Monetary Parameters' influence on Organic and Conventional Fruit Consumption

A Demand-System Analysis of a Swedish Supermarket

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Abstract

This paper examines the influence of prices and income on organic fruits. Fresh fruit consumption is impacted by high price volatility, and these price changes influence especially organic goods. Own-price, cross-price, and expenditure elasticities are examined with a QAIDS based on a dataset of a Swedish supermarket. The analysis shows that organic goods are always more price and expenditure sensitive than their conventional counterpart. The results suggest that consumers compare the relative prices of organic and conventional goods and that declining prices could increase the market share for some organic fruits. On the other hand, organic demand seems to be limited by the lack of advantages for consumers, even for organic products with a small price. Furthermore, expenditure elasticities suggest that a higher fruit budget leads to higher consumption of organic goods. Overall, organic goods seem to be purchased by a small group of organic consumers that are willing to pay a price premium. Demand could be pushed by non-monetary measures like highlighting positive impacts of organic production.

Keywords: QAIDS, demand analysis, organic fruits, Sweden

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Abbreviations

AIDS	Almost Ideal Demand System
EU	European Union
PIGLOG	Price-Independent generalized logarithmic
QAIDS	Quadratic Almost Ideal Demand System
SCB	Statistikmyndigheten (Statistical Agency of Sweden)

1. Introduction

Organic food production has many advantages for the environment, especially in comparison with conventional food production. The ban on synthetic pesticides leads to fewer toxins in the surface- and groundwater, and with the correct management, eutrophication can decline due to less nitrogen surplus (Mondelaers et al., 2009; Tuomisto et al., 2012). Moreover, and most importantly, in light of the global biodiversity crises, the population of birds, insects, and other species can recover (Tuck et al., 2014). Also, the European Union (EU) recognises these advantages and wants to stimulate organic production and consumption with the Organic Action Plan; The two main goals are to promote the organic label of the EU and to support the increase of the organic agricultural production area (European Commission, 2022). An increase in supply leads to more efficiency, which should lead to a price decrease at the consumer level. On the other hand, price increases and real income decreases, letter caused by inflation, are likely, especially considering current developments and upcoming global shocks, such as droughts, wars, and the COVID-19 pandemic. Moreover, due to higher production costs, organic products are more expensive than conventional. Prices and price premiums are barriers to organic food consumption (Hoffmann & Wivstad, 2015; Irandoust, 2016). Economic research can contribute to understanding influential monetary parameters, like prices, price premiums and income, by studying consumers' attitudes towards organic products.

Accordingly, the prospected study is tackling the question of how these monetary parameters influence consumers' organic demand. The research is conducted with the help of a dataset on organic and conventional fruits' purchases in Sweden. The quantitative demand system, QAIDS, is used to estimate price and income elasticities and the substitution relation between organic and conventional fruits. Hence, the study adds to an overall picture of the influence of fruit price changes and real income decline on organic fruit demand. The analysed fruits are apples, berries, citrus fruits, exotic fruits and grapes.

Sweden's organic consumption per capita is the 5th largest in the world (Willer et al., 2022, p. 66). Organic fruits are especially popular, with organic sale shares of 16% (SCB, 2021). Only organic fish make up for higher shares with 19.5%. Nonetheless, a demand analysis of the perception of organic fish is not straightforward because of the MSC label which is additional information that could lead to interaction effects with the organic label. Furthermore, the consumption of fruits has gained a lot in popularity lately, and consumption has risen by 170% since the beginning of the century (SCB, 2021). Additionally, consumers do not react sensitively to price increases, which was shown in 2020 when fruit sales increased by 6% despite a price increase of 8% (Daniel Wester & SCB, 2021, p. 16); this suggests that Swedes perceive fruits as an important part of their diets. Nevertheless, the expenditure share of organic fruits decreased during this period (ibid.). The decline in demand for organic fruits is not surprising because organic goods are often very price elastic, and demand decreases over proportional with price increases (Gschwandtner, 2018, p. 1; Lin et al., 2009, p. 475). Nonetheless, the organic market also has many loyal customers willing to pay a price premium, grounded on the expectation that organic food is healthier and has a positive impact on the environment (e.g., Denver & Jensen, 2014; Hempel & Hamm, 2016).

The prospected analysis is conducted with the quadratic almost ideal demand system (QAIDS) on eight-month purchasing data from a supermarket in Stockholm. Even though qualitative research gives important input on consumers' motives, quantitative demand systems can exploit bigger datasets and examine revealed preferences that are often different from stated preferences (Gschwandtner, 2018; Hughner et al., 2007; Shafie & Rennie, 2012). Previous research on organic goods has been mainly conducted on milk (e.g. Li et al., 2018; Lindström, 2022) and vegetable (e.g., Glaser & Thompson, 1998; Schröck, 2013). It has been established that these organic goods, in comparison to their conventional counterparts, are more price sensitive, show a stickiness in demand and are superior (demand increases over proportionally when real income increases) (e.g., Li et al., 2018; Lin et al., 2009; Zhang et al., 2011). However, most research is conducted in rather old organic markets with small organic market shares. Schröck (2012) showed that price and income reactions are less elastic in more mature organic markets, hence the price and expenditure sensitivity decreases.

The influence of prices and income is controversial in the literature on organic goods. Several researchers suggest that price and income are the driving factors for demand changes, while socio-demographic variables show little effect (Fourmouzi et al., 2012; Kasteridis & Yen, 2012). Schröck (2012) argues that some variables increase the likelihood of consumers entering the organic market but that afterwards, monetary variables become crucial. Contrary, Bunte et al. (2010) found in a real-life experiment that consumers show little reaction to sudden price decreases. Dhar et al. (2003) and Hsieh et al. (2009) support this finding with their quantitively arrived income elasticities. They found rather small income elasticities for organic goods and suggest that other factors drive the recent increase of organic consumption. A further discussion of the relevant literature is found in Chapter 2.2, which additionally provides more elaborated hypotheses.

It needs to be stressed that very little is known about organic fruit demand. Hence, this study is the first to analyse organic fruits using an AIDS model. Moreover, this work can help to generate fresh insights on organic demand with a rather new dataset in a more mature market. Furthermore, this paper adds to the discussion of the importance of monetary variables on organic consumption. The findings can be important for policymakers and marketing strategists who aim to increase organic selling shares with price measures.

The paper is structured as follows: First, there is background information about the concept of elasticities, a comprehensive literature review, and the research hypotheses (Chapter 2). After that follows a description of the research design, including the Quadratic Almost Ideal Demand System (QAIDS) and an introduction to the data set (Chapter 3). Furthermore, the results of the analysis of organic and conventional fruits' own- cross- and income elasticities are stated and critically discussed with the help of previous literature (Chapter 4). The analysis chapter also includes a sensitivity analysis applied to the data set where the separation of organic and conventional fruits and the assumption of evenly distributed elasticities throughout the observation period is questioned (Chapter 4.4). It follows a discussion section that summarises the most important findings and discusses their implication for the role of prices and income (Chapter 5). The conclusion answers the research question of monetary variables' influence on organic fruit consumption (Chapter 6).

2. Theoretical Background

This chapter provides background to the conducted research. It starts with an introduction in demand systems elasticities. This knowledge is the back stone for understanding Chapter 3.1.2 all other variables must be held constant for the interpretation of expenditure and price changes.
Estimation of Elasticities as the used model (QAIDS) provides the necessary parameters to derive at demand elasticities. Moreover, the understanding of elasticities is useful for reading the literature review. The second part of this chapter summarises the most valuable findings related to the research question. The important parts start with one of the four hypotheses on how monetary values influence consumers' choice of organic fruits.

2.1 Key Assumptions

2.1.1 Demand-System

Microeconomic theory assumes that goods' demand depends on their own prices (p_i), the price vector of other goods ($\mathbf{p}$), and the income spent on the good itself (I). This so-called Marshallian demand arrives from utility maximisation with fixed income and stable prices (1). An underlying assumption is that consumers' preferences, as well as their number, stays constant. The market demand curve, which we need for this study's scope, is calculated by horizontal aggregation of individual demand curves and represents an average consumer. However, market demand can change with the group of people observed.

$$q_i^M = q(p_i, \mathbf{p}, I) \qquad (1)$$

This paper uses the QAIDS model, which parameters are the base for the elasticity calculation. Elasticities indicate the percentage of the quantity shift caused by a 1% change in the independent variable. The derivatives of the demand curves are the foundation of the Marshallian own-price, cross-price and income elasticities (2).

2.1.2 Elasticities

The income elasticity (ε_i^I) indicates a good's affordability and substitutability (Kenton, 2021). A negative income elasticity signals that the good is *inferior,* in which case the demand decreases with an increase in income. Furthermore, goods with a positive income elasticity are called *normal,* or *necessity goods,* and, lastly, goods with income elasticities greater than 1 are *superior* or *luxurious*. For the latter, a 1% change in income leads to an over-proportional shift in demand. Income elasticities can differ depending on a country's prosperity (Fukase & Martin, 2020).

$$\varepsilon_i^M = \frac{\partial q_i}{\partial p_i} * \frac{p_i}{q_i};\ \varepsilon_{ij}^M = \frac{\partial q_i}{\partial p_j} * \frac{p_j}{q_i};\ \varepsilon_i^I = \frac{\partial q_i}{\partial I} * \frac{I}{q_i} \qquad (2)$$

The own-price elasticity (ε_i^M) represents the quantity change with a change of 1% of the own price. It’s usually negative, indicating that an increase in the own price leads to a decrease in quantity demanded. Goods with own-price elasticities above |1| show that demand is in the elastic part of the demand curve (left half), whereas goods with own-price elasticity smaller than 1 are in the inelastic part (right half). Elastic demand indicates that consumers are over-proportional sensitive to price changes. Moreover, these goods usually have close substitutes, which means that other goods can replace them easily.

The price elasticity for a single good is often more elastic than for a group of goods for which fewer substitutes are available (Schröck, 2013). In addition to the Marshallian own-price elasticity, the Hicksian elasticity will be discussed later.

In general, a positive cross-price elasticity (ε_{ij}^M) means that two goods are substitutes and a negative that they are complements. Complementary goods are bought or consumed together and can be part of a varied food basket. The uncompensated or Marshallian cross-price elasticity consists of the income ($\varepsilon_i^I * s_j$) and the substitution effect (ε_{ij}^H). These effects are calculated with the Slutsky equation (3).

$$\varepsilon_{ij}^M = \varepsilon_{ij}^H - \varepsilon_i^I * s_j \qquad (3)$$

The substitution effect, expressed by the Hicksian elasticity, reveals the relationship between two goods and is compensated by the income effect. The Hicksian demand curve is based on expenditure minimisation with fixed utility. For its calculation, Roy’s identity is applied after the maximisation problem. In other words, the substitution effect shows the change of demand based on a relative change in prices with a constant utility level and compensation for the change in purchasing power. For normal goods, Hicksian demand curves are always more elastic (steeper) than Marshallian demand curves. Furthermore, the income effect is the demand reaction to a shift in purchasing power caused by a price change. For a normal good, the income effect always moves in the opposite direction of the price shift.

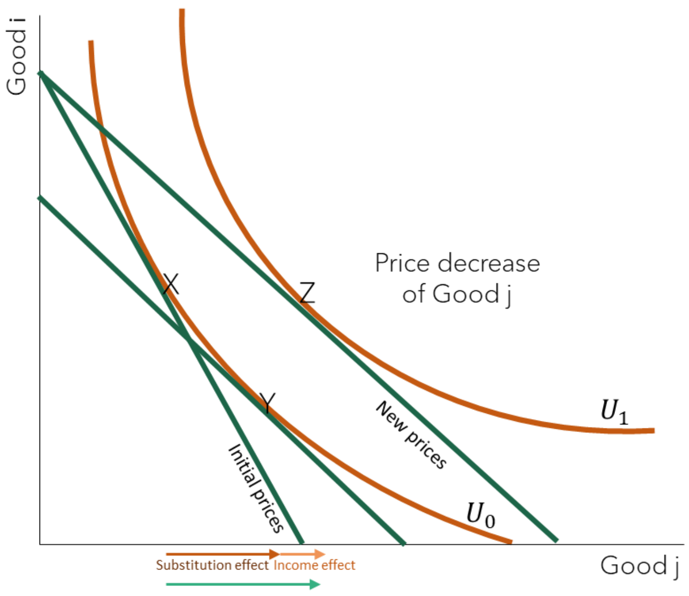

Figure 1. Cross price effects.

Source: Own figure.

Figure 1 shows the effect of a price decrease of good j on the substitutes good i and good j. The assumption is that income is fully spent on these two goods. In this example, good j becomes relatively less expensive than good i, meaning consumers demand more of good j. The quantity shift from X to Y shows the substitution effect with a change in relative prices. Furthermore, the price decrease leads to a positive income effect observable by the change between points Y and Z. The consumer has free income due to the price decrease and can purchase more of these two goods; this increases the utility level and leads to an optimal point on a higher indifference curve.

For complements, substitution and income effect can cancel each other out. Hence, a Marshallian elasticity around zero does not necessarily mean that goods are independent of each other (Schröck, 2013). Moreover, a high difference between compensated and uncompensated elasticity reveals that consumers' reaction to another goods' price change is mainly based on a *real income change* and not on a shift in price relations (ibid.).

This paper mainly focuses on the Marshallian demand function, showing consumers' observable price and income reactions. Additionally, most researchers only publish their Marshallian elasticities, and focusing on them makes comparing with other studies easier. Nonetheless, we must highlight that we do not consider the fruit budget perceptively to other food budgets. Hence, we assume a fixed level of expenditure on fruit and the Marshallian elasticities are compensated by the income effect for the whole food group. The above-described income effect shows the expenditure effect based on a change in purchasing power for the fixed fruit budget.

2.2 Literature Review

Much research on organic consumption has been carried out with the help of surveys (e.g., Bosona & Gebresenbet, 2018; Irandoust, 2016; Magnusson et al., 2001) or choice experiments (e.g., Denver & Jensen, 2014; Wirth et al., 2011). Overall, these studies contribute to the understanding of the decision-making processes of organic and non-organic consumers. On the other hand, quantitative demand systems, like the AIDS, QAIDS, Translog and Rotterdam model, can observe consumers' revealed choices and do not need to rely on stated preferences (Gschwandtner, 2018). This chapter is divided as follows: It starts with a summary of the reasons for organic and non-organic consumption. The second part gives an overview of the results of quantitative demand systems, focusing on uncompensated income- and price-elasticities of organic and conventional goods. A hypothesis starts each important paragraph.

2.2.1 Motives and Barriers for Organic Consumption

Previous research has established that many factors influence consumers' choices for organic goods. First, sensory and quality aspects are important for them; This includes, for example, taste and freshness. Previous literature suggests that consumers often perceive organic products as tastier and fresher than conventional (Costanigro et al., 2014; Hoffmann & Wivstad, 2015). Additional, organic products are often associated with a better performance in non-use attributes. An often-stated opinion is that organic goods are healthier - because of higher nutrient levels (Hoffmann & Wivstad, 2015) and less intake of pesticides or medicine (Wier et al., 2001) - and better for the environment (Irandoust, 2016). For the non-use values, Wier et al. (2001) examine in their study that the consideration of both, the use and the non-use values, leads to the highest organic purchases (p. 15). Further research also suggests that regular consumers of organic goods generally focus more on environmentally friendly consumption than occasional buyers (e.g., Onozaka et al.). Moreover, personality traits can be influential. While a self-image push might be in favour of buying organic products, traditional values can hinder purchases (Irandoust, 2016, p. 84). Further barriers are the availability of organic goods, a sceptic about the controlling measures of organic labels, and the higher prices (e.g., Hoffmann & Wivstad, 2015). Letter means that even though organic consumers are willing to pay a price premium (e.g., Denver & Jensen, 2014, p. 132 Hempel & Hamm, 2016, p. 737), prices, as well as income, have a great impact on consumers' decisions (e.g., Irandoust, 2016).

For Sweden, Shepherd et al. (2005) and Irandoust (2016) found that health aspects are more important to organic consumers than the environmental impact (Shepherd et al., 2005, p. 352), whereas Bosona and Gebresenbet (2018) state that sustainability factors are more important determinants for purchasing goods than price and nutrient levels (p. 53). All of these studies rely on stated preferences. Hence, their findings can be used to explain and discuss revealed preferences. Hence, income- and price elasticities can provide implications for motivation, as shown by Dhar et al. (2003) and Hsieh et al. (2009). In Chapter 5, these factors will be discussed with the study's results.

2.2.2 Previous Literature on Quantitative Demand-Systems and Hypotheses

Quantitative demand analysis of organic goods are mainly conducted for milk (Chen et al., 2018; Dhar & Foltz, 2005; Glaser & Thompson, 2000; Jonas & Roosen, 2008; Li et al., 2018; Lindström, 2022) or vegetable (Fourmouzi et al., 2012; Glaser & Thompson, 1998; Hsieh et al., 2009; Kasteridis & Yen, 2012; Schröck, 2013; Zhang et al., 2011). For organic milk, the focus is mainly on the differences between organic and conventional branded and private labelled milk (Chen et al., 2018; Glaser & Thompson, 2000; Lindström, 2022). Additionally, different retailers are analysed (Li et al., 2018). Similar to the prospected study's aim, the focus of the vegetable analysis is often on the differences in demand of organic and conventional vegetable items. Additional, a few papers focus on organic and conventional frozen vegetables (Glaser & Thompson, 1998; Schröck, 2013).

Studies on fruits, without analysing organic and conventional separately, show that apples are often the most established fruit item (e.g., Paudel et al., 2010; Tiffin, 1995), while grapes show a very high price sensitivity (e.g., Durham & Eales, 2010; Henneberry et al., 1999). For citrus fruits, Brown and Lee (2002) and Lee (1994) show differences in elasticity of oranges, grapefruits and lemons, with oranges being the less elastic goods, while the results of Chung et al. are very similar for all citrus fruits. Strawberries' and cherries' own price elasticities are often small (e.g., Henneberry et al., 1999; Tiffin, 1995). The only study on exotic fruits shows differences in own price elasticities even though all of them are inelastic (Nzaku et al., 2010).

The differences in results can be explained by varying data sets, methods and observation periods. Furthermore, Edgerton (1997) stresses the importance of having the same budget level for comparing studies (p. 78). For the coming section, this is crucial to keep in mind The remaining chapter, firstly, summarises findings of organic and conventional own prices elasticities with conventional as a benchmark. Furthermore, comprehensive results of income and cross-price elasticities are stated. Each section starts with a research hypothesis that presumes a part of the answer to price's, price premiums', and income's impact on organic fruits. The hypothesis are tested and discussed in Chapter 4 and 5.

Hypothesis 1

Organic fruits with a high expenditure share show similar own-price elasticities to their conventional counterpart. An underlying assumption must be that consumers see an advantage in organic fruits. Exceptions are possible for fruit items with very large price premiums.

To my knowledge, no research has been conducted on the relationship between organic and conventional fruits with the QAIDS model. The only available study is from Lin et al. (2009), who use the translog demand system. They show that organic apples, bananas, grapes and oranges are much more price elastic than their conventional counterpart (p. 470f.). An exception are strawberries, even though this result is not significant. Furthermore, organic apples, bananas, and grapes show elastic demand with own price elasticities above |1|. Other studies show similar results (e.g., Chen et al., 2018; Fourmouzi et al., 2012; Kasteridis & Yen, 2012). With a few exceptions (Li et al., 2018; Schröck, 2012; Zhang et al., 2011)[1], own-price elasticities of organic items are always higher than their conventional part, and for vegetables and eggs, organic goods are mainly elastic while conventional goods are mostly inelastic (e.g., Bakhtavoryan et al., 2021; Kasteridis & Yen,

[1] Zhang (2011) analyses Hicksian elasticities.

2012). One of the exceptions is Schröck (2012), who found smaller and inelastic own-price elasticities for organic milk, eggs and fresh vegetable. They argue that previous research has always been conducted in markets with a small organic share and that consumers are less price sensitive as soon as the market establishment of organic goods rises. Lin et al. (2009) state the same and add that the price premium between organic and conventional goods also increases the own-price elasticities (p. 472). Glaser and Thompson (1998) support this strain of argumentation. They found that decreasing nominal prices and price premium demishes price sensitivity of organic frozen vegetable (p. 11). However, Lindström (2022) claims that consumer need a positive perception of organic goods. They show that the own-price elasticity of organic milk is surprisingly high besides the small price premium and argue that Swedish consumers might not see an advantage in organic milk compared to the conventional products.

Hypothesis 2

Expenditure elasticities for organic fruits are positive and get smaller and close to unity (1) with higher budget shares.

Even though researchers provide expenditure elasticities in their papers, their nature is less explained than own-price elasticities'. Lin et al. (2009) found positive and almost unity expenditure elasticities for organic and conventional fruit items, whereas Zhang et al. (2011) and Schröck (2013) state higher expenditure elasticities for organic items than for conventional. Glaser and Thompson (1998) found the same for organic frozen vegetables except for corn, where they observed higher expenditure elasticity for the organic item. In most cases, the estimated expenditure elasticities imply that organic goods are superior (above 1) or unity (e.g., Fourmouzi et al., 2012; Kasteridis & Yen, 2012). Like their findings on own-price elasticities, Schröck (2012) concludes that the asymmetry between expenditure elasticities declines with increasing market development. Additionally, Glaser and Thompson (1998) state that their expenditure elasticities tend to decrease towards unity when the sale volume of organic increases. On the other hand, Dhar and Foltz (2005) and Hsieh et al. (2009) examined rather small income elasticities for organic milk and potatoes. While Hsieh et al. (2009) argue that other factors than increasing income must explain the increase of the organic potatoe market, Dhar et al. (2003) speculates that households with high expenditure on milk, i.e., households with children, might not have enough budget to additionally also buy the organic good

Hypothesis 3

Cross-price relations between counterparts are asymmetric and organic goods are more sensitive to conventional price changes. Most of the relations are positive and more significant for goods with a small price premium. Asymmetry gets bigger with differences in budget shares and income elasticities.

Previous research observed positive and asymmetric cross-price relations between conventional and organic fruits. It has been shown that the switch from conventional to organic is more elastic than the switch from organic to conventional goods, which means that a price increase of a conventional good leads to a higher demand change for the organic counterpart than the other way around (e.g., Kasteridis & Yen, 2012; Lin et al., 2009). Even though most counterparts show a substitution relation, Li et al. (2018) further add that the magnitude is always greater, regardless of a complementary or substitutable relationship. Zhang et al. (2011) suggest that cross-price elasticities are just significant for high price premium (p. 455) whereas Glaser and Thompson (1998) implies that lower price premium leads to more significant cross-price relations between counterparts (p. 10). Lin et al. (2009) assume that increasing conventional prices close the price gap and make organic goods relatively less expensive, facilitating the switch from conventional goods (p.472).

Li et al. (2018) add that the stickiness to organic goods implies that a rise in the price premium through increasing organic prices would not lead to a switch to conventional again. Furthermore, they say that asymmetry comes from the differences in budget shares and income elasticities. They derive their arguments through a mathematical derivation based on elasticities properties. Schröck (2013) further adds that this property is also seen in the Slutsky equation (3) as a difference in income elasticities and budget shares alter the income effect. Since the substitution effect can be positive and negative, the asymmetry of the income effects impacts complements and substitutes differently (ibid.)

Glaser and Thompson (2000) suggest that the finding of small organic market shares, long after market implementation, should prove that there is no great cross-over from conventional to organic goods. This is supported by Hansen (2003) and Zhang et al. (2011) who suggest that substitution only appears between organic goods while conventional goods impact demand only with the income effect. They detected organic crowding out in their data set, which means that a reduction in the price premium between organic and conventional goods would not lead to more organic consumption. Their weak separability test shows that there is a group of consumers that only buy organic goods. of organic. This assumption is not going to be tested.

<u>Hypothesis 4</u>

The organic group is characterised by substitution relations, and the within relationships' magnitude is higher than to the conventional group. Furthermore, the magnitude within the organic groups is greater than the price reaction to changes in conventional goods' prices.

Even though Wier et al. (2011) argue that high own-price elasticities of organic products imply that consumers switch to the conventional counterparts, Lin et al. (2009) found that substitution relations within the organic group are higher than to the conventional group - even compared to the cross-price elasticity to their conventional counterpart. Glaser and Thompson (2000), in line with their argumentation on the counterpart relations, state that the reason could be smaller price differences between organic goods (p. 15). Furthermore, Lin et al.'s (2009) conventional fruits show the greatest substitution relation to their organic fellow and not within the conventional group.

Hansen (2003) found higher magnitudes in cross-price relations within the organic group in comparison to the within relation of the conventional group (p. 22). Contrary, Li et al. (2018) findings imply that substitution only occurs between conventional milk products but not between organic milk products with different fat contents.

In line with Hansen (2003), Kasteridis and Yen (2012) also states higher substitution relation within the organic group. Additionally, they discuss Hicksian elasticities. Their results show that the complementary relations between conventional goods are mainly influenced by the income effect and that there are also substitution effects between conventional vegetables. Nevertheless, except for tomatoes, the compensated substitution relations to the organic group are greater than to other conventional goods.

The Hicksian cross-price elasticities of Zhang et al. (2011) are not that clear. Conventional vegetables tend to have higher substitution effects to the organic group but these results are not significant. As Zhang et al. (2011) and Kasteridis and Yen (2012) do not share their price premiums, the statement on the influence of small price premiums of Glaser and Thompson (2000) can neither be confirmed nor denied.

3. Research design

The Quadratic Almost Ideal System (QAIDS) is used to analyse consumer demand; It regresses the influence of prices and expenditure on budget shares of goods. The foundation of this analysis is data from a Swedish supermarket. The dataset includes information about all fruit items sold within eight months, including organic labels, prices, and quantities. This chapter first introduces the QAIDS Model, followed by the description of the dataset.

3.1 Quadratic Almost Ideal Demand-System

The QAIDS Model (Banks et al., 1997) is an extension of the AIDS model by Deaton and Muellbauer (1980). The basis are PIGLOG (Price-Independent Generalized Logarithmic) preferences, derived from expenditure minimisation and linear in logarithmic expenditure (Deaton & Muellbauer, 1980, p. 313). In addition, the QAIDS Model includes a quadratic term that allows for a quadratic relationship between goods' total expenditure and the indirect utility function of the PIGLOG demand functions. In other words, the Engel curve can be quadratic. Hence, raising income can lead to an increase and, after a certain income level, a decrease in a good's utility (Banks et al., 1997, 513f.). Roy's identity indicates the budget shares formula, which includes estimates to calculate the demand elasticities (ibid.).

3.1.1 Equation, Restrictions and Assumptions

As stated before, the QAIDS model regresses all prices and the income on the budget shares. Prices to the respective quantities, q_j, are denoted as p_j with j = {1, ... n} while income is the total expenditure spent on the goods, shown by $X = \sum_i^n p_i * q_i$. Following this denotation, the budget share of a single good i is given by $s_i = {p_i * q_i}/{X}$. The budget share equations, derived from PIGLOG preferences functions, are given by (4).

$$s_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left(\frac{X}{P}\right) + \frac{\mu_i}{Q} \ln\left(\frac{X}{P}\right)^2 \qquad (4)$$

P is the translog price index of the QAIDS model, given by (5). P is the same for all weakly separable groups (discussed later). A price index corrects expenditure by the inflation rate. The corrected expenditure is called real expenditure. For an easier understanding, in the following course, the word expenditure refers to real expenditure.

$$\ln P = \alpha_0 + \sum_{i=1}^{n} \ln p_i \, \alpha_i + \frac{1}{2} \sum_{i}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln(p_i + p_j) \qquad (5)$$

Q, given by (6), is the simple Cobb-Douglas price aggregator

$$Q = \prod p_i^{\beta_i} \qquad (6)$$

The parameters of the QAIDS-equation are often restricted. Many papers make assumptions about adding-up, homogeneity, and symmetry (e.g., Säll et al., 2020). That means that, first of all, the initial consumption, α_i, needs to add-up to 1 to control that 100% of the respective budget is spend in this group. Furthermore, the share's reaction to real income changes, β_i, to price changes, γ_{ij}, and the quadratic term, μ_i, needs to add up to zero to ensure that consumer's substitution reactions, to price or expenditure change, remains on one level and within in the group. These restrictions are given by (7) and (8).

$$\text{Adding-up: } \sum_{i=1}^{n} \alpha_i = 1 \qquad (7)$$

$$\text{Homogeneity: } \sum_{i=1}^{n} \beta_i = \sum_{i=1}^{n} \gamma_{ij} = \sum_{i=1}^{n} \mu_i = 0 \qquad (8)$$

$$\text{Symmetry: } \gamma_{ij} = \gamma_{ji} \qquad (9)$$

Furthermore, the estimate of the price reaction parameter, γ_{ij}, is symmetric to ensure that the influence on the share of good i from price j is the same as that from price i on share j (9). The term α_0 is set equal to 0 in this analysis.

A further assumption is *weak separability*. In a multi-stage demand system with different income levels and price indices, the groups that share a price index, in the case of this paper the fruit group, is assumed to be weakly separable from other goods like, e.g., vegetable or bread. For interaction between weakly separable groups, the substitution effect is eliminated, and goods outside a group influence the goods inside only through the income effect (Edgerton, 1997).

Deaton and Muellbauer (1980) AIDS model has been tested by several researchers who found that the estimates are often better fitted compared with other demand-system, like the Rotterdam model (e.g., Zhang et al.). As stated before, the extension of a quadratic term in the QAIDS allows for quadratic Engel's curves, which fit our data best. Moreover, the PIGLOG preferences assure ideal aggregation among consumers. Nonetheless, there are some limitations to interpretation. First of all, the restriction of weak separability allows goods only to enter one group; hence we are presuming that consumers have a fixed preference and budget for fruits. For this study, the assumption is that consumers substitute fruits only with other fruits. Especially for organic fruits, this is questionable as there is also the possibility that organic fruits are seen as part of an organic fresh produced group together with organic vegetables. Hansen (2003) and Zhang et al. (2011) rejected the hypothesis of weak separability between organic goods (Chapter 2.2.2). As this method exceeds the scope of this study, we won't apply a weak separability test. Lastly, we need to note that all other variables must be held constant for the interpretation of expenditure and price changes.

3.1.2 Estimation of Elasticities

Based on the estimated parameters of γ_{ij} and β_i and the budget share equation, s_i, price and expenditure elasticities, seen in equation (2), can be derived. Therefore, we take the derivative of quantities with respect to logarithmic prices and expenditure.

$$\varepsilon_{ij}^{M} = \frac{\partial q_i}{\partial \ln p_j} = -\delta_{ij} + \frac{\partial s_i}{\partial \ln p_j} / s_i \tag{10}$$

$$\begin{aligned} \frac{\partial s_i}{\partial \ln p_j} &= \gamma_{ij} - \beta_i \frac{\partial P}{\partial \ln p_j} + \frac{\partial}{\partial \ln p_j} \frac{\mu_i}{Q} \ln\left(\frac{X}{P}\right)^2 \\ &= \gamma_{ij} - \beta_i s_j \end{aligned} \tag{11}$$

$$\Leftrightarrow \varepsilon_{ij}^{M} = \frac{\gamma_{ij} - \beta_i s_j}{s_i} - \delta_{ij} \tag{12}$$

$$\begin{aligned} \frac{\partial q_i}{\partial \ln(X/P)} = \delta_{ij} + \frac{\partial s_i}{\partial \ln(X/P)} / s_i = \delta_{ij} \\ + \left(\beta_i + \frac{\partial}{\partial \ln(X/P)} \frac{\mu_i}{Q} \ln\left(\frac{X}{P}\right)^2 \right) / s_i \end{aligned} \tag{13}$$

$$\varepsilon_i^{I} = 1 + \frac{\beta_i}{s_i} \tag{14}$$

Equation (12) shows the Marshallian price elasticity, and equation (14) the expenditure elasticity. Following Green and Alston (1990), the derivative of the price index with respect to logarithmic price j minimises to $\frac{\partial P}{\partial \ln p_j} = s_j$. Moreover, following Säll et al. (2020) on simplification, demand curves are assumed to be linear functions of prices; this means that the derivative of the quadratic term is equal to zero for price and expenditure elasticities.[2] The Kronecker delta, δ_{ij}, becomes 1 for i=j. The reason is that in this case s_i/s_i is added to the equation. The price elasticity equation in (11) looks similar to Chalfant (1987) results of the elasticity estimate of the Linear Appoximate AIDS (LA/AIDS) model with the Stone's price index ($\ln P^* = \sum s_i * p_i$). The Stone's price index is especially used for models with aggregated annual time-series data as the translog price index can lead to empirical difficulties (Green & Alston, 1990, p. 442). This dataset uses daily and not annualy observations, which is why we are using the translog price index (5). Furthermore, parameters derived from QAIDS allow for more precised estimation compared to the LA/AIDS.

$$\varepsilon_{ij}^{H} = \varepsilon_{ij}^{M} + \varepsilon_{i}^{I} * s_j \tag{15}$$

$$\varepsilon_{ij}^{H} = \frac{\gamma_{ij} - \beta_i s_j}{s_i} - \delta_{ij} + s_j + \frac{\beta_i * s_j}{s_i} = \frac{\gamma_{ij}}{s_i} + s_j - \delta_{ij} \tag{16}$$

After setting the arrived Marshallian and expenditure elasticity in the Slutsky equation (3), we can solve for the Hicksian elasticity (16). Chapter 2.1.2 discusses the interpretation of elasticities. For the framework of this study, they are calculated at their mean prices and quantities. The same applies to the expenditure shares. Furthermore, demand curves are not estimated due to the scope of this study. For more information on the calculation of demand curves read Säll et al. (2020).

3.2 Data

This paper explores consumers' decision processes regarding conventional and organic fruits in a Swedish supermarket. It's exploiting selling data of an ICA Stormarknad Maxi placed in Nacka, Stockholm. The data was collected over eight months between August 1st,

[2] For a more precise estimation of elasticities with the QAIDS read Banks et al. (1997).

2019 and March 31st, 2020. The data collection is part of the EPIC (Economic Policy Instruments for reducing Climate Impact from food in Sweden) project that aims to arrive at an overall demand system for all goods sold during this period. The project is financed by Formas. The data covers prices and quantities of all goods that were sold during this period. The supermarket has a wide range of products, including delicacies and a cheese-, fish- and meat counter. Hence, it also attracts people from outside Nacka. Nevertheless, Nacka is one of Stockholm's richest quarters, which might indicate that the average consumer has a medium to high budget food.

3.2.1 Data Handling

We handled the dataset in an excel document. It includes the amount in kilogram and the value in SEK of every good for every day of the observation. This leads to a total of 243 observations. The goods were divided into categories, while each category could have subcategories, i.e., organic. The dataset includes nine fruit groups: Apples, bananas, berries, citrus fruits, exotic fruits, grapes, melons, pears and plums. For this research, bananas, melons, pears and plums are removed from the dataset. Former because the respective supermarket just sold organic bananas during the observation period and letters because of their small value share (Table 1). Hence, the demand system includes about 74% of all fruits sold. The expenditure share is the value for the fruit items for each day divided by the total amount for this day. The averages are presented in Table 1. The remaining five groups are apples, berries, citrus fruits, exotic fruits and grapes. Each of the varieties has been sold as organic and conventional goods, which leads to a 10-goods demand system. After excluding bananas, the organic value share decreases from 22% to 5.75% of the remaining dataset. Conventional fruits make up 94%.

For analysing the dataset, we used quantities and prices. The quantities are the daily amount sold for each item; they are measure in kilograms. Furthermore, prices for every day are the value divided by the amount sold and weighted by 1.12 to account for taxes; This gives the price pre kilogram in SEK after taxes which is also the actual price for consumers paid for this good on this day.

Table 1. Fruits Value Shares.
Source: Based on ICA data.

Fruits	Value Share Total	Value Share Conventional	Value Share Organic
Apples	**12.68%**	**11.53%**	**1.14%**
Bananas	17.56%	0.00%	17.56%
Berries	**14.94%**	**14.48%**	**0.46%**
Citrus	**24.61%**	**23.54%**	**1.07%**
Exotic	**12.36%**	**11.95%**	**0.41%**
Grapes	**9.20%**	**8.04%**	**1.16%**
Melons	4.95%	4.70%	0.25%
Pears	3.39%	3.12%	0.27%
Plums	0.32%	0.31%	0.01%
	100.00%	77.67%	22.33%
Analysed Fruits	**73.78%**	**69.54%**	**4.24%**
	100%	**94.25%**	**5.75%**

3.2.2 Descriptive Statistic

For analysing prices, quantities and shares, we used TSP 5.1. For this, the respective fruit quantities in kg and the prices in SEK/kg were inserted into the program. Table 2 shows their means, the standard deviation, the maximum and minimum points. For the expenditure share, we used fruits' daily values, which are their price times the quantitiy, and divided it by the total value of the respective day. With the help of these values, TSP 5.1 estimated the needed parameters of the QAIDS. Furthermore, it calculated the elasticities based on the above equations (12), (14) and (16).

Table 2 shows that prices for organic goods are generally higher than the one for their conventional counterpart, with the highest price for organic berries (292 SEK/kg). In general, berries are the variety with the highest prices. On the other hand, prices of conventional and organic apples and citrus fruits are quite small, at around 30 to 40 SEK/kg. For exotic fruits and grapes, the price differences are higher, with organic grapes bearing a price premium of 80%. This price premium is calculated by dividing the

Table 2. Fruits Prices, Quantities & Shares.

Source: Based on ICA data.

Fruits		Mean	Std. Dev.	Min.	Max.	$\frac{(p_o - p_c)}{p_c}$ Price Premium	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Min.	Max.
Apples	**Conventional**	**32.82**	**4.71**	**17.61**	**42.55**	30%	**400.63**	**93.16**	**147.52**	**941.65**	**0.254**	**0.063**	**0.134**	**0.442**
	Organic	42.78	5.80	25.28	57.44		23.10	11.18	6.43	91.35	0.015	0.007	0.003	0.037
Berries	Conventional	164.96	29.15	68.72	230.55	77%	92.15	66.09	27.13	323.58	0.055	0.034	0.016	0.203
	Organic	291.72	35.74	197.25	386.27		1.34	0.80	0.13	4.63	0.001	0.000	0.000	0.003
Citrus	Conventional	27.00	5.06	15.63	37.43	33%	785.80	450.85	88.54	3533.09	0.435	0.140	0.098	0.650
	Organic	35.78	7.45	20.11	45.51		29.38	21.30	2.92	117.70	0.015	0.006	0.003	0.039
Exotic	Conventional	45.37	8.72	13.06	64.34	66%	237.62	102.23	84.42	676.63	0.143	0.052	0.066	0.319
	Organic	75.39	11.02	44.73	99.90		4.50	2.07	0.30	14.00	0.003	0.001	0.000	0.008
Grapes	Conventional	58.06	9.46	41.83	79.06	81%	123.34	59.44	30.00	336.40	0.074	0.025	0.026	0.152
	Organic	104.80	25.39	52.08	149.88		10.49	9.13	0.40	66.00	0.006	0.004	0.000	0.020

difference between organic and conventional prices by the conventional price as a benchmark.

The standard deviation shows that price fluctuations are rather high, which is reasonable as the whole dataset includes eight months in which some of the respective fruits went in and out seasons. Also, quantities' fluctuation is high. Furthermore, the quantity mean for organic goods is always much smaller than for their conventional counterpart. Both berry varieties show a very small quantity which is explainable by the small weight and size of them. Citrus fruits quantity on the other hand is the highest. The high standard errors for prices and quantities could suggest that they move conjunctively. Nonetheless, this is not apparent from the table; thus, we will apply a sensitivity test to test if elasticities are evenly spread throughout the dataset (Chapter 4.4).

The last section of Table 2 shows the expenditure share. Expenditure shares of conventional fruits exceed their counterpart a lot. The highest shares have conventional apples and citrus fruits which make up almost two third of the data set. Very small expenditure shares are especially observable for organic berries, grapes and exotic fruits.

3.3 Limitation of Data

The advantage of this dataset is that the number of observations allow for a clear picture of consumers' demand within the period of observation. The focus on one supermarket, on the other hand, also has a disadvantage compared to other data collection methods. Other researchers often use household scanner data or aggregated data of a region or country. The first one has the advantage of observing household purchases in different market channels and additionally gives information on socio-demographic variables. Nevertheless, collecting data from different households is time and money-consuming; furthermore, only the dataset of selected households is observed, while our dataset allows for more observations. This could, on the other hand, also be a disadvantage as Nacka is a wealthy region in Stockholm, and the observation could be biased towards higher-income households. Moreover, the lack of knowledge of households' income does not allow to observe the share of income spend on food, hence the actually income elasticities can even not be observed when adding more stages to the demand system.

Aggregated data of a whole country and region allows for more observation. The main disadvantage is that labels are not included, and only highly aggregated elasticities can be derived. A further disadvantage of this study is the small market share of organic goods. The dataset reveals that the organic fruit market is not mature, as bananas make up most of the organic consumption. Bananas were excluded because they are only sold as organic, and the research plan is to compare conventional and organic fruits. The exclusion should not interfere with arriving at correct elasticities.

4. Analysis of prices and income’s impact on organic demand

This chapter provides a synopsis of the main findings, together with a discussion of the relevant literature. The four research hypotheses, which presume answers for the research question of monetary parameters' influence on demand for organic fruit consumption, divide this chapter in four sections. The first part discusses the impact of own prices on organic fruits and compares the findings with conventional fruits as a benchmark. Furthermore, it provides insights into the relationship between price sensitivity, prices, and the price premium. The second part deals with the influence on expenditure. However, one limitation of this study is that, based on the weak separability assumption, we are implying that fruit expenditure never changes. Hence, we can not expect all of the consumers' fruit budget to be spent in this supermarket. Nonetheless, expenditure elasticities are also discussed with the prices. The third part summarises the most important results of the cross-price relationships. The focus is on the relationships of counterparts and within the organic group. Last but not least, two sensitivity analyses are presented. This chapter is followed by a discussion chapter that summarises the most important findings and discusses possible reasons for surprising results. It furthermore states the limitations of the analysis. After that, we are closing with the conclusion.

The results were estimated by using TSP 5.1. A first run of the analysis showed high autocorrelation that was fixed by taking a log(X+1) function. Afterwards, most of the relevant elasticities were significant. All values are calculated at their mean points and can only be interpreted by holding the other prices and quantities constant. The comparison to other studies can only show patterns as this is only possible for the same expenditure level (Edgerton, 1997). Furthermore, the model is based on the PIGLOG preferences and shows the average consumer's preference at this supermarket. Table 4 provides the Marshallian uncompensated elasticities. For better understanding, own price and expenditure elasticities are also observable in Table *3*, with prices, price premiums and shares from Table 2. This chapter mainly discusses the Marshallian elasticities. When referring to Hicksian elasticities, this is stated.

4.1 Own-price elasticities

Besides organic berries, that have a large standard error, all Marshallian and Hicksian own-price elasticities are significant on a 5% level (see Table 4 and Appendix 1). Furthermore, all of them are negative and organic goods always show a higher price sensitivity than their conventional counterparts. This is similar to other studies on organic goods with small market shares (e.g., Lin et al., 2009). Besides organic apples, organic products are elastic. The same applies to conventional berries and grapes that show own-price elasticities of -1.53 and -1.42, which means that with a 1% price increase the share would decline by 1.53 % and 1.42% respectively. Hence, high price sensitivity in this dataset is not only observed in organic goods, contrary to Schröck (2012) and Kasteridis and Yen (2012). This can be explained by difference in market shares and that the above studies analysed vegetables. Consumers could perceive some conventional fruits as treats while conventional vegetable might be more important for people's diets.

High market shares and price sensitivity are, to some extent, aligned. Table *3* shows that conventional berries and grapes, in addition to organic fruits, have relatively small expenditure shares. Moreover, fruit items with high market shares show inelastic own-price elasticities. An exception are organic apples, with a small expenditure share (1.5%) and a small own-price elasticity (-0.77). Hence, our results are broadly in line with Schröck (2012) and Li et al. (2018); Small market shares influence organic's price sensitivity and, over and above, the one of conventional items. The inelastic of organic apples is not in line with Lin (2009), it might be that apples are more important for Swedish consumers than for US citizens.

The magnitude of uncompensated own-price elasticities is not related to their prices which is observable in Table *3*. This is evident in organic apples and citrus fruits, which are more price sensitive than conventional grapes and berries, although having smaller prices. Nevertheless, the results, consistent with Glaser and Thompson (1998) and Lin et al. (2009), suggest that own-price elasticities and the price premium are correlated. One exception are organic berries, with the 2nd smallest own-price elasticity (-1.9) but the 2nd highest price premium (71%). A possible explanation for the differences between prices and price premiums might be that consumers only consider the relative price of an organic item with the conventional price as a benchmark.

Interestingly, despite the high price premium and a small organic expenditure share, organic and conventional berries show similar own-price elasticities, while the citrus-fruits own-price elasticities are surprisingly asymmetric with precisely opposite findings. This observation questions Hypothesis 1, that organic and conventional own-price elasticities converge with increasing organic market share and decreasing price premiums. On the other hand, based on visual judgement, asymmetry for exotic fruits and grapes is high and the one for apples low, which supports Hypothesis 1. Nonetheless, regarding considering our dataset with only small organic market shares, we can only speculate that organics' price sensitivity would approach their conventional counterparts' with raising market penetration. One indicator could be that conventional goods with small expenditure shares show elastic, and the one with higher expenditure shares inelastic demand.

Table 3. Overview of own- and income-elasticities with prices and shares.
Source: Own calculation based on ICA data.

		Income elasticity	Own-price elasticities	Prices at mean (SEK)	Expenditure Share at mean	Price Premium $\frac{(p_o - p_c)}{p_c}$
Conventional	**Apples**	0.44***	-0.52***	32.8	25.40%	
		(0.031)	(0.048)			
	Berries	1.11***	-1.53***	165	5.47%	
		(0.075)	(0.109)			
	Citrus	0.41***	-0.90***	27	43.40%	
		(0.056)	(0.070)			
	Exotic	0.76***	-0.69***	45.4	14.40%	
		(0.044)	(0.042)			
	Grapes	1.02***	-1.42***	58.1	7.36%	
		(0.068)	(0.118)			
Organic	**Apples**	0.77***	-0.81**	42.8	1.49%	30%
		(0.143)	(0.257)			
	Berries	3.69***	-1.90	291.77	0.01%	77%
		(0.550)	(1.424)			
	Citrus	1.63***	-1.95***	35.8	1.54%	33%
		(0.147)	(0.175)			
	Exotic	2.05***	-2.34***	75.4	0.28%	66%
		(0.295)	(0.505)			
	Grapes	2.22***	-2.83**	104.8	0.59%	81%
		(0.265)	(0.378)			
Significance level: ***1%LEVEL, **5% LEVEL, *10% LEVEL						

4.2 Expenditure elasticities

The expenditure elasticity shows the demand change of a product when expenditure rises by 1%. The analysis shows that all expenditure elasticities are positive and significant on a 1% level (Table *3*). This implies that all fruits are normal goods; Their consumption increases when consumers spend more money on fruits.[3] Furthermore, most organic goods (except apples), as well as conventional berries and grapes, are luxury goods with expenditure elasticities above 1. Hence, their share of expenditure increases with an increase in the fruit budget. Nonetheless, we need to highlight that conventional grapes' expenditure elasticity is almost at unity (1.02), which means that their growth is nearly proportional to the fruits' budget increase.

These results support the findings of Zhang et al. (2011) that organic goods are always superior. On the other hand, Hsieh et al. (2009) and Dhar and Foltz (2005) observed small expenditure elasticities for organic potatoes and milk. The former suggests that organic potatoes' market growth was driven by improved taste and the rising awareness of healthy diets, while the latter assumes that only customers with a small expenditure on milk, like single households with no children, buy organic. Since Hsieh et al. (2009) study is from 2009, an explanation for higher expenditure elasticities nowadays could be that organic fruits are more established and that taste has been very similar for years. Furthermore, customers in Sweden are already well informed about organic goods, and health-aware people might've already started buying organic goods; hence, it might be that market expansion needs to focus on increasing overall fruit's budget rather than other aspects. This is also in line with Schröck (2012) who implies that with the introduction of organic goods firstly non-use values are important and later on monetary parameters become more important. The importance of income is also analysed and proven by surveys and analyses of demand systems that add socio-economy data (e.g., Irandoust, 2016, p. 85).

Expenditure elasticities correlate with the price premium and prices. More expensive goods, as well as organic goods with a high price premium, are demanded more with an

[3] Moreover, consumption of normal goods should also increase in case of deflation. In this case the price index decreases and consumer can buy more goods with their income.

increasing fruit budget. Two exceptions are – again - citrus fruits and berries. Organic citrus fruits are considered luxurious even though they are the 3rd cheapest good and conventional berries, on the other side, are the second most expensive good with a small expenditure elasticity. Furthermore, all superior goods are price elastic (Conventional: Grapes & berries; Organic: Citrus, exotic, grapes & berries) while all normal goods are price inelastic (Conventional Citrus, Apples, Exotic and Organic Apples). The relationship between own price and expenditure elasticity is not apparent for the Hicksian elasticity (Appendix 1: Hicksian elasticity). Hence, it is mainly the income effect that is related to the income elasticities.

Hypothesis 2 states that organic expenditure elasticities are getting closer to unity with market growth. Because of the small market shares in this dataset, this can neither be proven nor denied.

4.3 Cross-price elasticities

In the final part of the elasticity analysis, we provide the result of the cross-price elasticities. The literature findings suggest two different discussions, the first of between and the second of within groups relations. Thus, this chapter is divided into two parts accordingly to their hypotheses. Furthermore, Table 4 is the main reference point.

4.3.1 Cross-price between groups

Table 4 presents the organic and conventional cross-price relations. It is observable that there are 9 out of 25 significant uncompensated cross-price elasticities between conventional and organic fruits; This includes 5 out of 16 significant complementary and 4 out of 9 significant substitution relations (down and left quarter). On the other side, there are 10 out of 25 significant relations between organic and conventional, with 4 out of 10 significant complementary and 6 out of 15 significant substitutable relations (upper right quarter). Thus, price increase of conventional goods leads in 16 cases to a decrease in organic demand (complementary relationship between conventional and organic), and a price increase of organic goods leads to an increase in demand for conventional goods (substitution from organic to conventional) in 15 cases. All of the cross-price relations are smaller than 1. Overall, and not only for the counterparts, the magnitude of cross-price elasticities between organic and conventional fruits are also mostly asymmetric.[4]

The asymmetry between organic and conventional goods is also found by other researchers (Li et al., 2018). This asymmetry suggests that organic goods are more price sensitive to a change in conventional prices than the other way around. Interestingly, out of the conventional groups, conventional citrus fruits have the most significant relationship to the organic group**.** Organic citrus fruits on the other hand only have neutral relationships to other conventional items except for their counterpart, where it is almost unity (-0.97). This will be discussed in the following chapter.

Price relations of organic goods to price changes of conventional counterparts range from almost unity, -0,97, for citrus fruits, to almost no reaction, -0.07, in the case of grapes. Interestingly, most cross-price reactions show that organic demand is complementary to conventional prices, which means that the change of demand for organic is in the same direction as the conventional own-price reactions; This implies that consumers buy organic fruits in addition to their conventional counterparts and that they are part of a diversified fruit basket. On the other hand, the demand reaction of conventional goods is mostly “neutral”. Conventional berries, exotic fruits and grapes show almost no reaction to price changes of their organic counterpart. Neutrality is especially apparent for grapes, with the highest price premium of 88% (see Table *3*). However, the Hicksian elasticities reveal that grapes compete with their counterpart while exotic fruits are complements, similar to citrus fruits.

Counterparts cross-price reactions are only significantly different from zero for apples, citrus fruits, and from conventional to organic exotic fruits. The cross-price elasticities of apples (i.e., 0.24) are the only one that suggest that the counterparts are substitutes and in competition with each other. Furthermore, Marshallian and Hicksian elasticities suggest that organic and conventional citrus fruits and exotic fruits are bought in addition to each other. One reason could be that there are some items, like oranges or lemons for citrus fruits, that are always bought as organic or conventional. Hence, this observation could question our aggregation process. A further argument for this is the combination of high price sensitivity but low expenditure elasticity in case of conventional citrus. The observation of differences in fruit elasticities for citrus fruit of Brown and Lee (2002) and

[4] Hint: Table 4 needs tob e read as followed. 1% price increase of conventional berries leads to a 0.8% decrease in organic exotic-fruit’s demand while a 1% increase in organic exotic-fruit’s prices just leads to a demand decrease of conventional berries of 0.06%.

Lee (1994) support this train of thought, as well as Nzaku et al. (2010) for exotic fruits while Chung et al. found almost no differences.

The significance of apples and citrus fruits' cross-price elasticities is in line with Glaser and Thompson (1998) statement that small price premiums leads to more interaction between counterparts. Contrary, Zhang et al. (2011) found significance for goods with a high price premium. A reason for this could be their high difference in market shares (p. 455), which is also the case for Glaser and Thompson (1998) and the prospected study; Table *3* shows that conventional apples and citrus fruits make up 25% and 43% of the expenditure share, while conventional berries and grapes have a very small share. Moreover, the cross-price asymmetry between citrus fruits is higher while having higher expenditure share and elasticity differences. Hence, we cannot conclude with certainty that the reason is the low-price premium and not the differences in expenditure share, as argued by Li (2018) and Schröck (2012. Nevertheless, as no test is applied, the hypothesis that differences in income- and budget-share increases asymmetry cannot be confirmed.

Some of the results are in line with Hypothesis 3. First, there is an asymmetry between conventional and organic fruits and not only in the counterpart relations. Furthermore, goods with a small price premium (apples and citrus fruits) show significant cross-price elasticities, which could also be caused by a high difference in market shares and expenditure elasticity. Interestingly, most of the relations are negative, implying they are complementary. Durham and Eales (2010) call this the “fruit salad effect” (p. 1349). Overall, conventional goods are demanded less when organic prices decrease (mostly substitutes), while organic fruits demand declines when conventional prices rise (mostly complements). This denies Lin et al.’s (2009) statement that conventional prices should increase to close the price gap but support Li et al. (2018) in their observation of stickiness in demand for organic products.

Table 4. Marshallian elasticities.

Source: Own calculation based on ICA Data,.

Marshallian		1% change of price										
		Conventional					Organic					
…% change quantity		**Apple**	**Berries**	**Citrus**	**Exotic**	**Grapes**	**Apple**	**Berries**	**Citrus**	**Exotic**	**Grapes**	**Income**
Conventional	**Apple**	**-0.52*** **	0.07	-0.15***	-0.05**	-0.03	0.15***	0.07	0.06	0.06	-0.09**	0.4***
	Berries	-0.01	**-1.53*** **	0.50***	-0.13**	0.09	-0.02	0.01	0.14*	-0.06	-0.09	1.11***
	Citrus	-0.13***	0.41***	**-0.90*** **	0.02	0.16***	-0.24***	0.13	-0.37***	0.31***	0.18***	0.41***
	Exotic	-0.11***	-0.07	-0.04	**-0.69**	0.04***	0.11	-0.06**	0.01	-0.08	0.12**	0.76***
	Grapes	-0.13**	0.1	0.12*	0.01	**-1.42*** **	-0.17	0.35***	-0.06	0.15	0.04	1.02***
Organic	**Apple**	0.24**	0.01	-0.55***	0.19*	-0.22	**-0.81*** **	-0.54***	0.65***	-0.15	0.44**	0.77***
	Berries	-0.01	-0.24	0.48	-0.80*	1.71**	-2.36***	**-1.9**	-0.75	0.83	-0.74	3.69***
	Citrus	-0.07	0.13	-0.97***	-0.1	-0.17	0.57***	-0.15	**-1.95*** **	0.14	0.94***	1.63***
	Exotic	-0.04	-0.28	0.93***	-0.44**	0.29	-0.4	0.44	0.23	**-2.34*** **	-0.46	2.05***
	Grapes	-0.54***	-0.31	0.23	-0.35	-0.07	0.50*	-0.24	-0.35	-0.35	**-2.83*** **	2.22***
Significance: ***1%LEVEL, **5% LEVEL, *10% LEVEL												

4.3.2 Cross-price within group

After excluding own-price reactions, seven cross-price relationships are significant within the organic group. Two organic goods are complements (apple and berries), and five are substitutes (apple & citrus; apple & grapes; grapes to citrus). On the other hand, the significant relationships in the conventional group imply that six items are complements and five substitutes. This differs from Li's finding of only significant relationships within the conventional group (Li et al., 2018). However, they analyse milk products with different fat content, which is very different from the prospected study. In line with Lin (2009) the highest substitution effects of the conventional group are to the organic group.

Interestingly, in the organic group, most of the significant relationships include apples, and the magnitude of the price reaction of the more expensive good is always higher than that of, the cheaper good. This asymmetry is similar to the findings of the cross-price elasticities in the last section. Nonetheless, this does not necessarily suggest that the prices cause the high reactiveness; Li et al. (2018) argue that differences in income elasticities can also cause asymmetry of cross-price elasticity. Moreover, the income effect in this group is very present.

Even though the organic group's most significant relations are substitutes, the division between complementary and substitution relations is quite equal when including insignificant relations. Without the own-price elasticities, there are 11 complements and 9 substitutes. This violates Hypothesis 4 that cross-price relations are mainly positive within the organic group. Furthermore, from casual observation, the magnitude of relations within the organic good is higher than within the conventional one. This asymmetry is similar to own prices and shows that organic goods are always more price reactive.

The last section revealed that organic fruits are mostly complements to conventional fruits. A closer look shows that organic fruits are more reactive to organic price changes than conventional ones. This is in line with Li et al. (2009) and Hypothesis 4. However, Glaser & Thompson (1998) suggest that the higher relationships within an organic group comes from a smaller price premium. Interestingly, our findings show that the most significant relationships are between the goods with a high price premium.

4.4 Sensitivity Analysis

The section below describes the results of two sensitivity analyses. The first one tests the assumption that there is no difference between our results and the elasticities of grouping the organic and conventional goods together. The reason is the small organic expenditure share. The second test examines if the dataset is evenly distributed because of the price and quantity fluctuation in the dataset (Chapter 3.2.2). The tests were conducted in excel.

The first sensitivity analysis is applied to test if organic and conventional goods should be grouped instead of performing a separate demand system. Therefore, organic and conventional goods' observed value (in SEK) and quantity (in kg) are aggregated. The analysis is conducted as before but only with a five-goods demand system (Chapter 3.2.2). The quantities are the amount sold for each day, and the prices are the amount of one day divided by the value and multiplied by 1.12 to account for taxes (SEK/kg). First, the cross-price elasticities between organic and conventional items are excluded. Afterwards, two two-tailed independent t-tests are performed to test the null hypothesis that elasticities are the same (Appendix 2: Sensitivity Analysis). The first test on conventional and grouping elasticities showed that the alternative hypothesis could be accepted on a 1% level for most of the elasticities. Exceptions are the own-price elasticity of conventional apples and exotic fruits and the cross-price elasticity of grapes with berries and exotic fruits. The alternative hypothesis that organic and grouping elasticities are different could be accepted on a 1% level for all elasticities. This observation is in line with Hansen (2003) and Zhang et al. (2011), that stated that organic goods are weakly seperable from organic goods and perceived differently by consumers.

For the second sensitivity analysis, the sample was split in two and analysed separability. Both samples include 121 observations. The first sample covers August 1st to November 29th and the second sample includes December 1st to March 31st. The first independent two-tailed t-test is conducted to test the null hypothesis that own- cross- and expenditure elasticities are equal between both sample periods. For 7 elasticities, the null Hypothesis cannot be rejected on a 1% level (see Appendix 2: Sensitivity Analysis. The second and third test compares the newly arrived elasticities with the already known one. A comparison of the original sample to the 1st half showed that for 17 elasticities (including the income elasticities of apples and exotic-fruits) the null could not be rejected, the same applied to 7 elasticities of the 2nd half. Both analyses are also stated in Appendix 2: Sensitivity Analysis.

5. Discussion on influential factors

The initial objective of this study is to determine the influence of monetary parameters. Results that are in line with the research hypothesis are the asymmetry in elasticities of organic and conventional items. Organic goods, in general, are more price sensitive; this implies the own price elasticities, the cross-price elasticities to the conventional goods and the difference in magnitudes within the two groups. Furthermore, expenditure elasticities imply that most organic goods are luxury goods and their budget shares increase with an increase in their fruit budget. However, previous research has already established that consumers' decision is additionally based on factors other than monetary values (e.g., Hoffmann & Wivstad, 2015; Irandoust, 2016). Thus, it is unsurprising that some observations are not explainable only with prices and income.

The own and income elasticity for apples is small, as well as their market share, which suggest that demand for them won’t increase anymore. Price sensitivity for organic citrus fruits is rather high, as well as expenditure elasticity, despite their small price and especially in comparison with conventional grapes and berries. Conventional citrus fruits, on the other hand, have a relatively high price elasticity compared to small prices. In contrast, organic berries seem to be very price insensitive besides a high price.

Aside from that, a sensitivity analysis suggests that organic goods should not be treated like conventional goods in most cases. On the other hand, demand systems for the first and second half suggest that elasticities for fruits are not homogeneous throughout the year.

5.1 The role of prices and price premium

This chapter discusses especially the price premium. Nonetheless, parts of the effects may be impacted by differences in market shares, as discussed in Chapter 4.3. The price premium seems to have a big influence on organic goods. The higher the price premium, the higher the own price elasticity (Chapter 4.1), the expenditure elasticity (Chapter 4.2) and the smaller the cross-price elasticity to the counterpart (Chapter 4.3.1)

The results suggest that consumers base their decision for organic goods on the relative price of the two counterparts. Two indices for this are the high price sensitivity of organic fruits, which moves with the price premium but not with the price, and the non-significant relationship to their counterpart. The letter implies that organic goods with a high price premium are not perceived as part of the conventional variety; hence they do not compete with each other. One example are grapes with the highest price premium but neutral Marshallian cross-price elasticities. Most cross-price relations of organic goods are with conventional citrus fruits and organic apples.

In this study, organic apples seem to be an "anchor point" for the organic fruit group. This becomes obvious, especially in comparison with the small substitution effects (Hicksian elasticities) of the conventional apples. Two reasons for this could either be their small price or that apples, in general, are a well-established good, which is suggested by other researchers' small own price elasticities (e.g., Paudel et al., 2010). However, following Schröck (2012), the small market share and their small price and expenditure elasticity suggest that their market establishment is completed. Furthermore, organic apples seem to compete with conventional apples; This is seen by their cross-price relations and the sensitivity analysis, which suggests that own-price elasticities of grouping these goods might be similar to the conventional ones. Their lack of variety might be the reason they are not bought more often (Hoffmann & Wivstad, 2015). Furthermore, they are the only good with a domestic counterpart, and previous research showed that domestic-produced food is preferred over organic (Denver & Jensen, 2014). To conclude, organic apples might only be attractive to organic buyers and serve as the above mentioned "anchor point". The existence of an organic consumer group is also suggested by the high interaction between the group. This is in line with Hansen, 2003 and Zhang et al., 2011.

Organic exotic fruits and grapes seem to be the two goods that behave accordingly to our expectations. The high price sensitivity suggests that a decrease in the price premium through a price decrease would increase their quantity. Hence, there is a potential for market growth and the, even though small, positive Hicksian counterpart cross-price elasticity for organic grapes could suggest that a price decrease could lead to the perception that they are part of the conventional group and compete with conventional grapes. For exotic fruits the sensitivity analysis suggested that own price elasticities would not change when grouped together. This might imply that some goods are only available as organic. As discussed before, this is a problem that we have with the aggregation process.

Moreover, the high negative cross-price elasticity between citrus suggest that they are consumed together; thus, the aggregation process should be questioned (see Chapter 4.3.1).

This is similar to exotic fruits which are also highly aggregated and show a negative cross-price elasticity to their counterpart. Organic citrus fruits' high price sensitivity, despite a small price premium, suggests that some of them do not have an advantage over conventional citrus fruits, similar to Lindström's observation (Lindström, 2022). Still, the highest organic share might also imply that some citrus fruits, such as lemons for their peel, are often bought organic even from non-organic consumers.

Following Wier et al.'s observation, organic berries can serve as an example for heavy organic buyers (p. 8). Their price premium, and especially their price, is very high but they still make up for 0.01% of the expenditure share. Their relatively small price sensitivity might suggest that with price growth, the price sensitivity of a good increases, but after a point, this good is bought by loyal (and not occasional) consumers only who are willing to pay a high price, hence, are not sensitive to price changes anymore.

Overall, these observations indicate that there is a small group of organic buyers that are willing to pay a price premium up to 80%. However, for non-organic buyers, organic goods do not seem to be that attractive, even with smaller prices. The observable "stickiness in demand" to the organic good suggests that the growth of the organic price premium through organic price would not lead to a switch to conventional (Li et al., 2018). On the other hand, a decrease of the price premium through an increase of conventional prices might have the unwanted effect that organic products are consumed less due to complementary relationships. Furthermore, the high price sensitivity of most goods might indicate that still some non-organic consumers could become occasional consumers. Still, the expenditure share is not expected to rise that much higher with only price changes as seen for organic apples.

5.2 The role of income and the organic consumer

The expenditure elasticity of this paper only indicates the demand change in case of a fruit budget shift. Table 3 shows that, except for organic apples, the expenditure elasticities for organic goods is always higher than the conventional one. Especially apparent is this for conventional berries that have a very high price but a surprisingly low expenditure elasticity (Chapter 4.2) and for organic citrus fruits with a very small price but high expenditure elasticity. Conventional berries' small expenditure elasticity could indicate that conventional goods are seen more as a necessity, while organic goods have higher expenditure elasticities and might only be consumed by a small group willing to spend more money on fruits.

Some reasons for a higher budget for fruits are a higher household income, for example, a couple without children, the aim to follow a healthier or environmentally friendlier diet, or that organic goods, in general, are more expensive and heavy organic consumers have to spend automatically more on fruits (Dhar & Foltz, 2005; Shepherd et al., 2005). Consumers that follow a healthier diet, thus, spend more money on fruits could also perceive organic goods as healthier. This would be in line with research on motives for organic consumption (Irandoust, 2016; Shepherd et al., 2005). Still, we need to know about the consumers motivation and can only speculate why they are willing to spend more money.

The explanation for the high-income assumption is that high-income households might generally pay more money for food. The small cross-price elasticities could indicate that high-income households do not have to compare prices (Glaser & Thompson, 1998). Nonetheless, it is interesting that the market shares for organic fruits are very low, even though the supermarket is in one of the wealthier parts of Stockholm. This would violate this assumption.

5.3 Limitations of Analysis

A few factors limit this analysis. First of all, we restricted the analysis to a single stage of a demand system. Thus, the interpretation of the expenditure elasticity is only possible with the fruit budget for the observation period. Furthermore, we are using aggregated data and not household expenditure on fruits which could distort the picture of organic fruit purchases, as consumers often use more than on marketing channel (Li et al., 2018). Additionally, the lack of household data means that we have no data on the income of organic and conventional consumers. Even though the expenditure elasticities suggest that a higher fruit budget leads to a higher demand for more expensive goods, there is also the possibility that low-income households spend a high amount of their budget on fruits. Moreover, no survey could prove our presumption that consumers perceive organic goods as healthier or more environmentally friendlier.

There are two critical points regarding the research design. First of all, a sensitivity analysis suggests that fruits follow seasonal patterns, which could create noise in our dataset for which we didn't control. Furthermore, the negative cross-price elasticities between exotic and citrus fruits suggest that they are consumed together, and this could imply that consumers buy some of them only organic or conventional. This information got lost in the aggregation process.

The last limitation is the lack of further tests. Asymmetry is only discussed by visual observations. Furthermore, a split in half of the data set might not follow seasonal patterns, which could end before the beginning of the Christmas holidays. Lastly, we do not test if organic and conventional goods are weakly separable from each other, and we can only imply an organic consumer group.

6. Conclusion

Organic fruit production is beneficial for the environment and especially for biodiversity (Tuck et al., 2014). Global shocks and policy-making can influence their prices significantly and, with it, the real expenditure that can be spent on fruits. Hence, this paper wants to answer how price and income changes influence demand for organic fruits by exploiting a eight months dataset of purchases in a Swedish supermarket with the help of the QAIDS.

The results show that organic fruits react very price sensitive to own and cross-price changes, with negative and elastic own-price elasticities. Furthermore, a decrease in expenditure would decrease organic fruit shares over proportional, shown by superior expenditure elasticities. Apart from this, organic goods' cross-price elasticities are the highest in the organic group, especially to organic apples.

The results suggest that organic goods are bought by a small group of organic consumers who spend more money on fruits and mostly interact within the organic group. Furthermore, even organic goods with smaller prices seem to lack advantages for conventional consumers that would justify the small price premium.

An overall decrease in fruit prices could push organic consumption to increase purchasing power. Furthermore, advertisements on fruits, in general, could increase the fruit budget and consumers might buy more organic fruits. This could also happen naturally following the trend of an increase in fruit budget in Sweden. Furthermore, a price decrease for some of the organic good could attract non-organic buyers to become occasional organic buyers by making organic goods relatively less expensive. Nonetheless, the results suggest that policies should focus on increasing the organic consumer group through other measures than price decreases. For this, it could be interesting to analyse how the German organic market achieved higher organic shares (Schröck, 2012). A first step could be to highlight use and non-use values as suggested by Wier et al. as price measures do not seem to bring a huge shift of the organic shares.

Disappointingly, one of the main objectives to determine demand in a mature organic market could not be fulfilled, as the data set suggest that organic bananas mainly drive the high organic market share in Sweden. Hence, the results are not surprisingly mostly in line with previous research.

Further research on the same data set could examine fruit elasticities for the whole budget spent in the supermarket by implementing a two-stage demand system, thus, including the budget shifter to other foods. Furthermore, it could be important to add a seasonality dummy to this dataset of fruits (Wildner, 2001). Moreover, to examine consumers motives more research should focus on a combination of revealed and stated preferences to give valuable suggestion for policy makers. Lastly, it could also be interesting to look further into the effects of domestically grown fresh produced. For a demand system analysis this could be a combination of fruits and vegetable.

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Appendix 1: Hicksian Elasticity

Table 5. Hicksian Fruit Elasticities.

Source: Own calculation based on ICA Data.

Hicksian	1% change of price									
		Conventional					Organic			
…% change quantity		**Apples**	**Berries**	**Citrus**	**Exotic**	**Grapes**	**Apples**	**Berries**	**Citrus**	**Exotic**	**Grapes**
Conventional	**Apples**	**-0.45*****| 0.12**	-0.07*	0.01	0.02	0.19***	0.08	0.1	0.08	-0.07
	Berries	0.16**	**-1.40*****	0.69***	0.03	0.23***	0.07	0.04	0.23**	-0.02	-0.03
	Citrus	-0.07*	0.46***	**-0.82*****	0.08**	0.22***	-0.20***	0.14*	-0.33***	0.32***	0.21***
	Exotic	0.01	0.02	0.09**	**-0.59*****	0.14***	0.17***	-0.04	0.08*	-0.05	0.16***
	Grapes	0.03	0.21***	0.30***	0.16***	**-1.30*****	-0.08	0.37***	0.02	0.19*	0.1
Organic	**Apples**	0.36***	0.09	-0.42***	0.30***	-0.13	**-0.75*****	-0.53**	0.71***	-0.12	0.48***
	Berries	0.59	0.19	1.13*	-0.27	2.18***	-2.05**	**-1.82**	-0.44	0.99	-0.52
	Citrus	0.18**	0.32***	-0.69***	0.13*	0.03	0.70***	-0.11	**-1.81*****	0.21	1.03***
	Exotic	0.29	-0.04	1.29***	-0.15	0.55*	-0.23	0.49	0.4	**-2.25*****	-0.34
	Grapes	-0.19	-0.05	0.62***	0.40***	0.21	0.68***	-0.19	1.48***	-0.25	**-2.70*****
Significance: ***1%LEVEL, **5% LEVEL, *10% LEVEL											

Appendix 2: Sensitivity Analysis

Independent two-tailed t-test of means:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_1^2}{n_1}}}$$

Degree of Freedom for two-sided mean test: v = (n1-1)+(n2-1)

I) Grouping:

n=243 for all observations; v=484 degree of freedom,

$t_{0.99;484} = 2.5865$; $t_{0.999;484} = 3.3113$

$t < t_{0.99;484}$; $t < t_{0.999;484}$

Table 6. Results t-test for Grouping *Source: Own calculation based on ICA data.*

	Group		Conv		Org		t-test	
	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error	Group & Conv.	Group & Org.
INC1	0.638686	0.033972	0.443663	0.031323	0.76502	0.142579	46.23325	-9.44202
INC2	1.54353	0.060945	1.10925	0.074648	3.77198	0.549851	49.36643	-44.1263
INC3	0.68014	0.034051	0.416556	0.056305	1.62022	0.147172	43.88131	-68.1721
INC4	1.08265	0.033885	0.758259	0.043971	2.06231	0.295225	64.01302	-36.1136
INC5	1.30279	0.049549	1.01658	0.067571	2.23309	0.264804	37.41775	-37.8283
ME11	-0.53607	0.050359	-0.52463	0.047888	-0.81386	0.256874	-1.80349	11.62492
ME12	0.083848	0.039616	0.067714	0.041568	-0.54275	0.212035	3.07788	31.82164
ME13	-0.1711	0.034969	-0.14746	0.037657	0.647952	0.149717	-5.03922	-58.3576
ME14	-0.10201	0.025677	-0.05486	0.027541	-0.15453	0.186079	-13.718	3.062591
ME15	0.086652	0.042672	-0.0313	0.045983	0.435924	0.181576	20.59757	-20.5127
ME21	-0.08532	0.055974	-0.01204	0.05813	-2.35554	0.823274	-9.94747	30.13793
ME22	-1.3981	0.078956	-1.53082	0.108655	-1.89634	1.42366	10.82453	3.82786
ME23	-0.06188	0.055462	0.498699	0.077216	-0.75195	0.645667	-64.5925	11.66479
ME24	-0.07209	0.040334	-0.13176	0.05551	0.831408	0.854336	9.5254	-11.572
ME25	0.073857	0.05905	0.094178	0.085578	-0.73853	0.799141	-2.14098	11.10569
ME31	-0.16829	0.032399	-0.13229	0.035425	0.571077	0.149067	-8.21381	-53.0941
ME32	0.097201	0.036206	0.413781	0.051523	-0.14607	0.165218	-55.0713	15.75546
ME33	-0.55505	0.042906	-0.89541	0.070035	-1.9471	0.174944	45.39417	84.65672
ME34	-0.10638	0.024099	0.016349	0.036151	0.139124	0.153092	-30.943	-17.353
ME35	0.05238	0.037139	0.164179	0.053076	0.936031	0.159557	-18.9057	-59.0879

ME41	-0.21306	0.029065	-0.1109	0.03068	-0.40183	0.357285	-26.4813	5.76865
ME42	0.015978	0.031952	-0.06566	0.043793	0.444965	0.421884	16.49625	-11.1071
ME43	-0.22451	0.029569	-0.03892	0.042611	0.231607	0.295558	-39.1985	-16.8215
ME44	-0.7043	0.030959	-0.69351	0.041707	-2.34072	0.504813	-2.27624	35.44377
ME45	0.043238	0.033436	0.044381	0.045603	-0.46026	0.35519	-0.22142	15.45999
ME51	-0.03892	0.055018	-0.13072	0.059123	0.498574	0.257251	12.45203	-22.3818
ME52	0.105637	0.053921	0.097295	0.078862	-0.23756	0.291491	0.956542	12.68233
ME53	-0.07839	0.051902	0.122596	0.073376	-0.34983	0.262145	-24.4964	11.12692
ME54	0.004822	0.038254	0.013897	0.053211	-0.34983	0.262145	-1.51687	14.66473
ME55	-1.29594	0.079259	-1.42211	0.11848	-2.83053	0.377826	9.695947	43.54513
1=Apple, 2=Berries, 3=Citrus, 4=Exotic, 5=Grapes; Conv.: Conventional; Org.: Organic								

II) Splitting:

n=121 for 1st and 2nd half; n=243 for both

a) Test for 1st half and 2nd half, 240 degree of freedom could not be rejected on 1% level
b) Test for 1st half and group, 362 degree of freedom could not be rejected on 1% level
c) Test for 2nd half and group, 362 degree of freedom could not be rejected on 1% level

Table 7. Results t-test for splitted dataset. *Source: Own calculation based on ICA data.*

quantity \ price		Apples		Berries		Citrus		Exotic		Grapes		
		Conv.	**Org,**	**Conv.**	**Org.**	**Conv.**	**Org.**	**Conv.**	**Org.**	**Conv.**	**Org.**	**Inc.**
Apple	**Conv.**	c)					c)	b)	b)	a)	c)	b)
	Org.											
Berries	**Conv.**				c)		a).			a), b)		
	Org.					c)				b)		
Citrus	**Conv.**			a)				b)				
	Org.								a)			
Exotic	**Conv.**					b)		b)		b)		b)
	Org.	b)				b)	a).					
Grape	**Conv.**		c)	a), b)	b)			b)	b)		c)	
	Org.							b)		c)		

Conv.: Conventional; Org.: Organic; Inc.: Income

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