ☐ Don't know  
 Farmer organization ☐ Yes ☐ No ☐ Don't know  
 Other, please name

21. Do you think that because of the research in agricultural and food technology

Do you think	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
Farmers are better off					
Consumers are better off					
Food manufacturers are better off					
Food exporters are better off					
Food importers are better off					

22. New agricultural and food technologies should focus on:

Focus	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
Preserving freshness					
Reducing the presence of additives					
Reducing the content of allergens					
Easing cooking					
Lowering the cost of food					
Reducing the amount of fertilizer used in production					
Reducing the amount of pesticide used in production					
Helping farmers earn more money					
Making agriculture more competitive on world markets					
Assure security of national food supply					
Assuring the trust of consumers in safe food supply from domestic or foreign sources					

23. How much trust do you have in the following organizations when they make claim about food quality?

Trust	No trust at all	No trust	Neither trust nor distrust	Trust	Trust very much
Farmers' organization					
Food manufacturers					
KFDA					
Newspapers					
Public health officials in the country					
Media					
Food retailers					
Consumer advocate groups					
International health organizations					

24. How much time does it take you, on average, to prepare the following meal:

Breakfast \_\_\_\_\_ minutes  
 Lunch \_\_\_\_\_ minutes  
 Dinner \_\_\_\_\_ minutes



25. What attributes of food are important to you in preparing meals for your family:

Foods that	Not important at all	Not important	Neither important nor unimportant	Important	Very important
Cook fast					
Can be prepared with little waste (like vegetables)					
I can buy partially prepared					
Can be micro waved					
Can be stored without refrigeration					
Keep well in the refrigerator					

26. Please indicate the importance of the following issues to you:

	Not important - - - - - Very important						
Issue	1	2	3	4	5	6	7
Reduce the possibility of food poisoning from contamination of fresh vegetables by, for example, harmful microorganisms							
Seafood by, for example, polluted water							
Meat by, for example, improper handling							
Fresh fruit by, for example harmful microorganisms							
Nuts by, for example, harmful microorganisms							

27. Do you think the following methods of reducing the presence of harmful microorganisms in food are acceptable ?

	Not acceptable at all - - - - - Very acceptable							Not familiar with method
Issue	1	2	3	4	5	6	7	
Irradiation								
treating with ozonated water								
washing in chlorinated water								

26. Have you experienced food poisoning in the last 12 months?

☐ Yes ☐ No

28. Has any of your family members experienced food poisoning in the last 12 months?  
☐ Yes ☐ No
29. Do you process any raw foods at your home:  
 Pickle cabbage ☐ Yes ☐ No  
 Dry fruit ☐ Yes ☐ No  
 Pickle vegetables other than cabbage ☐ Yes ☐ No  
 Make fruit preserves ☐ Yes ☐ No  
 Other, please name \_\_\_\_\_
30. Do you know the difference between organically produced foods and conventionally produced foods: ☐ Yes ☐ No ☐ Don't know

If YES, how did you learn about organic foods (Please check all that apply)

- From friends ☐  
 From family members ☐  
 From television ☐  
 From newspapers ☐  
 At my workplace ☐  
 At school ☐  
 From radio ☐  
 From Internet ☐  
 In the supermarket ☐  
 From other sources, please name \_\_\_\_\_.

31. Do you think organically produced foods in comparison to conventionally produced foods are:  
 More expensive ☐ Yes ☐ No ☐ Don't know  
 More healthy ☐ Yes ☐ No ☐ Don't know  
 Better tasting ☐ Yes ☐ No ☐ Don't know  
 Store better ☐ Yes ☐ No ☐ Don't know  
 Easier to prepare/cook ☐ Yes ☐ No ☐ Don't know  
 Have a better appearance ☐ Yes ☐ No ☐ Don't know

32. I am \_\_\_\_\_ years of age.
33. Approximately how heavy are you? \_\_\_\_\_ pounds  
 And, approximately how tall are you? \_\_\_\_\_ feet. \_\_\_\_\_ inches

34. Do you smoke cigarettes? ☐ Yes ☐ No

35. My gender is: ☐ Male ☐ Female

36. My years of education are:  
 Elementary school \_\_\_\_\_ years  
 Middle school \_\_\_\_\_ years  
 High school \_\_\_\_\_ years  
 College & University \_\_\_\_\_ years  
 Total years of education \_\_\_\_\_ years

37. My gross annual income ranges from:

- Less than 1,099 ☐  
 1,100 - 1,699 ☐  
 1,700 - 2,299 ☐  
 2,300 - 2,899 ☐  
 2,900 - 3,499 ☐  
 3,500 - 4,499 ☐  
 4,500 - 5,499 ☐  
 5,500 or more ☐

38. How many members are in your family?

Number of adults (including yourself and all age 19 and over)

There are children 18 years old or younger in our household ☐ Yes ☐ No

1. Child \_\_\_\_\_ years old  
 2. Child \_\_\_\_\_ years old  
 3. Child \_\_\_\_\_ years old  
 4. Child \_\_\_\_\_ years old  
 5.  
 6.  
 7.  
 8.

39. Which of the following best describes your occupation (please check)

0	Legislators, senior officials and managers	
1	Professionals	
2	Technicians or associated professionals *Professionals, technicians, administrators & managers	
3	Clerks	
4	Service workers	
5	Sale workers *Service & sales workers	
6	Skilled agricultural, forestry & fishing workers	
7	Craft & related trades workers	
8	Plant, machine operators & assemblers	
9	Elementary occupations *Craft, machine operator & assemblers	

40. In your opinion, how important is the subject of this survey, 1=Not important at all to 10=Extremely important (please check box under number).

1	2	3	4	5	6	7	8	9	10