Institut für Lebensmittel- und Ressourcenökonomik

Demand for organic food in Switzerland

Dissertation

zur Erlangung des Grades

Doktorin der Agrarwissenschaften (Dr. agr.)

der Landwirtschaftlichen Fakultät
der Rheinischen Friedrich-Wilhelms-Universität Bonn

von

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aus

Belzig

Bonn 2019

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Tag der mündlichen Prüfung: 21.06.2019

Angefertigt mit Genehmigung der Landwirtschaftlichen Fakultät der Universität Bonn

Danksagung

Allen, die zum Gelingen dieser Arbeit beigetragen haben, möchte ich von Herzen Danke sagen. Ein grosser Dank gilt meinem Doktorvater Prof. Dr. Thomas Heckelei für die stets hilfreiche und motivierende Betreuung meiner Dissertation sowie die vielen Gespräche und Diskussionen. Unter anderem bot er mir die Möglichkeit, die Forschungstätigkeit während zwei Monaten an seinem Lehrstuhl in Bonn durchzuführen, was zum Gelingen der Arbeit entscheidend beigetragen hat.

Dr. Dr. habil. Stefan Mann danke ich für die immerwährende Unterstützung während meiner Zeit in Tänikon und danach. Neben der wertvollen inhaltlichen Unterstützung ermöglichte er mir die Teilnahme an internationalen Konferenzen und am Promotionskolleg Agrarökonomik. Einen herzlichen Dank möchte ich ihm auch für die Übernahme des Korreferats aussprechen.

Dr. Ali Ferjani und Dr. Andreas Kohler danke ich für die Betreuung meiner Arbeit bei Agroscope. In vielen hilfreichen Gesprächen und Diskussionen haben sie ihr Wissen geteilt, mir neue Wege aufgezeigt und so entscheidend weitergeholfen.

Ein Dank gilt auch den anonymen Reviewern für die Kommentare zu den Kapiteln II und III.

Meinen Kolleginnen und Kollegen aus der Forschungsgruppe Sozioökonomie bei Agroscope danke ich für das stets freundliche und produktive Arbeitsklima und die schöne gemeinsame Zeit in Tänikon. Danke auch an die „Täniker Jugend“ Anja, Elisabeth, Aska, Tim, Maria, Alena, Daniela, Sabrina, Berlenga und Judith für unvergesslich schöne Zeiten während und abseits der Arbeit.

Diese Dissertationsschrift widme ich meiner Familie. Die immerwährende Unterstützung und das Vertrauen, das sie mir in Bezug auf meine Entscheidungen entgegengebracht haben, sowie ihr Rückhalt und Verständnis waren während der Zeit der Promotion für mich besonders wichtig und eine grosse Unterstützung. Dafür kann ich ihnen nicht genug danken. Ein grosser Dank gilt auch meinem Partner Marco, der mich beim Abschluss meiner Promotion unterstützt und die Kapitel dieser Dissertation Korrektur gelesen hat.

Kurzfassung

Das Ziel dieser Dissertation ist es, das Verständnis für den Schweizer Markt für Bio-Lebensmittel zu verbessern. Über die letzten drei Jahrzehnte hat sich der Bio-Markt in der Schweiz sehr positiv entwickelt und wächst weiterhin kontinuierlich. Die Treiber und Hemmnisse in Bezug auf den Konsum zu kennen, ist sowohl für diejenigen, die Bio-Lebensmittel produzieren und vermarkten, als auch für agrarpolitische Entscheidungsträger erfolgsentscheidend.

Diese Dissertation betrachtet den Markt für Bio-Lebensmittel für den Zeitraum 2006 bis 2011 aus unterschiedlichen Blickwinkeln und zeigt Faktoren auf, die die Kaufentscheidung beeinflussen. Im zweiten Kapitel werden Produktcharakteristika, die für die Bio-Konsumentinnen und -Konsumenten von Bedeutung sind, identifiziert. Demnach haben unverarbeitete Produkte, die in der Schweiz produziert wurden, einen Vorteil auf dem Markt. Weiterhin kann aufgezeigt werden, dass der Preis ein wichtiges Entscheidungskriterium ist, da die Konsumentinnen und Konsumenten Bio-Lebensmittel eher mit der konventionell produzierten Alternative vergleichen als mit anderen Bio-Produkten.

Im dritten Kapitel wird der Zusammenhang zwischen der Kultur und dem Bio-Konsum untersucht. Bisher wurde dieser Zusammenhang untersucht, indem verschiedene Sprachgruppen aus unterschiedlichen Ländern miteinander verglichen wurden. Im Rahmen dieser Arbeit kann der Einfluss der Kultur durch den Vergleich verschiedener Sprachgruppen in ein und demselben Land präziser abgeschätzt werden als in bisherigen Studien, weil die institutionellen Rahmenbedingungen sehr ähnlich sind. Einige der soziodemografischen Einflussfaktoren, die bereits in früheren Studien untersucht wurden, können in der Analyse bestätigt werden. Den

stärksten Einfluss hat jedoch die Kultur. Demnach existiert auch beim Bio-Konsum ein *Röstigraben* zwischen der Deutsch- und der französischsprachigen Schweiz.

Das letzte Kapitel dieser Dissertation untersucht den Einfluss von Einkommen und Preisen auf den Bio-Konsum. Dabei werden verschiedene Ansätze für die Schätzung von Nachfrageelastizitäten miteinander verglichen. Da Nachfragelastizitäten ein wichtiger Bestandteil von Gleichgewichtsmodellen sind und für die quantitative Abschätzung der Auswirkungen agrarpolitischer Massnahmen damit von grosser Bedeutung, sollte die Methode zur Schätzung der Elastizitäten mit Bedacht gewählt werden. Um den Einfluss der Methodenwahl auf das Ergebnis der Elastizitätenschätzung abzuschätzen, werden fünf Versionen des Almost Ideal Demand Systems (AIDS) verglichen. Die Studie deckt dabei eine Schwachstelle des weit verbreiteten zweistufigen Schätzverfahrens des quadratischen AIDS-Modells (QUAIDS) und der Methode von Shonkwiler und Yen (1999) auf: Die Nichteinhaltung der Homogenität der Elastizitäten. Dieses zweistufige Schätzverfahren erfüllt demnach nicht die eigentlich auferlegten Bedingungen der Nachfragetheorie. Die Nichteinhaltung der Homogenität wird im Rahmen dieser Arbeit durch die Neuformulierung des QUAIDS-Modells angegangen. Das neuformulierte Modell erfüllt die Bedingungen der Nachfragetheorie nicht vollständig, ist jedoch die bisher bestmögliche Lösung, wenn das QUAIDS-Modell mit der Methode von Shonkwiler und Yen (1999) kombiniert wird.

Schlüsselwörter: *Konsumentenverhalten, Nachfrageanalyse, Bio-Lebensmittel, Schweiz*

Abstract

The aim of this dissertation is to better understand the functioning of the organic food market in Switzerland. Over the last three decades the market for organic food in Switzerland has developed positively and continues to grow steadily. Understanding what drives and hinders consumption is crucial for those producing and marketing organic food as well as for agricultural policy makers.

This dissertation sheds light on the demand for organic food for the years 2006 to 2011 from different perspectives and identifies factors affecting purchase decisions. In the second chapter, product characteristics that are of importance to organic food consumers are identified. Accordingly, unprocessed products that have been produced in Switzerland have an advantage on the market. It is also shown that the price is an important criterion since consumers compare organic food with their conventional counterpart rather than with other organic alternatives.

The third chapter investigates the connection between culture and organic food consumption. This relationship was thus far addressed by comparing linguistic groups from different countries with one another. By comparing language groups of the same country within the framework of this dissertation, the influence of culture can be assessed more accurately than has been done in previous studies as large institutional differences do not apply. Some of the socio-demographic influencing factors that have already been identified in the past can be confirmed. The influence of culture is, however, the largest. Hence, a *Röstigraben* between German- and French-speaking Switzerland regarding organic food exists.

The final chapter of this dissertation explores the effect of income and prices on organic food consumption. Thereby, different approaches for the estimation of demand elasticities are compared. As demand elasticities are an important part of computable equilibrium models used to predict the impact of agricultural policies, the methodology for the elasticity estimation must be chosen with care. To investigate the influence of the methodological approach on the outcome of the elasticity estimation, five versions of the Almost Ideal Demand System (AIDS) are compared. The study reveals a shortcoming of the widely-used consistent two-step estimation of the quadratic AIDS (QUAIDS) model and the approach of Shonkwiler and Yen (1999): the non-fulfilment of the homogeneity of the elasticities. Hence, the two-step estimation procedure does not comply with the initially imposed conditions of demand theory. The non-fulfilment is addressed by reformulating the QUAIDS model. This refined model does not fully comply with the conditions of demand theory but is the so far best possible solution when the approach of Shonkwiler and Yen (1999) and the QUAIDS model are combined.

Keywords: *consumer behaviour, demand analysis, organic food, Switzerland*

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Abbreviations

AIDS	Almost Ideal Demand System
cdf	Cumulative Distribution Function
Fr.	Swiss Francs
FSO	Swiss Federal Statistical Office
HBS	Household Budget Survey
HW	Heien and Wessels
LA/AIDS	Linear Approximated Almost Ideal Demand System
pdf	Probability Density Function
QUAIDS	Quadratic Almost Ideal Demand System
SY	Shonkwiler and Yen

Chapter I
Thesis Overview[1]

1.1 Motivation and general research question

The organic food market in Switzerland has been a success story for more than three decades. Since the Association of Swiss organic farming organisations – called *Bio Suisse*[2] – was founded in 1981, a steady increase of organic farming has taken place. Alongside the growing interest for healthy eating and sustainable consumption, the formal legal recognition of organic agriculture and the governmental provision of subsidies for farm conversion from conventional to organic production support the development, growth and success of the organic food market in Switzerland.

The demand side of the organic food market developed positively alongside production with increasing sales during each year of the last two decades (Bio Suisse, 2003, 2010 and 2016). Even though, organic food products could only reach small market shares – the share was at 6% in 2011 – Switzerland ranked high in an international comparison with average expenditure on organic food of 221 Swiss Francs (Fr.) per capita[3] (Bio Suisse, 2012; Kilcher et al., 2011). Over time, the market for organic food has grown from a small niche market to an important part of the food industry with considerable growth rates regarding production and sales.

The two retailers Coop and Migros are the largest players and early supporters of

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[1] Part of the research for this thesis was conducted during a two-month research stay at the Chair of Economic and Agricultural Policy at the University of Bonn, Germany.
[2] https://www.bio-suisse.ch/
[3] not adjusted for purchasing power

organic food products in Switzerland. The availability of organic products has increased since they first offered organic food products in 1993 (Coop) and 1995 (Migros), respectively. Not only are organic products comprehensively available in Switzerland nowadays but the product range structure has also expanded. Today, a wide range of products is accessible in various types of shopping locations across the country. Furthermore, most product types are available in organic and conventional quality – in nearly all distribution channels and degrees of processing (Schröck, 2013a), even in rural areas. Consumers can easily compare conventional products with their organic counterpart because they are often available in the same store, sometimes even placed next to each other.

Even though the organic food market has become an important part of the food industry, scientific evidence on the motives to consume is yet missing for the Swiss case. Only a few studies have so far analysed the reasons behind organic food consumption for the Swiss case (e.g. Schletti, 2001; Stolz et al., 2011; Mann et al., 2012).

Switzerland is a country worth investigating because it is surrounded by the European Union and still protecting part of the market for organic as well as conventional food and agricultural products. During several months of the year, the Swiss market and thus organic production is protected from imports—specifically for those products that can be produced by Swiss farmers leading to high self-sufficiency rates.[4] These import regulations may be justified if there is a strong support of Swiss organic products by consumers. The Swiss case is also particular as incomes are relatively high in comparison to other industrialised countries in Europe and Northern America. Most studies confirm that organic food consumption is higher the higher the financial capabilities of the household are (e.g. Wier et al., 2008; Schröck, 2013b). However, as Askegaard and Madsen (1998) show, the differences in food consumption in Switzerland cannot solely be attributed to income differences because a food cultural border runs through Switzerland (the *Röstigraben*) and income varies only little in the different linguistic regions whereas

[4] See https://www.bio-suisse.ch/de/import2.php#3 for details. (in German)

food cultures are quite different.

Up-to-date information and knowledge about the motives to consume organic food are not only useful for those working in the food industry who aim to sell products according to the needs of consumers. Understanding consumers and their motives to purchase is also an important prerequisite to make well-founded recommendations to political decision-makers and to shape Swiss agricultural policies successfully. Agricultural policies are in turn able to affect both the economy and the environment. Hence, knowledge about the consumer side of the organic food market is essential to shape the future of the organic and conventional food market.

The increasing demand for organic food in the last three decades has resulted in a wide and still continuously growing range of products. Because organic food products are readily available nowadays, the consumer group that bought organic food in the first place has assumingly changed as the market evolved. While the growing concerns about the environmental pollution and destruction were a main driver for 'turning green' in the late 1980ies (Mellor, 1989:17), the consumption motives are likely more diverse today and so may be the range of organic food consumers. However, the scientific literature on organic food in Switzerland has somewhat neglected the demand side in the past years. Therefore, this dissertation sets out to understand consumer behaviour regarding organic food better by quantitatively expressing what drives organic food demand in Switzerland. By identifying not only the product characteristics of organic products that matter to consumers but also the average consumer profile as well as the influence of the product price, this dissertation sheds light on the organic food market more extensively than has been done in the past.

To understand the demand for organic food in Switzerland, the thesis is divided into three chapters (II, III, and IV). The following section gives an overview of the three analyses that have been carried out and highlights their contributions to the existing literature. The final section of this chapter summarises the results and concludes this dissertation by showing the limitations and giving an outlook on future research opportunities.

1.2 Contribution of the thesis

The following sub sections give an overview on the results of the three studies and show how the chapters add to the existing body of literature.

1.2.1 *Explaining market shares of organic food: evidence from Swiss household data*[5]

Even though the organic food market has strongly evolved over the past decades and has attracted the attention of scientific scholars, hardly any studies can be found that focus on the influencing factors of the organic market share. Those studies that make organic market shares the focus of discussion do so either for organic food without referring to individual products (Baker et al., 2002; Raynolds, 2004; Sahota, 2010) or in a descriptive and non-systematic way if individual products are addressed (Michelsen et al., 1999; von Borell and Sørensen, 2004; Oberholtzer et al., 2005 and 2006; Kilcher et al., 2011).

If the market for and demand of organic food is to be understood fully, the analysis of market shares of individual organic products is a useful additional research activity. Previous studies on organic food used, for example, experiments, questionnaire surveys or scanner data to learn about the decision-making process. Based on these findings, insight into the motives to consume and partly into consumers' shopping behaviour can be gained. It should, however, be borne in mind that the analysis of real and complete purchasing data is helpful especially in a fast-changing market as that for organic food because the intention-behaviour gap (Padel and Foster, 2005; Carrington et al., 2010) can be avoided. The analysis of household

[5] This chapter is published as Götze F., S. Mann, A. Ferjani, A. Kohler and T. Heckelei (2016). Explaining market shares of organic food: evidence from Swiss household data. *British Food Journal* **118**(4): 931-945.
A preliminary version of this chapter is published as Götze F., S. Mann, A. Ferjani, A. Kohler and T. Heckelei (2016). An approach towards explaining market shares of organic food – Evidence from Swiss household data. Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e. V., Band 51:269-280.
A short communication of this chapter is published as Götze F., S. Mann, A. Ferjani, A. Kohler and T. Heckelei (2015). An approach towards explaining market shares of organic food – Evidence from Swiss household data. *Acta Fytotechnica et Zootechnica* (Scientific Journal for phytotechnics and zootechnics) **18**(Special Issue):78-80.

data (the result of real shopping situations) represents a complementary way to understand consumer behaviour better. Instead of statements or purchases for individual retail chains (scanner data), chapter II analyses household data and provides new insights into how consumers behave instead of how they want to behave.

The set of household data that has been used for all three studies comprises more than 19 000 observations and was kindly provided by the Swiss Federal Statistical Office (FSO) (HBS, 2013). The data give a detailed insight into how Swiss households have consumed during the period of one month. The market shares – which were calculated by aggregating the purchases of all households of one month – were analysed at the product level. The analyses of the product characteristics have not been performed frequently, neither for Switzerland nor for other countries. The aim was, therefore, to find out which product characteristics are important for the organic food consumption decision.

Chapter II adds to the current body of literature by identifying three important dimensions that explain the level of the organic market share in Switzerland. Accordingly, organic products that have undergone little or no processing have an advantage on the market. The same applies to organic products that have a small price premium compared to the conventional alternative. Furthermore, consumers prefer Swiss organic products over imported ones. The results are both useful for the food industry that wants to produce food according to the needs of consumers as well as for future scientific studies. The identified dimensions give a first insight into the decision-making process of organic food consumers for the Swiss case. The results are promising for Swiss farmers and the Swiss food industry as domestically produced as well as low- and unprocessed products are more popular than imported and higher processed ones as the on average lower market shares of imported and higher processed organic products show.

The study, however, also concludes that Swiss agriculture and the food industry need to be cautious to meet the price expectations of consumers. Consumers consider the price as well as the premium for organic quality. Hence, the additional price premium paid for organic quality might be an obstacle for certain consumers to buy. The price premium becomes specifically relevant in those cases when the household spends a considerable share of its food budget on a product, e.g. staple foods.

As with most studies, the analysis of organic market shares presented in chapter II has its limitations. Even though the data that was used for the analysis comprises more than 19 000 households all over Switzerland with detailed information on characteristics and purchases of the household, there are some caveats. The Household Budget Survey (HBS, 2013) sample does not include information on prices (which also concerns chapter IV). The HBS documented expenditure and partly purchased quantities. To solve the issue of missing price information, quantity-weighted average unit values that were corrected for inflation serve as price information in the analysis. The analysis shows that some product groups are more heterogeneous than others, hence the price range differs more for some products and less for others.

The product characteristics are not part of the survey but are assigned to the product groups. The HBS (2013) sample does not provide information regarding the product origin, for example. The level of detail of the data (what type of products are contained in each product group) as well as the product characteristics was one of the empirical challenges of this study. The products were divided into domestic and imported ones by referring to the self-sufficiency rate (additional data was used). For future research, it would be helpful if the HBS documented the product origin in addition.

The study sheds light on a complex decision-making process in everyday life. The explanatory value of the model is satisfactory with an R^2 of 40.5%. The complexity of the decision-making process can, however, also be affirmed. As other decisive factors are obviously not included in the analysis, chapter III sheds light on the organic food demand from a different perspective.

1.2.2 *Culture and organic consumption – evidence from the Röstigraben*[6]

Chapter III focusses on consumers of organic food in Switzerland and their profile. Whereas studying household characteristics and income has been a popular research approach in other countries in the last decades, the influence of the cultural background of consumers on organic food consumption has been studied less. If culture and food consumption have been the subject of analysis, the focus was often on the comparison between countries (Askegaard and Madsen, 1998; Guerrero et al., 2009), or on different ethnicities living in the same region (e.g. the US study of Batte et al., 2007). Even though Switzerland – with its four official languages[7] – provides an almost exceptional opportunity to study the influence of cultural differences on the consumption and choice of organic and conventional food, up-to-date results on the influence of culture on organic food consumption were yet missing. The last study that investigated this was by Schletti (2001). It is likely that the organic market has since changed, and a broader (or at least different) range of consumers is buying organic products today since the data of Schletti (2001) were collected in 1998.

As all official languages can be assigned to specific regions in Switzerland, the term *Röstigraben* refers not only to the different popularity of the potato-based dish *Rösti* which is traditionally eaten more often in the German-speaking part than in French-speaking Romandy. The term more generally refers to the 'imaginary cultural border between German and French speaking Switzerland' (Baccini, 2003:302) and the differences among these language groups, not only with respect to the food culture but also with respect to other aspects such as political views. Hence, because language is a strong identifier for belonging to a group, the difference in language here implies a cultural difference (Clots-Figueiras and Masella, 2009). This chapter contributes to the literature by giving a better understanding of not only the socio-demographic profile of organic food consumers but also of the influence of the

[6] A preliminary version of this chapter was presented at the 6th EAAE PhD Workshop in Rome (Italy) as Götze, F., A. Ferjani, S. Mann and A. Kohler (2015). Who buys organic food in Switzerland.
A preliminary version of this chapter is published as Götze F. and A. Ferjani (2014). Wer in der Schweiz Bio-Lebensmittel kauft (Qui achète des aliments bio en Suisse?). *Agrarforschung Schweiz (Recherche Agronomique Suisse)* **5**(9):338-343 (in German and French).
[7] German, French, Italian and Romansh

cultural background in Switzerland.

The existence of the *Röstigraben* in Switzerland has been examined for certain aspects already (Lauer and Weber, 2003; Freitag, 2004; Fernández, 2007; Brügger et al., 2009 and 2011; Steinhauer, 2013). Askegaard and Madsen (1998) pointed out that an important cultural border runs through Switzerland, dividing the country into a Germanic and a francophone food culture. For organic food this has, however, not yet been confirmed and was therefore the aim of this study. The analysis of culture on organic food consumption is also interesting for the Swiss case because institutional differences are much smaller when language groups of the same country are compared. By contrast, when language groups of different countries are compared, the isolated effect of culture on organic food consumption is more difficult to identify because institutional differences cannot or only in part be isolated from cultural differences. In this sense, the Swiss case offers an opportunity to analyse the effect of culture on organic food consumption separately from the institutional environment (Steinhauer, 2013). The study examines the influence of cultural differences regarding organic food consumption not only for the linguistic divide but also at lower regional scale. Because some cantons of Switzerland cover two linguistic regions, i.e. are bilingual, this study can exploit cultural differences within linguistically divided cantons for analysis and, hence, rule out more potentially confounding factors than cross-canton and cross-country studies can do.

While – in the past – cultural differences for food in general could be shown for the Swiss case (Askegaard and Madsen, 1998) it is so far unclear how culture influences the preference for organic food. Askegaard and Madsen (1998) showed that German-speaking Swiss (like Germans and Austrians) follow an 'ascetic (…) food culture accompanied by guilt feelings over indulgence' (p. 559) while French-speaking Swiss (like Wallonian Belgians and the French) prioritise sensory enjoyment when eating. Hence, different factors are important for the choice of food in different cultural regions. Based on this, it might be hypothesized that organic food consumption is higher in German-speaking Switzerland because consumers try to avoid feelings of guilt when they buy organic animal products with a higher ethical standard. Harper and Makatouni (2002) and Zepeda and Deal (2009) showed that ethical concerns influence organic food demand which would suggest a higher demand in German-speaking Switzerland. However, it might as well be hypothesized that the French-speaking Swiss consume more organic food because of the assumed better taste of it that Padel and Foster (2005) and Rembiałkowska et al. (2007) found as one decision criterion for organic food.

Thus far, the marketing campaigns of the two large Swiss retailers Migros and Coop (who together account for the vast majority of organic sales) are not specifically designed for each linguistic region (instead they are only translated). Whether organic consumption is equally high in all linguistic regions should also be of interest to those concerned with organic food marketing. It can be questioned whether the marketing campaigns meet the needs of all consumers in Switzerland.

To identify whether the linguistic (cultural) regions of Switzerland differ in their preferences for organic food was, therefore, the goal of chapter III. Schletti (2001) already showed for 1998 that the linguistic regions consumed differently regarding organic food.

Furthermore, it was so far unclear whether there are differences in the preference for organic food between rural and more urban areas of Switzerland. Because the HBS (2013) data only provide information on the linguistic region and canton that the households are living in, additional data (FSO, 2014b) was used to allow for a comparison between rather rural and more urban regions.

Regarding the characteristics of the household, income is identified as a determinant of consumer behaviour in many scientific studies. The higher price of organic relative to conventional food suggests that income affects organic food consumption. However, Swiss households only spend a small share of their income on food, and consumption cannot solely be related to income. For example, Italian-speaking Swiss spend on average more on food but less on sheep and goat meat than their German- and French-speaking neighbours as shown by Aepli and Finger (2013). Hence, other factors than income must also have an influence on which (organic) food products are consumed. For other countries, the socio-demographic profile was identified as important already (Davies et al., 1995; Thompson and Kidwell, 1998;

Magnusson et al., 2001; Cicia et al., 2002; Hill and Lynchehaun, 2002; Valli and Traill, 2005; Zepeda and Li, 2007; Dettmann, 2008; Jonas and Roosen, 2008; MRS, 2008; Thiele, 2008; Wier et al., 2008; Briz and Ward, 2009; Riefer and Hamm; 2009; Zepeda and Nie, 2012; Schröck; 2013a and 2013b). Because scientific evidence is missing regarding the profile of organic food consumers in Switzerland, gaining knowledge on this issue was, therefore, another goal of this study.

The data set used for chapter III is slightly adapted in comparison to the sample used in chapter II. Households that did not purchase any food products or drinks are eliminated from the data because they are considered to show unrealistic food consumption behaviour during the observation period. In contrast to chapter II where purchases of all households of one month are aggregated, this matters since the analysis is carried out at the household level. In the HBS (2013) sample, household characteristics are documented in a more detailed manner than the product characteristics. Hence, in contrast to chapter II most variables can be taken directly from the sample.

Past studies have often used questionnaires or interviews to reveal the reasons behind consumption. These are appropriate when the aim of the study is to identify attitudes, intentions and purchasing motives regarding organic food consumption. Because intentions and what people finally put into their shopping basket can sometimes contradict (Carrington et al., 2010), the analysis of actual household purchase data is a particularly interesting complementary research opportunity.

A methodology to uncover the importance of the socio-demographic profile and culture of the household on consumption decisions is the Heckman two-step estimation (Heckman, 1979). This approach corrects biases that may arise when analysing nonrandomly selected samples. In the context of this study such biases may arise if the effects of the socio-demographic characteristics on organic food consumption are only analysed for the subsample of households which consume organic food without considering that this subsample may be an unrepresentative selection of the overall survey sample.

The approach assumes that real consumption decisions are made in two steps. First, the household decides whether it will participate in the market – in our case consume organic food or not. If this decision is positive and the household decides to consume, it will, second, think about the allocation of the budget for each product. Therefore, as a first step, households are divided into consumers and non-consumers of organic food (probit regression), and the probability of consuming organic food is estimated. Thereby, the determinants of being an organic food consumer are identified. Subsequently, only those households that had consumed organic food during the observation period are analysed with respect to their socio-demographic profile. More precisely, the factors that influence the level of the organic expenditure share are determined. This means that the number of households is smaller in the second estimation step and only comprises those households that belong to the consuming group.

Chapter III contributes to the literature by not only giving insights into the profile of the average organic food consumer in Switzerland. The chapter shows in detail which factors are important for the decision to consume organic food or not. Furthermore, factors are identified that influence the level of consumption, hence, how much consumers spend on organic in comparison to conventional food. These results are of particular interest for those producing and consuming organic food as well as for agricultural policy makers that are interested in supporting organic farming in Switzerland.

The results of chapter III confirm the cultural segregation (*Röstigraben*) between the German- and the French-speaking part of Switzerland and show that different linguistic regions consume differently. Accordingly, German-speaking households are more likely to belong to the organic food consumer group than their French-speaking neighbours. The analysis of the bilingual canton of Bern also confirms that cultural differences explain why consumers participate in the organic food market or not. The analysis of culture on organic food consumption in a region with such a similar institutional environment is, to the best of our knowledge, the first of its kind.

The results also show how large the influence of culture is on the organic consumption decision compared to other factors. The analysis reveals that the cultural background has a greater impact on organic consumption than any of the socio-demographic variables that were considered. This contrasts with, for example, Schröck (2013a) who found that income followed by the education level has the by far greatest influence on the probability to consume organic food. The German case is, however, different from the Swiss case because Germany is not divided into linguistic regions like Switzerland. However, the cultural background might still have an influence on organic food consumption in Germany.

No verifiable differences regarding the probability of being an organic food consumer are detected between the French- and the Italian-speaking part. Apparently, the differences in organic food consumption are not as clear as those between German- and French-speaking Switzerland. It should be borne in mind that the data were collected between 2006 and 2011. As the organic food market is dynamic and has constantly evolved in the last decades, an estimation with more recent data might be worthwhile and may provide insights into how demand has changed since then. The availability of organic food has, for example, improved in the last few years. Hence, an easier accessibility in all linguistic regions of Switzerland may have resulted in higher participation rates and expenditure shares.

This chapter further adds new findings by comparing the rural food culture to the urban one with respect to organic products. The analysis proves this difference in organic food consumption for the German- as well as the French-speaking part. Accordingly, in both linguistic regions urban households are more inclined to be organic food consumers than households in more rural areas. Furthermore, for the German-speaking part higher levels of organic spending (in relative terms) can be found for urban households whereas no verifiable differences are detected for the French-speaking part. Hence, it can be assumed that consumption differences between rural and urban regions cannot be generalised.

As in chapter II, some limitations can be attributed to the data and the data quality. This is in part due to the way the data have been collected. Certain characteristics of the households refer to the reference person in the household. This is the person that contributes the most to the household income. This person is, however, not necessarily the person making the decisions regarding what foods the household consumes. Hence, certain information that refer to what is in principle the main earner of the household cannot be used. Overall the data do not reveal who the decision maker of the household is. This issue is addressed by creating new variables such as a dummy for a single female adult in the household. For future analyses, more information on the household members (apart from the main earner, i.e. the reference person), especially those responsible for the food shopping, is certainly interesting.

While this study reveals the determinants that drive actual consumption behaviour, it is mute on the underlying motives and intentions linked to the consumption of organic food. The coefficient of determination hints that the considered variables can only in part explain organic food consumption. Therefore, other factors such as trust in organic production, the importance of animal welfare, environmental awareness and health consciousness may also be investigated and could contribute to the understanding of organic food demand. For future research, qualitative research could be conducted in addition to the data collection of the Swiss Federal Statistical Office. Semi-structured interviews are only one approach to gain more insights into consumers' motives in general and consumption motives regarding organic food in particular. As certain results were less expected than others, more insights into the reasons, e.g. why families with more children spend less of their budget on organic food or why households living only of social benefits and daily allowances are more probable to be organic food consumers, may increase the understanding of the demand side of the organic food market.

The organic food consumption decision might also follow different patterns depending on the product (Schröck, 2013a). However, an answer to this question is beyond the scope of chapter III and left for future research.

The high level of zero observations for the organic product categories in the data impedes the analysis on a less aggregated product level. For all products, the share of zero consumption is at 31.1% for organic products (across all linguistic regions). The share of zero observations increases, however, when individual product groups are investigated, and censoring is even higher for individual products. The following chapter IV analyses the issue of zero consumption (censoring) in more detail. With partly very low levels of observed consumption, however, credible results are hard to envision. Future research might focus on individual products that are often bought by consumers. Also, future research on differentiated products might become more feasible as the market is still growing.

As the price difference between organic and non-organic food is assumed to be an important decision criterion as shown in chapter II, this issue is addressed in the final chapter of this thesis. Chapter IV shows that an appropriate methodology is crucial to deal with data such as the HBS (2013) sample.

1.2.3 *Estimation of demand elasticities for organic and conventional food in Switzerland*

The last chapter of this dissertation focusses on the estimation of demand elasticities for organic and conventional food in Switzerland. In the last decades, the estimation of price and income elasticities has been a frequent exercise in analysing the demand for food products. Often these analyses have been carried out for industrialised countries (Abdulai, 2002; Jaquet et al., 2000; Bunte et al., 2007; Bilgic and Yen, 2013; Schröck, 2013a; Aepli, 2014a and 2014b). However, studies for other countries also exist (e.g. Chung et al., 2005; Hoang, 2009; Zheng and Henneberry, 2010; Majumder et al., 2012). For agricultural policy makers, knowledge about consumer behaviour regarding organic and conventional food products serves as a basis to assess the outcome of agricultural policy instruments. For that, demand elasticities are often used in computable equilibrium models helping to predict the outcome of policy instruments more precisely and realistically. For Switzerland, this is especially relevant because the country still protects the market for certain food products. For organic products, this is especially relevant for those products with a high self-sufficiency rate.

While previous studies have shown that consumers behave differently when they buy organic and when they buy conventional food, most computable equilibrium models which require realistic demand elasticities do not yet incorporate distinct elasticities for both organic and conventional products. Then again, to receive realistic elasticity estimates, the choice of the methodology is crucial (Banks et al., 1997) – even more so when the data set is as challenging as the one used within the framework of this study (HBS, 2013). The objective of Chapter IV was, therefore, to compare different estimation models to better understand the influence of the model specification on the estimation results.

In contrast to other countries, up-to-date demand elasticities for organic food were yet missing for the Swiss case. Results from Germany and the U.S., for example, suggest a considerable own-price response (to lower prices) for certain organic products, e.g. milk (Glaser and Thompson, 2000; Jonas and Roosen, 2008). Hence, it can be assumed that the product price is an important decision criterion for consumers. Bunte et al. (2007) confirm this for organic food in general for the Dutch case. Schröck (2013a) further shows for the German market that the expenditure elasticity for organic vegetables is in general higher than for conventional vegetables – hence, when the overall expenditure of a household increases, households tend to increase their organic expenditure more than their conventional. Jonas and Roosen (2008) also find a higher expenditure elasticity for organic milk in Germany. These results suggest that taking a closer look at organic demand for the Swiss case is worthwhile even though the organic market share is still small in comparison to the conventional one. As the market is, however, constantly growing and was at 8.4% in 2016 (Bio Suisse, 2017), it is important to understand what drives demand and what matters to consumers. Chapters II and III already revealed product and socio-demographic characteristics of importance. By analysing the influence of income and prices, chapter IV adds another dimension to better understand the organic food market in Switzerland.

Different specifications of the Almost Ideal Demand System (AIDS) are estimated to explore how sensitive the different model specifications are to the data and to reveal which model version fits the HBS (2013) data best. To the best of our knowledge, no study compared a range of model specifications on the same data set on organic food consumption so far. The estimations follow the development of the

AIDS model over time, from the original (AIDS) to the Linear Approximated (LA/AIDS) to the Quadratic (QUAIDS) model. Each model comparison addresses another methodological issue. In the first model comparison (see Table 4.3 for all specifications), the issue of data aggregation is addressed. Both aggregated and household-level data have their advantages and disadvantages. As shown by Green et al. (2013), the aggregation level can influence the outcome of the estimation. Both models I and II utilise the original AIDS of Deaton and Muellbauer (1980a). Because the share of households that had not consumed all ten product groups during the observation period is substantial and because several studies suggest that zero observations may have an influence on the estimation outcome, those households are removed from the data for this first comparison – creating a much smaller sample (around 4% of the original data set). Due to the substantial share of zero observations, estimations are only carried out on aggregate data, but not at the product level. Instead ten product categories (five organic and five conventional ones) are analysed. In this way, the share of zero observations at the household level is reduced to an acceptable level. In addition, the unit value of each product group (approximated prices) is corrected for inflation. To facilitate the comparison of the models and estimation results, and as the inclusion is not reasonable for model I, no household characteristics (socio-demographics) are included in any of the models.

For the second comparison (models II and III), the quadratic specification (QUAIDS, model III) was compared to the original AIDS model (model II). Both models II and III also use a sample of the HBS (2013) from which zero observations are removed. The third comparison (models III and IV) addresses zero consumption. More precisely, the aim of the third model comparison is to assess the outcome of the estimation when zero observations are highly present in the data and when they are not. Therefore, the same QUAIDS model is estimated for data without (model III) and with (model IV) zero observations. A problem with household studies is that market prices are often not documented. In model IV missing prices are considered using deflated quantity-weighted average unit values as approximations for market prices to solve the problem of missing price information. The aim of the comparison of models III and IV is to assess the impact of zero observations. The final comparison of models IV and V evaluates the approach of Shonkwiler and Yen (1999)[8] (hereinafter referred to as SY) which is applied prior to the elasticity estimation to avoid biased estimation results (selection bias) when zero observations are highly present. Thereby, a refined version of the QUAIDS is proposed and estimated (model V).

While the existing literature has so far not addressed the fact that the homogeneity of the elasticities cannot be fulfilled when the SY approach is applied prior to a (QU)AIDS model, the reformulated QUAIDS solves this issue at least partially. It is proven to be the best possible solution to address this issue. Ideally, no censoring was present in the data and the additional step of applying the SY approach was not necessary. In this case the estimation model complies with the imposed conditions of demand theory. However, zero observations can be expected in most household surveys and accounting for them, thus preventing biased estimation results, seems unavoidable.

The comparison of the five models gives interesting new insights into important methodological issues when estimating demand elasticities. The estimated budget shares, and price and expenditure elasticities vary partly considerably. For example, the organic budget shares of models I, II and III are substantially higher. In those models, only households are included in the sample that had consumed all ten product categories during the observation period whereas models IV and V include also non-consuming households.

Regarding the expenditure elasticities, smaller changes across models compared to the own-price elasticities are found. The validity of the estimated expenditure elasticities is difficult to assess. However, they are at least in the range around one as might be expected and was found in other European studies (e.g. Abdulai, 2002; Thiele, 2008; Schröck, 2013b; Aepli, 2014b). Nevertheless, the organic expenditure elasticities are not in every case higher than the conventional ones. On the contrary, in many cases the conventional elasticities exceed the organic ones. This result contrasts with studies that show that organic expenditure elasticities are usually

[8] Following Aepli (2014a), a multivariate instead of a univariate probit regression is applied.

higher than the conventional ones (Schröck, 2013a and 2013b) and that consumers tend to switch to more expensive food products (luxury goods) if their food expenditures increase (Bunte et al., 2007). Hence, it can be expected that consumers increase their organic food expenditure more than their conventional since organic products are on average more expensive.

The aggregation and disaggregation of the data (model I and II) leads to some obvious changes in the magnitude of the estimates. Comparing the results to, for example, Schröck (2013a), distinctly different estimates are found in model II whereas model I is closer to the results for Germany. The comparison of using aggregated and disaggregated data (ceteris paribus) suggests that the aggregation level of the data can influence the outcome of the estimation. The comparison of the results to other studies is somewhat difficult. However, it is at least unexpected to obtain own-price elasticities of e.g. -30 (for organic fruit in model II) and large differences between model specifications which differ only in the level of data aggregation. Moreover, the variation of the estimates of model II is surprising – not as much between the uncompensated and compensated elasticity estimates but between the individual product groups. This suggests that the AIDS model is less capable of dealing with a heterogeneous data structure compared to smoother data (model I) where households are aggregated into one representative household for each month. The heterogeneity within the product categories could also play a role.

As with all model outcomes in this study, it is difficult to gauge which of the elasticities are closest to the true ones. However, those of model I are closer to what one would expect – especially in view of already existing estimation results for the Swiss case such as those of Abdulai (2002) and Aepli (2014b). Hence, the heterogeneity of household-level data and a considerable share of zero consumption might have an influence or even a distortive effect on the outcome as the two are not present in model I.

The comparison of the original AIDS model of Deaton and Muellbauer (1980a) and the QUAIDS model of Banks et al. (1997) using the same set of disaggregated (household-level) data reveals differences in the estimation results as well. The

QUAIDS as employed in model III allows for more income flexibility represented by a quadratic term in the budget share equation. While the variation of the estimates within the model is not as large as within model II, the own-price elasticity estimates of e.g. -10 (organic milk products) and -20 (organic fruit) are still rather high in absolute values. Furthermore, the estimates are also unexpected because they are positive for some product categories. The somewhat larger variation of the organic estimates might also stem from a larger heterogeneity within each product group.

The third comparison covers the issue of censoring. Therefore, the same QUAIDS of model III is utilised for model IV. The comparison of models III (n=751, no zero observations present) and IV (n=19566, zero observations are present but not considered during the estimation process) also shows some interesting results. The estimates are again rather high in absolute terms with, for example, an own-price elasticity of 40 for organic bread and cereal products. Not only are the results different between product groups, and between organic and conventional products but they also differ in comparison to model III. This suggests that zero observations can be challenging in such estimation procedures. The comparison of model III and model IV supports the hypothesis that the higher the share of zero observations in the data is, the less capable is the model to cope with this issue.

As the third model comparison hints that zero observations are an issue in elasticity estimations, the last model comparison addresses again the question of how to deal with censoring. Following Aepli (2014a), a multivariate probit regression model is estimated in model V prior to the QUAIDS. The multivariate probit regression is based on the SY approach. The approach was developed to avoid biased estimation results (selection bias) which occur when a considerable share of households has not consumed the analysed products during the observation period.

The comparison of models IV and V underlines the importance of addressing censoring during the estimation. Even though the new model is not fully consistent with demand theory, the results of the refined version of the QUAIDS (using the SY approach as a first step) are more similar to estimates from previous studies (in Switzerland and abroad). Hence, the reformulated QUAIDS model combined with the SY approach seems to be the best possible solution thus far when censoring is present in the data at hand. What chapter IV can, however, not provide is a perfect solution for an elasticity estimation that is consistent with demand theory.

In summary, this chapter adds some novel findings to the literature. While the estimated elasticities are not suitable to be used as such in computable equilibrium models, the results confirm that the methodological approach for an elasticity estimation must be chosen with care and will depend on the heterogeneity, aggregation level and censoring of the data among other things. If censoring is an issue, approaches such as the SY approach can improve the quality of the estimation results. The chapter also shows that a reassessment of the SY approach is necessary to ensure that the estimation is consistent with demand theory. Hence, this study also emphasises how important consistency checks are following the estimation. These have apparently been ignored in past studies as the noncompliance with the imposed demand theory was thus far not addressed.

The different comparisons carried out throughout chapter IV hint that the AIDS and QUAIDS model are sometimes more, sometimes less able to cope with the data used for this study. Hence, a key message of this chapter is that the nature of the data is a critical factor for both the model choice and consequently the estimation outcome.

For future research it will be necessary to reassess the approaches of Shonkwiler and Yen (1999) and the proposed reformulated version of the QUAIDS model when they are utilised together. The refined version of the QUAIDS model in combination with the SY approach is, however, the preferred model when censoring is present as it is the best possible solution to date (the AIDS model of Deaton and Muellbauer (1980) might well be used when censoring is not an issue).

1.3 Conclusions

Summary of results

This dissertation sheds light on the demand side of the organic food market in Switzerland. The overall aim of this dissertation was to better understand the demand for organic food. For that, a large data set provided by the Swiss Federal Statistical Office (HBS, 2013) comprising the consumption decisions for organic as well as conventional food of more than 19 000 households was analysed. The dissertation looks at the demand side of the organic food market from different perspectives and thereby helps understanding who consumes organic food in Switzerland, which the main drivers of the purchase decision are and which methodological pitfalls must be considered in the empirical analysis.

The dissertation consists of three chapters (II, III and IV). Chapter II closes a knowledge gap by revealing three product-related dimensions of importance for organic food consumption. First, organic food products that are unprocessed have an advantage on the market. This means that Swiss consumers appreciate natural products more than processed ones when they choose organic food. Hence, promoting the potential benefits of organic products seems more promising for un- and low processed products than for highly processed ones. Furthermore, the product price of organic food matters. More precisely, organic products with a high price premium (compared to their conventional counterpart) have a disadvantage on the market because consumers are reluctant to buy them. Hence, consumers clearly compare the organic product with the conventional alternative – not necessarily with other organic products. Finally, 'Swissness' (Swiss made) is a strong buying argument – not only for food in general but specifically for organic products. This means that consumers appreciate the domestic origin of organic food products. These three dimensions are of interest for those producing and marketing organic products and give a first understanding of what makes the success of organic food in Switzerland.

Chapter III analyses organic food demand at the household level. Whereas some predictors of organic food consumption which were already discovered in previous studies can be confirmed (e.g. that women and households with young children belong more often to the group of organic food consumers), other determinants are new and sometimes unexpected (e.g. that households with more children have a lower likelihood to belong to the group of organic food consumers). The strongest positive influence at the household level is, however, the cultural background the household lives in. Hence, on which side of the language border (*Röstigraben*) that runs through Switzerland the household lives has the strongest influence on organic food consumption. The uniqueness of Switzerland's linguistic regions allows for a more precise analysis of culture on organic food consumption than has been done before (e.g. inter-country comparisons) because the Swiss live in very similar institutional environments in all three linguistic regions.

The final chapter (IV) of this thesis proposes a refined version of the QUAIDS model. As censoring is a major concern in household data, the approach of Shonkwiler and Yen (1999) is often used as a first step when estimating demand elasticities. The refined version of the QUAIDS model is an improved yet imperfect solution to the problem that the QUAIDS model does not comply with demand theory when it is utilised with the SY approach in the first step. The results of the model comparisons reveal that zero observations are a major concern when estimating demand elasticities. The results suggest that the QUAIDS model might not be an appropriate approach when censoring is high. Moreover, the results indicate that the heterogeneity of household-level data must be taken into consideration when estimating demand elasticities with a QUAIDS model. The use of the QUAIDS seems therefore most promising when zero consumption is not or only to a small extent present in the data. Also, the use of aggregated monthly data is favourable in comparison to household-level data. As zero consumption are, however, usually present in household survey data, a case-specific choice of the estimation model seems most appropriate.

Limitations and perspectives for future research

This dissertation adds new findings to the exiting body of literature regarding organic food in Switzerland and the estimation of demand elasticities in general. As there was not much scientific evidence regarding the demand for organic food in Switzerland, this study helps guide those involved in organic food – producers, marketers, agricultural policy makers etc. However, this dissertation cannot answer all questions regarding the demand for organic food. In the following, more general shortcomings and limitations are presented, whereas more analysis-specific conclusions are drawn in the individual chapters II, III and IV.

As this dissertation shows the potential of analysing household survey data, it also demonstrates the difficulties that the use of them entail. In general, the quality of the analyses depends on the data that are used (among others). As regards Switzerland, the Swiss Federal Statistical Office (FSO) gathers one of the largest and most detailed data sets regarding food consumption. A large variety of variables is recorded every month and the Household Budget Survey (HBS) covers a wide range of variables, not only regarding food but also regarding household characteristics and the consumption of other goods. Additional data could still be helpful to improve the quality of the results of the analyses, e.g. a broader description of the household members. As household characteristics were proven to be important in other studies already and as the coefficients of determination were rather low in chapters II and III, the HBS obviously misses out on recording a certain range of influencing factors. A more precise description of all household members – including who the main responsible regarding food purchases is – is only one example to name that could improve the results of this dissertation. Another example is the language spoken in the household (which concerns specifically chapter III).

Another shortcoming that can be attributed to the data is the lack of market price information. The HBS only records expenditure and partly the consumed quantities, but not prices (which is not uncommon in household surveys). Market prices, especially for organic products, were unfortunately not available from other sources for the observation period. To still include price information – as this is regarded important, just as income – an approximation was calculated, corrected for inflation and used in the analysis (chapters II and IV). As the price information (deflated unit values) can be regarded as approximations to market prices, this has to be borne in mind when interpreting the results (chapters II and IV).

Furthermore, considering the dynamic and fast-changing organic food market in Switzerland, it seems worthwhile using more recent data to repeat the analyses. The FSO publishes the data once every three years which results in a time delay for analyses of the organic food market. Therefore, the available data at the time this dissertation started are used (2006-2011). Using a longer observation period could also help to better understand the development of the Swiss organic food market over time.

While the dissertation investigates short-term behaviour, an analysis of the long-term behaviour may also be of interest. The HBS is a cross-sectional survey and records the income and expenditure for the period of one month for each household and food purchases are documented during the first or the last two weeks of the month. As different households are observed every month, habits and how the individual households change their behaviour over time cannot be considered. This might be an interesting complementary research for the future.

The development of the market over time (also with regard to the growing product range) was partly considered by including monthly and yearly dummy variables (chapters II and IV). These trend variables can though only in part display the actual development of the market. In this regard, again, rerunning the analyses with more recent data could be insightful. Furthermore, since every household's purchases are aggregated to the month, daily shopping habits are not documented. Thus, it was not possible to analyse individual consumption decisions, the number of purchases during the observation period and households' food baskets. The same applies to shopping locations and special offers. Furthermore, shopping tourism in the neighbouring countries is a non-negligible factor in Switzerland and should also be addressed in future studies.

While this dissertation generates insights into consumer behaviour regarding organic food, it could be interesting to complement them with insights into consumer intentions and attitudes. Complementary research activities, e.g. interviews, could be helpful to fully understand the motives driving consumption for organic food. For example, consumer attitudes towards environmental protection and animal welfare, to only name two, could influence the consumption patterns regarding organic food.

Methodologically, chapters II and III rely on approved and often used methodologies. Chapter IV proposes a refined version of the Quadratic Almost Ideal Demand System. This version is an improved but far from perfect solution. The model does not fully comply with the imposed demand theory (unless for a trivial solution) but is the best possible solution to date. For future research, the issue of non-compliance with the imposed demand theory within the model should be addressed. Also, the results of the estimations in chapter IV suggest that the Quadratic Almost Ideal Demand System might not fit all data sets. For future research, it will be important to address specifically the issue of censoring in order to develop a model that can handle difficult data such as the one used for this dissertation.

Even though this dissertation allows for a first understanding of the organic food market in Switzerland, the analyses cover the product level at a rather aggregated level which is due to the high share of zero consumption in the data. Considering the growing consumption of organic food in Switzerland, analyses on a less aggregated product level seem more realistic for the period since 2012 than for the period of 2006 to 2011. The product groups that are analysed in chapters II and IV are sometimes more, sometimes less heterogeneous. The quality differences within each group and of the organic group compared with its conventional counterpart are also difficult to assess. The calculated unit values of the product groups indicate that the quality varies across production systems (organic/conventional) and across groups. This should be borne in mind. For the future, the comparison of different household types regarding organic food consumption patterns could also be envisioned and would improve the understanding of the organic food market.

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Chapter II
Explaining market shares of organic food: evidence from Swiss household data[9]

Abstract

Purpose – The purpose of this paper is to identify those product characteristics that are of importance to consumers of organic food in Switzerland.

Design/methodology/approach – In order to identify important organic product characteristics, this study applies a Generalized Linear Model using a six-year sample of Swiss household data distinguishing between organic and conventional products at the product level.

Findings – The analysis reveals three product-related dimensions of importance. First, Swiss consumers prefer unprocessed organic products over highly processed ones suggesting that communicating potential benefits of organic food is more promising for unprocessed products. Second, organic consumers are reluctant to buy products with high price premiums. Third, Swiss consumers prefer domestically

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[9] This chapter is published as Götze F., S. Mann, A. Ferjani, A. Kohler and T. Heckelei (2016). Explaining market shares of organic food: evidence from Swiss household data. *British Food Journal* **118**(4): 931-945.
A preliminary version of this chapter is published as Götze F., S. Mann, A. Ferjani, A. Kohler and T. Heckelei (2016). An approach towards explaining market shares of organic food – Evidence from Swiss household data. Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e. V., Band 51:269-280.
A short communication of this chapter is published as Götze F., S. Mann, A. Ferjani, A. Kohler and T. Heckelei (2015). An approach towards explaining market shares of organic food – Evidence from Swiss household data. *Acta Fytotechnica et Zootechnica* (Scientific Journal for phytotechnics and zootechnics) **18**(Special Issue):78-80.

produced organic products over imported ones.

Practical implications – The results imply that supporting organic agriculture in Switzerland is still promising from a policy and a marketing perspective as long as the organic price premium is not too high.

Originality/value – This paper presents results regarding the determinants of the organic market share in Switzerland. They give a first understanding of which product characteristics determine organic market shares. From a policy as well as from a marketing perspective a further investigation at the household level is promising in order to understand and respond to the needs and expectations of Swiss consumers.

Keywords: Consumer behaviour; Switzerland; Organic food; Generalized Linear Model

2.1 Introduction

The market for organic food has become an important part of the global food market, especially in wealthy parts of the world. Even though the market share of organic food is still low, it has been growing continuously since the 1990s (Thompson, 1998). The market for organic food in Switzerland, together with that in Denmark, is one of the most mature ones with a market share of 6.3% in 2012 which is considerably higher than the shares in other countries like the USA (4.3%), Germany (3.7%), France (2.4%) and the Netherlands (2.3%) (Fitch Haumann, 2014; Willer et al., 2014).

Over the past two decades, the market for organic food in Switzerland has grown in terms of production[10] as well as product variety and availability. In Switzerland, the majority of organic products is produced according to the standards of the private-sector organisation Bio Suisse[11] and mainly sold via two large retailers – Coop and

[10] The area of organically farmed land has nearly doubled from 1997 to 2013 to around 128 000 ha (FSO, 2014a).

[11] Bio Suisse is the federation of Swiss organic farmers, with over 6,000 members, for further information see: www.bio-suisse.ch/en/home.php

Migros. In 1993 and 1995, respectively, these supermarket chains launched their first organic food products. Today organic food is no longer a niche market. For example, the market leader in organic food retailing Coop made 6.2% (Fr. 1.1 billion) of their food sales with organic products in 2014. In terms of turnover, the share of Coop and Migros together accounted for 74% of all organic sales in Switzerland in 2014 (Bio Suisse, 2015). Organic sales are expected to continue to grow in the future.

Even though the organic food market has become an important part of the food industry, especially in Switzerland, there is a lack of studies regarding which product characteristics are important for the demand of organic food. Numerous surveys have been collected on why consumers buy organic food (e.g. Harper and Makatouni, 2002; Lockie et al., 2004; Hughner et al., 2007; Mohamad et al., 2014). In some cases, consumer surveys are complemented by experiments (Vermeir and Verbeke, 2006; Batte et al., 2007) or scanner data are used (Andersen, 2011; Schröck, 2013a) to study behavioural patterns. By analysing actual purchasing decisions based on a household survey rather than analysing consumer statements or scanner data (which often document purchases of only a few supermarkets), this paper presents a complementary way to study purchasing decisions regarding organic food. As Lee and Yun (2015), who study how consumers in the US perceive organic food attributes and how this perception influences buying decisions, we focus on how different product attributes are valued by Swiss consumers (reflected in their purchases) and thereby affect organic market shares. By comparing and explaining shares of different organic food products patterns emerge which provide a new perspective on the underlying motives to participate in the Swiss organic food market.

The literature about organic food has largely neglected the systematic study of market shares. Most studies concerned with organic markets mention the market share of organic food as a whole (Baker et al., 2002; Raynolds, 2004; Sahota, 2010). Where market shares of individual products are discussed, this usually happens in a non-systematic and descriptive manner. We learn that fresh produce is the largest sector of organic food (Oberholtzer et al., 2005) or that the market share of meat is low (Michelsen et al., 1999; Kilcher et al., 2011) while the market share of organic poultry is very low (von Borell and Sørensen, 2004; Oberholtzer et al., 2006). However, we are not aware of studies that systematically analyse variations of organic market shares across a wide range of products.

The next section develops hypotheses about the determinants of market shares of organic products based on the existing literature. The subsequent section introduces the data and methodology used to test those hypotheses. Results are presented and discussed in Section 4, before the final section concludes this study.

2.2 Literature review and hypotheses

Consumers of organic food are considered to be more conscious buyers compared to conventional food shoppers and emphasise reflection traits such as healthfulness, ethical and environmental aspects in addition to observation traits such as outer appearance and taste (Torjusen et al., 2001). In the early phase of organic farming, environmental awareness was the main motive to produce and consume organic food (Mellor, 1989). Soon, however, the motives shifted towards health reasons (Hutchins and Greenhalgh, 1997). Wier et al. (2008), Hauser et al. (2011) and Goetzke et al. (2014) find further evidence that the consumption of organic food is closely related to a healthy lifestyle.

The notion that organic food is most attractive where food choices are related to health consciousness suggests that health-related factors play a strong role in the decision to consume organic food. Based on these suggestions we formulate the first two hypotheses.

First, the dichotomy between 'healthy and unhealthy eating' (Povey et al., 1998, p. 171) is much more common than between healthy and unhealthy drinking. The health aspect regarding drinks is usually related to whether a drink contains alcohol or not, and less to other ingredients (Rabanales Sotos et al., 2015). This leads to the first hypothesis:

H1. The product characteristic 'drink' is negatively related to its organic market share.

Nowadays consumers are increasingly suspicious of conventional food value chains and production regimes. Hauser et al. (2011) find that consumers' perceptions of modern food production as well as the 'current eating culture' (p. 335) contrasts strongly with the kind of food consumers wish to eat. Consumers perceive today's food production systems as highly obscure and are 'sceptical about ingredients' (Hauser et al., 2011). Health aspects as well as the naturalness of food are closely related to how consumers want to eat and what is important to them personally regarding their nutrition. Guerrero et al. (2009), by studying consumer perceptions of food internationally, find a negative relationship between the degree of processing and a perceived positive impact on human health. Based on these findings we propose that organic products are bought less often for health reasons the more processed they are. This leads to the next hypothesis:

H2. The degree of processing of a product is negatively related to its organic market share.

Another important product characteristic likely affecting the consumption decision is the price. Economic theory states that supply is an increasing function of relative prices (Park and Lohr, 1996). This means that a high organic price premium increases the output of organic products. The opposite is the case for the demand side. Several studies suggest that the additional premium paid for organic quality is one of the main reasons that organic consumption is currently still low (Magnusson et al., 2001; Shafie and Rennie, 2012). This leads to the following hypothesis:

H3a. A high price premium is negatively related to the organic market share.

H3a can be complemented by further considering the relative importance of a product in terms of the household's food budget. The relative importance of a food product can be assessed by means of the budget share. In our study, we define the budget share as the overall organic and conventional expenditure, respectively, for a certain food product relative to the total expenditure for all food products. It can be assumed that buying a product with a price premium is a higher economic burden when the household spends a high fraction of its food budget on that product compared to the situation when the household spends only a small fraction on a product. A high budget share might, therefore, keep households from buying a product in organic quality. This leads to the following hypothesis:

H3b. A high budget share (organic and conventional) is negatively related to the organic market share.

Since we hypothesise that the price premium and the budget share both have an impact on organic market shares, we also assume an interaction of these two factors. In particular, we expect that a given price premium for organic quality hurts consumers less when they spend only a small fraction of their food budget on that product. This implies that H3a and H3b can be complemented by taking the interaction of the price premium and the budget share into account:

H3c. The impact of the price premium on the organic market share is stronger, the higher the budget share of the product is.

Another aspect worth investigating is the comparison between plant and animal products. The legal framework for keeping farm animals on conventional farms in Switzerland is strict in comparison to other countries[12]. The level of animal welfare is, therefore, not necessarily higher in organic agriculture than in conventional systems. However, Harper and Makatouni (2002) show that even though consumers buy organic animal products such as eggs and meat mainly because of health reasons, ethical aspects such as animal welfare (e.g. natural rearing) are also important in their consumption decision. Furthermore, several food scandals and how food-related topics are covered by the media influence how consumers perceive food (both in a positive and negative way) Based on the consumer perception that organic animal products are not only healthier but also more animal friendly, we propose the next hypothesis:

H4. The characteristic 'animal product' is positively related to the organic market share.

[12] Furthermore, the Swiss Agricultural Policy offers financial incentives to exceed legal minimum standards in animal husbandry. These programmes are called BTS (special animal friendly housing systems) and RAUS (regular access to free-range areas outdoors for animals). Both have a high participation rate.

A last aspect is the origin of the products. In general, consumers place higher trust in agricultural goods produced in their own country than in imported goods (Nygård and Storstad, 1998). In Switzerland, high standards of animal welfare might explain this high degree of consumer trust. As buying organic might often be a consequence of a lack of trust regarding conventional farming, it is reasonable to assume that consumers favour organic quality when they buy imported food products. Hence, our last hypothesis is as follows:

H5. The characteristic 'imported product' is positively related to the organic market share.

2.3 Data and methodology

2.3.1 *Data base and sample*

Since the year 2000, the Swiss Federal Statistical Office (FSO) continuously collects data of about 250 randomly selected Swiss households every month. In the analysed sample of the Household Budget Survey (HBS, 2013) that covers the years 2006-2011 19 653 private households are recorded. These households comprise a representative sample of the Swiss residential population. Households participate once in the survey and document their income and expenditures for the period of one month (repeated cross-sectional survey). Hence, a large variety of households is included in the sample.

The participating households document food products for home consumption as organic if they are marked with a recognised label (e.g. the 'Bio Bud', Migros Bio, 'naturaplan'). The data of the HBS are compiled at the household level. Because product characteristics do not vary across households, we aggregate the data over all households for each product and each year. This results in a total of 60 organic product categories which are analysed over the six-year observation period, giving us a total of 360 observations. A detailed list of the product categories and descriptive statistics can be found in the appendix.

The product characteristics included in the analysis are not part of the HBS. The characteristics are assigned to each product by the authors (see the subsequent section).

2.3.2 *Methodology*

This analysis aims at identifying and quantifying the product attributes as they are valued by consumers. To do so, the influence of different product characteristic on the organic market share is estimated. Our dependent variable y, the organic market share, is bounded between 0 and 1 ($0 \leq y \leq 1$). If the dependent variable is limited, e.g. as in our case is a fraction, the predicted values of y conditional on x will not necessarily lie within the boundaries of 0 and 1. Therefore, a linear regression model estimated by OLS is not suitable. Papke and Wooldridge (1996) developed an approach that accounts for limited dependent variables (see also Baum, 2008 for an application). They suggest a Generalized Linear Model with the assumption that, for all observations i:

$$E(y_i|\mathbf{x_i}) = G(\mathbf{x_i}\boldsymbol{\beta}) \quad (1)$$

where we assume that y_i is statistically independent (no grouping or clustering of the data) and where $G(.)$ is a known and correctly specified (transformation) function that ensures that the expected value of y_i lies within the required value range. For our case that the dependent variable y_i is a fraction, Papke and Wooldridge (1996) suggest using the logit link function as the transformation function $G(.)$. By including the logit link transformation function, we ensure that the expected value of the dependent variable (the organic market share) will take only values within the range of 0 and 1. Our empirical model is then specified as follows:

$$E(ms_{it}^{org}\,|x_{it}) = G(\beta_0 + \beta_1 drink_i + \beta_2 animalpr_i + \beta_3 lowprocessed_i + \beta_4 highlyprocessed_i + \beta_5 imported_i + \beta_6 bs_{it} + \beta_7 priceprem_{it}^{org} + \beta_8 bs\_priceprem_{it} + \beta_9 D_{2007} + \beta_{10} D_{2008} + \beta_{11} D_{2009} + \beta_{12} D_{2010} + \beta_{13} D_{2011} + u_{it}) \quad (2)$$

where i, products; t, time/year; and u, error term.

The organic market share (ms_{it}^{org}), our dependent variable, is the quantity share of the organic product i in year t. It is calculated by summing up over all households for each product and each observation year:

$$ms_{it}^{org} = quantity_{it}^{org} / (quantity_{it}^{org} + quantity_{it}^{conv}) \quad (3)$$

Because the HBS does not include information on prices, quantity-weighted unit values are calculated by dividing expenditure by quantity (taking the sums of expenditures and quantities across all households for each product category and each year). The organic price premium ($pricepremorg_{it}$) is the relative difference between the organic and the conventional quantity-weighted unit value (average over all households for each observation year). The explanatory variables further comprise dummy variables to distinguish drinks from solid food products ($drink_i$), animal from plant products ($animalpr_i$)[13] and imported from domestically grown products ($imported_i$)[14]. Moreover, three levels of processing are considered: unprocessed, low-processed and highly processed. Because it cannot be assumed that the difference between unprocessed and low-processed products equals the difference between low-processed and highly processed products, we include the level of processing as dummy variables into our model instead of one categorical variable. Low-processed products ($lowprocessed_i$) are those that are processed and consist of one main ingredient (e.g. milk, beef, pasta), while highly processed products ($highlyprocessed_i$) are processed and contain two or more main ingredients (e.g. jam, soda, alcoholic beverages). The reference category is, therefore, raw and unprocessed products. To consider the relative importance of a product for the household, the average budget share of each product category and observation year (bs_{it}) is included in the model. The budget share is defined as the average ratio of the sum of organic and conventional expenditure for the particular product category to the overall expenditure for food and beverages of the household. To account for a possible interaction of the budget share and the price premium, an interaction term

[13] A threshold of 50% (of the ingredients) was set to distinguish animal from plant products in cases where products are composed of ingredients of animal and plant origin.
[14] For the distinction between imported and domestically grown products, data from the Swiss Farmers Union (SFU, 2013) is used. Accordingly, products with a self-sufficiency rate of less than 50% (in 2011) are categorised as 'imported' and 'domestic' in case of a self-sufficiency rate of 50% or higher.

($bs\_priceprem_{it}$) is included in the model. That way it is possible to test whether the impact of the price premium changes with varying budget shares. To control for year specific effects, we include dummy variables for the years 2007-2011. β_0 is the constant term and $\beta_1 - \beta_{13}$ are the corresponding parameters of the explanatory variables to be estimated. Note that those explanatory variables without a time index t are constant over time.

The model is estimated in Stata by Maximum Likelihood with standard errors that are robust to some kind of misspecification (using the Huber/White/sandwich estimator of variance).

2.4 Results and discussion

This section discusses the results reported in Table 2.1 in detail. Since the regression model is non-linear, we report the coefficients as well as the marginal effects (evaluated at the means of the explanatory variables) with the corresponding significance levels and robust standard errors[15].

[15] Reading example of Table 2.1: a marginal effect of -1 in case of a binary (0/1) explanatory variable means that the organic market share decreases by 1 percentage point (unit change) if the explanatory variable changes from 0 to 1 (holding all other explanatory variables constant at their means, thus assuming an 'average situation'). In case of a continuous explanatory variable, the marginal effect describes the instantaneous rate of change. This means that if the explanatory variable (mean) changes by a small amount, e.g. 0.01 units, the organic market share would change by:
-1 × 0.01 = -0.01 percentage points.

Table 2.1: Determinants of the level of the organic market share, regression results: coefficients and marginal effects

Explanatory variables		Coefficient	P>|t|	Robust Std. Err.	***Marginal Effect***		***P>|t|***
Monetary variables	bs_{it}	**-23.927**	***	6.638	***-0.011***	b	***
	$priceprem_{it}^{org}$	**-1.022**	***	0.255	***-0.001***	b	***
	$bs\_priceprem_{it}$ (interaction term)	**21.829**		17.558			
Product characteristics	$drink_i$ †	**0.467**	*	0.224	***0.025***	a	*
	$animalpr_i$ †	**-0.270**	**	0.108	***-0.014***	a	***
	$lowprocessed_i$ †	**0.161**		0.121			
	$highlyprocessed_i$ †	**-1.540**	***	0.243	***-0.082***	a	***
	$imported_i$ †	**-0.458**	***	0.099	***-0.024***	a	***
Observation year	D_{2007} †	**0.093**		0.171			
	D_{2008} †	**-0.016**		0.149			
	D_{2009} †	**0.124**		0.154			
	D_{2010} †	**0.137**		0.157			
	D_{2011} †	**0.207**		0.150			
	Constant term	**-1.879**	***	0.173			

† dummy variable (0/1)
No. of observations: 360
Pseudo R^2: 0.405
Significance levels: *** p<0.01 ** p<0.05 * p<0.1
[a] Marginal effect for a discrete change of the dummy variable from 0 to 1.
[b] Marginal effect for a 1 % increase of the mean of the explanatory variables.
The marginal effects are depicted for those variables that are significant determinants of the organic market share ms_{it}^{org}.

Source: own calculations

The results in Table 2.1 show that some of the product attributes significantly determine the level of the organic market share. For completeness, the coefficients of the year dummies are included in Table 2.1. However, they are not significant for any of the years, suggesting that, at least in our sample, there are no detectable year specific effects within the observation period.

H1 that the product characteristic ‘drink’ is negatively related to the organic market share has to be rejected. We do not find that the organic market share of drinks is significantly lower than that of solid food products (ceteris paribus). Our analysis suggests that there is only evidence for a systematic difference between the organic market share of drinks and solid food products at the 10% level[16]. Thus, we cannot rule out that health aspects may be as relevant for the consumption of drinks as they seem for the consumption of food. Organic drinks might still be niche products in some cases. In other cases, however, they have reached a certain market maturity already. The success of e.g. organic vegetable juices might be related to an increased health awareness.

There is mixed evidence for H2 that the processing degree is negatively related to the organic market share. We find that highly processed products like sausages or jams have a systematically lower organic market share than unprocessed products like bananas or apples. However, it seems not to make a difference to consumers if the product has undergone some low form of processing. Low-processed products like pasta or beef do not have a significantly lower organic market share than unprocessed products. It appears that consumers of organic food relate raw and unprocessed products more closely to naturalness and a healthy lifestyle than highly processed ones. The small but growing market for organic convenience food (Schröck, 2013a) also shows that a low level of processing might not be a crucial factor for consumers after all. Nevertheless, for the food industry it might be important to communicate that the advantages of organic farming are hardly compromised by the level of processing of food products.

We find evidence in favour of H3a, stating that the higher the price premium is, the lower will be the organic market share. However, the price premium only has a small effect on the level of the organic market share. This suggests that other factors than the price difference might also be important. Our results are consistent with those of Magnusson et al. (2001) and Kilcher et al. (2011) who find that consumers are willing to accept an organic price premium between 10% and 30% (on average). And even though the willingness to pay in Switzerland is higher than in other European countries due to the high level of income, high price premiums still seem to be problematic at least for some products such as organic animal products (see also Kilcher et al., 2011). This suggests that consumers compare organic products with

[16] Usually, 5% is the threshold for hypothesis testing in regression analysis.

their conventional counterparts when they make their buying decision, not necessarily with other organic options.

H3b that an increase in the budget share implies a decrease in the organic market share cannot be rejected. Food products that are relatively important for households in terms of their food budget are bought less often in organic quality. Consequently, less important goods have higher organic market shares and vice versa. This result is somewhat surprising as the health aspect is important to an increasing number of consumers today (Schifferstein and Oude Ophuis, 1998; Goetzke et al., 2014). One might expect consumers to buy especially those products in organic quality that represent a large part of what they eat on a daily basis. However, in this case the financial burden of consuming organic products seems to outweigh the health aspect. From this it could be followed that households react more cautious when prices change and make their buying decisions more carefully when they spend a high proportion of their food budget on a product. However, we do not find a systematic interaction between the budget share and the price premium. There appears to be no systematic relationship between these two variables. Thus, we reject the hypothesis that the effect of the price premium on the organic market share is stronger the higher the budget share is (H3c).

We also reject H4. We do not find that the product characteristic ‘animal product’ is positively related to the organic market share. In fact, the opposite is the case. According to our analysis, organic animal products have on average lower market shares than organic plant products. At first glance, this result is surprising as we expected consumers to buy organic animal products to ensure a high level of animal welfare in production as suggested by Harper and Makatouni (2002). However, as Andersen (2011) shows, the motives to consume or not to consume organic animal products are various and animal welfare might only play a minor role. Furthermore, not all consumers who are concerned with animal welfare actually consume animal products. According to Harper and Makatouni (2002), consumers of organic food are also ‘more likely to be vegetarian than non-organic buyers’ (p. 297). Hence, a high awareness of animal welfare does not necessarily result in the consumption of organic animal products.

Regarding the origin of food products, Guerrero et al. (2009) find that consumers care about where their food comes from. Nygård and Storstad (1998) find that consumers associate domestically produced food with a high level of quality. In a globalised world in which a considerable share of what we eat is not produced within a single country, consumers are increasingly sceptical about the production conditions and the quality of imported food because food value chains become less and less traceable. In contrast, consumers feel that they know the conditions of agricultural production methods inside their own country better. Nevertheless, we do not find that Swiss consumers buy imported food products in organic quality to ensure that these products are of high quality. In other words, the hypothesis that the characteristic ‘imported product’ is positively related to the organic market share has to be rejected (H5). This suggests that Swiss consumers have a high preference for products that are produced in their own country. This home bias in food consumption (called ‘Swissness’) might be related to a greater willingness to pay as suggested by a Swiss consumer study (USG, 2013).

2.5 Conclusions

This study identifies three important dimensions that determine the market share for organic products. The first dimension is the apparent demand for unprocessed organic food, mirroring the longing of Swiss consumers for a natural nutrition. In an increasingly industrialised and specialised world with growing rates of cardiovascular diseases and obesity, a growing number of consumers cares about a healthy lifestyle. This study confirms that the dimension of naturalness is important to the average consumer. From a consumer perspective, organic products are closely related to a healthy, responsible and sustainable lifestyle. Hence, where a low degree of processing plays an important role, organic products have a clear advantage on the market and thus higher market shares. The organic market share of products that are raw and unprocessed is, therefore, higher than that of products that are highly processed. For the food industry this means that promoting highly processed organic foodstuffs is less promising than marketing unprocessed ones. Nevertheless, it is important to point out to consumers that the authentic nature of organic food is hardly compromised when a product is processed in any way.

The second dimension refers to the product's budget share and the price premium for organic quality. We find that the higher the share is that is spent on a certain product, the more reluctant is the household to buy this product in organic quality. That financial considerations matter to consumers when they buy organic food is also supported by the finding that organic products with high price premiums have on average lower market shares than those with small price premiums. Organic products with high price premiums therefore have a disadvantage on the market. For the food industry, the challenge is to convince consumers of the advantages of buying organic products with high price premiums.

The third dimension of importance is the preference for domestically grown food. Our results reveal that the characteristic 'imported product' is negatively related to the organic market share. The food industry might on the one hand use the existing preference for domestically produced food to further increase their sales. On the other hand, it might be promising to supply consumers with information on how organic food is produced in other countries.

It should be noted that food-related consumption decisions are complex. Covering all factors that influence these decisions is neither possible nor realistic. Our analysis gives a first understanding of what the influencing factors of the market share of different organic food products in Switzerland are. What is beyond the scope of our current analysis is which types of households are more likely to consume organic food and which households do not consume organic food at all. However, future research analysing the organic food market at the household level would be promising in order to gain a better understanding of which household characteristics influence the purchasing decisions. If it is known which consumers prefer which products and why certain consumer groups refuse to consume organic products, agricultural policies as well as marketing campaigns of the food industry could be targeted more specifically.

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2.7 Appendix

Appendix 2.7.1: Overview of the products and product characteristics used in the analysis and the means of the explanatory variables

	Market share (organic)	Drink / food product	Animal / crop product	Level of processing	Imported / domestic product	Budget share	Price premium (organic)
All products	0.067					0.014	0.391
Bread & cereal products							
Rice	0.053	food	crop	unprocessed	imported	0.004	0.141
Pasta	0.041	food	crop	low-processed	imported	0.014	0.696
Bread	0.092	food	crop	low-processed	domestic	0.047	0.218
Wheat flour	0.081	food	crop	low-processed	domestic	0.002	0.541
Other cereal grains & grain-based products	0.118	food	crop	low-processed	domestic	0.020	-0.026
Meat							
Beef	0.095	food	animal	low-processed	domestic	0.026	0.226
Veal	0.120	food	animal	low-processed	domestic	0.010	-0.104
Pork, ham & bacon	0.028	food	animal	low-processed	domestic	0.053	0.157
Sheep & goat meat	0.051	food	animal	low-processed	imported	0.006	0.033
Poultry	0.030	food	animal	low-processed	imported	0.030	0.222
Other edible meat products, offal, preserved meat & products containing meat	0.030	food	animal	low-processed	domestic	0.023	0.267
Sausages, sausage products & pâtés	0.017	food	animal	highly processed	domestic	0.045	0.254
Fish							
Fish & sea food	0.033	food	animal	low-processed	imported	0.027	0.765

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Appendix 2.7.1: ***continued***

	Market share (organic)	Drink / food product	Animal / crop product	Level of processing	Imported / domestic product	Budget share	Price premium (organic)
Milk, cheese & eggs							
Whole & skimmed milk, milk drinks	0.124	food	animal	low-processed	domestic	0.026	0.300
Cheese	0.047	food	animal	low-processed	domestic	0.069	0.222
Cream	0.034	food	animal	low-processed	domestic	0.011	0.402
Curd	0.068	food	animal	low-processed	domestic	0.003	0.365
Yogurt	0.102	food	animal	low-processed	domestic	0.023	0.088
Edible fats & oils							
Butter	0.066	food	animal	low-processed	domestic	0.012	0.432
Margarine, other edible vegetable fats & oils, animal fats	0.035	food	crop	low-processed	imported	0.006	1.090
Olive oil	0.072	food	crop	low-processed	imported	0.005	0.703
Fruit							
Lemons, oranges & other citrus fruits	0.061	food	crop	unprocessed	imported	0.010	0.484
Bananas	0.210	food	crop	unprocessed	imported	0.007	0.174
Apples	0.076	food	crop	unprocessed	domestic	0.012	0.396
Pears & quinces	0.052	food	crop	unprocessed	domestic	0.003	0.360
Stone fruit	0.040	food	crop	unprocessed	imported	0.010	0.383
Berries	0.048	food	crop	unprocessed	imported	0.007	0.523
Grapes	0.020	food	crop	unprocessed	imported	0.005	0.610
Melons & water melons	0.019	food	crop	unprocessed	imported	0.003	0.309
Other exotic fruit	0.042	food	crop	unprocessed	imported	0.007	0.309
Nuts, edible nuts, oily & dried fruit	0.123	food	crop	low-processed	imported	0.012	0.226
Fruit preserves	0.020	food	crop	low-processed	imported	0.003	1.243

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Appendix 2.7.1: ***continued***

	Market share (organic)	Drink / food product	Animal / crop product	Level of processing	Imported / domestic product	Budget share	Price premium (organic)
Vegetables							
Green salads & other leafy vegetables	0.094	food	crop	unprocessed	domestic	0.022	0.378
Stem vegetables	0.136	food	crop	unprocessed	domestic	0.004	0.511
Cabbage	0.107	food	crop	unprocessed	domestic	0.005	0.427
Tomatoes	0.073	food	crop	unprocessed	imported	0.010	0.516
Beans & peas	0.090	food	crop	unprocessed	domestic	0.002	0.239
Fruiting vegetables	0.110	food	crop	unprocessed	imported	0.010	0.312
Onions, garlic	0.074	food	crop	unprocessed	domestic	0.003	0.637
Turnips & other root vegetables	0.154	food	crop	unprocessed	domestic	0.012	0.142
Fresh mushrooms	0.038	food	crop	unprocessed	imported	0.003	0.291
Processed, tinned & canned vegetables & mushrooms	0.060	food	crop	low-processed	imported	0.011	0.214
Potatoes	0.083	food	crop	unprocessed	domestic	0.008	0.458
Products containing potatoes & other tubers	0.018	food	crop	low-processed	domestic	0.011	0.200
Sugar, jams, honey & chocolate							
Sugar	0.035	food	crop	low-processed	domestic	0.003	0.688
Jams, marmalades & stewed fruit	0.054	food	crop	highly processed	imported	0.006	0.605
Honey	0.087	food	animal	unprocessed	imported	0.003	0.265
Chocolate	0.009	food	crop	highly processed	domestic	0.029	0.127
Coffee, tea & cocoa							
Coffee & coffee surrogates	0.032	drink	crop	low-processed	imported	0.024	-0.097
Tea, herbal tea, surrogates	0.101	drink	crop	low-processed	imported	0.005	0.750
Drinks containing cocoa	0.010	drink	crop	highly processed	imported	0.003	0.546

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Appendix 2.7.1: ***continued***

	Market share (organic)	Drink / food product	Animal / crop product	Level of processing	Imported / domestic product	Budget share	Price premium (organic)
Mineral water, sodas & juices							
Mineral water	0.001	drink	crop	unprocessed	domestic	0.014	0.762
Non-alcoholic sodas	0.006	drink	crop	highly processed	domestic	0.020	0.338
Syrups for drinks	0.030	drink	crop	highly processed	imported	0.003	2.051
Fruit juices	0.058	drink	crop	low-processed	imported	0.015	0.588
Vegetable juices	0.445	drink	crop	low-processed	domestic	0.0004	0.149
Wine							
Swiss wines	0.012	drink	crop	highly processed	domestic	0.014	0.172
Foreign wines & wines without indication of origin	0.025	drink	crop	highly processed	imported	0.031	0.062
Sparkling wines, wine-based aperitifs, ciders, sweet wines (non-alcoholic & alcoholic)	0.024	drink	crop	highly processed	imported	0.007	-0.193
Beer							
Non-alcoholic & alcoholic beer	0.014	drink	crop	highly processed	imported	0.0116	0.2985

Note: The **market share (organic)** is the ratio of the consumed quantity of a good i (organic) to the overall consumed quantity of that good i (organic and conventional). The **budget share** is the ratio of the expenditure for a good i (organic and conventional) to the overall expenditure for food and beverages. The **price premium (organic)** is the relative difference between the organic and the conventional unit value of a good (quantity-weighted).

The values of the market share (organic), budget share and price premium (organic) are the means over the observation period (2006-2011).

Source: HBS (2013), own calculations, FSO (2014a)

Chapter III
Culture and organic consumption – evidence from the *Röstigraben*[17]

Abstract

The *Röstigraben*, the imaginary border between French- and German-speaking Switzerland, separates the Germanic food culture from the francophone one. An analysis of a sample of Swiss cross-sectional household data from the years 2006-2011 is carried out to investigate the impact of this cultural distinction on the consumption of organic food. Whereas many predictors for organic food consumption which are known from other studies can be confirmed, this study reveals a significantly higher consumption of organic food in Switzerland's German-speaking part. This paper argues that the budget share a household spends on organic food is strongly influenced by the cultural background of the household. In the context of organic food consumption, one of the most important determinants is on which side of the *Röstigraben* the household lives. It can be concluded that as culture matters for organic food consumption, organic marketing campaigns should be more target group oriented to reach also the French-speaking side of the *Röstigraben*.

Keywords: organic food consumption; household data; Heckman two-step estimation; socio-demographic profile; culture

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[17] A preliminary version of this chapter was presented at the 6th EAAE PhD Workshop in Rome (Italy) as Götze, F., A. Ferjani, S. Mann and A. Kohler (2015). Who buys organic food in Switzerland.
A preliminary version of this chapter is published as Götze F. and A. Ferjani (2014). Wer in der Schweiz Bio-Lebensmittel kauft (Qui achète des aliments bio en Suisse?). *Agrarforschung Schweiz (Recherche Agronomique Suisse)* **5**(9):338-343 (in German and French).

3.1 Introduction

The market for organic[18] food in Switzerland is dynamic and demand has grown considerably over the past two decades. Today, a wide and growing range of products is available on the market. This positive trend on the demand side is accompanied by an expansion of organic farming. The number of consumers interested in and regularly consuming organic food has increased within the last two decades since the two main Swiss retailers (Coop and Migros) launched their first organic products in 1993 and 1995, respectively. Today, the Swiss organic food market is one of the most mature ones with annual growth rates of 4% to 12% in sales since 2007, and a share of turnover of 7.1% in 2014 (Bio Suisse, 2015). In 2014, almost two thirds of Swiss consumers bought organic food products several times a month and the average per capita consumption increased to 269 Swiss Francs (Fr.) (ibid.). This makes the organic segment a promising market for Swiss retailers.

The term *Röstigraben* denotes the 'imaginary cultural border between German and French speaking Switzerland' (Baccini, 2003) and provides an almost unique opportunity to examine the effect of cultural differences under very similar institutional conditions. The difference in language here implies a cultural difference (Clots-Figueiras and Masella, 2009).

The literal translation of *Röstigraben* is a ditch of fried grated potatoes. The term originates from the different food preferences and eating habits of the German- and French-speaking region, with the French-speaking being closer to the French eating culture. *Rösti* is a frequent dish for the German-speaking population of Switzerland but less common in the French-speaking part. Indeed, Askegaard and Madsen (1998) showed in a pan-European study on food consumption habits that one of the most significant cultural borders within Europe with respect to food choice runs through Switzerland. German-speaking Swiss, together with Germans and Austrians, follow an 'ascetic (…) food culture accompanied by guilt feelings over indulgence' (p. 559), while French-speaking Swiss, as Wallonian Belgians and the French, prioritise

[18] Organic products are according to the definition of the Household Budget Survey those that are marked with an official label (e.g. the Bio Suisse Bud, Bio Bud or Demeter label).

sensory enjoyment when eating.

This raises the question how this cultural difference translates into the demand for organic food. On the one hand, ethical concerns have been shown to influence consumption decisions for organic food (Harper and Makatouni, 2002; Zepeda and Deal, 2009), which may indicate a higher consumption of organic food in Switzerland's German-speaking part. On the other hand, it is often reported that the better taste of organic food is decisive (Padel and Foster, 2005; Rembiałkowska et al., 2007). This would imply a higher demand for organic food west of the *Röstigraben*.

Another question to be answered within the framework of this study is which socio-demographic and monetary factors decide upon the consumption of organic food. It can be expected that the consumer group that bought organic food in the first place – when this market was still a niche – has broadened since then. As there are various motives to consume organic food today (e.g. health and environmental reasons, animal welfare, prestige), this also means that various types of consumers likely buy organic food.

Even though per capita consumption is nowhere higher than in Switzerland, to this date only few studies can be found that quantitatively analyse the determinants of organic food consumption in Switzerland. Furthermore, the existing studies partly contradict in their findings. Up-to-date information on the cultural background and the socio-demographic profile of organic food consumers is, however, useful because it can give insights into the consumption motives and attitudes towards organic food. Knowing the profile of organic food consumers in Switzerland is useful for producers and retailers of organic food (Dettmann, 2008) in order to align organic marketing towards the needs of consumers and exploit the full potential of the market. Furthermore, potential consumers could be reached more efficiently. Besides that, understanding consumption decisions and the determining factors of buying organic food can help shaping the Swiss agricultural policies more efficient and target-aimed.

This study, after a review of factors identified as influential for the choice of organic food, uses consumption data on the household level to identify the impact of culture and other determinants to better understand organic food consumption.

3.2 Demand patterns of organic food consumption

3.2.1 *Culture, institutional setting and environmental awareness*

The influence of culture on a variety of aspects (e.g. women's employment, unemployment, social insurance, social capital, consumption) has been investigated in the academic literature (e.g. Lauer and Weber, 2003; Freitag, 2004; Fernández, 2007; Brügger et al., 2009 and 2011; Steinhauer, 2013). It was found that French-speaking Swiss have a stronger preference for the expansion of social security (Brügger et al., 2011) and are more strongly opposed to vegetarianism (Fehlbaum et al., 2010). Furthermore, French-speaking Swiss have a narrower social network than their German-speaking neighbours (Freitag, 2004) and francophone Swiss women with small children have a higher labour force participation than those in the German-speaking part (Steinhauer, 2013).

In the literature, there is no single definition of culture. The culture of a group or region is formed by the people living in it: their language, values, norms, (inter-) actions, religion, identity, even by what they eat. Language and culture are closely linked (Steinhauer, 2013) since language provides a communication tool to interact within a group. Furthermore, language is an important basis for the establishment and development of norms and values within a group or region and protects against external influences. Culture contributes to and strengthens a person's identity and sense of belonging to a group (Clots-Figueras and Masella, 2009). Hence, it can be expected that if two groups speak different languages, their cultures differ. Moreover, culture influences markets because of different attitudes, preferences, habits, lifestyles and behavioural patterns.

Askegaard and Madsen (1998) and Guerrero et al. (2009) showed that even in relatively homogeneous areas, such as the European Union, cultural differences (i.e.

the linguistic regions[19]) explain differences in how consumers behave, e.g. which food products they choose. The study of Askegaard and Madsen (1998) identified similar consumption behaviour in regions that speak the same language (even across national borders[20]), suggesting that language is linked to what people consume and eat. Hence, cultural differences likely explain differences in food consumption and must be taken into consideration in order to fully understand consumption patterns.

When comparing food consumption between different countries, it is – in most cases – challenging to measure the impact of culture in isolation from the institutional setting. As regards Switzerland, however, this comparison is possible because households live in a similar institutional environment across the country (Steinhauer, 2013). In Switzerland four official languages[21] are spoken (Figure 3.1). The cultural aspect is of interest because the Swiss identify themselves with their language. This results in separate newspapers, and television and radio programmes. *Röstigraben* is a term often used to refer to this cultural segregation but especially that of the German- and the French-speaking part. Because of these linguistic peculiarities and the fact that the languages are assigned to specific regions, it can be expected that the linguistic regions differ regarding food choice and organic food consumption in particular.

[19] E.g. the Latin European, Anglo-Saxon and Germanic region.
[20] E.g. French-speaking Switzerland and France; German-speaking Switzerland, Austria and Germany.
[21] German, French, Italian and Romansh (the latter representing 0.5% of the Swiss population).

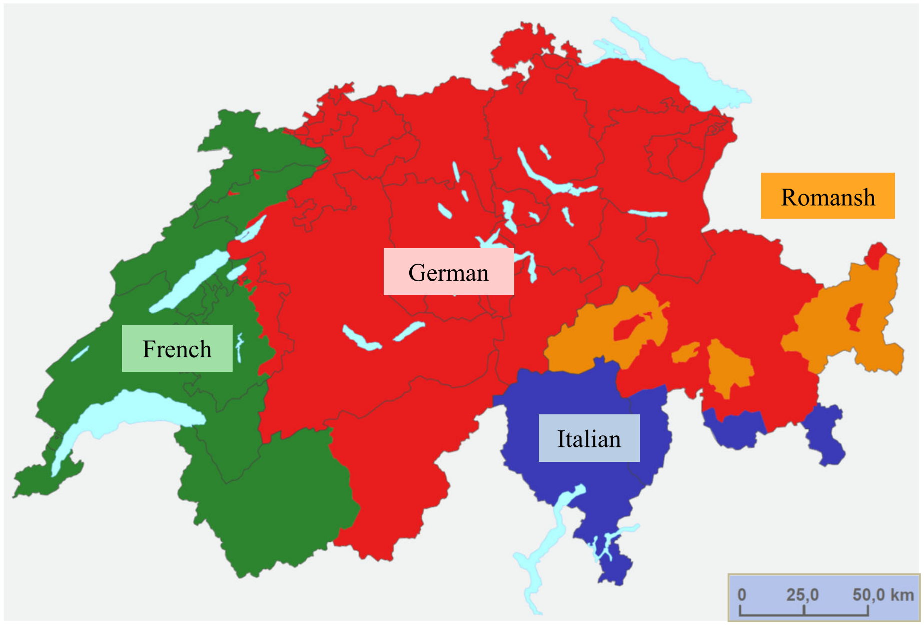

Figure 3.1: Linguistic regions of Switzerland
Source: FSO (2016b) – ThemaKart (Competence Centre for Thematic Cartography)

A few studies investigated the relationship between language and (organic) food consumption (e.g. Batte et al., 2007). Food is an important part of a cultural group – in some countries more than in others (Puoane et al., 2006). As in most industrialised countries, the Swiss spend only a small share of their income on food. How much a household spends on food and which products it buys varies across regions. In terms of food consumption behaviour and attitudes, Askegaard and Madsen (1998) found an 'extreme heterogeneity' between the French- and the German-speaking part of Switzerland (p. 566). Consequently, differences in food consumption cannot be solely related to income as income varies only slightly across linguistic regions. The cultural background likely plays an important role (ibid.). The studies of Aepli and Finger (2013) and Schletti (2001) found that households in different linguistic regions show different consumption patterns when it comes to organic food and to food in general. Aepli and Finger (2013), for example, showed that households in the Italian-speaking part of Switzerland spend on average more on food in general but less on sheep and goat meat than households in the French- and German-speaking part of Switzerland. Similar heterogeneities may also be present with regard to organic food.

The only study that analysed the impact of language on organic food consumption within Switzerland is that of Schletti (2001). The study revealed that households in the German- and Romansh-speaking part of Switzerland have a higher affinity towards organic food. Schletti (2001) explained this by a higher level of environmental awareness compared to households in French- and Italian-speaking Switzerland. Indicators of a higher environmental awareness, following Schletti (2001), are the use of public transportation systems instead of a car or a motorcycle. This means that the more cars a household owns, the less likely is the consumption of organic food and the lower is the expenditure share.

Another aspect likely explaining differences in food consumption in general and consumption of organic food in particular is whether a household lives in a rural or urban area. Several studies found that consumption patterns regarding (organic) food differ between rural and urban areas (Mazengo et al., 1997; Sun and Wu, 2004; Padoch et al., 2008; Wier et al., 2008; Zhang et al., 2008; Ke, 2009; Schröck, 2013a and 2013b). For Switzerland, Schletti (2001) hypothesised that households living in urban areas are more open-minded towards alternative products and, therefore, consume organic food more often than rural households. However, the study did not find evidence that this aspect really matters. Zhang et al. (2008) found that urban households in the U.S. are more likely to be organic buyers and spend more on organic products than households in rural areas. Wier et al. (2008) showed that British and Danish households in urban areas spend a higher share of their budget on organic products than rural households. However, rural households may care just as much about food quality as households in urban areas. Hence, it cannot be ruled out that households in rural areas have a high affinity to organic food. Moreover, rural households may choose organic more often than urban households because they are closer located to agricultural farms and, therefore, may know more about production practices and farming systems. Hence, rural households may be just as interested in consuming organic products. Conversely, it cannot be ruled out that due to the (on average) lower level of understanding about agricultural production, urban consumers choose organic products more often because they are uncertain about product quality and safety (Schröck, 2013a).

When comparing the demand for organic food in different countries, a large range of economic, political and cultural differences play into the variance and are conceptually and methodologically different to distinguish (Lohr, 2001; Wier and Calverley, 2002). The different parts of Switzerland, as indicated above, may provide an exception from the rule, as their economic and political system is very similar. However, while Aepli and Finger (2013) showed that households in the Italian-speaking part of Switzerland spend on average more on food overall but less on sheep and goat meat than households in the French- and German-speaking part of Switzerland, such evidence is yet missing for the consumption of organic food.

3.2.2 *Socio-demographic characteristics of organic food consumers*

The influence of the household's financial capabilities on the consumption decision was analysed in most household studies. This aspect is interesting for investigation because there is a price difference between organic and conventional food, so consumers most likely take the premium paid for organic quality into account when they plan their food budget and make their buying decisions. Therefore, an influence of the available food budget on organic consumption can be assumed. Most scientific studies showed that there is a positive relationship between income and the consumption of organic food, which means that with increasing financial capabilities, the consumption of organic food increases (Davies et al., 1995; Schifferstein and Oude Ophuis, 1998; Hill and Lynchehaun, 2002; Jonas and Roosen, 2008; MRS, 2008; Dettmann and Dimitri, 2010; Schröck, 2013b). Only a few studies found either no verifiable systematic relationship or that organic food consumers have rather low incomes (Schletti, 2001; Cicia et al., 2002; Zepeda and Li, 2007). The finding that consumers with low incomes still consume organic food is according to Cicia et al. (2002) a 'proof of a new developing life and consumption style' (p. 207). In this case, factors other than the financial capabilities of a household may have been relevant for the choice of organic food. Zepeda and Li (2007) found no relation and concluded that as income does not explain organic food consumption, organic products, therefore, are no superior or luxury goods.

Contradicting evidence was found regarding the impact of children in the household. This aspect has been analysed in several studies because of an assumed higher health awareness and consciousness of parents in comparison to persons without children (Hill and Lynchehaun, 2002). In general, health is a strong motive for consumers to buy organic food (Wier et al., 2008, Hauser et al., 2011, Goetzke et al., 2014). Hence, if it is assumed that with the arrival of children in the household consumers are even more concerned about the ingredients of food and how food is produced, this may also affect quality choices. Consequently, at least some consumers may be more prone to choose organic food. A few studies found that households with children are less likely to consume organic food (e.g. Zepeda and Li, 2007; Jonas and Roosen, 2008), while most studies found the opposite (e.g. Davies et al., 1995; Thompson and Kidwell, 1998; Hill and Lynchehaun, 2002, Wier et al., 2008). It is important to note that this aspect is investigated in different ways. While some studies solely considered whether there was at least one child in the household, other studies also analysed the number of children and their age. Schröck (2013b), for example, considered the number of children in her analysis and found a lower probability to buy in households with three or more children.

Wier et al. (2008) and Riefer and Hamm (2009) showed that comparing households with children of different age groups may be worth investigating because the attitude towards organic food is likely to change as children get older. A reason for this is that small children influence the buying behaviour of their parents in an indirect way[22], while older children can (directly) express preferences and wishes in terms of what the family eats (ibid.). This may, for example, lead to a higher consumption of conventionally grown food. The consciousness for a healthy nutrition may also be overshadowed by the increasing cost of living as children get older. Most studies found that the presence of young children is positively related to organic food consumption (Cicia et al., 2002; Schröck, 2013b). Other studies found that the opposite is the case (Jonas and Roosen, 2008) or that the children' age does not influence organic food consumption systematically (Schletti, 2001; Dettmann,

[22] During pregnancy and with the arrival of children, parents are often more interested in health-related aspects of nutrition.

2008).

For Switzerland, only one study analysed the influence of children on organic consumption. Schletti (2001), by analysing organic food consumption based on data from 1998, found no significant evidence that children influence the organic buying quota. It is to be examined whether this result is still up-to-date.

The impact of the household size on consumption of or the attitude towards organic food has been investigated by some studies. An influence of the household size on organic food consumption can be assumed because the household's budget is shared among the number of people living in the household. It can, therefore, be expected that the more people live in a household, the more they will think about their consumption decisions as their budget per person becomes smaller. Scientific results obtained so far differ partly. On the one hand, a negative relationship between household size and the probability to consume organic food was found in some studies meaning that single households and small families are more likely to consume organic food than larger households (Schletti, 2001; Schröck, 2013b). However, opposite results exist as well (Zepeda and Nie, 2012). If it is assumed that households with one or two children are more likely to buy organic food than households with many children or no children at all, an inverse U-shaped buying probability is most likely; with the highest buying probability of medium-sized households.

The gender of the person(s) taking food-related consumption decisions in the household is of interest as it was considered in several household studies already. Most studies dealing with organic food consumption found that female consumers have a higher probability to consume or preference for organic food (Davies et al., 1995; Schletti, 2001; Valli and Traill, 2005; MRS, 2008; Zepeda and Nie, 2012; Schröck, 2013b). The reason for the assumingly higher buying probability of women may be an on average greater interest in and consciousness for a healthy lifestyle and nutrition. Furthermore, feeding children with healthy food may be another incentive for women to buy organic food (Schletti, 2001). Only few studies found no proof of a relationship between gender and organic food consumption (Magnusson et al., 2001; Zepeda and Li, 2007).

The age of consumers is another aspect worth investigating. Because the organic food market is a relatively young market, one may expect that mainly young consumers – eager to try new products – are interested in this market (Schröck, 2013a). Such generational effects might be one reason why consumers of different age groups behave differently. Then again, the price difference might hinder young consumers to buy products with a price premium if their incomes are low. One reason for a higher affinity to organic food among older consumers could not only be their partially better financial situation, but also their growing interest in healthy living and eating (ibid.). There are plausible reasons to anticipate the one or the other relationship between age and organic food consumption. While some studies identified older consumers to be more likely (Valli and Traill, 2005; Jonas and Roosen, 2008; Briz and Ward, 2009), others found that younger or middle-aged consumers preferred organic products more than older consumers (Davies et al., 1995; Schifferstein and Oude Ophuis, 1998; Cicia et al., 2002; Magnusson et al., 2001; Zepeda and Li, 2007; Dettmann and Dimitri, 2010). Schletti (2001) and Dettmann (2008), however, found no evidence that the age of the household's decision-maker matters for organic food consumption.

Few results can be found concerning the influence of the overall expenditure on food or consumed food quantities of households. How much a household spends on food for the consumption at home reflects not only its financial capabilities but also how interested the household members are in cooking and preparing meals at home. Some studies did not reveal a significant impact of the overall food expenses on organic consumption (e.g. Zepeda and Li, 2007). For Switzerland, Schletti (2001), however, showed that the organic buying quota increases the more food the household buys for home consumption. It is to be verified whether the results are still consistent because Schletti (2001) used a sample from 1998.

The level of education was examined in most studies. These studies revealed a positive correlation, showing that the more educated consumers are, the more likely they are to consume organic food (Schletti, 2001; Zepeda and Li, 2007; Dettmann, 2008; Schröck, 2013b). Only the study of Thiele (2008) found a negative relationship.

3.3 Data and methodology

3.3.1 *Survey design and sample*

For the first time since 2001 (Schletti, 2001), the Swiss Household Budget Survey (HBS, 2013) is analysed with regard to the consumption of organic food. The sample is representative in terms of the distribution of the residential population of Switzerland. To ensure the representativeness, the participating households are weighted according to their probability of being chosen from the register of private telephone lines and of taking part in the survey (e.g. based on their household size and the nationality of the household's main earner). Furthermore, a calibration procedure corrects these weights.

The Swiss Federal Statistical Office (FSO) collects the data on a monthly basis. Households participate only once in the survey and document the income and consumption data of every household member for the period of one month (repeated cross-sectional data). For this study, a sample covering the six-year observation period of 2006-2011 is used to analyse organic food consumption patterns in Switzerland. 19 599 Swiss households are investigated according to their socio-demographic structure and consumption decisions. The households record their expenditures and partly their consumed quantities for food and beverages in a diary while distinguishing their purchases between organic and conventional products.

3.3.2 *Variable description and summary statistics*

Most of the explanatory variables are based on the documented household structure in the HBS. Other variables are created by the authors based on the variables available in the survey.

The variable to be explained is the expenditure share for organic food and beverages for at home consumption. The organic expenditure share for each household h is the ratio of the expenditure on organic food and non-alcoholic beverages to the overall expenditure on organic and conventional food and non-alcoholic beverages for consumption at home:

$$share_{h,org} = \frac{expenditure_{h,org}}{expenditure_{h,org} + expenditure_{h,conv}} \qquad (4)$$

With regard to the characteristics of the household's decision maker, the information on the household member making the food consumption choices is most interesting. Since it cannot necessarily be assumed that the person that contributes the most to the household income is the one deciding upon food purchases[23], characteristics referring to so-called reference person (main earner) of the household are not considered in this analysis. As shown in previous studies, the gender and age of the decision maker are worth investigating. Because the HBS does not provide information on who the decision maker regarding food is, a variable to distinguish households with a female decision maker from other households is created for this analysis. The dummy variable 'single female adult' comprises households with a single woman and households with one female adult and a child or children[24]. For these household types, it can be assumed that a woman does the food shopping and takes the consumption decisions.

Regarding the age, three dummy variables for the presence of young (34 years and younger), middle-aged (35-54 years) and older (55 years and older) household members are included. The household size is accounted for by including a binary variable to distinguish single- from multi-person households. Furthermore, the household size in equivalences is calculated based on the number of children and adults living in the household. For that, the 'OECD-modified equivalence scale'[25] is used, assigning a value of 1 to the first adult of the household, 0.5 to every other

[23] Even though the employment rate of Swiss women is steadily increasing (1991: 68.2% – 2015: 79.8%, FSO, 2016c), it still can be assumed that part of the households in Switzerland still lives in traditional families nowadays, with the male working and the female looking after children and taking care of the household (especially in the 25-45 age group). In this case it is less clear who takes the food-related consumption decisions. Hence, doubts about the main earner (reference person) being equal to the decision maker are justified.
[24] Reference category: households with a single male person and households with more than one adult – with or without child/children.
[25] http://www.oecd.org/eco/growth/OECD-Note-EquivalenceScales.pdf

person over the age of 14, and 0.3 to every child living in the household (0-14 years).

Furthermore, the number of children (0-14 years) and a dummy for the presence of a small child (0-4 years) are considered in the analysis.

Because product availability and prices may vary over time, seasonal and time effects are considered. To cover year effects, dummies for each observation year are included. These year dummies interact with the canton[26] to account for year-specific effects in the different institutional areas of Switzerland. To account for seasonal effects, quarter dummies are further included in the model leaving out the first quarter to avoid multicollinearity.

A variable to distinguish rural from urban households is not available in the HBS (2013) sample. We, therefore, compare cantons with different shares of urban population, using additional data from the FSO (2014b). The households living in the cantons of Geneva and Zurich can be regarded as urban by 95 and 99%, respectively, because these cantons do not comprise much more than the agglomerations of Zurich and Geneva. In comparison, households in the cantons of Lucerne and Vaud have smaller shares of urban population (51% and 74%). By comparing the cantons Vaud and Geneva (for the French-speaking region), differences in organic food consumption that are caused by the area the households are living in are estimated. This is repeated for the German-speaking part of Switzerland by comparing the urban canton of Zurich with the more rural canton of Lucerne.

Two dummy variables are included in the model that refer to the linguistic region the households live in (German/Romansh and Italian) while excluding the dummy for households living in the French-speaking part of Switzerland.

The household’s financial capabilities are accounted for by including a dummy that takes the value 1 if the household lives only of social benefits or daily allowances[27], and is 0 otherwise. It can be expected that a budget constraint is one of the main

[26] The 26 cantons are the member states of the Swiss Confederation.
[27] Daily allowances are paid as compensation for people that become unemployed during the first 12 to 24 months.

obstacles to consume organic food. However, this might not be as relevant once a household decides to consume. The level of consumption, in this case the level of the expenditure share, is assumingly only partly influenced by the household's financial capabilities. Other (partly qualitative) factors such as preferences and attitudes might, however, also be decisive as suggested by the study of Vermeir and Verbeke (2008). Hence, the dummy for a household living only of social benefits and daily allowances is excluded from the second stage of the analysis.

The expenditure share of food consumption away from home includes food and non-alcoholic beverages consumed in restaurants, cafés, canteens etc. It is calculated as the ratio to the overall spending on food and non-alcoholic beverages (at home and away from home). The share spent on food away from home might affect the organic expenditure share as the latter refers to the consumption at home only.

Additionally, the overall expenditure on food and beverages is included in the model. The amount spent on food and beverages (in part) indicates the financial capabilities of the household. In this respect, the squared overall food expenditure is also included because it can be assumed that the expenditure on food and beverages does not increase linearly with increasing income. However, higher expenditure on food products for consumption at home might be related to the products a household buys and to how much it spends on organic food.

To capture the level of education, an approximation is used. The HBS enquires the level of education of each household member. According to the information provided by the FSO, this variable is, however, not reliable because of missing and incorrect data recording. Therefore, this variable is not used within the framework of this analysis. To capture the level of education, an approximation is used instead. This variable refers to the positive relationship between income and education. Most studies found that education influences the level of income positively. Therefore, income per wage-earning and/or retired household member is used for this analysis[28]. Because the information on how many employed and self-employed persons,

[28] Relevant persons are self-employed and employed persons, pensioners and persons in training. Hence, non-working adults ('others') and children are not considered relevant.

pensioners and persons in training are living in the household is part of the HBS, the average income/pension per working and/or retired person is calculated for each household and used as an approximation for the education level[29].

It should be taken into consideration that the earned income from employment, self-employment and pension might not necessarily reflect the level of education in every case, especially when household members work part-time. Working less than full-time is common in Switzerland, especially with the arrival of children. It can be expected that the earned income varies across households, depending on the existence and the number of children. In Switzerland, adults with children work less often full-time than adults without children. To control for variations across households with and without children, an interaction term of the education proxy and the number of children is added to the model. That way, it is possible to verify if the impact of income changes with an increasing number of children in the household.

Because it can be assumed that at least a portion of organic food consumers is health-conscious, health expenditures are also included in the analysis. These comprise the expenditure for the compulsory basic health insurance and for supplementary health insurances as well as other health expenditures. Furthermore, health awareness is considered by distinguishing households into those that purchased tobacco products during the observation period (i.e. smoker households) and those that did not.

The HBS sample does not include information on the environmental awareness of the households. To approximate, a dummy variable is included which takes the value 1 if the household owns at least one car or motorcycle and is 0 if the household does not own any.

Table 3.1, Table 3.2 and Table 3.3 give an overview of the dependent variable and the explanatory variables used within the framework of this analysis.

[29] The income of a pensioner is multiplied by 1.5, as pensioner households, on average, have two thirds of a working household's income (FSIO, 2011). In case of more than one income-/pension-earning person in the household, the average income is used.

Table 3.1: Means of the monthly observations (across all months) of the Household Budget Survey sample, by linguistic region (2006-2011)

	Total Switzerland	**German- and Romansh-speaking Switzerland**	**French-speaking Switzerland**	**Italian-speaking Switzerland**
Number of observations	**19 599**	**13 876**	**3918**	**1805**
(in %)		70.8	20.0	9.2
Households consuming organic food	**13 494**	**10 032**	**2320**	**1142**
(in %)	**68.9**	72.3	59.2	63.3
Organic expenditure share[1] (in %)	**6.4**	7.1	4.2	5.1
	(11.0)	*(11.6)*	*(8.7)*	*(9.9)*
Expenditure on food and beverages[2,3] (in Fr.)	**1052.28**	1045.66	1097.11	1005.88
	(579.32)	*(565.58)*	*(622.05)*	*(581.91)*
Food away from home consumption[2] (in Fr.)	**398.03**	408.59	387.05	340.73
	(356.60)	*(351.53)*	*(372.19)*	*(354.70)*
In % of total expenditure on food & beverages	**35.1**	36.5	32.2	30.8
	(21.3)	*(21.3)*	*(20.9)*	*(21.4)*
Household size (in equivalences)[4]	**1.60**	1.59	1.63	1.61
	(0.50)	*(0.50)*	*(0.51)*	*(0.48)*
Single-person households	**5311**	3853	999	459
(in %)	**27.1**	27.8	25.5	25.4
Share of households with child(ren) (0-14 years) (in %)	**26.7**	25.6	29.9	28.4
No. of children (0-14 years)	**0.46**	0.45	0.51	0.46
	(0.86)	*(0.86)*	*(0.88)*	*(0.82)*

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Table 3.1: ***continued***

	Total Switzerland	**German- and Romansh-speaking Switzerland**	**French-speaking Switzerland**	**Italian-speaking Switzerland**
Share of households with 1 child (in %)	**11.7**	10.9	13.4	14.2
Share of households with 2 children (in %)	**11.4**	11.0	12.7	11.4
Share of households with 3+ children (in %)	**3.6**	3.6	3.8	2.8
Share of households with a single female adult[5] (in %)	**18.7**	18.8	18.6	18.3
Share of smoker households (in%)	**26.0**	25.3	27.1	29.5
Share of households with 1+ cars / motorcycles (in %)	**83.5**	81.7	86.7	90.6
Health expenditure[6] (in Fr.)	**930.88** ***(582.62)***	903.70 *(571.77)*	1'002.23 *(631.29)*	984.91 *(536.91)*

All values in Swiss Francs (Fr.) have been adjusted for inflation (reference: December 2010)

[1] Food and beverages for consumption at home.
[2] Food and non-alcoholic beverages.
[3] Consumption at home and out of home, without alcoholic beverages.
[4] According to the OECD equivalence scale (1st adult = 1, every additional adult = 0.5, per child = 0.3).
[5] Single or single-parent household.
[6] Includes healthcare expenditures and premiums for the basic and supplemental health insurance.

Standard deviations in brackets

Source: HBS (2013), own calculations

Table 3.2: Means of the monthly observations (across all months) of the Household Budget Survey sample, canton of Bern (2006-2011)

	Canton of Bern	
Linguistic region	**German**	**French**
Number of observations	**2535**	**119**
(in %)	12.9	0.6
Households consuming organic food	**1853**	**68**
(in %)	73.1	57.1
Organic expenditure share[1] (in %)	9.9	5.3
	(12.4)	*(8.4)*
Expenditure on food and beverages[2,3] (in Fr.)	1005.66	1016.63
	(534.04)	*(558.21)*
Food away from home consumption[2] (in Fr.)	372.56	342.23
	(315.44)	*(310.10)*
In % of total expenditure on food & beverages	34.8	31.6
	(20.5)	*(21.0)*
Household size (in equivalences)[4]	1.58	1.67
	(0.50)	*(0.55)*
Single-person households	688	34
(in %)	27.1	28.6
Share of households with child(ren) (0-14 years) (in %)	24.4	37.8
No. of children (0-14 years)	0.41	0.66
	(0.81)	*(0.94)*
Share of households with 1 child (in %)	11.1	13.4
Share of households with 2 children (in %)	10.6	20.2
Share of households with 3+ children (in %)	2.7	4.2
Share of households with a single female adult[5] (in %)	20.9	17.6
Share of smoker households (in %)	23.7	37.0
Share of households with 1+ cars / motorcycles (in %)	81.0	89.1
Health expenditure[6] (in Fr.)	958.44	938.68
	(602.00)	*(566.38)*

All values in Swiss Francs (Fr.) have been adjusted for inflation (reference: December 2010).
[1] Food and beverages for consumption at home.
[2] Food and non-alcoholic beverages.
[3] Consumption at home and out of home, without alcoholic beverages.
[4] According to the OECD equivalence scale (1st adult = 1, every additional adult = 0.5, per child = 0.3).
[5] Single or single-parent household.
[6] Includes healthcare expenditures and premiums for the basic and supplemental health insurance.
Standard deviations in brackets

Source: HBS (2013), own calculations

Table 3.3: Means of the monthly observations (across all months) of the Household Budget Survey sample, by canton (2006-2011)

	Geneva	**Vaud**	**Zurich**	**Lucerne**
Linguistic region	**French**	**French**	**German**	**German**
Number of observations	**755**	**1580**	**3408**	**1059**
(in %)	3.9	8.1	17.4	5.4
Households consuming organic food	**502**	**950**	**2584**	**720**
(in %)	66.5	60.1	75.8	68.0
Share of urban population (in %)	**99.2**	**74.3**	**95.2**	**50.8**
Organic expenditure share[1]	5.8	4.1	8.8	5.7
(in %)	*(10.2)*	*(8.1)*	*(13.4)*	*(10.1)*
Expenditure on food & beverages[2,3] (in Fr.)	1120.80	1095.83	1089.07	1032.81
	(683.83)	*(630.49)*	*(603.36)*	*(531.37)*
Food away from home consumption[2] (in Fr.)	421.56	391.52	456.36	399.99
	(426.16)	*(380.51)*	*(386.89)*	*(336.36)*
In % of total expenditure on food & beverages	33.9	32.7	39.0	36.1
	(21.1)	*(21.2)*	*(21.9)*	*(20.7)*
Household size (in equivalences)[4]	1.59	1.60	1.64	1.64
	(0.50)	*(0.51)*	*(0.48)*	*(0.53)*
Single-person households	214	426	1112	270
(in %)	28.3	27.0	32.6	25.5

continued on the next page

Table 3.3: ***continued***

	Geneva	Vaud	Zurich	Lucerne
Share of households with child(ren) (0-14 years) (in %)	28.3	29.1	23.0	30.9
No. of children (0-14 years)	0.45	0.49	0.39	0.55
	(0.81)	*(0.86)*	*(0.81)*	*(0.93)*
Share of households with 1 child (in %)	13.8	13.5	10.5	12.4
Share of households with 2 children (in %)	12.5	12.3	9.7	14.2
Share of households with 3+ children (in %)	2.1	3.3	2.9	4.3
Share of households with a single female adult[5] (in %)	21.3	19.9	20.7	17.0
Share of smoker households (in %)	27.4	26.5	25.7	22.9
Share of households with 1+ cars / motorcycles (in %)	81.9	85.4	75.4	84.1
Health expenditures[6] (in Fr.)	1187.05	1012.12	937.80	823.79
	(817.33)	*(623.80)*	*(617.23)*	*(472.60)*

All values in Swiss Francs (Fr.) have been adjusted for inflation (reference: December 2010).
[1] Food and beverages for consumption at home.
[2] Food and non-alcoholic beverages.
[3] Consumption at home and out of home, without alcoholic beverages.
[4] According to the OECD equivalence scale (1st adult = 1, every additional adult = 0.5, per child = 0.3).
[5] Single or single-parent household.
[6] Includes healthcare expenditures and premiums for the basic and supplemental health insurance.
Standard deviations in brackets

Sources: HBS (2013), own calculations, FSO (2014b)

3.3.3 *Methodological framework and estimation model*

The purpose of this analysis is, first, to answer the question which (socio-demographic) factors determine the decision of Swiss households to buy organic food. Second, it should be investigated how the (socio-demographic) factors influence the level of organic food consumption. This analysis allows a differentiated investigation of which socio-demographics are relatively more important for the consumption decision and for the consumption level of Swiss households.

Methods often used to investigate consumers' attitudes towards and consumer behaviour regarding organic food are questionnaires (Chinnici et al., 2002; Cicia et al., 2002; Magnusson et al., 2003; Chen, 2007), interviews (Makatouni, 2002; Zanoli and Naspetti, 2002) and experiments (Stolz et al., 2011; Janssen and Hamm, 2012; Illichmann, 2013). These approaches can give insights into the buying motives of organic food consumers. However, it should be borne in mind that attitudes do not necessarily reflect how consumers behave in real shopping situations. It cannot be ruled out that how consumers behave when they buy food contradicts their initial buying motives (Vermeir and Verbeke, 2006; Hughner et al., 2007; Zepeda and Nie, 2012; Schröck, 2013b). To avoid this 'intention-behaviour-gap' (Carrington et al., 2010), the analysis of actual consumption data is an important complementary research activity.

The methodological approach applied within the framework of this study is the Heckman two-step estimation (Heckman, 1979). This procedure accounts for the fact that sample selection biases can occur in household surveys. In general, sample selection is an issue occurring within the framework of real consumption data because the variable of interest is only observed for a certain subset of the population. The reasons behind sample selection bias are in general twofold. Sample selection biases may, first, stem from the individuals that are being investigated in the study (self selection) and, second, from the data collection method used by the researchers.

In the context of this study, different potential biases are conceivable. One reason for non-randomly selected samples may be the different willingness of the Swiss population to participate in the HBS. The FSO contacts several hundred households every month of which only a share finally participates in the survey (between 222 and 324 households per month in our data sample). This potential bias is (at least in part) addressed by the FSO as mentioned above (see chapter 3.3.1). In order to ensure the representativeness of households in the HBS in relation to the total population of Switzerland, the participating households are weighted according to their probability of being selected from the register of private telephone lines and of participating in the survey (e.g. based on their household size and the nationality of the household's main earner). These weights are additionally corrected using a calibration procedure.

Regarding organic food consumption, self-selection biases may also occur due to seasonal effects. Seasonality might affect sample selection if the organic shopping basket of the household and how much the household spends on organic food varies across seasons. Seasonality is relevant for organic food consumption as, for example, Swiss-grown fruit and vegetables are not available throughout the whole year.

Other possible reasons behind sample selection biases may also be household-related or due to the design of the survey and the way data is recorded. For certain households and product groups, the observation period might be too short to observe the household's usual organic shopping behaviour. For example, a household might consume certain organic products, just not within the time that it records its consumption data for the HBS. Hence, the absence from consumption may not reflect the household's usual purchasing behaviour. In the HBS, the recording period is set to two weeks because the FSO considers this period to be sufficiently long enough to record the average consumption behaviour of a household regarding food and beverages[30]. As mentioned above, this observation period might not be long enough in every case.

Heckman's two-step estimation model, also referred to as Tobit II model, can account for different kinds of sample selection biases. For this study, the model is chosen because it can take into consideration that organic non-consumption is not random. Hence, it considers that the sub-sample of organic food consumers may be

[30] The data is then aggregated to the whole month.

non-randomly selected from the entire HBS sample.

Furthermore, Heckman's two-step estimation model is suitable to analyse data with a high degree of censoring which is relevant because the dependent variable, the organic expenditure share, includes a large share of zero observations. This means that only values of the variable of interest are observed if a certain threshold is exceeded. For values below the threshold, organic food consumption is zero.

The aim of Heckman's two-step estimation is to identify and estimate the influence of a vector of explanatory variables x'_{1i} on the expenditure share that a household spends on organic food for consumption at home s_i^* (1)

$$s_i^* = x'_{1i}\beta_1 + \varepsilon_{1i} \tag{5}$$

with β_1 as the corresponding parameters and ε_{1i} as the error term.

The share in equation (5) is denoted with an asterisk '*' because only those households that consumed organic food during the observation period are considered ($s_i = s_i^*$ if $s_i^* > 0$). Consequently, households are divided into consumers and non-consumers of organic food.

For the outcome equation, in which the organic expenditure share is estimated, it applies that:

$$s_i = s_i^*, \qquad c_i = 1 \qquad \text{if} \qquad c_i^* > 0 \tag{6}$$

$$s_i \text{ not observed}, \qquad c_i = 0 \qquad \text{if} \qquad c_i^* \leq 0 \tag{7}$$

Hence, in this part of the outcome model the expenditure share $s_i = s_i^*$ is only observed if the household is considered an 'organic food consumer' ($c_i = 1$). By contrast, households are not considered consumers of organic food ($c_i = 0$) if c_i^* is equal to or smaller than the threshold. In this case, s_i is not observed.

To capture the determinants of being an organic food consumer ($c_i = 1$) – thus explain the propensity to consume organic food – an equation that estimates whether a household participates in the organic food market or not is estimated. The following equation describes the dichotomous selection problem:

$$c_i^* = x_{2i}'\beta_2 + \varepsilon_{2i} \quad (8)$$

where x_{2i}' is a set of explanatory variables, β_2 are the corresponding parameters and ε_{2i} is the error term. c_i^* is not observed, but we observe whether the household consumes organic food or not. c_i^* is the measure (threshold) that divides households into consumers and non-consumers of organic food. For this study, c_i^* can be considered as the difference of a household's utility when the household consumes organic food and when it does not. The utility of 'consuming organic' is higher than the utility of 'not consuming organic' in cases where the household buys organic food ($Utility_{cons.}^{org.} > Utility_{no\ cons.}^{org.}$). In case of non-consuming households, this difference in utility is negative or zero ($Utility_{cons.}^{org.} \leq Utility_{no\ cons.}^{org.}$). These relationships are reflected in the following equations:

Organic food consumption: $c_i = 1 \quad \text{if} \quad c_1^* > 0$ (9)

No organic food consumption: $c_i = 0 \quad \text{if} \quad c_1^* \leq 0$ (10)

Equation (9) describes the case of a consuming household, equation (10) the case of a non-consuming household. While the described utility difference is positive in case of organic food consumption, households that do not consume organic food have a higher or equal utility from non-consumption than from consumption.

The aim of the selection model is to estimate the probability of success, thus, the probability that the household buys at least one organic food product during the observation period. Thereby, those variables that explain the participation decision ($c_i = 1$) are identified. The empirical model is specified as follows

$$Pr\{c_i = 1 | x_{2i}'\} = \Phi(x_{2i}'\beta_2) \quad (11)$$

where x_{2i}' represents the set of explanatory variables, β_2 are the corresponding parameters and Φ is the cumulative distribution function.

From the probit (binary choice) model, Heckman's lambda λ_i, the 'omitted variable' is calculated. λ_i accounts for possible sample selection biases. Omitting this term may lead to biased estimates of $\hat{\beta}_1$ in equation (5) if sample selection bias was present because the error terms of equations (5) and (8) were correlated in this case. If they were not correlated, one could estimate an OLS regression without the correcting term λ_i (Verbeek, 2012). λ_i is the inverse Mill's ratio, calculated as the ratio of the standard normal probability density function (ϕ) and the cumulative distribution function (Φ) of the probit model (stage one):

$$\lambda_i = \phi(x'_{2i}\hat{\beta}_2)/\Phi(x'_{2i}\hat{\beta}_2) \quad (12)$$

λ_i is then integrated into equation (5). Hence, the expected value of the organic expenditure share in the outcome equation (second stage) is specified as follows:

$$E(s_i|x_i, c_i = 1) = \beta_1 x'_{1i} + \beta_\lambda \lambda_i \quad (13)$$

with β_λ as the coefficient of the inverse Mill's ratio λ_i.

The use of Heckman's sample selection model requires excluding some explanatory variables from the outcome model that are in the selection model (Puhani, 2000). If no explanatory variables were excluded from the outcome model, collinearity problems might occur as λ_i is an 'approximately linear function' of the explanatory variables in this case (ibid.: 57). Six variables of the selection model (stage one) are, therefore, excluded from the outcome model: the seasonal (quarter) dummies, the education proxy, the interaction term of the education proxy and the number of children, and the dummy for a household living only of social benefits and daily allowances. Seasonal effects are likely to be decisive whether a household buys a certain product or not – especially in case of organic food. However, it is questionable that seasonal effects matter how much the household buys of a product once it decides to buy. Likewise, the level of education and whether a household lives only of social benefits and daily allowances might be more relevant for the decision to buy or not, and less for the level of consumption. Other factors might be more relevant for the share a household spends on organic food.

Within the framework of this study, the data is analysed for different regions. In the first model, the consumption of organic food is analysed for all regions of Switzerland. In addition, the analysis of the data is carried out for selected cantons

(Bern, Zurich/Lucerne and Geneva/Vaud). That way it is analysed whether the influence of the household characteristics on the consumption probability und level changes across regions.

3.4 Results and discussion

This section presents the regression results of Heckman's two-step estimation model. Different thresholds were investigated to distinguish consumers from non-consumers. Three threshold levels were tested: an organic share of greater than 0%, 2.5% and 5%. The variation of this value, however, does not change the results of the regression considerably. The threshold of being an organic food consumer is, therefore, set to (greater than) 0%. Consequently, households are considered 'organic food consumers' if they had bought at least one organic food product or non-alcoholic beverage for consumption at home during the observation period.

Table 3.4, Table 3.5 and Table 3.6 present the estimated coefficients of the probit and ordinary least squares regression. The selection (probit) model in the first stage is non-linear. Therefore, the marginal effects are reported in addition. These are evaluated at the means of the explanatory variables. In case of a dummy variable, the marginal effect for a discrete change of the dummy variable from 0 to 1 are reported while holding all other variables constant at their means (ceteris paribus assumption). The marginal effect describes the unit change in probability if an explanatory variable changes by some amount. The marginal effect facilitates the comparison between the effects of the explanatory variables on the probability to be an organic food consumer.

Table 3.4: Culture, socio-demographic household characteristics and other determinants of the organic food consumption decision and the level of the organic expenditure share, regression results of Heckman's sample selection model: coefficients and marginal effects

	Stage				
	Selection model			Outcome model	
Variable	**Coefficient**	**Std. Err.**	**Marginal effect**	**Coefficient / marginal effect**	**Std. Err.**
Culture:					
Dummy: household in German-speaking Switzerland	0.511***	0.038	0.184 †	0.031***	0.006
Dummy: household in Italian-speaking Switzerland	0.118	0.215	0.040 †	-0.006	0.025
Socio-demographics:					
Household size (equivalences)[a]	-0.294***	0.050	-0.101	-0.017**	0.006
Dummy: single household	-0.111**	0.039	-0.039 †	0.011*	0.004
Dummy: single female adult household[b]	0.272***	0.035	0.089 †	0.022***	0.004
No. of children in the household	-0.145**	0.029	-0.050	-0.009***	0.002
Dummy: small child (0-4 years)	0.105***	0.040	0.035 †	0.023***	0.004
Dummy: smoker household	-0.228***	0.022	-0.080 †	-0.021***	0.003
Dummy: household with car(s)	-0.165***	0.029	-0.055 †	-0.044***	0.003
Dummy: young adult(s) (15-34 years)	-0.006	0.033	-0.002	-0.012**	0.003
Dummy: middle-aged adult(s) (35-54 years)	-0.041	0.031	-0.014	0.010**	0.003
Dummy: older adult(s) (over 55 years)	-0.134***	0.035	-0.046	-0.014***	0.004

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Table 3.4: ***continued***

Variable	Stage: Selection model – Coefficient	Selection model – Std. Err.	Selection model – Marginal effect	Outcome model – Coefficient / marginal effect	Outcome model – Std. Err.
Financials:					
Health expenditure	0.000***	0.000	0.000	0.000***	0.000
Expenditure on food and non-alc. beverages	0.001***	0.000	0.000	0.000***	0.000
(Expenditure on food and non-alc. beverages)^2	-0.000***	0.000	-0.000	-0.000*	0.000
Expenditure share of food away from home	-0.734***	0.053	-0.252	0.015*	0.008
Education of the household members[c]	0.000***	0.000	0.000	*excluded*	
<u>*Interaction term*</u>: education*no. of children	0.000**	0.000	0.000	*excluded*	
Dummy: household living only of social benefits and daily allowances	0.084**	0.025	0.029 †	*excluded*	
Time:					
Dummy: 2nd quarter of the year	0.041	0.028	0.014 †	*excluded*	
Dummy: 3rd quarter of the year	-0.061*	0.027	-0.021 †	*excluded*	
Dummy: 4th quarter of the year	-0.080**	0.028	-0.028 †	*excluded*	

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Table 3.4: ***continued***

		Stage				
		Selection model			**Outcome model**	
Variable		**Coefficient**	**Std. Err.**	**Marginal effect**	**Coefficient / marginal effect**	**Std. Err.**
Year-specific effects in the cantons (interaction term)[††]*:*						
Zurich:	2007	-0.160(*)	0.084	0.673	0.006	0.008
Zurich:	2008	-0.142(*)	0.083	0.679	-0.003	0.008
Zurich:	2009	-0.097	0.086	0.693	-0.003	0.008
Zurich:	2010	0.037	0.088	0.734	0.009	0.008
Zurich:	2011	-0.158(*)	0.086	0.673	0.005	0.008
Bern:	2006	-0.044	0.091	0.709	-0.009	0.009
Bern:	2007	-0.050	0.091	0.708	-0.015(*)	0.009
Bern:	2008	-0.113	0.091	0.688	-0.012	0.009
Bern:	2009	-0.213*	0.088	0.655	-0.014	0.009
Bern:	2010	-0.084	0.089	0.697	-0.020*	0.009
Bern:	2011	-0.091	0.090	0.695	0.003	0.009

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Table 3.4: ***continued***

		Stage				
		Selection model			Outcome model	
Variable		**Coefficient**	**Std. Err.**	**Marginal effect**	**Coefficient / marginal effect**	**Std. Err.**
Year-specific effects in the cantons (interaction term)††:						
Lucerne:	2006	-0.366**	0.121	0.603	-0.039**	0.014
Lucerne:	2007	-0.093	0.118	0.694	-0.027*	0.012
Lucerne:	2008	-0.379**	0.112	0.598	-0.022(*)	0.012
Lucerne:	2009	-0.238*	0.119	0.647	-0.026*	0.012
Lucerne:	2010	-0.271*	0.117	0.636	-0.004	0.012
Lucerne:	2011	-0.025	0.128	0.715	-0.039**	0.013
St. Gallen:	2006	-0.100	0.118	0.692	-0.018	0.012
St. Gallen:	2007	-0.252*	0.117	0.642	-0.021(*)	0.013
St. Gallen:	2008	-0.139	0.114	0.680	-0.048***	0.012
St. Gallen:	2009	-0.282**	0.119	0.632	-0.015	0.013
St. Gallen:	2010	-0.369***	0.117	0.602	-0.017	0.013
St. Gallen:	2011	-0.085	0.125	0.697	-0.006	0.012

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Table 3.4: ***continued***

Variable		Stage				
		Selection model			Outcome model	
		Coefficient	Std. Err.	Marginal effect	Coefficient / marginal effect	Std. Err.
Year-specific effects in the cantons (interaction term)[††]*:*						
Aargau:	2006	-0.172	0.109	0.669	-0.011	0.011
Aargau:	2007	-0.168	0.105	0.670	-0.027*	0.011
Aargau:	2008	-0.169	0.109	0.670	-0.015	0.011
Aargau:	2009	-0.235**	0.107	0.648	-0.014	0.011
Aargau:	2010	-0.144	0.111	0.678	-0.015	0.011
Aargau:	2011	-0.155	0.114	0.674	-0.012	0.011
Ticino:	2006	-0.044	0.236	0.710	0.012	0.027
Ticino:	2007	-0.038	0.235	0.712	0.009	0.027
Ticino:	2008	-0.064	0.233	0.703	0.008	0.027
Ticino:	2009	-0.029	0.234	0.714	0.021	0.027
Ticino:	2010	0.058	0.236	0.740	0.020	0.027
Ticino:	2011	0.168	0.237	0.772	0.007	0.027

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Table 3.4: *continued*

		Stage				
		Selection model			Outcome model	
Variable		Coefficient	Std. Err.	Marginal effect	Coefficient / marginal effect	Std. Err.
Year-specific effects in the cantons (interaction term)[††]*:*						
Vaud:	2006	-0.080	0.113	0.698	-0.017	0.013
Vaud:	2007	0.038	0.104	0.734	-0.012	0.011
Vaud:	2008	-0.299**	0.106	0.626	-0.018	0.013
Vaud:	2009	-0.067	0.110	0.703	-0.009	0.012
Vaud:	2010	-0.075	0.105	0.700	-0.022(*)	0.012
Vaud:	2011	0.116	0.111	0.757	-0.012	0.012
Geneva:	2006	-0.014	0.142	0.719	-0.007	0.016
Geneva:	2007	-0.108	0.136	0.689	-0.010	0.016
Geneva:	2008	0.086	0.140	0.749	-0.010	0.015
Geneva:	2009	0.091	0.133	0.750	0.008	0.014
Geneva:	2010	0.294*	0.145	0.804	0.008	0.015
Geneva:	2011	0.243(*)	0.146	0.792	0.021	0.015

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Table 3.4: *continued*

		Stage				
		Selection model			Outcome model	
Variable		**Coefficient**	**Std. Err.**	**Marginal effect**	**Coefficient / marginal effect**	**Std. Err.**
Year-specific effects in the cantons (interaction term)[††]*:*						
Others[d]:	2006	-0.222**	0.076	0.652	-0.021**	0.008
Others:	2007	-0.124(*)	0.075	0.684	-0.005	0.008
Others:	2008	-0.156*	0.075	0.674	-0.013(*)	0.008
Others:	2009	-0.187*	0.075	0.664	-0.018*	0.008
Others:	2010	-0.135(*)	0.075	0.681	-0.017*	0.007
Others:	2011	-0.090	0.077	0.695	-0.009	0.008
Constant term		-0.133	0.108		0.079***	0.016
lambda					*0.031**	*0.015*
Number of observations:		**19599**			**Wald chi^2 (69):**	**779.94**
Censored observations:		**6105**			**Prob > chi^2:**	**0.000**
Uncensored observations:		**13494**				
Pseudo R^2 (Selection model):		**9.1%**				
R^2 (Outcome model):		**6.5%**				

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Table 3.4: ***continued***

<u>Significance levels</u>: (*) <0.1, * <0.05, ** <0.01, * <0.001**

<u>Dependent variable – Selection model</u>: dummy 'organic household' = 1 if at least one organic product (for home consumption) was bought during the observation period; otherwise 0.

<u>Dependent variable – Outcome model</u>: organic expenditure share = expenditure on organic food / expenditure on organic and conventional food (for home consumption).

lambda (λ): 'omitted variable', the inverse Mill's ratio, corrects for sample selection bias.

[a] According to the OECD equivalence scale (1st adult = 1, other adults = 0.5, child = 0.3).

[b] Single or single-parent household.

[c] Considering working and retired household members.

[d] Other cantons: Uri, Schwyz, Obwalden and Nidwalden, Glarus, Zug, Fribourg, Solothurn, Basel-Stadt and Basel-Landschaft, Schaffhausen, Appenzell Ausserrhoden and Appenzell Innerrhoden, Graubünden, Thurgau, Valais, Neuchâtel, and Jura.

[†] Marginal effect for a discrete change of the dummy variable from 0 to 1, keeping all other covariates at their means.

[††] The marginal effect is the marginal probability if the household was located in the particular canton and consumed in the particular year.

Source: own calculations

Table 3.4 presents the regression results of the model comprising all cantons and regions of Switzerland in detail. The coefficient λ_i (the inverse Mill's ratio) which accounts for possible sample selection biases is significant at the 5% level, supporting the use of Heckman's two-step estimator.

The model accuracy is measured using Pseudo R^2 for the selection model and R^2 for the outcome model. With values between 6.5% and 11% (see Table 3.4, Table 3.5 and Table 3.6) the models fit the data relatively well (compared to other organic food studies). The reference household chosen in the overall model (Table 3.4) participated in the first quarter of the year, is a multiperson household with a male decision maker or several decision makers, has no small children and lives in the French-speaking part of Switzerland. Furthermore, the reference household does not smoke, does not only live of social benefits or daily allowances and does not own a car.

The dependent variable of stage one (selection model) is a binary dummy which takes the value 1 if a household has consumed at least one organic product during the period of observation and is 0 otherwise. The variable to be explained in the outcome model is the expenditure share for organic food and non-alcoholic beverages for consumption at home.

3.4.1 *Culture as a determining factor of organic food consumption*

As explained in chapter 3.2.1, the relationship between culture (language) and consumption is of interest for the Swiss case because four official languages are spoken in distinct regions. The results of past studies have shown that the cultural background influences the consumption of food (e.g. Askegaard and Madsen, 1998; Schletti, 2001; Aepli and Finger, 2013).

The results in Table 3.4 confirm the cultural segregation (*Röstigraben*) between the German- and the French-speaking part of Switzerland that also Askegaard and Madsen (1998) found – however not between the French- and the Italian-speaking part. According to the results, households in the German-speaking part are more likely to consume organic food and, if they decide to consume, spend a higher share of their food budget on organics than their French-speaking neighbours (previously also found in Schletti, 2001). Comparing the French- to the Italian-speaking part, we find that households in Italian-speaking Switzerland are not more or less likely to be consumers of organic food than the French-speaking. Furthermore, significant differences regarding the level of expenditure between the two linguistic regions cannot be proven. Consequently, there are no verifiable differences regarding the expenditure level of households in the French- and Italian-speaking region. This does not mean that there are no differences at all. Potentially there are small differences and a certain overlap resulted in this non-verifiable result. Aepli and Finger (2013), for example, found significant differences in sheep and goat meat consumption. Hence, it is not unlikely that some differences in organic food consumption exist as well. Askegaard and Madsen (1998) showed that both Italy and the French-speaking region of Europe care about ‘sensory enjoyment’ (p. 559) regarding food, even though they state that French-speaking Romandy is ‘very different from the rest of Switzerland’ (p. 562). Even if the food cultures of the French- and Italian-speaking part differ, similarities in how food is chosen may lead to non-verifiable differences for the two regions.

To exploit the influence of culture and language on organic food consumption in isolation from the institutional setting, another model is estimated that comprises only those households that live in the bilingual canton of Bern (Table 3.5). In Switzerland, three out of 26 cantons are bilingual (German and French – Bern, Fribourg and Valais), and the canton of Grisons has three official languages (German, Italian and Romansh). However, Bern is the only canton that is reported separately in the HBS[31]. Because the language border cross-cuts the canton, Bern is segregated into a French- and a German-speaking part. These households live in even more similar institutional environments. Hence, in this case cultural differences can be explored more precisely than in the intercantonal comparison because the institutional differences are not part of the language variable.

[31] The HBS groups the cantons of Fribourg, Valais and Grisons together with 15 other cantons into the category ‘other cantons’.

Table 3.5: Selected regression results of Heckman's sample selection model: canton of Bern (2006-2011)

	Stage							
	Selection model					Outcome model		
Variable	**Coefficient**		**Std. Err.**	**Marginal effect**		**Coefficient / marginal effect**		**Std. Err.**
Household in German-speaking Switzerland	0.406	**	0.126	0.143	†	0.040	*	0.016
(Other variables omitted)								

Number of observations:	**2654**	**Wald chi² (20):**	**143.24**
Censored observations:	**733**	**Prob > chi²:**	**0.000**
Uncensored observations:	**1921**		
Pseudo R^2 (Selection model):	**11.0%**		
R^2 (Outcome model):	**7.4%**		

Significance levels: (*) <0.1, * <0.05, ** <0.01, * <0.001**

† Marginal effect for a discrete change of the dummy variable from 0 to 1, keeping all other covariates at their means.

Source: own calculations

The explanatory values (Pseudo R^2/R^2) of the Heckman model for the canton of Bern (Table 3.5) are higher in both stages compared to the overall model (Table 3.4). The higher coefficients of determination hint that – regarding structure and consumption behaviour – the households vary less than in the overall sample. More similar preferences and habits might be another explanation. The result of the language variable is depicted in Table 3.5 and supports the finding of the overall model (Table 3.4). While the results for the remaining explanatory variables (which are omitted in Table 3.5) do not differ much from those depicted in the overall model (Table 3.4), we observe that the marginal effects of the language variable have the same sign in both models but differ in their level. The *Röstigraben* that we observe in the overall model can also be proven for the canton of Bern. Thus far, and to the best of our knowledge, the influence of culture on organic food consumption has not been studied for such similar institutional environments.

The participation rate in the organic food market in Bern does not differ much from the Swiss average (72% vs. 69%). The same is true for the probability of being an organic food consumer in the German-speaking part of Bern. The German language is positively related to the decision to buy organic food (consistent with the finding in Table 3.4). However, the level of influence (marginal effect) is lower for households in the German-speaking part of Bern than it is in the overall model. In contrast, the influence of the German language on the organic expenditure share is larger in Bern than in the model comprising all cantons of Switzerland. This suggests that households in the German-speaking part of Bern have on average an organic expenditure share which is by 57% higher than that of households in the French-speaking part of the canton (≙ +4 percentage points). In comparison, the expenditure share of organic food consumers in the German-speaking part of the whole of Switzerland is on average 48% higher (≙ +3.1 percentage points) (Table 3.4). Hence, in both models it can be shown that households in the French-speaking part spend on average a smaller share of their food budget on organic products. This finding suggests that the language variable in the overall model might include some other information than cultural (language) aspects. The difference in the marginal effects of the Bern model and the overall model, among other things, might be related to differences with respect to the institutional setting. Whereas the institutional environment across one canton is very similar (even if it covers two linguistic regions like in Bern), differences in the institutional framework might explain in part how households behave in different cantons.

3.4.2 *Rural-urban differences in organic food consumption*

Another cultural aspect likely influencing the consumption behaviour is whether a household lives in a rural or urban region which was previously proven by Askegaard and Madsen (1998) for the European level. Several other studies showed that there are differences between rural and urban households (see chapter 3.2.1). For the Swiss case, Schletti (2001) hypothesised that urban households are on average more open-minded than rural households and would therefore consume organic food more often than rural households. The HBS (2013) sample does not document whether the participating households live in an urban or a rural community. Therefore, an approximation to reveal consumption differences is used. To do so, additional data from the FSO (2014b) is utilised to distinguish the cantons based on their share of urban population into rural and urban cantons. Consequently, it is analysed how households in the urban canton of Geneva behave in comparison to households in the rather rural canton of Vaud (for the French-speaking region). In another model, the same is done for the German-speaking part of Switzerland by comparing the canton of Zurich (urban) to Lucerne (rural)[32]. The results of the rural-urban comparison are presented in Table 3.6 and unlike Schletti (2001) show differences between urban and more rural regions.

[32] Urban population: Geneva: 99.2% vs. Vaud: 74.3%, Zurich: 95.2% vs. Lucerne: 50.8%

Table 3.6: Selected regression results of Heckman's sample selection model: rural-urban comparison in two linguistic regions (2006-2011)

	Stage							
	Selection model					Outcome model		
Variable	Coefficient		Std. Err.	Marginal effect		Coefficient / marginal effect		Std. Err.
***Zurich-Lucerne model* (German-speaking Switzerland):**								
Urban household (Zurich)	0.152	**	0.050	0.048	†	0.031	***	0.007
***Geneva-Vaud model* (French-speaking Switzerland):**								
Urban household (Geneva)	0.166	**	0.059	0.062	†	0.010		0.006
(Other variables omitted)								

***Zurich-Lucerne model*:**			
Number of observations:	**4467**	**Wald chi^2 (20):**	**229.70**
Censored observations:	**1163**	**Prob > chi^2:**	**0.000**
Uncensored observations:	**3304**		
Pseudo R^2 (Selection model):	**10.0%**		
R^2 (Outcome model):	**7.9%**		

continued on the next page

Table 3.6: ***continued***

<u>Geneva-Vaud model</u>:			
Number of observations:	**2335**	**Wald chi^2 (20):**	**95.36**
Censored observations:	**883**	**Prob > chi^2:**	**0.000**
Uncensored observations:	**1452**		
Pseudo R^2 (Selection model):	**6.5%**		
R^2 (Outcome model):	**6.5%**		

<u>Significance levels</u>: (*) <0.1, * <0.05, ** <0.01, * <0.001**

† Marginal effect for a discrete change of the dummy variable from 0 to 1, keeping all other covariates at their means.

Source: own calculations

The results show that there are detectable differences between urban and rural cantons. For the German-speaking part of Switzerland (Zurich-Lucerne model), the first stage (selection) indicates a higher probability to consume organic food in the canton of Zurich in comparison to more rural Lucerne. Furthermore, households in Zurich, if they consume organic food, also spend significantly more of their budget on organic food than households in Lucerne. The higher probability to consume organic food in the urban area can also be proven for the French-speaking part of Switzerland even though the share of consuming households is below the Swiss average and lower than in the Zurich-Lucerne sample (62% in Geneva/Vaud vs. 74% in Zurich/Lucerne). Households in urban Geneva also participate in the organic market at a higher probability than households in more rural Vaud. However, it cannot be proven that organic food consumers in Vaud spend significantly more or less than those in Geneva. Note that the explanatory value of the outcome model of the Geneva-Vaud model is rather low (6.5%, Table 3.6). Obviously, the model is less capable of explaining organic food consumption than the Zurich-Lucerne model is (7.9%). A high variation across households in the two cantons (Geneva and Vaud) and greater differences in preferences could explain this. Another reason could be that the French-speaking part of Switzerland has a lower participation rate in the organic food market overall and consumes organic food at a lower rate in comparison to the German- and Italian-speaking part of Switzerland. Furthermore, the average expenditure share of organic food consumers in Geneva and Vaud (8.7% vs. 6.8%) does not differ as much as it does in the cantons of Zurich and Lucerne (11.7% vs. 8.3%).

Comparing the results to other studies shows that rural-urban differences could also be found for other countries. Zhang et al. (2008), Wier et al. (2008) and Schröck (2013a) also found urban households being more prone to organic food consumption. Zhang et al. (2008) and Wier et al. (2008) did not specify the reasons why organic food consumption is higher in urban areas. Zhang et al. (2008) only stated that organic expenditures are higher in urban areas because the propensity to consume is higher. Schröck (2013a) assumed that the lacking connection to agricultural production and a higher income in urban areas could be reasons. Urban households may therefore feel less confident about the quality of food and might, therefore, opt for organic products which they also consider to be safer than conventional ones.

3.4.3 *Socio-demographic factors*

The regression results in Table 3.4 indicate that the household size is negatively related to organic food consumption. Hence, the more people live in a household, the less likely is the household to consume organic food. This was previously also found for the Swiss case by Schletti (2001). The second part of the analysis reveals that the larger the household is, the less it spends on organic food relative to its total expenditure on food and non-alcoholic beverages for consumption at home. Interestingly and in contrast to Schletti (2001), single-person households are also less likely to be organic buyers compared to households with more than one person (Schröck, 2013a, found this only for certain organic products). This is in line with the study of Zepeda and Nie (2012) who identified the most probable consumer group as that with more than one adult in the household. The results of this study, however, show that if a single household decides to consumer organic food, it spends on average a higher share of its budget on organic food than households with more than one person. On the one hand, it can be assumed that small households are less often restricted in their food budget per person in comparison to larger households. However, even though if we assume single households to be less restricted in their food budget, they might still spend less on food for consumption at home. Hence, single and larger households are still interesting consumer groups, even though they are to date less often among the organic food consumer group than medium-sized households.

The results in Table 3.4 show that households with a female decision maker are on average more likely to be among the organic food consumer group and spend a considerably higher share of their budget on organic food. This result comes as no surprise as several studies have found women to be more likely to participate in the organic food market than men (e.g. Davies et al., 1995; Schletti, 2001; Valli and Traill, 2005; MRS, 2008; Zepeda and Nie, 2012; Schröck, 2013b). According to our results, the organic expenditure share of a household with a woman doing the food shopping is on average by 34% (≙ +2.2 percentage points) higher in comparison to households with a single male decision maker or households in which consumption decisions are taken by more than one adult. This higher affinity towards organic food in women may be related to a greater interest in and awareness for a healthy way of living and nutrition, preparation of meals at home and the fact that women are more likely to be responsible for the food shopping in the household (Lockie et al., 2004; Dettmann and Dimitri, 2010). In this context, children might also play a role whether a female decision maker buys organic food. As Schröck (2013a) showed, women buy baby food more often in organic quality than men do. Hence, providing a healthy diet for children is a strong incentive for women to buy organic food. This study confirms that the presence of a small child (0-4 years) is positively related to the probability of being an organic food consumer. We further find that households with small children are not only more likely to be organic food consumers but also spend on average 36% (≙ +2.3 percentage points) more of their food budget on organic food than households without a small child. It can be assumed that the health aspect is one of the reasons for the consumption decision. The number of children, however, is negatively related to organic food consumption (Schröck, 2013a, only confirmed this for certain products). The health aspect might still be important with the presence of more and older children living in the household. However, the financial disadvantage of buying a product with a price premium might outweigh the (assumed) health benefits of organic food in this case. Furthermore, the decision which food is bought might be taken not only by the parents once children get older and are able to express their own preferences. Buying a food product in organic quality may not be of equal importance for children and adults which could lead to less or no consumption of organic food in this case.

Regarding the age of the adults living in the households (which is related to the family composition), we cannot prove that the presence of young (15-34 years) and middle-aged (35-54 years) adults influences the probability to consume organic food. However, the results show that the presence of older adults (over 55 years) in the household is negatively related to organic food consumption. Accordingly, older consumers belong less often to the group of organic food consumers. This result is somewhat unexpected as it is not unreasonable to assume older consumers to be increasingly health-conscious and thus be organic food consumers at a higher probability as hinted by a study comparing Danish and British consumers (Wier et al., 2008) and a German study (Jonas and Roosen, 2008). These studies found that health awareness increases with age. What hinders older consumers in Switzerland to buy organic food cannot be determined in this study. Zepeda and Nie (2012) hinted that older consumers are more conservative which also affects their food choice. This could also be the case in the HBS sample. Schröck (2013a) found mixed results depending on the product. This might be another reason why there is no clear relation between age and the propensity to consume in this study.

Regarding age and the share spent on organic food (outcome model), the regression results are clearer. The results indicate a U-shaped relationship between age and the organic expenditure share. Even though there is no verifiable relationship between the middle-aged class and the probability to buy organic food, households with middle-aged adults spend on average more on organic food than households with younger or older adults. More precisely, if young or older adults live in a household, the household spends on average 19% and 22%, respectively, less on organic food (≙ -1.2 and -1.4 percentage points). The motives for the higher consumption of households in the middle age group can only be conjectured. The assumingly better financial capabilities of households in this age group could explain this. By contrast, younger consumers may not be able to buy organic food because of their limited budget. Furthermore, it can be expected that households with middle-aged adults are often those with children. This could influence organic food consumption positively as shown above.

Regarding time effects, seasonal and yearly effects are considered in the analysis. As mentioned in chapter 3.2.2, if organic food consumers are expected to be environmentally conscious, seasonal effects are at least as relevant as for consumers of conventional products. The regression results for the seasonal variables are, however, mixed. In comparison to the reference scenario – the first quarter of the year – the average Swiss household is less likely to buy organic food in the third and fourth quarter of the year. This might be the result of seasonal price fluctuations and product availability. Whereas the prices of milk and meat products are not very volatile throughout the year, the consumer basket of e.g. organic fruit and vegetables is subject to stronger seasonal price changes. The basket is most expensive in the months of July to September, i.e. the third quarter of the year (because the range of Swiss-grown fruit and vegetables is largest). High prices are an obstacle to buy organic food (chapter II) and might explain the negative relationship between the third quarter and the organic buying probability. In the fourth quarter of the year consumers are potentially more reluctant to buy organic food because of the holidays. It can be assumed that at least part of the analysed households spends a higher share of their budget on other things than their daily nutrition (e.g. presents, serving of guests with food and drinks) compared to the other quarters of the year. In this case, households may offset the higher financial burden by choosing cheaper, thus non-organic, food products. Across all products, the results are difficult assess. The study of Schröck (2013a) hinted that seasonality varies across products. For example, consumers opt for higher quality (e.g. organic) meat during barbecue season. Certain vegetables, however, are in season at a different time of the year. Therefore, it is less surprising that the influence of the season is not as clear in this study.

In addition to seasonal effects, the model also considers year-specific effects in the different cantons. However, we do not observe verifiable differences between the observation year in the different cantons and the organic food consumption decision and level. The short observation period might be one explanation. Hence, organic food consumption might not differ enough over time to detect clear differences.

To assess the influence of the financial capabilities of the household, the overall expenditure on food and non-alcoholic beverages, the share spent on food away from home, an approximation of the education level, and a dummy for households living only of social benefits and daily allowances are included in the model (see chapter 3.3.2). The overall expenditure on food and beverages neither have a positive nor negative influence on organic food consumption (Table 3.4). Hence, if a household increases its overall food expenditure, the probability and the share spent on organic food does not change on average. In the past, Schletti (2001) found a different result for her observation period (1998). At that time, the consumption of organic food was positively related to the total consumption of food. Schletti (2001) assumed that households that buy more food overall have an on average greater interest in food and nutrition, and therefore are not deterred by the organic price premium.

In contrast, if the expenditure share for food away from home increases, the probability to consume organic food decreases. Hence, households which often consume food away from home are less likely to be organic consumers. At the same time, the share that a household spends on organic food for consumption at home is positively related to the expenditure share for food away from home. The overall sample might, on the one hand, include a fair share of households that show little interest in preparing food at home and, therefore, prefer to eat out. On the other hand, organic food consumption, a healthy nutrition and eating out might not necessarily be contradictory because more and more restaurants offer organic food and other special options (local, dairy free, vegan etc.).

The education proxy which is the average income earned per working or retired household member is only included in the selection model. Contrary to Zhang et al. (2008) and Schröck (2013a) who found higher probabilities of being an organic food consumer for higher educated and richer households, this analysis shows that the financial contribution of each working or retired household member to the household's overall budget does not influence the share that is spent on organic food in a positive or negative way. Consistent with the findings for the overall expenditure on food and beverages, the result for the education level shows an influence on the buying probability of nearly zero. Accordingly, whether a household buys organic food or not is not depending on the level of education. Furthermore, the coefficient close to zero suggests that the financial aspect of buying a product with a price premium is less important than one might expect; possibly because of the on average high income level in Switzerland overall. The latter is supported by the fact that living only of social benefits and/or daily allowances has a positive impact on the purchasing probability of organic food. Even though receiving social benefits and/or daily allowances increases the financial capabilities of a household, it can still be assumed that those households rather belong to the group of low-income earners.

That households that live only of social benefits or daily allowances still buy organic food must, therefore, be attributed to other factors than their income. Factors such as a strong belief in organic farming or habitual behaviour could be relevant in this case.

Whether the health aspect is important to the average Swiss organic food consumer is investigated using two variables: health expenditure and a dummy for a smoker household. However, health expenditures do not influence organic food consumption in a positive or negative way – neither the purchase probability nor the expenditure level. By contrast, it can be shown that households with smokers belong less often to the group of organic food consumers. And if they do, they spend proportionally less on organic food. This suggests that there is a relationship between health awareness and organic food consumption. Obviously organic food consumers are on average more health-conscious (also found in Zepeda and Nie, 2012) and can be found less often among the group of smokers.

Whether organic food consumers are not only more health- but also more environmentally conscious than non-organic consumers is investigated by using an approximation. For that, a distinction is made between households with cars or motorcycles and those without any. The analysis proves that households with motor vehicles are significantly less likely to be organic food consumers than households without any (also found in Zepeda and Nie, 2012). According to Zepeda and Nie (2012), consumers 'having high environmental concern' (p. 473) are more likely to be organic food consumers. In our study, it can further be shown that even if households with a motor vehicle decide to consume organic food, they still spend less on organic food. This may hint that organic food consumers are more environmentally conscious and therefore use public transportation systems instead of a car or motorcycle. However, the result could also indicate that organic food consumers rather live in urban areas with good connections to public transportation systems and are, therefore, less dependent on owning a car or motorcycle (see also chapter 3.4.2).

3.5 Conclusions and outlook

In a dynamic and fast changing market as that for organic food, up-to-date information is needed to 'help guide those making organic marketing and production decisions' (Dettmann and Dimitri, 2010: 89). The motivation for this study was to measure the influence of culture on organic food consumption and reveal the characteristics of the 'average' organic food consumer in Switzerland.

The Heckman two-step estimation reveals that culture matters for the consumption of organic food. Accordingly, the average Swiss organic food consumer lives in an urban environment on the German-speaking side of the *Röstigraben*, in a rather small household but not necessarily a single household. Furthermore, organic food consumers are more often women than men and small children are a strong incentive to purchase organic. Moreover, the lifestyle of organic food consumers differs from that of other consumers. Accordingly, smoking, driving a car and eating out is something that organic food consumers do less often. Interestingly, consumers that live only of social benefits or daily allowances have a higher probability of belonging to the group of organic buyers.

Comparing organic food consumers with one another we find that small and single households, households with a female decision maker and those located in German-speaking Switzerland, households with small children and middle-aged adults spend a higher share of their budget on organic products whereas large households and those with many children, smokers and those owning a car consume proportionately less organic food. Target-group specific marketing might be worthwhile because the reasons for consumption most likely differ, for example, between single and large households. While a budget restriction might be relevant for larger households, one reason for organic non-consumption of single households might be a lower motivation to prepare meals at home. The results suggest that if it was possible to convince single households to prepare more meals at home instead of eating out, they might spend a higher proportion of their food budget on organic food. Hence, marketing campaigns might emphasise a good price-performance ratio when larger households are addressed and an easy preparation of the product when single-person households are the target group.

The coefficient of determination shows that some important influencing variables could not be included in the regression models. These are possibly qualitative factors such as underlying preferences, attitudes or habits. Certain issues were only covered by approximations (attitudes towards health and the environment, the education level). Using additional data sources (questionnaires, interviews etc.) can be beneficial in supporting the plausibility of the results of this study.

What we learn from this study is that organic food marketing strategies are able to reach a certain range of consumers already. The availability of organic products seems to be less of a problem than it used to be in the past. Today, a wide and growing range of products is available in most parts of Switzerland, even in rural areas. However, as chapter II shows, the price difference between organic and conventional products is still an obstacle to buy for certain consumer groups. This might be relevant on the French-speaking side of the *Röstigraben*. However, this study hints that the financial aspect of buying a product at a price premium can only in part explain why consumers refuse to buy organic food. In order to reach those households that still do not consume organic food or that consume only little, target group-oriented marketing strategies are necessary. If consumer needs are so different across cultural groups, it may not be appropriate to cover their needs with a uniform marketing strategy as it is done so far by the large retailers. This study raises the question whether an organic marketing strategy adapted to the needs of French-speaking Switzerland could increase organic food consumption.

Future research as well as marketing strategies of the Swiss organic food sector might, therefore, focus on the needs and expectations of French-speaking consumers more than they have in the past.

Furthermore, it might be of interest to understand how consumption patterns vary across products. Just as for conventional food products, it can be assumed that consumption motives and patterns vary across products as a German study hinted (Schröck, 2013a). Knowledge about the influence of qualitative determinants (e.g. attitudes, preferences, habitual behaviour) may be just as important as knowledge about the impact of non-demographic factors (e.g. price premium, degree of processing, shopping location).

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Chapter IV
Estimation of demand elasticities for organic and conventional food in Switzerland

Abstract

The objective of this study is to better understand the influence of data aggregation and the model specification on the outcome of demand elasticity models with a focus on organic food. Within the framework of this study, the original Almost Ideal Demand System (AIDS) and enhancements such as the Quadratic Almost Ideal Demand System (QUAIDS) and the Shonkwiler and Yen approach are investigated.

Using a sample of Swiss household data covering the period 2006-2011, price elasticities of demand for five organic food products and their conventional counterparts are estimated. This paper discusses the methodological issues associated with the estimation of the models. First, two model versions are compared with respect to the level of data aggregation. For that, a model using household-level data is estimated and compared to the results of the same model version using aggregated data. Furthermore, the linear and quadratic specifications of the AIDS model are compared, leaving all other specifications equal and using the same sample of household-level data. Two further comparisons concern zero observations in the data.

The results show that the AIDS model in its different versions is sometimes more, sometimes less capable of estimating plausible elasticities. The elasticity estimates of the five models differ partly substantially. The analyses suggest that the kind of

data is an important criterion in the choice of the estimation model. For example, the data aggregation level and the share of zero observations impact the outcome of the estimation. Therefore, the model specification must be chosen so that it is suitable for the specific data set.

The discussions also focus on the non-fulfilment of homogeneity of the elasticities (when applying the Shonkwiler and Yen approach in the first step). A reformulated version of the consistent two-step estimation of the QUAIDS model and the Shonkwiler and Yen approach is presented and discussed. The non-fulfilment of homogeneity of the elasticities is thus far neither addressed in the literature nor solved. The reformulated version of the estimation model presented here is an improved yet far from complete solution to address this issue.

Keywords: consumer demand; AIDS; QUAIDS; household data; price and expenditure elasticities

4.1 Introduction

The market for organic food products in Switzerland (as in most European and Northern American countries) is up to now small in comparison to the conventional (Götze and Ferjani, 2014), but growth rates in terms of the market share and per capita consumption are high – especially in Switzerland[33].Within ten years, Swiss organic food sales have doubled reaching 2.3 billion Swiss Francs (Fr.) in 2015 (Bio Suisse, 2010 and 2016).

Despite the price difference between organic and conventional products which is for at least part of consumers an obstacle to buy (chapter II), there is a clear positive trend on the consumer side. This growth in organic food demand can at least in part be attributed to an increased awareness for a healthy lifestyle and nutrition overall (Wier et al., 2008, Hauser et al., 2011, Goetzke et al., 2014, chapter III). Hence, this market is both interesting and relevant for agricultural policy makers and the food

[33] Sales increased by 7.5% from 2013 to 2014 (the market share from 6.9 % to 7.1% in the same period). From 2012 to 2013, sales increased by 12.1% (the market share from 6.3 to 6.9%) (Bio Suisse, 2016).

industry.

Previous studies suggest that consumers behave differently when they buy organic and when they buy conventional food (e.g. Glaser and Thompson, 2000; Bunte et al., 2007; Jonas and Roosen, 2008; Schröck, 2013a). Glaser and Thompson (2000), for example, showed that there is a significant reaction to lower prices of organic milk on the consumer side (also shown by Jonas and Roosen, 2008). The study of Bunte et al. (2007) proved this for organic food in the Netherlands. Glaser and Thompson showed that consumers react more strongly to price changes of organic food than to changes in conventional prices. The same applies for the change in overall expenditure. Schröck (2013a) proved a higher expenditure elasticity for organic vegetables than for conventional ones in Germany. This means that households tend to increase their organic expenditure more than their conventional if the overall expenditure on food increases.

As the market for organic food is becoming increasingly important, this has also raised the attention of researchers and agricultural policy makers who demand information on how this market works. To predict, for example, the future development of the food market and assess the outcome of agricultural policy instruments, computable equilibrium models are often used. Demand elasticities are part of such computable equilibrium models and a basic requirement to achieve plausible and realistic results of such predictions. Hence, up-to-date and realistic demand elasticities – including the demand for organic food – that reflect how consumers react to changes in product prices and income are an important prerequisite.

The aim of this study is to understand a widely used and accepted approach to estimating price and income elasticities of demand. Elasticity estimates are compared across different data aggregation levels and model versions to better understand how the outcome of these estimations are influenced by data characteristics and model specifications. In particular, the realistic representation of the organic food market in computable equilibrium models may be problematic due to poor data availability and high shares of zero observations.

The subsequent chapter gives an overview of the state-of-the-art literature. The data that are used for this study are introduced in chapter 4.3. In the following, the methodological framework (chapter 4.4) and the empirical approach (chapter 4.5) are presented in detail. Chapter 4.6 presents the model results and discusses them, before the final section 4.7 concludes this study and gives an outlook on future research needs.

4.2 Motivation of this study and organic food market literature

In the past, only few studies were carried out that estimated demand elasticities for Switzerland (Jaquet et al., 2000; Abdulai, 2002; Aepli and Finger, 2013; Aepli, 2014a and 2014b). However, these studies do not distinguish between organic and conventional food products. This distinction is, however, useful because these markets function differently. Furthermore, the organic food market in Switzerland cannot necessarily be compared with the market in other high-income countries. This might stem from different preferences due to cultural differences as well as other factors (chapter III). Furthermore, the institutional environment and income level in Switzerland differ from those in other European countries. It should also be borne in mind that the organic food market is a relatively new and evolving market. Hence, consumers' motives to buy organic food might differ from those to buy conventional food. Because this market is changing dynamically over time, consumers' motives might also change. The essence is that estimating demand elasticities that refer to more recent data and, thus, account for the current political, institutional and cultural peculiarities can increase the quality of the estimates. Consequently, understanding consumers and their motivations to purchase is helpful to appropriately shape (Swiss) agricultural policies. Also, the Swiss agricultural policy supports environmentally friendly production regimes such as organic agriculture.

What drives consumer demand for organic food has been a field of interest for agricultural and food economists in industrialised and developing countries for the past decades (Abdulai, 2002). Whether consumers decide to buy organic food can be influenced by various factors. Studies referring to economic theory focus on income and prices (Schletti, 2001; Bunte et al., 2007; Zander and Hamm, 2010; Smed, 2012; Bezawada and Pauwels, 2013; Schröck, 2013a and 2013b). However, these studies also showed that the price is not the only criterion. The study of Zander and Hamm (2010), for example, showed that besides the product price, ethical and environmental aspects such as animal-friendly husbandry, regional production and fair treatment of farmers are also important to consumers of organic products. Other motives to buy are health-related, e.g. the kind of ingredients, the composition and possible additives of food products as well as the use of non-organic fertilisers, antibiotics and pesticides in conventional farming systems (Harper and Makatouni, 2002; Goetzke et al., 2014).

Overall, the consciousness for healthy living and eating as well as the scepticism regarding food in general have increased within the last two decades (Hauser et al., 2011; Goetzke et al., 2014). Consumers are increasingly sceptical about the way food is produced and, therefore, demand safer, fresh and natural food products. Especially in view of increasingly specialised and diversified food supply chains that are less and less traceable, consumers doubt the quality of food products and are uncertain about the ingredients (Hamzaoui-Essoussi et al., 2013). This growing feeling of uncertainty – which is at least partly due to an asymmetric distribution of information between the supply and demand (consumer) side in favour of the supply side (Janssen and Hamm, 2012) – is one of the reasons that labelled products, such as organics, are more and more appreciated.

Factors such as socio-demographics, attitudes and motives are important determinants of consumption decisions. Whereas the motives to consume organic food are diverse, the focus of the study is in a first step, however, on the evaluation of estimation procedures. Therefore, a minimal set of control variables is estimated initially. Chapter 4.4.8 shows in detail how socio-demographics, attitudes and motives can be integrated into the estimation model and we recommend doing so in cases where the estimation results are to be used further, e.g. in computable equilibrium models.

4.3 Data and summary statistics

4.3.1 *Survey design, sample and variable description*

For this study, a sample of the Swiss Household Budget Survey (HBS) (HBS, 2013) – a survey which is conducted by the Swiss Federal Statistical Office (FSO) since 1990 – is analysed. Households that participate in the HBS are chosen randomly from the Swiss register of private telephone lines. The survey covers only private households. Furthermore, only permanent residents of Switzerland can participate (regardless of their nationality). In total, there are 19 653 households in the data set that covers the years 2006 to 2011. Since the survey is a repeated cross-sectional survey, different households are surveyed every month (= observation period). Since the year 2000, the FSO conducts the data on a monthly continuous basis. Participation is not obligatory, and the number of participating households per month varies and lies between 222 and 324 households for the years 2006-2011. Participating households document their income, expenditure and partly consumed quantities for food and beverages and distinguish between organic and conventional products in their food diary. To ensure that the sample represents the permanent resident population of Switzerland, the participating households are weighted according to their probability of being included and of taking part in the survey (e.g. based on the number of people living in the household, the nationality of the household's main earner etc.). Furthermore, a calibration procedure is applied that refers to the actual distribution of Switzerland's resident population. Hence, the sample represents the permanent resident population accurately regarding certain criteria[34].

For this study, a sample covering the six-year observation period of 2006-2011 is used to analyse consumption patterns regarding organic and conventional food products. Since there have been revisions of the content of the survey and the process of conducting it, the data before and after 2006 cannot be compared (according to

[34] For further information see: https://www.bfs.admin.ch/bfs/en/home/statistics/economic-social-situation-population/surveys/habe.html

the information provided by the FSO).

From the original sample, 54 households that had zero expenditure on food and beverages are eliminated. Consequently, 19 599 households remain in the data.

The variable to be explained is the share that the participating households spend on five organic and five conventional food product categories:

$$w_{ih} = x_i/x. \quad (14)$$

The expenditure on the particular product category (x_i) is divided by the expenditure on all ten product categories x. Hence the share w_{ih} is the household h's ratio of the expenditure on a product category i to the expenditure on all product categories of household h. According to Kilcher et al. (2011) and Leppänen and Grönroos (2009), most consumers show hybrid consumption behaviour, meaning that they do not only consume one level of quality (e.g. only organic) but higher-priced premium products as well as cheaper budget alternatives. This means that it is unlikely that households only consume organic products. Hybrid consumption behaviour is what we observe within the HBS (2013) data for most of the households.

Table 4.2 gives an overview of the means of the considered socio-demographics used in the multivariate probit regression of model V (see section 4.4.8 for methodological explanations regarding demographic translating). Binary dummies for the presence of a small child, for a single female adult, for at least one household member smoking, for a household living only of social benefits or daily allowances, and a household in the German-speaking part of Switzerland are created based on the variables in the HBS sample. The household size is calculated using the 'OECD-modified equivalence scale'[35], assigning a value of 1 to the first adult of the household, 0.5 to every additional adult and 0.3 to every child in the household.

[35] http://www.oecd.org/eco/growth/OECD-Note-EquivalenceScales.pdf

4.3.2 *Summary statistics*

Most of the households (about 70%) are from the German- and Romansh-speaking[36] part of Switzerland. Since the HBS mirrors the Swiss population representatively, most households in the data are from this region[37]. Table 4.1 shows the structure of the households as well as the expenditure on food and beverages and hints some differences between the linguistic regions. The average size of households in the French-speaking part of Switzerland is slightly larger. The German-speaking region has a smaller average household size but the households' average spending on food and beverages is higher than in the Italian-speaking part. The lowest average spending on food and beverages can be found in the Italian-speaking region. These differences can only hint actual differences among the linguistic regions and were not statistically tested. This also applies in the following.

Taking a closer look at the data reveals a high number of zero observations for the organic product categories. Table 4.2 shows that zero observations are much less present in the conventional categories.

The product categories that are investigated in this study are bread and cereal products, meat products, milk products, fruit, and vegetables, both organic and conventional. Table 4.2 provides an overview of the expenditure and unit values for each product category for of Switzerland as a whole and the three linguistic regions. Note that the observed unit values cannot necessarily be equated with market prices. Rather, these unit values hint that households in different regions buy different qualities and kinds of products. To account for possible heterogeneities within each product category (which explain price differences to some extent), quantity-weighted average unit values are used for the price adjustment instead of unweighted

[36] As of 2014, 0.5% of the resident population speaks Romansh as their main language. See: https://www.bfs.admin.ch/bfs/de/home/statistiken/bevoelkerung/sprachen-religionen/sprachen.html (accessed 24 February 2017, available in German, French and Italian). For simplicity, hereinafter the German- and Romansh-speaking region is referred to as the German-speaking region.

[37] Side note: It should be borne in mind that the language region does not always reflect the language actually spoken among the household members. Across all linguistic regions, about 11% of the population speaks another first language than the four official ones. By naming a region e. g. 'French-speaking', French is the language that is predominantly spoken in this region. However, it can be assumed that this 'bias' is roughly the same in all linguistic regions.

unit values (see chapter 4.4.7 for a detailed discussion). Table 4.2 further shows that households in the French-speaking part of Switzerland spent on average more on food and beverages overall (sum of organic and conventional) than the other two regions. However, across the different product categories they spent less on organic products than the Swiss average and less than households in the other two regions; even though the average household size does not differ much across regions (Table 4.1). German-speaking households spent on average more on organic food than households in the other two regions. By contrast, they spent less on the five conventional product categories than their French- and Italian-speaking neighbours. Regarding prices, the means hint that the average price payed for organic food is higher than that for conventional food.

Table 4.1: Summary statistics of the socio-demographic variables (model V) of the multivariate probit model, total and by linguistic region

	Total Switzerland	German-speaking Switzerland	French-speaking Switzerland	Italian-speaking Switzerland
Sample size	**19599**	**13876**	**3918**	**1805**
Expenditure on food and beverages[2,3] (in Fr.)	**1'052.28** *(579.32)*	**1'045.66** *(565.58)*	**1'097.11** *(622.05)*	**1'005.88** *(581.91)*
Household size in equivalences[1]	**1.60** *(0.50)*	**1.59** *(0.50)*	**1.63** *(0.51)*	**1.61** *(0.48)*
Household with at least one small child (in %)	**11.27** *(31.62)*	**11.02** *(31.31)*	**11.97** *(32.47)*	**11.63** *(32.07)*
Share of households with a single female adult (in %)	**18.72** *(45.53)*	**18.81** *(45.24)*	**18.61** *(46.51)*	**18.28** *(45.50)*
Household with smoker(s) (in %)	**26.04** *(43.88)*	**25.30** *(43.48)*	**27.05** *(44.43)*	**29.47** *(45.61)*
Household receiving social benefits (in %)	**43.97** *(49.64)*	**41.82** *(49.33)*	**48.88** *(49.99)*	**49.86** *(50.01)*

[1] using the OECD equivalence scale (1st adult = 1, other adults = 0.5, child = 0.3).
[2] Food and non-alcoholic beverages.
[3] Consumption at home and out-of-home, without alcoholic beverages.
Standard deviations in brackets

Source: HBS (2013), own calculations

Table 4.2: Sample sizes, zero consumption and summary statistics of expenditures and prices

	Total Switzerland		German-speaking Switzerland		French-speaking Switzerland		Italian-speaking Switzerland	
Sample size	**19599**		**13876**		**3918**		**1805**	
Expenditure on food and non-alcoholic beverages (in Fr.)	**1'052.28**		**1'045.66**		**1'097.11**		**1'005.88**	
	(579.32)		**(565.58)**		**(622.05)**		**(581.91)**	
Share of food away from home (in %)	**35.1**		**36.5**		**32.2**		**30.8**	
	Org.	Conv.	**Org.**	Conv.	**Org.**	Conv.	**Org.**	Conv.
Bread and cereal products								
Zero consumption (in %)	**64.0**	3.0	**61.6**	3.0	**71.5**	3.0	**66.9**	3.1
Expenditure (in Fr.)	**5.96**	52.32	**6.41**	50.96	**4.49**	56.14	**5.68**	54.48
	(13.6)	*(40.7)*	***(14.0)***	*(40.0)*	***(11.6)***	*(42.3)*	***(14.3)***	*(42.6)*
Observed unit value (in Fr. per kg)[1]	**7.23**	5.68	**7.18**	5.64	**7.39**	5.88	**7.25**	5.54
Meat products								
Zero consumption (in %)	**86.1**	5.4	**84.4**	5.9	**90.2**	5.9	**90.1**	3.8
Expenditure (in Fr.)	**7.17**	143.68	**8.51**	134.54	**3.89**	169.55	**4.00**	157.79
	(43.1)	*(144.8)*	***(49.1)***	*(133.1)*	***(23.9)***	*(175.2)*	***(20.1)***	*(149.9)*
Observed unit value (in Fr. per kg)	**28.41**	22.13	**28.87**	22.02	**26.55**	22.13	**28.91**	22.93

continued on the next page

Table 4.2: ***continued***

	Org.	Conv.	**Org.**	Conv.	**Org.**	Conv.	**Org.**	Conv.
Milk products								
Zero consumption (in %)	**65.9**	1.5	**62.4**	1.5	**76.2**	1.8	**70.2**	1.2
Expenditure (in Fr.)	**7.47**	81.52	**8.58**	79.20	**4.10**	86.59	**6.28**	88.36
	(19.2)	*(61.1)*	***(20.6)***	*(58.8)*	***(11.9)***	*(64.4)*	***(19.9)***	*(69.8)*
Observed unit value (in Fr. per	**3.84**	4.68	**3.72**	4.55	**4.07**	5.05	**4.29**	4.89
Fruit								
Zero consumption (in %)	**70.8**	6.1	**68.7**	6.0	**76.3**	6.0	**75.6**	5.7
Expenditure (in Fr.)	**4.99**	47.34	**5.31**	46.68	**4.19**	49.94	**4.24**	46.72
	(15.7)	*(43.3)*	***(15.5)***	*(42.8)*	***(16.4)***	*(45.3)*	***(15.6)***	*(42.2)*
Observed unit value (in Fr. per	**5.49**	4.30	**5.50**	4.35	**5.46**	4.28	**5.51**	3.94
Vegetables:								
Zero consumption (in %)	**65.5**	3.9	**63.1**	4.2	**72.9**	4.2	**68.0**	2.9
Expenditure (in Fr.)	**7.95**	62.15	**8.63**	59.87	**6.07**	69.93	**6.73**	62.73
	(22.8)	*(50.0)*	***(22.6)***	*(47.5)*	***(24.3)***	*(58.4)*	***(20.6)***	*(47.8)*
Observed unit value (in Fr. per	**6.17**	4.89	**6.14**	4.93	**6.34**	4.90	**6.00**	4.59

All values in Swiss Francs (Fr.) have been adjusted for inflation (reference: December 2010)

[1] Quantity-weighted average unit value

Standard deviations in brackets

Sources: HBS (2013), own calculations

4.4 Methodological framework

This chapter presents the methodology used in this study in detail. The following subsections show the development of the Almost Ideal Demand System over time. In section 4.4.1, Deaton and Muellbauers (1980a) original AIDS is presented. Chapter 4.4.2 discusses the influence of the data aggregation level on the outcome of the estimation. In the following, the linearised (LA/AIDS, chapter 4.4.3) and quadratic (QUAIDS, chapter 4.4.4) enhancements of the AIDS model are introduced. Chapter 4.4.5 discusses a further methodological issue of importance which is considered in this study: zero observations (censoring). Chapter 4.4.6 develops a reformulated version of the QUAIDS model. Chapter 4.4.7 shows how the issue of missing market prices can be solved in demand estimation models. As mentioned above, the final subsection 4.4.8 presents some methodological issues which are not considered in this study because they are of minor interest for the study's purpose.

4.4.1 *The Almost Ideal Demand System (AIDS)*

The first two models (I and II) are methodologically based on the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980b). The other three estimation models (III-V) are enhancements of this model. Deaton and Muellbauer describe their model as 'an arbitrary first-order approximation' (1980a, p. 312) which fulfils the axioms of choice and is relatively easy to estimate because non-linear estimation can be avoided.

The AIDS model is based on a 'specific class of preferences' (ibid., p. 313). This specific class is called PIGLOG (price-independent, generalized logarithmic) and treats the demand of the whole market as if it was the outcome of a single representative consumer who acts rationally and maximizes her utility. PIGLOG preferences are expressed via a cost or expenditure function $c(u, p)$ with u being utility and p being a price vector.

$$log\, c(u,p) = (1-u)\, log\{a(p)\} + u\, log\{b(p)\}. \qquad (15)$$

With utility lying between 0 (minimum or subsistence) and 1 (maximum or bliss), $a(p)$ and $b(p)$ are positive linearly homogeneous functions or the costs of minimum and maximum utility (see Deaton and Muellbauer, 1980a, p. 323ff. for a detailed explanation). $log\ \{a(p)\}$ and $log\ \{b(p)\}$ are defined such as to enable the cost function $c(u,p)$ to be a flexible functional form.

$$log\, a(p) = \alpha_0 + \sum_k \alpha_k\, log\, p_k + \frac{1}{2}\sum_k \sum_j \gamma^*_{kj}\, log\, p_k\, log\, p_j \qquad (16)$$

$$log\, b(p) = log\, a(p) + \beta_0 \prod_k {p_k}^{\beta_k} \qquad (17)$$

k and j are the products, n is the total number of products in the system, α_0 is a constant term and α_k and γ^*_{kj} are parameters to be estimated.

Using (16) and (17), the cost function $c(u,p)$ can be reformulated from (15):

$$\log c(u,p) = \alpha_0 + \sum_k \alpha_k \log p_k + \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log p_k \log p_j + u\beta_0 \prod_k p_k^{\beta_k} \qquad (18)$$

with parameters α, β and γ^*. The linearly homogeneous character of the cost function is ensured by imposing the following restrictions on the parameters:

$$\sum_i \alpha_i = 1; \qquad \sum_j \gamma^*_{kj} = \sum_k \gamma^*_{jk} = \sum_j \beta_j = 0. \qquad (19)$$

The AIDS demand function is then derived using (18) and expressed in budget share form. The budget share is the first derivative of the log cost function with respect to the log price of each product i, or the quotient of the expenditure for the consumed quantity of i and the cost function $c(u,p)$. Hence, it is assumed that for all products i expenditure x equals costs $c(u,p)$ if consumers maximise their utility, assuming global non-satiation for every consumer. (18) can be inverted to express u as a function of prices p and expenditure x (c) instead of $c(u,p)$, and substituted into the budget share equation $w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i u \beta_0 \prod_k p_k^{\beta_k}$ with $\gamma_{ij} = \frac{1}{2}(\gamma^*_{ij} + \gamma^*_{ji})$. This yields the AIDS demand function in budget share form:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log\{x/P\}. \qquad (20)$$

The translog price index $\log P$ is defined as follows:

$$\log P = \alpha_0 + \sum_k \alpha_k \log p_k + \frac{1}{2}\sum_j \sum_k \gamma_{kj}\, log\, p_k \log p_j. \qquad (21)$$

Given that the following restrictions hold,

$$\sum_{i=1}^{n} \alpha_i = 1 \qquad \sum_{i=1}^{n} \gamma_{ij} = 0 \qquad \sum_{i=1}^{n} \beta_i = 0 \qquad (22)$$

$$\sum_j \gamma_{ij} = 0 \qquad (23)$$

$$\gamma_{ij} = \gamma_{ji} \qquad (24)$$

it is ensured that the budget shares add up to unity across all products ($\sum w_i = 1$). Restriction (23) ensures homogeneity which means that the demand system is homogeneous of degree zero in prices and total expenditure and, thus consistent with demand theory. Hence, if prices and total expenditure (or income) increase by the same percentage, demand does not change, or if (x/P) remains constant, the budget shares do not change, i.e. there is no money illusion. Slutsky symmetry is fulfilled if restriction (24) holds, meaning that the substitution effect of j on i equals that of i on j.

Deaton and Muellbauer (1980a) state in their study that their AIDS model is not a 'fully satisfactory explanation of consumers' behavior' (p. 312) but a good starting point for further developments of their demand system.

Using the Almost Ideal Demand System of Deaton and Muellbauer (1980a), the elasticities are calculated using the formulae of Green and Alston (1990). The income (total expenditure) elasticity for the ith product is calculated as follows:

$$\eta_i = 1 + \beta_i / w_i. \qquad (25)$$

The uncompensated and compensated own- and cross-price elasticities are calculated using the following equations:

$$\varepsilon_{ij}^{u} = \left(\gamma_{ij} - \beta_i w_j\right)/w_i \qquad (26)$$

$$\varepsilon_{ij}^{c} = \varepsilon_{ij}^{u} + w_j \eta_i. \qquad (27)$$

The following section discusses the issue of data aggregation and the bias that it may cause. In the subsequent chapters 4.4.3 and 4.4.4 further developments of the AIDS model are presented.

4.4.2 *Data aggregation and aggregation bias*

Green et al. (2013) found that the aggregation level of the data influences the estimation results. Hence, the methodology is to be chosen with care when using censored as well as aggregated data. Deaton and Muellbauer (1980a) show that aggregation across households is possible if for an individual household h the AIDS demand function for good i in budget share form is described by

$$w_{ih} = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log(x_h/\boldsymbol{k_h}P) \qquad (28)$$

where w_{ih} is the budget share of good i for household h, x_h is the household's total expenditure, and $\log P$ is the price index defined as:

$$\log P = \alpha_0 + \sum_k \alpha_k \log p_k + \frac{1}{2}\sum_j \sum_k \gamma_{kj} \log p_k \log p_j. \qquad (29)$$

Deaton and Muellbauer (1980a) describe $\boldsymbol{k_h}$ (equation (28)) as a 'sophisticated measure of household size' (p. 314) which considers the age composition and other characteristics of the household as well as economies of household size. That way $\boldsymbol{k_h}$ corrects for taste variations in the overall expenditure of each household h, leading to 'needs corrected' household expenditure (ibid.). Hence, if all households had the same taste, then $\boldsymbol{k_h}$ would be 1 for all households. Aggregating across households gives the following aggregate demand function in budget share form

$$\bar{w}_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log(\bar{x}/\boldsymbol{k}P) \qquad (30)$$

where $\bar{w}_i$ is the share of aggregate expenditure on good i in the overall budget of all households and given by $\sum_h p_i q_{ih} / \sum_h x_h \equiv \sum_h x_h w_{ih} / \sum_h x_h$. The aggregate index $\boldsymbol{k}$ is defined by $\log(\bar{x}/\boldsymbol{k}) \equiv \sum_h x_h \log(x_h/\boldsymbol{k_h}) / \sum_h x_h$, and $\bar{x}$ is the average level of total expenditure x_h (see Mittelhammer et al., 1996 for an extensive discussion on aggregation bias in the AIDS model).

Given that the set of restrictions (22)-(24) is imposed on (30), the model represents a system of demand functions which adds up to total expenditure, $\sum_i \bar{w}_i = 1$, is homogeneous of degree zero in prices and total expenditure, and which satisfies Slutsky symmetry.

As suggested by Nichèle and Robin (1995), we include trends and time dummies into the AIDS version using aggregated data (model I). This is important not only to control for changes in the income distribution over the six-year observation period (alleviate aggregation bias) but also to ensure the comparability of models I and II (model II using household-level data).

4.4.3 *The Linear Approximated Almost Ideal Demand System (LA/AIDS)*

To reduce the complexity of the estimation, a linearised version of Deaton and Muellbauer's AIDS model (LA/AIDS) can also be applied (such that the estimation model is linear in parameters), replacing the non-linear translog price index (29) by Stone's price index:

$$\log P^* = \sum w_k \log p_k. \tag{31}$$

Deaton and Muellbauer (1980a) suggest using this approximated price index in cases where prices are collinear or 'closely collinear' (p. 316). Stone's price index P^* is an approximation for the translog price index (29) and proportional to P^*.

Other than that, the LA/AIDS model is equivalent to the original AIDS model presented in the previous chapter 4.4.1. Therefore, the expenditure elasticities as well as the uncompensated and compensated own- and cross-price elasticities are also calculated using the formulae (25), (26) and (27).

4.4.4 *The Quadratic Almost Ideal Demand System (QUAIDS)*

In this study, we further compare a reformulated version of the Quadratic Almost Ideal Demand System (QUAIDS) with the original AIDS model proposed by Deaton and Muellbauer (1980a) and the QUAIDS model originally proposed by Banks et al. (1997).

In general, demand systems assume that income is a crucial factor in consumer and household choices because it restricts households in maximizing their utility. The relationship between income and consumption is described by the concept of the Engel curve.

In their study, Banks et al. (1997) found Engel curves being non-linear or close to being linear for different types of products. While the original AIDS model of Deaton and Muellbauer (1980a) allows for flexible price responses, it lacks flexibility in the expenditure (income) term. Applying nonparametric techniques, their analysis suggests that certain kinds of products require some flexibility in the expenditure term of the budget share equation. Hence, not all products have Engel curves that are linear in the logarithm of income (total expenditure)[38].

Furthermore, the shape of the Engel curve is likely to vary across regions. Banks et al. (1997) showed that allowing for non-linearity is advantageous, even though the Engel curves for food 'do look very close to being linear in log income' (p. 528), confirming Engel's Law of decreasing expenditure shares on food as income increases. This linear relationship might not necessarily hold for all types of food products, e.g. organic, because these might in some cases be luxury goods (i.e. an income elasticity of larger than one). Therefore, an additional term in the budget share equation might be needed to accurately describe consumer behaviour, while allowing for a non-linear relationship between income and consumption. In practice, this means that if we allow demand to respond flexibly to income, we also allow products to be luxuries at some income ranges while being necessities at others.

In contrast to Deaton and Muellbauer's (1980a) AIDS model, the QUAIDS model allows for non-linear relationships between the expenditure share of a commodity and the logarithm of total expenditure (income), thus non-linear more flexible Engel curves. Thereby, the model satisfies the axioms of choice and aggregates perfectly across households.

[38] E.g. domestic fuel, clothing and alcoholic beverages.

The QUAIDS model assumes an indirect utility function of the following form:

$$\ln V = \left\{\left[\frac{\ln x - \ln a(\mathrm{p})}{b(\mathrm{p})}\right]^{-1} + \lambda(\mathrm{p})\right\}^{-1} \qquad (32)$$

with $\ln x$ being the log of total expenditure, $\ln a(\mathrm{p})$ the translog price index, $b(\mathrm{p})$ the Cobb-Douglas price aggregator and λ a differentiable homogeneous function of prices p[39]. Both $b(\mathrm{p})$ and $\lambda(\mathrm{p})$ are homogeneous of degree zero in prices p. The expression $[\ln x - \ln a(\mathrm{p})]/b(\mathrm{p})$ is the indirect utility function of a PIGLOG demand system. As mentioned above, a PIGLOG demand system assumes a 'specific class of preferences' (Deaton and Muellbauer, 1980a, p. 313) in which aggregate consumer behaviour is the outcome of a single maximizing representative consumer (see also chapter 4.4.1).

The price index $\ln a(p)$ used for the QUAIDS model is equivalent to that used in the original AIDS (see equation (16) in chapter 4.4.1). Furthermore, the indirect utility function (32) incorporates the Cobb-Douglas price aggregator $b(\mathrm{p})$ that is of the following functional form

$$b(\mathrm{p}) = \prod_{i=1}^{n} p_i^{\beta_i} \qquad (33)$$

and the term lambda λ is defined as follows:

$$\lambda(\mathrm{p}) = \sum_{i=1}^{n} \lambda_i \ln p_i, \qquad \text{where } \sum_i \lambda_i = 0. \qquad (34)$$

The budget share equation in the QUAIDS model is extended by a quadratic term to allow for income flexibility. By applying Roy's identity, the budget share equation of the QUAIDS is specified as follows:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{x}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{ln\left[\frac{x}{a(p)}\right]\right\}^2 \qquad (35)$$

where w_i is the budget share spent on product i.

To ensure consistency with the underlying demand theory, additivity, homogeneity and symmetry restrictions are also imposed on the parameters of the QUAIDS

[39] In the original AIDS model, the term λ is set to zero.

budget share equation. The additivity restriction imposes that:

$$\sum_{i=1}^{n} \alpha_i = 1 , \qquad \sum_{i=1}^{n} \beta_i = 0 , \qquad \sum_{i=1}^{n} \gamma_{ij} = 0. \tag{36}$$

The homogeneity restriction is imposed by:

$$\sum_{j=1}^{n} \gamma_{ij} = 0 \text{ for any } j. \tag{37}$$

And symmetry is ensured by:

$$\gamma_{ij} = \gamma_{ji} \text{ for any } i \text{ and } j. \tag{38}$$

In practice, these restrictions are satisfied by estimating n-1 budget share equations instead of the full set of budget share equations (n). The parameters of the last budget share equation are then obtained by applying the adding up, homogeneity and symmetry restrictions.

Banks et al. (1997) suggest the following formulae (39)-(43) to calculate the elasticities. The expenditure elasticity is calculated as follows:

$$e_i = \mu_i / w_i + 1 \tag{39}$$

The uncompensated own- and cross-price elasticities are calculated as follows:

$$e_{ij}^{u} = \mu_{ij} / w_i - \delta_{ij} \text{ , with } \delta_{ij} = 1 \text{ if } i = j, \text{ and } \delta_{ij} = 0 \text{ otherwise} \tag{40}$$

μ_i and μ_{ij} are expressed as follows:

$$\mu_i \equiv \frac{\partial w_i}{\partial \ln x} = \beta_i + \frac{2\lambda_i}{b(\mathbf{p})} \left\{ ln \left[\frac{x}{a(\mathbf{p})} \right] \right\} \tag{41}$$

$$\mu_{ij} \equiv \frac{\partial w_i}{\partial \ln p_j} = \gamma_{ij} - \mu_i \left(\alpha_j + \sum_k \gamma_{jk} \ln P_k \right) - \frac{\lambda_i \beta_j}{b(\mathbf{p})} \left\{ \ln \left[\frac{x}{a(\mathbf{p})} \right] \right\}^2 \tag{42}$$

The compensated own- and cross-price elasticities are then retrieved using:

$$e_{ij}^{c} = e_{ij}^{u} + e_i w_j \tag{43}$$

4.4.5 *Zero observations (censoring)*

Zero consumption is an issue often occurring in analyses using cross-sectional household data. This means that not all households always consume all products. Hence, otherwise typical purchasing behaviour is not necessarily observed during the observation period. Furthermore, observed consumption patterns are non-random. In other words, there is likely unobserved selection regarding consumption, e.g. because vegetarian households never buy meat. Due to high shares of zero consumption in some product categories, here especially in case of the organic products (see Table 4.2), this can be a challenge in the elasticity estimation.

The households of the HBS sample documented their expenditure on food and beverages for half of the observation period (either the first or second half of the month). According to the information provided by the FSO which is responsible for the HBS, the documentation period is set to two weeks because it is assumed as sufficiently long enough to document the household's representative food consumption behaviour. This might, however, not always be the case. If we assume certain products to be '*luxuries*', it is likely that households do not consume them as frequently as other goods. Furthermore, it should be taken into consideration that households might never consume certain goods. Other reasons such as missing or wrong documentation are also conceivable.

If zero observations constitute a considerable percentage of the observations, the estimation results can be biased (selection bias). To avoid selection bias which occurs when a non-negligible number of households do not consume the good(s) of interest within the observation period, zero observations should not be ignored. There are different options to address this issue.

One option is to use data at a higher aggregation level as we did with model I (see also chapter 4.4.2). The advantage is that the share of zero observations can be reduced. However, information is lost either because the products are aggregated into larger, more heterogeneous categories (applies to all models) or if we aggregate over households (e.g. all households as one monthly observation).

When working with household-level data, it is assumed that consumption decisions are taken in two steps. In the first step, the household decides whether to participate in the market or not (participation decision). If this decision is positive and the household decides to consume, it must decide which products it will spend how much of its budget on.

To assess the influence a) of the presence of zero observations in the data and b) of considering them by applying additional techniques, the approach of Shonkwiler and Yen (1999) (hereafter referred to as SY) is used in model V.

Shonkwiler and Yen (1999) presented a 'consistent two-step […] estimation procedure for systems of equations with limited dependent variables' (p. 972). The SY approach is an alternative to the approach of Heien and Wessels (HW) (1990). The HW procedure adds the Inverse Mill's Ratio (which is the result of a probit regression prior to the actual elasticity estimation) to the budget share equation. The advantage is that the new budget share equation is still linear. Consequently, adding up, homogeneity and symmetry of the parameters can be fulfilled leading to elasticities which are consistent with the underlying demand theory. Hence, the elasticities are homogeneous of degree zero in prices and income, and the Slutsky matrix is symmetric.

Despite its convenience, the HW procedure has been criticised. Shonkwiler and Yen (1999) showed, by using Monte Carlo simulations, that the HW procedure performs poorly when censoring is present. More precisely, it was found that the accuracy of the parameters decreases the higher the share of zero observations is.

The SY approach is introduced in the following. The dichotomous decision of the household (buying vs. not buying, called participation decision) (first step) can be expressed using the following equations:

$$w_i^* = f(\boldsymbol{x}_{ij}\,\boldsymbol{\mu}_{ij}) + \epsilon_i \qquad d_i^* = \boldsymbol{z}'_{ik}\,\boldsymbol{\theta}_{ik} + v_i \tag{44}$$

$$d_i = \begin{cases} 1 & \text{if } d_i^* > 0 \\ 0 & \text{if } d_i^* \leq 0 \end{cases} \qquad w_i = d_i * w_i^* \tag{45}$$

$(i = 1, 2, \ldots, n; \quad j = 1, \ldots, n; \quad k = 1, \ldots, K)$

In this system, the dependent variables w_i (budget share) and d_i (dummy) are observed. d_i is a binary variable that takes the value 1, if the household consumes the particular product i. If the household consumes, the budget share is $w_i > 0$. Vice versa, if $w_i = 0$, the household does not consume. From the definition of d_i, it follows that the budget share w_i is zero (= zero expenditure) if d_i takes the value 0. w_i^* and d_i^* are the corresponding latent variables. They are latent since they are unobserved. $\mathbf{x}_{ij}$ and $\mathbf{z}'_{ij}$ are the explanatory variables. As explanatory variables, the household's overall expenditure on all ten product categories[40], log-unit values of all ten products, the household size in equivalences[41], the overall expenditure on food and non-alcoholic beverages, and dummy variables for the presence of a small child (0-4 years), for a single female adult, for the presence of a smoker in the household, for the household receiving social benefits and for the German linguistic region are incorporated into the multivariate probit model (see Table 4.1).

Following Aepli (2014a), a multivariate probit regression is estimated instead of univariate ones, because it can be expected that households simultaneously decide upon which products they want to consume. Thus, it is considered that the decision to consume a certain good can interact with or depend on the decision to consume other goods. Hence, it is considered that some goods can be complementary ones while others may be substitutes. The multivariate probit model incorporates ten dependant variables. The parameters of each equation are estimated simultaneously.

As a result, we obtain the expected values of the parameters $\boldsymbol{\theta}_i$ of equation (44) which we call $\widehat{\boldsymbol{\theta}}_i$. Then, the probability of a positive outcome of the dependent variable (linear prediction) is assessed. To calculate the probability density function (pdf) $\emptyset(\mathbf{z}'_{ih}\,\boldsymbol{\theta}_i)$ and cumulative distribution function (cdf) $\varphi(\mathbf{z}'_{\mathrm{ih}}\,\boldsymbol{\theta}_i)$ for every household, and their corresponding means, the predicted probability is used.

[40] All monetary values have been adjusted for inflation.
[41] Using the OECD equivalence scale: 1st adult = 1, per other adult = 0.5, per child = 0.3 http://www.oecd.org/eco/growth/OECD-Note-EquivalenceScales.pdf.

The pdf and cdf are then integrated into the new budget share equation $\widetilde{w}_i$:

$$\widetilde{w}_i = \emptyset(\boldsymbol{z}_i' \boldsymbol{\theta}_i)\left\{\alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{X}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{ln\left[\frac{X}{a(p)}\right]\right\}^2\right\} + \delta_i \varphi(\boldsymbol{z}_i' \boldsymbol{\theta}_i) \tag{46}$$

with δ_i as an additional parameter, which is the covariance between the error terms of the QUAIDS and the multivariate probit model (Zheng and Henneberry, 2010; Aepli, 2014a).

4.4.6 *A refined version of the Quadratic Almost Ideal Demand System*

The reformulated version of Banks et al.'s (1997) QUAIDS model uses equation (46) because partly high shares of zero observations are present in the data. Taking the correction of zero observations into account, the parameter restrictions must be defined other than in the original QUAIDS.

This becomes clear if equation (46) is reformulated in the following way:

$$\widetilde{w}_i = \emptyset(.)\alpha_i + \sum_{j=1}^{n} \emptyset(.)\gamma_{ij} \ln p_j + \emptyset(.)\beta_i \ln\left[\frac{X}{a(p)}\right] + \frac{\emptyset(.)\lambda_i}{b(p)}\left\{ln\left[\frac{X}{a(p)}\right]\right\}^2 + \delta_i \varphi(\boldsymbol{z}_i' \boldsymbol{\theta}_i) \tag{47}$$

or

$$\widetilde{w}_i = \tilde{\alpha}_i + \sum_{j=1}^{n} \tilde{\gamma}_{ij} \ln p_j + \tilde{\beta}_i \ln\left[\frac{X}{a(p)}\right] + \frac{\tilde{\lambda}_i}{b(p)}\left\{ln\left[\frac{X}{a(p)}\right]\right\}^2 + \delta_i \varphi(.) \tag{48}$$

where $\tilde{\alpha}_i = \emptyset(.)\alpha_i$, $\tilde{\gamma}_{ij} = \emptyset(.)\gamma_{ij}$, $\tilde{\beta}_i = \emptyset(.)\beta_i$ and $\tilde{\lambda}_i = \emptyset(.)\lambda_i$. Equation (48) is isomorphic to equation (46) except for the added term $\delta_i \varphi(.)$. From equations (47) and (48), we see that the budget shares will not sum up to 1 if the original parameter restrictions (36), (37) and (38) of the QUAIDS are imposed. Consequently, new restrictions on the tilde (~) parameters must be defined. These are the following:

$$\sum_i \tilde{\alpha}_i = 1, \quad \sum_i \tilde{\gamma}_{ij} = 0, \quad \sum_i \tilde{\beta}_i = 0, \quad \sum_i \tilde{\lambda}_i = 0 \quad \text{and} \quad \sum_i \delta_i = 0 \tag{49}$$

where the last restriction for parameter δ_i is added. Furthermore, the following homogeneity restriction is imposed:

$\sum_j \gamma_{ij} = 0$ for all j. (50)

This restriction is equal to the original QUAIDS because we add over j and the pdf $\emptyset(.)$ depends only on i and not on j.

Finally, the following symmetry restriction is imposed:

$$\tilde{\gamma}_{ij} = \tilde{\gamma}_{ji} \qquad \text{for all } i \text{ and } j. \qquad (51)$$

As with models II, III and IV, n-1 equations (equations 1-9) are estimated. The parameters of the *n*th (in our case 10th) budget share equation are obtained by applying adding-up, homogeneity and symmetry of the parameters.

The QUAIDS is estimated by iterative feasible generalized nonlinear least squares (ifgnls), which is equivalent to maximum likelihood estimation, with robust standard errors. The elasticities are then calculated using adjusted elasticity formulae based on Zheng and Henneberry (2010). The uncompensated (Marshallian) price elasticities are calculated as follows:

$$\tilde{e}_{ij}^{u} = w_i^{-1} * \left\{\tilde{\gamma}_{ij} - \left(\tilde{\beta}_i + \frac{2\tilde{\lambda}_i}{b(p)} * \ln\left(\frac{X}{a(p)}\right)\right) * \left(\alpha_j + \sum_k^N \gamma_{jk} * ln(p_k)\right) - \frac{\tilde{\lambda}_i * \beta_j}{b(p)} * \left(ln\left(\frac{X}{a(p)}\right)\right)^2\right\} + \varphi * \tau_{ij}\left(\frac{1-\delta_i}{w_i}\right) - \delta_{ij} \qquad (52)$$

and the expenditure elasticities:

$$\tilde{e}_i = 1 + w_i^{-1}\left(\tilde{\beta}_i + \frac{2 * \tilde{\lambda}_i}{b(p)} * ln\left(\frac{X}{a(p)}\right)\right). \qquad (53)$$

The compensated (Hicksian) price elasticities are calculated as follows:

$$\tilde{e}_{ij}^{c} = \tilde{e}_{ij}^{u} + \tilde{e}_i * w_j. \qquad (54)$$

Equations (52), (53) and (54) include original as well as tilde (~) parameters. This combination of original and tilde parameters leads to some difficulties regarding the homogeneity of the elasticities. Whereas adding-up of the budget shares to unity and the symmetry of the Slutsky matrix are fulfilled, homogeneity of the elasticities cannot be fulfilled. Homogeneity cannot be fulfilled, i.e. it is not possible to impose restrictions on α_i and β_i as well as $\tilde{\alpha}_i$ and $\tilde{\beta}_i$ – unless for trivial solutions, hence, if $\varphi = 1$. In this trivial case, the first step (probit model) would be irrelevant (which is not the case with censored data). To date, the state-of-the-art literature does not offer appropriate solutions concerning the homogeneity non-fulfilment.

Whereas the original QUAIDS model is a demand system which complies with the conditions of demand theory, it must be questioned whether the SY approach is the appropriate method to account for zero observations in household level data models if these require consistency with demand theory.

4.4.7 *Missing price information and quality-adjustment of prices*

Household surveys often document the households' expenditure and partly consumed quantities but do not include market prices. Likewise, the HBS (2013) sample contains only expenditure and partly consumed quantities. However, no information on individual purchases is documented in the data as the FSO summarises all purchases of the observation period for each product category. Hence, the sum of all expenditure and the sum of the consumed quantity for each product aggregated to the month is observed[42]. This means that each product category may contain one or more purchases. From overall expenditure and quantity, average unit values can be calculated. However, it should be borne in mind that unit values are not equal to market prices. This issue will be discussed in the following.

Prices are assumed to be one of the most important factors explaining demand patterns of organic food and food consumption in general. When dealing with price information regarding household surveys and demand analyses, two questions arise. First, it is unknown why different prices are observed within one product category. Second, as mentioned above, it is also not known why no prices are observed for a part of the households. Previous studies suggest that there are several reasons for observing various prices or no prices at all. One reason for observing varying prices is the point in time (when and how long we observe households) or price variation (Waugh, 1928; Deaton, 1988). Prices tend to fluctuate from day to day, week to

[42] Food consumption is documented during two weeks of the observation month and aggregated to the whole month afterwards.

week, and season to season. Another reason is differences in financial means of the household (Deaton, 1988). Hence, which unit value one observes in household surveys reflects a quality as well as quantity choice the household makes (Cox and Wohlgenant, 1986). This means that the household's budget affects the kind of products that are consumed, and product prices influence what level of quality consumers (can) choose. Therefore, it is likely to observe higher unit values for wealthier households and smaller ones for poorer households. In other words, prices are functions of supply as well as demand.

Another reason for observing different prices is that various quality levels are available on the market. In this study, the quality differences that are analysed originate in part from the organic and conventional production system. Organic prices are in most cases higher than those for conventional products. Furthermore, the analysed product categories include a sometimes more, sometimes less heterogeneous selection of goods resulting in a more or less wide range of prices (see Table 4.2). And even if the quality of two items in a product category is identical, prices can still vary depending on the kind of store and region. Regional price variations can also affect how much a household consumes (Chung et al., 2005). Moreover, it can be expected that households in different regions face different market prices. This may be related to the type of store but also to the regional (food) culture, preferences and income of the households (see chapter III). From these region-specific factors, it follows that consumers in different regions likely choose varying quantities and qualities of goods. Furthermore, purchases from promotions and special offers might also be present in the data.

The question is how to address the issue of missing price information in the data. Furthermore, it has to be considered that censoring can be important in the estimation process. Dhar et al. (2003), Stockton (2003) and Chung et al. (2005) show that under certain circumstances it is important to consider endogeneity resulting from the above-mentioned aspects. Clearly, ignoring missing prices is neither an option nor realistic and may lead to biased and inconsistent estimation results. Furthermore, every household faces a market price – whether the household consumes or not. The question arises how price information can be included in the analysis if it cannot be taken directly from the survey.

Various approaches have been developed to account for price variations and how to deal with missing price information. One option to include price data is to use price data from other (official) sources. For this study, however, such data is not available for all product categories and months. A higher aggregation level of the products can reduce the problem of missing prices. However, it raises another difficulty: the heterogeneity of products within each category tends to be even larger when products are aggregated. The consequence may be a larger price variation. For this analysis however, the products are aggregated into product categories. The main reason for doing so is the small number of positive observations for the individual organic products.

Furthermore, unit values, i.e. the ratio of expenditure and quantity, are used to incorporate price information in case of zero consumption of the households. However, this is necessarily unproblematic as mentioned above.

Cox and Wohlgenant (1986) and Chung et al. (2005) suggest using quality-adjusted prices instead of unadjusted unit values to avoid biased and inconsistent estimation results. By dividing the products into two groups (organic and non-organic) a certain quality adjustment is achieved. The approach of Cox and Wohlgenant (applied e.g. in Thiele, 2008; Hoang, 2009; Schröck, 2013a and 2013b) and advancements thereof (e.g. Majumder et al., 2012) assume that all households face the same regional prices. However, households mostly face prices deviating from those regional averages. Cox and Wohlgenant (1986) as well as Majumder et al. (2012) relate the deviation from the regional average price mainly to household-related factors and income.

Stockton (2003) suggests an approach that is especially suitable for data with many zero observations. The approach suggests using a Heckman two-step estimation (Heckman, 1979) procedure to compensate for possible biases due to the non-consumption of part of the households in the sample. In the first step, households are divided into consumers and non-consumers where a threshold is set for the observed price (= 0). This means that households that have bought at least one product during the observation period are considered consumers. From the probability model in the first step, the inverse Mill's ratio is calculated and included in the OLS regression (second step). See chapter 3.3.3 for a detailed explanation of Heckman's two-step estimation.

In testing the above-mentioned approaches, it was found that the relationship between household characteristics and income, and the observed prices are rather weak as adjusted prices do not differ much from the observed unit values. Hence, socio-demographic variables and income can only explain a small part of the variation of the observed unit values. It is not unlikely that income has low explanatory power with regard to the observed price variation and thus the households' quality choices because Swiss households spend only a small share of their income on food and beverages (around 8% on average for 2006-2011).

Due to the large size of the analysed data sample and the poor results of the quality-adjustments, quantity-weighted regional monthly averages (corrected for inflation) are assigned to the non-consuming households. Note that this only applies to those models that use household-level data with zero observations (models IV and V). It can be assumed that the bias caused by the price is rather small when using such large data sets.

4.4.8 *Other methodological issues of interest*

This chapter presents methodological issues that are primarily interesting once the actual elasticity estimates are going to be used in computational equilibrium models e.g. for policy advice. Because the focus of this study is not on the actual estimation results but rather on the comparison of the results, we keep the estimation models as simple as possible and do not consider the following methodological issues in the elasticity estimation, but briefly discuss them in this subsection.

Demographic translating

Socio-demographic variables have been identified in many studies as key determinants of consumer behaviour. Therefore, it can be assumed that different types of households consume differently (Pollak and Wales, 1978; Deaton and Muellbauer, 1980b). If information on socio-demographic characteristics was not included explicitly in the budget share equation, it would be partially absorbed in the intercept term α_i of the budget share equation (35). The empirical studies of Abdulai (2002) and Aepli (2014a) applied the *demographic translating* approach of Pollak and Wales (1978) to Swiss household data and included socio-demographic variables not only in the multivariate probit model (see chapter 4.4.5) but also in the actual AIDS (QUAIDS). The intercept α_i in the budget share equation of the QUAIDS (34) is then replaced by the following term:

$$\alpha_i = \rho_{i0} + \sum_{k=1}^{K} \rho_{ik} D_{kh} \quad (55)$$

where ρ_{i0} is the new intercept (constant term), D_{kh} are the socio-demographic variables and ρ_{ik} are the corresponding parameters. To ensure that the adding up condition of the intercept term α_i (55) holds, the following restrictions on ρ_{i0} and ρ_{ik} are imposed:

$$\sum_{i=1}^{n} \rho_{i0} = 1 \text{ and } \sum_{i=1}^{n} \rho_{ik} = 0. \quad (56)$$

As socio-demographic regressors (demand shifters) the household size, the number of children in the household, a dummy for the presence of a small child (0-4 years) in the household, the gender and age of the household's main earner, a dummy for at least one smoker in the household, a dummy to consider whether the household receives social benefits or not, the linguistic region etc. are worth considering within the framework of empirical studies. Furthermore, other monetary variables are an option as well (overall expenditure on food and beverages, the budget share that the household spends on food away from home etc.).

If *demographic translating* is considered within the QUAIDS, the budget share equation (35) is adjusted. Neglecting the previously discussed adjustment for zero observations, the new budget share equation is specified as follows:

$$w_i = \rho_{i0} + \sum_{k=1}^{K} \rho_{ik} D_{kh} + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{X}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{ln\left[\frac{X}{a(p)}\right]\right\}^2 \quad (57)$$

When the SY approach is applied, the budget share equation (46) is adjusted as follows:

$$\widetilde{w}_i = \emptyset_i(\boldsymbol{z}_i' \boldsymbol{\theta}_i)\left\{\rho_{i0} + \sum_{k=1}^{K} \rho_{ik} D_{kh} + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{X}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{ln\left[\frac{X}{a(p)}\right]\right\}^2\right\} + \delta_i \varphi_{ih}(\boldsymbol{z}_i' \boldsymbol{\theta}_i). \quad (58)$$

To compare models I to V more easily, socio-demographic variables are not considered in the AIDS and QUAIDS equations (models I-V). However, they are considered in the multivariate probit model in the first step of estimation V (see Table 4.1 for the summary statistics of the socio-demographic variables).

Endogeneity issues: unobserved heterogeneity and total expenditure

Unobserved heterogeneity is a special form of endogeneity and occurs if at least one of the explanatory variables in the model correlates with the error term. This means that the error term contains one or more explanatory variables that are unobserved but correlated with an explanatory variable. Unobserved heterogeneity often occurs when household data are analysed. In analyses drawing on different waves of cross-sectional surveys, the observed households differ from wave to wave (in contrast to analyses using panel data). This may potentially lead to differences in the composition of the samples. This would be particularly problematic if the samples differed in non-observable factors.

Unobserved heterogeneity is also a potential problem because many factors can only be measured with difficulty and are not present in household surveys. The decision to buy or not to buy a (food) product is complex and involves psychological and other qualitative factors (preferences, attitudes etc.) among others. In the case of food decisions, it can be recommended to consider seasonality in an empirical study. This might be more important for some products than for others. For instance, Zheng and Henneberry (2010), and Steinbach and Aepli (2014a) suggest including a dummy variable for each observation month into the multivariate probit regression and the QUAIDS model. This may help to avoid inconsistencies and biases due to seasonality in the consumption of products.

Another endogeneity problem is related to the overall expenditure for the products included in the model. According to Blundell and Robin (1999), Dhar et al. (2003) and Aepli (2014a) it is likely that the log of total expenditure (and the squares of the log-transformed expenditure) is correlated with the error term of the QUAIDS' budget share equation. This endogeneity problem needs to be addressed in order to obtain unbiased and consistent parameter estimates. Blundell and Robin (1999) (applied in Zheng and Henneberry, 2010) suggest regressing all explanatory variables (log of prices, socio-demographic variables, monthly dummies etc.) of the QUAIDS budget share equation on the log of total expenditure, i.e. they suggest using the household's disposable income as an instrumental variable. Aepli (2014a) further suggests considering the square of household income. Following, the residuals res_i are predicted and integrated into the budget share equation (58):

$$\widetilde{w}_i = \emptyset_i(\boldsymbol{z}_i' \boldsymbol{\theta}_i)\left\{\rho_{i0} + \sum_{k=1}^{K} \rho_{ik} D_{kh} + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{X}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{ln\left[\frac{X}{a(p)}\right]\right\}^2 + \zeta_i res_i\right\} + \delta_i \varphi_{ih}(\boldsymbol{z}_i' \boldsymbol{\theta}_i). \quad (59)$$

ζ_i is the corresponding parameter of the residuals. The significance level of this parameter, then, also reveals whether endogeneity is present (significant) or not (not significant).

4.5 Empirical approach

Within the framework of this study, we compare five versions of Deaton and Muellbauers (1980a) Almost Ideal Demand System (AIDS). For an overview of the model specifications see Table 4.3.

The main objective of this analysis is to compare different versions of the Almost Ideal Demand System. In doing so, we strive to detect how sensitive the magnitudes of the elasticity estimates are in response to the different specifications and data aggregation levels. Five versions of the AIDS model are explored in this study, leading to partly very different results as shown in the following. Overall, this study supports the assumption that the demand system must be chosen with care in order to obtain 'plausible' results.

Table 4.3: Overview of the model specifications

	Model I	Model II	Model III	Model IV	Model V
Number of observations	72	751	751	19566	19566
Prices	Deflated unit values (averages across households for each month)	Deflated unit values	Deflated unit values	Deflated unit values for consuming households, deflated quantity-weighted averages for non-consuming households	Deflated unit values for consuming households, deflated quantity-weighted averages for non-consuming households
Aggregation level of the data	Aggregated over households for each observation month	Household data	Household data	Household data	Household data
AIDS specification	AIDS (Deaton & Muellbauer, 1980a)	AIDS (Deaton & Muellbauer, 1980a)	Quadratic AIDS (Banks et al., 1997)	Quadratic AIDS (Banks et al., 1997)	Refined Quadratic AIDS (Banks et al., 1997)
Censoring / zero consumption	No zero consumption is present in the sample	No zero consumption is present in the sample	No zero consumption is present in the sample	Zero consumption is present in the sample, but not considered in the estimation	Zero consumption is present in the sample and considered in the estimation applying the approach of Shonkwiler & Yen (1999)
Additional explanatory variables[1]	Dummies for months and years	–	–	–	Probability density function (pdf), cumulative distribution function (cdf)
Predicted budget shares add up to unity	fulfilled	fulfilled	fulfilled	fulfilled	fulfilled
Homogeneity of elasticities	fulfilled	fulfilled	fulfilled	fulfilled	**rejected**
Symmetry of the Slutsky matrix	fulfilled	fulfilled	fulfilled	fulfilled	fulfilled

[1] Explanatory variables that are included in all models are log-prices (deflated unit values) and log-expenditure.

The approach of this study is to start from a rather simple estimation model (model I) and developing it to a more sophisticated one (model V). The analysis starts by using the original AIDS model of Deaton and Muellbauer (1980a) for a data sample that contains only those households that have consumed all ten product categories during the observation period. That way, we avoid dealing with the issue of censoring (i.e. zero observations). The first two models assess the influence of data aggregation. While applying the same specification in models I and II, the data are aggregated over all households for each month in model I, resulting in a total of 72 observations. Hence, for every month the overall expenditure, the consumed quantity and the average price paid is used. In the second AIDS model (model II), the number of observations is about tenfold (n=751) as the data are analysed at the household level. As there is only one 'household' per month, representing the average household in terms of the socio-demographic profile, no household characteristics are included in the model. To facilitate the comparison of model version I to the other versions II to V, we likewise refrain from including household characteristics in the other models.

In models III-V, the QUAIDS by Banks et al. (1997), which has been widely used in recent years (see chapter 4.4.4) and constitutes the most recent refinement of the AIDS, is applied. First, the sensitivity of the QUAIDS with its quadratic terms in model III is compared to the original AIDS in model II (both using household-level data without any zero observations). Furthermore, the estimation results are compared for a sample of households that consumed all ten product groups (model III; n=751) and one including households with zero expenditure in addition (model IV; n=19 566). In this way, the influence of zero observations on the estimation results is investigated. The analysis of the influence of censoring is twofold. When working with household level data, zero observations are often an issue (see also chapter 4.4.5). Especially when analysing products such as organic foods, we are at least in part confronted with high shares of zero consumption because most of the households did not consume the product of interest during the observation period. Model IV examines how well the QUAIDS approach fits with the data when there are high shares of zero consumption and no other techniques (such as the SY approach) are applied. The last objective is to analyse how well the SY approach can account for the bias caused by zero observations. For this purpose, model IV is compared to model V – which adds the SY approach to model IV.

For the sake of simplicity, only the results of the predicted budget shares, the estimated expenditure elasticities and uncompensated as well as compensated own-price elasticities are shown in the main section of this study (Table 4.4, Table 4.5 and Table 4.6). The whole set of the uncompensated and compensated own- and cross-price elasticities can be found in the appendix).

Note that due to the cross-sectional data structure of the HBS (2013) the elasticities calculated within the framework of this study should be regarded as the short-term demand response of the consumer (household). Furthermore, it should be borne in mind that consumers may not always behave according to the underlying theory of the AIDS and QUAIDS models and especially the underlying theory of the rational and utility-maximizing consumer. It should be taken into consideration that factors such as impulse purchases, habitual and socially dependent and desirable behaviour as well as altruism, advertisement and lacking or incomplete information may also influence what consumers buy but may not be adequately reflected in the model. In case of organic food products, it cannot necessarily be ruled out that the households of the HBS behaved differently than rational utility-maximizing consumers. These kinds of phenomena are, however, beyond the scope of this study because households document their data only at one point in time. Therefore, information on impulse buying, habits etc. are not available for the analysis.

Nevertheless, this does not necessarily mean that the AIDS and QUAIDS models are inappropriate to model consumption decisions for organic and conventional food. Income and prices are very likely important factors for consumption decisions and even if they cannot explain each and every consumer decision, the predictions about average consumer behaviour can be very informative.

4.6 Results and discussion

4.6.1 *Predicted budget shares and introductory remarks*

Table 4.4 shows the results for the predicted budget shares of the five models. The shares do not vary much in models I, II and III. In models IV and V, however, a decrease in the predicted organic budget shares can be observed. The organic share drops from around one third to just below 8%. Accordingly, the conventional expenditure share increases from around 67% (models I, II and III) to over 90% (models IV and V).

Table 4.4: Predicted expenditure shares of the model specifications

		Model I	Model II	Model III	Model IV	Model V
organic	Bread and cereal products	4.7%	4.9%	4.9%	1.5%	1.5%
	Meat products	8.2%	8.4%	8.4%	1.3%	1.3%
	Milk products	6.8%	6.9%	6.9%	1.8%	1.8%
	Fruit	4.5%	4.5%	4.5%	1.2%	1.2%
	Vegetables	7.6%	7.8%	7.8%	1.8%	1.8%
	organic expenditure share	**31.8%**	**32.5%**	**32.5%**	**7.6%**	**7.6%**
conventional	Bread and cereal products	9.7%	9.8%	9.8%	13.3%	13.3%
	Meat products	22.6%	21.7%	21.7%	31.2%	31.2%
	Milk products	14.5%	14.4%	14.4%	20.6%	20.6%
	Fruit	10.1%	10.4%	10.4%	12.0%	12.0%
	Vegetables	11.2%	11.3%	11.3%	15.3%	15.3%
	conv. expenditure share	**68.1%**	**67.5%**	**67.5%**	**92.4%**	**92.4%**

Source: own calculations

The overall organic budget shares in models I, II and III seem rather high compared to what can be observed in the data (see Table 3.1). The results of models I, II and III would suggest that, on average, one third of the household's food budget for consumption at home is spent on organic food while two thirds are spent on non-organic products. The organic expenditure share in this data sample is at 6.4% across all linguistic regions and years (Table 3.1). Hence, models IV and V predict this more realistically, whereas models I, II and III estimate rather high expenditure shares for organic food and smaller ones for conventional food, respectively.

Table 4.5 shows the expenditure elasticities and corresponding significance levels for the five estimation models.

Table 4.5: Expenditure elasticities for organic and conventional food

		Model I		**Model II**		**Model III**		**Model IV**		**Model V**	
organic	Bread and cereal products	0.511	*	0.819	***	0.351	***	0.522	***	0.586	n.a.
	Meat products	1.083	**	0.963	***	1.030	***	1.884	***	1.307	n.a.
	Milk products	0.322		0.691	***	0.534	***	0.244	***	0.602	n.a.
	Fruit	0.618	*	0.520	***	0.647	***	0.702	***	0.627	n.a.
	Vegetables	0.809	***	0.659	***	0.443	***	0.538	***	0.670	n.a.
conventional	Bread and cereal products	1.065	***	1.113	***	0.754	***	1.127	***	0.811	n.a.
	Meat products	1.345	***	1.301	***	1.678	***	1.282	***	1.204	n.a.
	Milk products	1.044	***	1.051	***	1.095	***	0.735	***	0.947	n.a.
	Fruit	1.263	***	0.892	***	0.862	***	0.774	***	0.813	n.a.
	Vegetables	0.794	***	1.081	***	0.982	***	0.987	***	1.097	n.a.

Significance levels: * p<0.05, ** p<0.01, *** p<0.001, n.a. not available

Source: own calculations

As in previous studies (e.g. Glaser and Thompson, 2000; Jonas and Roosen, 2008; Schröck, 2013a), we also find that when either total expenditure or prices change, the demand reactions are different for organic and for conventional food products. Overall the elasticities (especially the price elasticities, Table 4.6) respond rather sensitively to the specification of the estimation model.

However, the expenditure elasticities are at an appropriate magnitude (in terms of what was expected, i.e. expenditure elasticities of around 1[43]) across all models. An expenditure elasticity of 1 suggests that with an increase of the overall expenditure on food of one unit, the expenditure on the product group would increase by the same

[43] See e.g. the estimations of Jonas and Roosen (2008) and Schröck (2013a and 2013b).

amount.

Comparing the expenditure elasticity estimates of the products, we find the largest estimates for meat products, both organic and conventional (Table 4.5). This means that with 1 Swiss Franc of additional budget, the demand for both organic and conventional meat would increase disproportionately (by more than 1 Swiss Franc). This would imply that consumers would decrease their expenditure on other goods in case of an increased overall food budget. Hence, meat appears to be a luxury good, even more so if it is organic meat. The expenditure elasticities for organic bread and cereal products, milk products, fruit and vegetables, however, are all below 1, suggesting that they are necessity goods (expenditure elasticity between 0 and 1). Hence, the demand for these products can be expected to increase underproportionately with an increase in food budget.

The expenditure elasticities for conventional bread and cereal products, milk products, fruit and vegetables are in some cases above 1, in others below 1, indicating mixed results. For these products, the variation across models is comparable to that of the organic categories. The variation for organic meat, however, is the highest, suggesting that this product category reacts most sensitive to changes in the specification of the estimation model. With the highest share of zero observations in the meat category (86%, see Table 4.2), this might be a reason for the high variation of the expenditure elasticity estimates.

The expenditure elasticity estimates for the organic products are in most cases smaller compared to their conventional counterparts. This means that with an increase in overall food expenditure, it can be expected that the expenditure for the conventional product increases more than in case of the organic one. Only in model IV and model V, the relationship between organic and conventional meat is inverted. In this case, a higher increase in the demand for organic meat than for conventional meat can be expected if the overall food expenditures increase.

Overall, the estimated price elasticities in Table 4.6 vary more than the estimated expenditure elasticities across model specifications.

Table 4.6: Compensated and uncompensated own-price elasticities

		Model I		Model II		Model III		Model IV		Model V	
		own-price elasticities		own-price elasticities		own-price elasticities		own-price elasticities		own-price elasticities	
		uncomp.	comp.	uncomp.	comp.	uncomp.	comp.	uncomp.	comp.	uncomp.	comp.
organic	Bread and cereal products	-0.655**	-0.631**	-10.035	-9.995	-5.450	-5.433	40.550***	40.558***	15.683***	15.692***
	Meat products	-0.605*	-0.516	2.767	2.847	2.855	2.941	-2.984	-2.959	-0.910***	-0.893***
	Milk products	-1.113***	-1.091***	-12.556***	-12.508***	-10.194***	-10.157***	2.754	2.758	-0.257**	-0.246**
	Fruit	-0.172	-0.144	-30.273***	-30.250***	-20.758***	-20.729***	11.848*	11.856*	2.668***	2.675***
	Vegetables	-0.921***	-0.860***	-7.379***	-7.327**	-6.215**	-6.180**	-0.867	-0.858	-0.170	-0.158
conventional	Bread and cereal products	-0.777***	-0.674***	8.662	8.771	6.950	7.023	0.800	0.951	0.595***	0.703***
	Meat products	-0.962***	-0.658**	0.979	1.262	1.049	1.414	-1.587***	-1.187***	-0.236***	0.139*
	Milk products	-1.025***	-0.874***	0.946	1.097	0.683	0.841	-2.774***	-2.623***	-1.147***	-0.952***
	Fruit	-0.914***	-0.786***	-0.252	-0.159	1.817	1.907	-5.814***	-5.721***	-3.900***	-3.803***
	Vegetables	-0.987***	-0.898***	-1.029***	-0.908***	-1.009***	-0.899	-0.917***	-0.766***	-1.431***	-1.263***

Significance levels: * p<0.05, ** p<0.01, *** p<0.001

Source: own calculations

4.6.2 *Influence of data aggregation – comparison of model I and model II*

Models I and II aim to investigate the influence of data aggregation on the magnitude of the elasticity estimates.

For both model I and model II, the original version of Deaton and Muellbauer's (1980a) Almost Ideal Demand System (AIDS) is applied (see section 4.4.1 for the methodological details). Model I analyses a set of households that have consumed all ten product categories during the observation period. Hence, no zero observations are present in the data of model I. The data for model I are aggregated over the considered households of each month resulting in 72 observations for the six years (2006-2011) while model II draws on disaggregated household-level data.

The comparison of model I and II shows that model II estimates much more heterogeneous elasticities for individual product categories, especially for the organic ones. Whereas the organic own-price elasticities of model I vary between -0.2 and -1.1, those of model II vary between 2.8 and -30.3 (Table 4.6). Similarly, however not as much, a rather large variation can be observed for the conventional product categories. A positive estimate would suggest that with an increasing product price the demand would increase. In case of food products, however, this seems rather unlikely.

Based on the results of other studies, the results of model I generally seem to be more realistic. Comparing the results of model I and model II suggests that the AIDS model is less capable of dealing with the household-specific variation in the data well when applied to disaggregated household-level data. However, it has to be borne in mind that disaggregated data do not necessarily cause this problem. The results obtained in model II may also be due to the data used (with low consumption volumes and variations in organic prices).

4.6.3 *Model specification (AIDS vs. QUAIDS) – comparison of model II and model III*

The next comparison aims to better understand the extension of the AIDS (model II) by a quadratic term (model III). In principle, the additional quadratic term in the budget share equation (35) allows for more flexible income responses, i.e. non-linear Engel curves. It is conceivable that Engel's curves for organic food are not necessarily linear as their higher prices compared to conventional products give them the flavour of a luxury good.

In model III, the same set of non-aggregated, hence, household-level data without any zero observations is used (n=751) (see Table 4.3 for all details of model III). As with model II, model III also does not include household characteristics. The only difference between the models consists in the quadratic term of the QUAIDS in model III (see chapters 4.4.1 and 4.4.4 for methodological details).

The comparison of model II and model III (Table 4.6) reveals that the estimates of each product category are more similar in models II and III than in the previous comparison of models I and II. With some exceptions, e.g. conventional fruit (here the sign of the estimate changes from negative to positive), the estimates do not change as much from model II to model III in absolute values (e.g. -12.6, model II, to 10.2, model III, uncompensated own-price elasticity of organic milk products).

The similarity of the estimated elasticities in models II to those in model III suggests that the specification of the model (from AIDS to QUAIDS) – at least in this study – does not seem to have much of an influence on the outcome of the estimation.

4.6.4 *Influence of zero observations in the data – comparison of model III and model IV*

The estimation of models III and IV is carried out to assess the influence of zero observations in the data on the outcome of the elasticity estimation. In both models III and IV, the QUAIDS model (Banks et al., 1997) is used. The two models differ only in the data they analyse. Whereas only households that had consumed all ten product categories (n=751) are included in model III, all households that had consumed at least one of the ten product categories (n=19566) are included in model IV. Hence, zero observations are present in the sample used in model IV but are not considered in the model specification. The missing price data (model IV) is, however, considered prior to the estimation. The observed unit values which are used as price information are deflated as in all the other models and in case of the missing price information deflated quantity-weighted average prices are included (see chapter 4.4.7 for the details on missing price information).

As with the first two models, the difference between the uncompensated and compensated own-price elasticities is not large. The results of models III and IV, however, are not easily comparable. The estimates of both models seem rather unexpected in view of the results of previous studies. Furthermore, some of the elasticities change their sign from positive to negative and vice versa. Also, the change is greater for the organic than for the conventional product categories. Considering that the share of zero observations is rather high for the organic categories of model IV (64-86.1%, see Table 4.2), the change of the elasticities might (at least in part) be attributed to this. The share of zero observations in the conventional categories is by contrast not as high as in model IV (1.5-6.1%, see Table 4.2). It can be assumed that the number of zero observations is crucial for the estimation. The quite large change of the organic own-price elasticities from model III to model IV (for the individual product categories) suggests that the model might need some adjustment to deal with censoring. At least, it does not seem possible to estimate plausible elasticities without additional steps prior to the elasticity estimation.

4.6.5 *Influence of (not) considering zero observations in the estimation – comparison of model IV and model V*

The last model comparison aims at evaluating how capable the SY approach is to account for zero observations in the data. As Table 4.2 shows, with 64-86% zero observations in the organic categories, the issue of censoring is substantial and, therefore, can hardly be ignored. A QUAIDS model is applied on household-level data in estimation IV, and a multivariate probit regression and a reformulated version of the QUAIDS in model V. Chapter 4.4.6 explains the reformulated estimation model (V) in detail.

Besides the fact, that the homogeneity of the elasticities cannot be fulfilled in model V, the own-price elasticity estimates seem more plausible than those of model IV supporting the use of the multivariate probit regression prior to the actual elasticity estimation.

Regardless of which of the two models is closer to the true elasticities, the comparison shows how important it is to adequately deal with the zero observations when estimating demand elasticities for food products. This is particularly true for the organic food products for which censoring is highly present in the data.

Apart from the own-price elasticity for organic bread and cereal products, the elasticity estimates of model V as a whole lie in a more plausible range than those of model IV. While the SY approach seems to improve the estimates for conventional products, the elasticities for the organic product categories still seem implausible. The conventional elasticity estimates of the individual product categories change only slightly from model IV to model V. For these products, censoring amounts to only to 6% (see Table 4.2). Hence, whereas the SY approach has an impact on the estimates when censoring is highly present in the data, it does not change the estimation results much with little shares of zero consumption.

Despite the rather unexpected results of model V, not dealing with censoring at all seems to be the worse option. The results of model V suggest that the suitability of the SY approach in combination with the QUAIDS model needs to be assessed case by case by taking a closer look at the data set to be estimated, especially when censoring is highly prominent.

Finally, it should be noted that models IV and V differ in the compliance with the restrictions. To ensure consistency with demand theory, additivity, homogeneity and symmetry restrictions (22)-(24), (36)-(38) and (49)-(51) are imposed on the parameters of every AIDS, QUAIDS and reformulated QUAIDS budget share equation, respectively. Following every estimation, postestimation tests were performed to check whether the estimates are consistent with the underlying demand theory. Whereas adding-up of the budget shares to unity and the symmetry of the Slutsky matrix are fulfilled in all models, homogeneity of the elasticities cannot be fulfilled in model V. As expected, homogeneity is violated using the reformulated QUAIDS unless for trivial solutions, hence, if the first step (probit model) was irrelevant. See chapter 4.4.6 for the methodological details.

4.7 Concluding remarks and future research

The comparison of the five model versions of the Almost Ideal Demand System originally proposed by Deaton and Muellbauer (1980a) along the timeline from the original version (AIDS), to the more sophisticated one (QUAIDS) and to the reformulated version of Banks et al.'s (1997) QUAIDS brought some interesting results and new insights regarding the estimation of demand elasticities.

Working with a demanding data set with very high shares of zero observations is a challenge and a fortunate coincidence at the same time. The results of the estimation models show that the Almost Ideal Demand System in its different specifications is sometimes more, sometimes less capable of estimating plausible elasticities.

Also, this work shows how important it is to apply consistency checks on the elasticities following the estimation process. This has (apparently) been neglected in previous studies.

Regarding the estimates, model I is the preferred model version when working with aggregated data sets that contain no zero observations. Regarding consistency with the underlying demand theory and when working with non-aggregated (i.e. household-level) data that contain zero observations, model V is the best possible, yet far from perfect solution for the estimation of elasticities. The estimation results from household level data differ in part considerably from those estimated with aggregated data. This raises the question whether the applied SY approach is suitable to model data with considerable shares of zero consumption. This issue might be reassessed in future research.

The correctness and plausibility of the estimated elasticities is difficult to verify and could also be analysed in more detail in future studies. However, the elasticities from aggregated data (without any zero observations) meet the expectations more than those from household-level data even though the predicted budget shares for organic food are much higher than expected. While model V is closer to common expectations than model I, the estimates are at most just satisfactory and advancements with respect to the methodology and data set are desirable.

For future research, it is worth investigating the non-fulfilment of the homogeneity of the elasticity estimates in order to obtain estimates that are consistent with demand theory – as required by computable equilibrium models. Furthermore, the approach of Shonkwiler and Yen (1999) needs a reassessment to determine for which levels of censoring it is appropriate. Even though the shares of zero consumption for organic food are expected to decrease over time, an approach that can deal with higher shares of zero observations might still be useful – not only for organic food or food in general but also for other products that are not consumed as frequently.

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4.9 Appendix

Appendix 4.8.1: Uncompensated (Marshallian) own- and cross-price elasticities – model I

		organic products					conventional products				
		bread / cereals	**meat products**	**milk products**	**fruit**	**vegetables**	**bread / cereals**	**meat products**	**milk products**	**fruit**	**vegetables**
organic products	**bread / cereals**	**-0.655****	0.182	-0.185	-0.413	-0.122	0.055	0.297	-0.049	0.128	0.252
	meat products	0.078	**-0.605***	-0.022	-0.068	-0.192	-0.140	-0.081	0.291	-0.305	-0.038
	milk products	-0.120	0.036	**-1.113*****	-0.036	0.206	0.001	0.276	0.174	0.259	-0.005
	fruit	-0.445	-0.088	-0.075	**-0.172**	-0.518	0.291	-0.083	0.059	0.646*	-0.234
	vegetables	-0.090	-0.185	0.151	-0.312	**-0.921*****	0.022	0.445	0.133	-0.045	-0.006
conventional products	**bread / cereals**	0.001	-0.118	-0.050	0.114	-0.002	**-0.777*****	-0.199	-0.197*	-0.097	0.261
	meat products	0.023	-0.051	0.013	-0.049	0.109	-0.112	**-0.962*****	-0.127	-0.086	-0.104
	milk products	-0.041	0.169	0.033	-0.001	0.052	-0.129	-0.129	**-1.025*****	-0.014	0.043
	fruit	0.024	-0.263	0.110	0.255	-0.069	-0.112	-0.174	-0.052	**-0.914*****	-0.070
	vegetables	0.093	-0.004	-0.036	-0.101	-0.003	0.251	-0.084	0.091	-0.015	**-0.987*****

* p<0.05, ** p<0.01, *** p<0.001

Source: own calculations

Appendix 4.8.2: Compensated (Hicksian) own- and cross-price elasticities – model I

		organic products					conventional products				
		bread / cereals	**meat products**	**milk products**	**fruit**	**vegetables**	**bread / cereals**	**meat products**	**milk products**	**fruit**	**vegetables**
organic products	**bread / cereals**	**-0.631****	0.224	-0.151	-0.390	-0.083	0.104	0.412	0.025	0.180	0.309
	meat products	0.129	**-0.516**	0.051	-0.020	-0.110	-0.036	0.164	0.448*	-0.195	0.084
	milk products	-0.105	0.062	**-1.091*****	-0.021	0.230	0.032	0.349	0.221	0.292	0.031
	fruit	-0.415	-0.037	-0.032	**-0.144**	-0.471	0.350	0.057	0.149	0.709*	-0.165
	vegetables	-0.052	-0.118	0.206	-0.275	**-0.860*****	0.100	0.628**	0.250*	0.037	0.085
conventional products	**bread / cereals**	0.051	-0.031	0.023	0.162	0.079	**-0.674*****	0.042	-0.043	0.011	0.381*
	meat products	0.086	0.060	0.105	0.011	0.212	0.018	**-0.658****	0.068	0.050	0.047
	milk products	0.008	0.255*	0.104	0.046	0.132	-0.029	0.107	**-0.874*****	0.092	0.160
	fruit	0.084	-0.159	0.196	0.312	0.028	0.010	0.111	0.131	**-0.786*****	0.072
	vegetables	0.131	0.062	0.019	-0.065	0.058	0.327*	0.095	0.206*	0.065	**-0.898*****

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Source: own calculations

Appendix 4.8.3: Uncompensated (Marshallian) own- and cross-price elasticities – model II

		organic products					conventional products				
		bread / cereals	meat products	milk products	fruit	vegetables	bread / cereals	meat products	milk products	fruit	vegetables
organic products	bread / cereals	**-10.035**	-4.140	9.585 **	2.724	3.773	-4.699	1.988	4.643	-4.714	0.056
	meat products	-2.398	**2.767**	0.266	-3.381	1.012	0.791	-4.985	-0.146	4.820	0.291 **
	milk products	6.705 **	0.283	**-12.556** ***	3.504 *	1.613	5.632 *	-2.791	-1.392	-1.875	0.186 *
	fruit	2.790	-6.348	5.105 *	**-30.273** ***	12.502 ***	3.238	13.113 **	-2.694	1.864	0.182 *
	vegetables	2.327	1.040	1.438	7.425 ***	**-7.379** ***	-5.690	-2.707	0.560	2.042	0.283 ***
conventional products	bread / cereals	-2.298	0.699	4.056 *	1.502	-4.457	**8.662**	-2.164	-5.214	-1.814	-0.085
	meat products	0.467	-1.877	-0.880	2.566 **	-0.952	-0.883	**0.979**	0.488	-1.181	-0.027
	milk products	1.548	-0.087	-0.733	-0.939	0.229	-3.503	0.933	**0.946**	0.722	-0.166 ***
	fruit	-2.253	3.839	-1.358	0.758	1.393	-1.683	-2.138	1.079	**-0.252**	-0.277 ***
	vegetables	0.021	0.223 **	0.093	0.006	0.173 **	-0.037	0.021	-0.239 ***	-0.311 ***	**-1.029** ***

* p<0.05, ** p<0.01, *** p<0.001

Source: own calculations

Appendix 4.8.4: Compensated (Hicksian) own- and cross-price elasticities – model II

		organic products					conventional products				
		bread / cereals	**meat products**	**milk products**	**fruit**	**vegetables**	**bread / cereals**	**meat products**	**milk products**	**fruit**	**vegetables**
organic products	**bread / cereals**	**-9.995**	-4.072	9.642*	2.761	3.837	-4.619	2.166	4.760	-4.628	0.148*
	meat products	-2.351	**2.847**	0.333	-3.337	1.087	0.885	-4.776	-0.008	4.920	0.399***
	milk products	6.739**	0.340	**-12.508*****	3.535**	1.667	5.699*	-2.641	-1.292	-1.803	0.264
	fruit	2.815	-6.305	5.141*	**-30.250*****	12.543***	3.289	13.226**	-2.619	1.918	0.241**
	vegetables	2.359	1.095	1.484	7.455***	**-7.327****	-5.625	-2.563	0.654	2.111	0.358***
conventional products	**bread / cereals**	-2.244	0.792	4.133*	1.552	-4.370	**8.771**	-1.922	-5.054	-1.698	0.040
	meat products	0.530	-1.768	-0.790	2.624**	-0.851	-0.756	**1.262**	0.675	-1.045	0.119**
	milk products	1.599	0.000	-0.660	-0.891	0.311	-3.401	1.161	**1.097**	0.831	-0.048
	fruit	-2.210	3.913	-1.297	0.798	1.463	-1.595	-1.945	1.207	**-0.159**	-0.176**
	vegetables	0.073*	0.313***	0.168***	0.055	0.257***	0.068	0.256**	-0.083	-0.198***	**-0.908*****

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Source: own calculations

Appendix 4.8.5: Uncompensated (Marshallian) own- and cross-price elasticities – model III

		organic products					conventional products				
		bread / cereals	**meat products**	**milk products**	**fruit**	**vegetables**	**bread / cereals**	**meat products**	**milk products**	**fruit**	**vegetables**
organic products	**bread / cereals**	**-5.450**	-3.327	7.973**	3.617	0.885	-4.689	2.280	2.888	-4.702	0.175*
	meat products	-1.871	**2.855**	0.115	-3.190	0.391	1.041	-5.356	0.146	4.561	0.276*
	milk products	5.635**	0.057	**-10.194*****	2.137	0.957	5.058*	-1.993	-1.462	-0.945	0.217**
	fruit	3.645	-5.938	2.993	**-20.758*****	9.721***	2.758	11.709**	-4.181	-0.723	0.127
	vegetables	0.564	0.322	0.811	5.820***	**-6.215****	-3.799	-0.998	1.799	0.909	0.345***
conventional products	**bread / cereals**	-2.298	0.844	3.590*	1.375	-3.001	**6.950**	-1.957	-3.998	-2.271	0.012
	meat products	0.483	-1.940	-0.601	2.182**	-0.373	-0.836	**1.049**	-0.013	-1.516	-0.114*
	milk products	0.902	0.107	-0.773	-1.386	0.879	-2.771	0.313	**0.683**	1.136	-0.186***
	fruit	-2.297	3.646	-0.745	-0.317	0.538	-2.226	-2.666	1.659	**1.817**	-0.270***
	vegetables	0.025	0.206**	0.080	0.032	0.170**	-0.030	0.020	-0.209***	-0.267***	**-1.009*****

* p<0.05, ** p<0.01, *** p<0.001

Source: own calculations

Appendix 4.8.6: Compensated (Hicksian) own- and cross-price elasticities – model III

		organic products					conventional products				
		bread / cereals	**meat products**	**milk products**	**fruit**	**vegetables**	**bread / cereals**	**meat products**	**milk products**	**fruit**	**vegetables**
organic products	**bread / cereals**	**-5.433**	-3.297	7.998**	3.632	0.912	-4.655	2.356	2.938	-4.666	0.215**
	meat products	-1.821	**2.941**	0.187	-3.144	0.472	1.141	-5.132	0.294	4.668	0.392***
	milk products	5.661**	0.101	**-10.157*****	2.161	0.998	5.110*	-1.877**	-1.385	-0.889	0.277***
	fruit	3.677	-5.884	3.038	**-20.729*****	9.772***	2.821	11.849	-4.088	-0.656	0.200*
	vegetables	0.585	0.359	0.841	5.840***	**-6.180****	-3.756	-0.902	1.862	0.955	0.395***
conventional products	**bread / cereals**	-2.261	0.907	3.642*	1.409	-2.942	**7.023**	-1.794	-3.889	-2.192	0.097
	meat products	0.564	-1.800	-0.484	2.258**	-0.242	-0.672	**1.414**	0.228	-1.342	0.075
	milk products	0.955	0.199	-0.697	-1.337	0.965	-2.664	0.551	**0.841**	1.250	-0.063
	fruit	-2.255	3.718	-0.686	-0.278	0.605	-2.141	-2.479	1.783	**1.907**	-0.173**
	vegetables	0.073*	0.288***	0.148**	0.076	0.246***	0.066	0.234*	-0.068	-0.164**	**-0.899*****

* p<0.05, ** p<0.01, *** p<0.001

Source: own calculations

Appendix 4.8.7: Uncompensated (Marshallian) own- and cross-price elasticities – model IV

		organic products					conventional products				
		bread / cereals	**meat products**	**milk products**	**fruit**	**vegetables**	**bread / cereals**	**meat products**	**milk products**	**fruit**	**vegetables**
organic products	**bread / cereals**	**40.550******	2.764	-4.140	-15.761**	-6.216	-11.263	-6.103	1.651	-2.423	0.418***
	meat products	3.201	**-2.984**	-3.935	1.155	6.985	16.469**	-3.247	-16.115***	-3.943	0.530***
	milk products	-3.395	-2.840	**2.754**	-3.807	-0.135	-4.454	5.498*	1.240	4.359	0.534***
	fruit	-20.009**	1.380	-5.962	**11.848***	0.346	-17.666*	12.230*	4.863	11.696*	0.571***
	vegetables	-5.177	4.987	-0.143	0.297	**-0.867**	-8.500*	-3.529	8.448**	3.148	0.800***
conventional products	**bread / cereals**	-1.306	1.637**	-0.649	-1.611*	-1.177*	**0.800**	-0.173	0.068	1.392*	-0.110***
	meat products	-0.316	-0.116	0.315*	0.424	-0.210	-0.186	**-1.587*****	0.415**	0.012	-0.032**
	milk products	0.140	-1.029***	0.112	0.323	0.745**	0.151	0.640**	**-2.774*****	1.052***	-0.097***
	fruit	-0.302	-0.418	0.637	1.191*	0.462	1.669**	0.196	1.705***	**-5.814*****	-0.101***
	vegetables	0.035***	0.055***	0.050***	0.043***	0.086***	-0.074***	0.020	-0.183***	-0.103***	**-0.917*****

* p<0.05, ** p<0.01, *** p<0.001

Source: own calculations

Appendix 4.8.8: Compensated (Hicksian) own- and cross-price elasticities – model IV

		organic products					conventional products				
		bread / cereals	**meat products**	**milk products**	**fruit**	**vegetables**	**bread / cereals**	**meat products**	**milk products**	**fruit**	**vegetables**
organic products	**bread / cereals**	**40.558*****	2.771	-4.131	-15.755**	-6.206	-11.193	-5.940	1.758	-2.360	0.498***
	meat products	3.230	**-2.959**	-3.901	1.178	7.019	16.720**	-2.659	-15.728***	-3.717	0.818***
	milk products	-3.391	-2.837	**2.758**	-3.804	-0.130	-4.421	5.574*	1.290	4.389	0.572***
	fruit	-19.998**	1.389	-5.949	**11.856***	0.358	-17.572*	12.449*	5.008	11.780*	0.679***
	vegetables	-5.169	4.994	-0.134	0.303	**-0.858**	-8.429*	-3.361	8.558**	3.213	0.882***
conventional products	**bread / cereals**	-1.288	1.652**	-0.628	-1.597*	-1.156 *	**0.951**	0.179	0.300	1.527**	0.062***
	meat products	-0.297	-0.099	0.338 *	0.439*	-0.187	-0.015	**-1.187*****	0.678***	0.165	0.164***
	milk products	0.151	-1.019***	0.126	0.332	0.759 *	0.249	0.869***	**-2.623*****	1.140***	0.015
	fruit	-0.290	-0.408	0.651	1.201*	0.476	1.772**	0.438	1.864***	**-5.721*****	0.017
	vegetables	0.050***	0.068***	0.068***	0.055***	0.104***	0.057***	0.328***	0.020	0.016	**-0.766*****

* p<0.05, ** p<0.01, *** p<0.001

Source: own calculations

Appendix 4.8.9: Uncompensated (Marshallian) own- and cross-price elasticities – model V

		organic products					conventional products				
		bread / cereals	**meat products**	**milk products**	**fruit**	**vegetables**	**bread / cereals**	**meat products**	**milk products**	**fruit**	**vegetables**
organic products	**bread / cereals**	**15.683*****	0.020	0.774***	-0.821***	0.303**	-2.985***	-13.035***	0.251***	-1.316***	0.195***
	meat products	0.334***	**-0.910*****	-0.760***	0.741***	0.268**	2.308***	-1.373***	-1.359***	-0.939***	0.114***
	milk products	0.368***	-0.548***	**-0.257****	0.016	-1.200***	-1.086***	0.815***	0.348***	1.256***	0.151***
	fruit	-1.192***	0.645***	0.136*	**2.668*****	-0.203*	-3.735***	-2.419***	0.003	2.822***	0.370***
	vegetables	0.052	0.092	-1.048***	-0.169	**-0.170**	1.973***	-2.873***	1.171***	0.353***	0.398***
conventional products	**bread / cereals**	-0.441***	0.235***	-0.176***	-0.372***	0.193***	**0.595*****	-0.841***	-1.101***	0.921***	-0.004***
	meat products	-0.521***	-0.005	0.010	-0.080	-0.157**	-0.394***	**-0.236*****	0.099***	0.042	0.156***
	milk products	-0.021	-0.106***	0.021*	-0.005	0.090***	-0.756***	0.288***	**-1.147*****	0.791***	-0.117***
	fruit	-0.287***	-0.123**	0.172***	0.249***	0.002	0.955***	0.377***	1.387***	**-3.900*****	0.224***
	vegetables	0.071***	0.026	0.001	0.029	0.046	-0.027	0.332***	-0.207***	0.098***	**-1.431*****

* p<0.05, ** p<0.01, *** p<0.001

Source: own calculations

Appendix 4.8.10: Compensated (Hicksian) own- and cross-price elasticities – model V

		organic products					conventional products				
		bread / cereals	**meat products**	**milk products**	**fruit**	**vegetables**	**bread / cereals**	**meat products**	**milk products**	**fruit**	**vegetables**
organic products	**bread / cereals**	**15.692*****	0.027	0.784***	-0.814***	0.314**	-2.907***	-12.853***	0.372***	-1.246***	0.285***
	meat products	0.354***	**-0.893*****	-0.737***	0.757***	0.292***	2.483***	-0.965***	-1.091***	-0.783***	0.314***
	milk products	0.377***	-0.541***	**-0.246****	0.024	-1.190***	-1.005***	1.003***	0.472***	1.328***	0.243***
	fruit	-1.182***	0.653***	0.147*	**2.675*****	-0.192	-3.652***	-2.223***	0.132*	2.897***	0.466***
	vegetables	0.063	0.101	-1.035***	-0.161	**-0.158**	2.062***	-2.664***	1.309***	0.433***	0.501***
conventional products	**bread / cereals**	-0.429***	0.246***	-0.162***	-0.362***	0.208***	**0.703*****	-0.589***	-0.935***	1.018***	0.121***
	meat products	-0.503***	0.011	0.032	-0.066	-0.135*	-0.233***	**0.139***	0.346***	0.186***	0.341***
	milk products	-0.007	-0.093***	0.038***	0.007	0.107***	-0.629***	0.583***	**-0.952*****	0.905***	0.028***
	fruit	-0.275***	-0.112**	0.186***	0.259***	0.017	1.064***	0.631***	1.554***	**-3.803*****	0.349***
	vegetables	0.087***	0.040*	0.021	0.042	0.066*	0.119***	0.675***	0.018	0.229***	**-1.263*****

* p<0.05, ** p<0.01, *** p<0.001

Source: own calculations

Appendix 4.8.11: Parameter estimates of the budget share equations – Model II

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
α_1	0.092	0.012	7.440	0.000	0.068	0.116
α_2	0.056	0.025	2.210	0.027	0.006	0.106
α_3	0.163	0.021	7.820	0.000	0.122	0.204
α_4	0.149	0.016	9.480	0.000	0.118	0.180
α_5	0.184	0.022	8.470	0.000	0.141	0.226
α_6	0.053	0.018	2.860	0.004	0.017	0.089
α_7	-0.130	0.047	-2.750	0.006	-0.222	-0.037
α_8	0.147	0.022	6.700	0.000	0.104	0.190
α_9	0.218	0.022	9.750	0.000	0.174	0.262
α_{10}	0.069	0.021	3.250	0.001	0.027	0.110
β_1	-0.009	0.002	-5.250	0.000	-0.012	-0.006
β_2	-0.003	0.004	-0.820	0.412	-0.010	0.004
β_3	-0.021	0.003	-6.830	0.000	-0.028	-0.015
β_4	-0.022	0.003	-8.470	0.000	-0.027	-0.017
β_5	-0.027	0.003	-8.020	0.000	-0.033	-0.020
β_6	0.011	0.003	4.280	0.000	0.006	0.016
β_7	0.065	0.008	8.420	0.000	0.050	0.081
β_8	0.007	0.003	2.360	0.018	0.001	0.013
β_9	-0.011	0.003	-3.530	0.000	-0.017	-0.005
β_{10}	0.009	0.003	2.880	0.004	0.003	0.015
γ_{11}	-0.438	0.312	-1.410	0.160	-1.049	0.173
γ_{12}	-0.200	0.228	-0.880	0.380	-0.646	0.246
γ_{13}	0.466	0.151	3.090	0.002	0.170	0.761
γ_{14}	0.127	0.209	0.610	0.543	-0.283	0.537
γ_{15}	0.183	0.228	0.810	0.420	-0.263	0.630
γ_{16}	-0.225	0.372	-0.610	0.545	-0.955	0.504
γ_{17}	0.098	0.263	0.370	0.710	-0.418	0.613
γ_{18}	0.222	0.210	1.060	0.291	-0.190	0.634
γ_{19}	-0.234	0.298	-0.780	0.433	-0.818	0.350
γ_{110}	0.002	0.004	0.490	0.627	-0.005	0.009

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Appendix 4.8.11: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
γ_{21}	-0.200	0.228	-0.880	0.380	-0.646	0.246
γ_{22}	0.315	0.256	1.230	0.218	-0.187	0.816
γ_{23}	0.022	0.116	0.190	0.848	-0.205	0.249
γ_{24}	-0.284	0.185	-1.530	0.125	-0.647	0.079
γ_{25}	0.085	0.179	0.470	0.636	-0.266	0.435
γ_{26}	0.067	0.276	0.240	0.808	-0.474	0.608
γ_{27}	-0.416	0.287	-1.450	0.148	-0.979	0.147
γ_{28}	-0.013	0.169	-0.080	0.936	-0.344	0.317
γ_{29}	0.401	0.255	1.570	0.116	-0.099	0.901
γ_{210}	0.024	0.009	2.750	0.006	0.007	0.041
γ_{31}	0.466	0.151	3.090	0.002	0.170	0.761
γ_{32}	0.022	0.116	0.190	0.848	-0.205	0.249
γ_{33}	-0.800	0.144	-5.560	0.000	-1.082	-0.518
γ_{34}	0.230	0.100	2.300	0.022	0.034	0.427
γ_{35}	0.112	0.112	1.010	0.315	-0.106	0.331
γ_{36}	0.397	0.191	2.080	0.038	0.023	0.771
γ_{37}	-0.191	0.131	-1.450	0.147	-0.448	0.067
γ_{38}	-0.105	0.116	-0.910	0.364	-0.332	0.122
γ_{39}	-0.141	0.148	-0.960	0.338	-0.431	0.148
γ_{310}	0.011	0.005	1.980	0.048	0.000	0.021
γ_{41}	0.127	0.209	0.610	0.543	-0.283	0.537
γ_{42}	-0.284	0.185	-1.530	0.125	-0.647	0.079
γ_{43}	0.230	0.100	2.300	0.022	0.034	0.427
γ_{44}	-1.335	0.227	-5.870	0.000	-1.780	-0.889
γ_{45}	0.565	0.142	3.990	0.000	0.287	0.843
γ_{46}	0.153	0.219	0.700	0.485	-0.277	0.583
γ_{47}	0.595	0.204	2.910	0.004	0.195	0.996
γ_{48}	-0.131	0.170	-0.770	0.443	-0.464	0.203
γ_{49}	0.072	0.213	0.340	0.734	-0.346	0.491
γ_{410}	0.006	0.004	1.470	0.140	-0.002	0.014
γ_{51}	0.183	0.228	0.810	0.420	-0.263	0.630

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Appendix 4.8.11: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
γ_{52}	0.085	0.179	0.470	0.636	-0.266	0.435
γ_{53}	0.112	0.112	1.010	0.315	-0.106	0.331
γ_{54}	0.565	0.142	3.990	0.000	0.287	0.843
γ_{55}	-0.498	0.197	-2.530	0.012	-0.885	-0.112
γ_{56}	-0.436	0.307	-1.420	0.156	-1.039	0.166
γ_{57}	-0.208	0.215	-0.970	0.333	-0.630	0.214
γ_{58}	0.033	0.193	0.170	0.865	-0.345	0.410
γ_{59}	0.145	0.252	0.580	0.565	-0.349	0.639
γ_{510}	0.019	0.006	3.490	0.000	0.008	0.030
γ_{61}	-0.225	0.372	-0.610	0.545	-0.955	0.504
γ_{62}	0.067	0.276	0.240	0.808	-0.474	0.608
γ_{63}	0.397	0.191	2.080	0.038	0.023	0.771
γ_{64}	0.153	0.219	0.700	0.485	-0.277	0.583
γ_{65}	-0.436	0.307	-1.420	0.156	-1.039	0.166
γ_{66}	0.942	0.588	1.600	0.109	-0.210	2.093
γ_{67}	-0.213	0.310	-0.690	0.492	-0.821	0.395
γ_{68}	-0.505	0.274	-1.850	0.065	-1.042	0.031
γ_{69}	-0.171	0.311	-0.550	0.581	-0.781	0.438
γ_{610}	-0.007	0.005	-1.340	0.180	-0.018	0.003
γ_{71}	0.098	0.263	0.370	0.710	-0.418	0.613
γ_{72}	-0.416	0.287	-1.450	0.148	-0.979	0.147
γ_{73}	-0.191	0.131	-1.450	0.147	-0.448	0.067
γ_{74}	0.595	0.204	2.910	0.004	0.195	0.996
γ_{75}	-0.208	0.215	-0.970	0.333	-0.630	0.214
γ_{76}	-0.213	0.310	-0.690	0.492	-0.821	0.395
γ_{77}	0.422	0.337	1.250	0.211	-0.239	1.083
γ_{78}	0.133	0.199	0.670	0.504	-0.257	0.523
γ_{79}	-0.221	0.257	-0.860	0.390	-0.725	0.283
γ_{710}	0.001	0.010	0.110	0.910	-0.019	0.022
γ_{81}	0.222	0.210	1.060	0.291	-0.190	0.634
γ_{82}	-0.013	0.169	-0.080	0.936	-0.344	0.317

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Appendix 4.8.11: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
γ_{83}	-0.105	0.116	-0.910	0.364	-0.332	0.122
γ_{84}	-0.131	0.170	-0.770	0.443	-0.464	0.203
γ_{85}	0.033	0.193	0.170	0.865	-0.345	0.410
γ_{86}	-0.505	0.274	-1.850	0.065	-1.042	0.031
γ_{87}	0.133	0.199	0.670	0.504	-0.257	0.523
γ_{88}	0.283	0.263	1.070	0.283	-0.233	0.798
γ_{89}	0.108	0.216	0.500	0.618	-0.315	0.530
γ_{810}	-0.023	0.006	-3.800	0.000	-0.035	-0.011
γ_{91}	-0.234	0.298	-0.780	0.433	-0.818	0.350
γ_{92}	0.401	0.255	1.570	0.116	-0.099	0.901
γ_{93}	-0.141	0.148	-0.960	0.338	-0.431	0.148
γ_{94}	0.072	0.213	0.340	0.734	-0.346	0.491
γ_{95}	0.145	0.252	0.580	0.565	-0.349	0.639
γ_{96}	-0.171	0.311	-0.550	0.581	-0.781	0.438
γ_{97}	-0.221	0.257	-0.860	0.390	-0.725	0.283
γ_{98}	0.108	0.216	0.500	0.618	-0.315	0.530
γ_{99}	0.072	0.406	0.180	0.860	-0.724	0.867
γ_{910}	-0.030	0.006	-5.200	0.000	-0.041	-0.019
γ_{101}	0.002	0.004	0.490	0.627	-0.005	0.009
γ_{102}	0.024	0.009	2.750	0.006	0.007	0.041
γ_{103}	0.011	0.005	1.980	0.048	0.000	0.021
γ_{104}	0.006	0.004	1.470	0.140	-0.002	0.014
γ_{105}	0.019	0.006	3.490	0.000	0.008	0.030
γ_{106}	-0.007	0.005	-1.340	0.180	-0.018	0.003
γ_{107}	0.001	0.010	0.110	0.910	-0.019	0.022
γ_{108}	-0.023	0.006	-3.800	0.000	-0.035	-0.011
γ_{109}	-0.030	0.006	-5.200	0.000	-0.041	-0.019
γ_{1010}	-0.002	0.006	-0.420	0.672	-0.013	0.008

Source: own calculations

Appendix 4.8.12: Parameter estimates of the budget share equations – Model III

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
α_1	0.002	0.019	0.120	0.903	-0.035	0.040
α_2	0.075	0.033	2.230	0.026	0.009	0.140
α_3	0.131	0.021	6.210	0.000	0.089	0.172
α_4	0.187	0.020	9.560	0.000	0.149	0.225
α_5	0.104	0.027	3.910	0.000	0.052	0.157
α_6	-0.094	0.033	-2.900	0.004	-0.158	-0.031
α_7	0.163	0.045	3.630	0.000	0.075	0.252
α_8	0.189	0.027	6.930	0.000	0.135	0.242
α_9	0.208	0.031	6.640	0.000	0.146	0.269
α_{10}	0.036	0.033	1.080	0.282	-0.029	0.101
β_1	0.033	0.007	4.720	0.000	0.020	0.047
β_2	-0.013	0.012	-1.110	0.268	-0.037	0.010
β_3	-0.008	0.007	-1.210	0.228	-0.021	0.005
β_4	-0.042	0.007	-5.630	0.000	-0.056	-0.027
β_5	0.005	0.009	0.540	0.590	-0.013	0.023
β_6	0.084	0.012	7.220	0.000	0.061	0.107
β_7	-0.072	0.016	-4.450	0.000	-0.103	-0.040
β_8	-0.009	0.010	-0.890	0.374	-0.028	0.010
β_9	-0.008	0.012	-0.680	0.495	-0.031	0.015
β_{10}	0.029	0.014	2.090	0.037	0.002	0.056
γ_{11}	-0.222	0.233	-0.950	0.341	-0.679	0.235
γ_{12}	-0.155	0.198	-0.780	0.434	-0.542	0.233
γ_{13}	0.389	0.124	3.140	0.002	0.146	0.631
γ_{14}	0.168	0.181	0.930	0.353	-0.187	0.523
γ_{15}	0.040	0.180	0.220	0.822	-0.312	0.392
γ_{16}	-0.236	0.316	-0.750	0.456	-0.855	0.384
γ_{17}	0.124	0.229	0.540	0.589	-0.324	0.571
γ_{18}	0.132	0.183	0.720	0.471	-0.226	0.489
γ_{19}	-0.239	0.259	-0.920	0.355	-0.746	0.268
γ_{110}	-0.001	0.004	-0.150	0.884	-0.008	0.007

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Appendix 4.8.12: *continued*

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
γ_{21}	-0.155	0.198	-0.780	0.434	-0.542	0.233
γ_{22}	0.321	0.220	1.460	0.145	-0.111	0.753
γ_{23}	0.009	0.100	0.090	0.927	-0.187	0.206
γ_{24}	-0.267	0.166	-1.610	0.107	-0.593	0.058
γ_{25}	0.033	0.145	0.230	0.820	-0.252	0.318
γ_{26}	0.091	0.252	0.360	0.719	-0.403	0.584
γ_{27}	-0.451	0.245	-1.840	0.066	-0.931	0.029
γ_{28}	0.013	0.158	0.080	0.936	-0.297	0.322
γ_{29}	0.381	0.216	1.770	0.077	-0.041	0.804
γ_{210}	0.025	0.009	2.860	0.004	0.008	0.042
γ_{31}	0.389	0.124	3.140	0.002	0.146	0.631
γ_{32}	0.009	0.100	0.090	0.927	-0.187	0.206
γ_{33}	-0.636	0.112	-5.670	0.000	-0.856	-0.416
γ_{34}	0.134	0.084	1.600	0.109	-0.030	0.299
γ_{35}	0.064	0.088	0.730	0.465	-0.108	0.236
γ_{36}	0.354	0.161	2.190	0.028	0.038	0.670
γ_{37}	-0.135	0.112	-1.210	0.227	-0.354	0.084
γ_{38}	-0.111	0.096	-1.160	0.245	-0.299	0.077
γ_{39}	-0.078	0.117	-0.660	0.506	-0.306	0.151
γ_{310}	0.010	0.005	1.820	0.068	-0.001	0.020
γ_{41}	0.168	0.181	0.930	0.353	-0.187	0.523
γ_{42}	-0.267	0.166	-1.610	0.107	-0.593	0.058
γ_{43}	0.134	0.084	1.600	0.109	-0.030	0.299
γ_{44}	-0.904	0.172	-5.250	0.000	-1.242	-0.567
γ_{45}	0.439	0.101	4.330	0.000	0.240	0.638
γ_{46}	0.137	0.189	0.720	0.469	-0.233	0.507
γ_{47}	0.521	0.177	2.950	0.003	0.175	0.868
γ_{48}	-0.195	0.147	-1.320	0.185	-0.484	0.094
γ_{49}	-0.040	0.178	-0.220	0.823	-0.388	0.309
γ_{410}	0.007	0.004	1.580	0.115	-0.002	0.015
γ_{51}	0.040	0.180	0.220	0.822	-0.312	0.392

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Appendix 4.8.12: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
γ_{52}	0.033	0.145	0.230	0.820	-0.252	0.318
γ_{53}	0.064	0.088	0.730	0.465	-0.108	0.236
γ_{54}	0.439	0.101	4.330	0.000	0.240	0.638
γ_{55}	-0.411	0.153	-2.680	0.007	-0.711	-0.110
γ_{56}	-0.297	0.248	-1.190	0.232	-0.783	0.190
γ_{57}	-0.070	0.185	-0.380	0.704	-0.432	0.292
γ_{58}	0.127	0.168	0.760	0.448	-0.201	0.456
γ_{59}	0.055	0.203	0.270	0.786	-0.343	0.453
γ_{510}	0.018	0.006	3.300	0.001	0.007	0.029
γ_{61}	-0.236	0.316	-0.750	0.456	-0.855	0.384
γ_{62}	0.091	0.252	0.360	0.719	-0.403	0.584
γ_{63}	0.354	0.161	2.190	0.028	0.038	0.670
γ_{64}	0.137	0.189	0.720	0.469	-0.233	0.507
γ_{65}	-0.297	0.248	-1.190	0.232	-0.783	0.190
γ_{66}	0.755	0.471	1.600	0.109	-0.167	1.678
γ_{67}	-0.168	0.285	-0.590	0.556	-0.727	0.391
γ_{68}	-0.396	0.230	-1.720	0.086	-0.847	0.055
γ_{69}	-0.229	0.279	-0.820	0.413	-0.776	0.319
γ_{610}	-0.011	0.006	-1.980	0.048	-0.023	0.000
γ_{71}	0.124	0.229	0.540	0.589	-0.324	0.571
γ_{72}	-0.451	0.245	-1.840	0.066	-0.931	0.029
γ_{73}	-0.135	0.112	-1.210	0.227	-0.354	0.084
γ_{74}	0.521	0.177	2.950	0.003	0.175	0.868
γ_{75}	-0.070	0.185	-0.380	0.704	-0.432	0.292
γ_{76}	-0.168	0.285	-0.590	0.556	-0.727	0.391
γ_{77}	0.406	0.291	1.400	0.163	-0.164	0.975
γ_{78}	0.041	0.183	0.220	0.824	-0.318	0.399
γ_{79}	-0.277	0.228	-1.210	0.225	-0.725	0.171
γ_{710}	0.009	0.011	0.880	0.377	-0.012	0.031
γ_{81}	0.132	0.183	0.720	0.471	-0.226	0.489
γ_{82}	0.013	0.158	0.080	0.936	-0.297	0.322

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Appendix 4.8.12: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
γ_{83}	-0.111	0.096	-1.160	0.245	-0.299	0.077
γ_{84}	-0.195	0.147	-1.320	0.185	-0.484	0.094
γ_{85}	0.127	0.168	0.760	0.448	-0.201	0.456
γ_{86}	-0.396	0.230	-1.720	0.086	-0.847	0.055
γ_{87}	0.041	0.183	0.220	0.824	-0.318	0.399
γ_{88}	0.246	0.225	1.090	0.276	-0.196	0.687
γ_{89}	0.168	0.197	0.850	0.393	-0.218	0.554
γ_{810}	-0.023	0.006	-3.810	0.000	-0.035	-0.011
γ_{91}	-0.239	0.259	-0.920	0.355	-0.746	0.268
γ_{92}	0.381	0.216	1.770	0.077	-0.041	0.804
γ_{93}	-0.078	0.117	-0.660	0.506	-0.306	0.151
γ_{94}	-0.040	0.178	-0.220	0.823	-0.388	0.309
γ_{95}	0.055	0.203	0.270	0.786	-0.343	0.453
γ_{96}	-0.229	0.279	-0.820	0.413	-0.776	0.319
γ_{97}	-0.277	0.228	-1.210	0.225	-0.725	0.171
γ_{98}	0.168	0.197	0.850	0.393	-0.218	0.554
γ_{99}	0.288	0.315	0.910	0.362	-0.330	0.905
γ_{910}	-0.030	0.006	-5.140	0.000	-0.041	-0.019
γ_{101}	-0.001	0.004	-0.150	0.884	-0.008	0.007
γ_{102}	0.025	0.009	2.860	0.004	0.008	0.042
γ_{103}	0.010	0.005	1.820	0.068	-0.001	0.020
γ_{104}	0.007	0.004	1.580	0.115	-0.002	0.015
γ_{105}	0.018	0.006	3.300	0.001	0.007	0.029
γ_{106}	-0.011	0.006	-1.980	0.048	-0.023	0.000
γ_{107}	0.009	0.011	0.880	0.377	-0.012	0.031
γ_{108}	-0.023	0.006	-3.810	0.000	-0.035	-0.011
γ_{109}	-0.030	0.006	-5.140	0.000	-0.041	-0.019
γ_{1010}	-0.004	0.006	-0.730	0.465	-0.015	0.007
λ_1	-0.004	0.001	-6.080	0.000	-0.006	-0.003
λ_2	0.001	0.001	0.850	0.394	-0.001	0.004
λ_3	-0.002	0.001	-2.550	0.011	-0.003	0.000

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Appendix 4.8.12: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
λ_4	0.002	0.001	2.470	0.013	0.000	0.003
λ_5	-0.003	0.001	-3.670	0.000	-0.005	-0.002
λ_6	-0.007	0.001	-6.490	0.000	-0.009	-0.005
λ_7	0.015	0.002	8.430	0.000	0.011	0.018
λ_8	0.001	0.001	1.460	0.145	-0.001	0.003
λ_9	0.000	0.001	-0.370	0.710	-0.003	0.002
λ_{10}	-0.002	0.001	-1.540	0.124	-0.005	0.001

Source: own calculations

Appendix 4.8.13: Parameter estimates of the budget share equations – Model IV

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
α_1	0.012	0.005	2.520	0.012	0.003	0.021
α_2	-0.003	0.005	-0.570	0.569	-0.012	0.006
α_3	-0.026	0.004	-6.100	0.000	-0.035	-0.018
α_4	0.008	0.010	0.820	0.410	-0.012	0.029
α_5	-0.036	0.005	-7.250	0.000	-0.046	-0.026
α_6	0.440	0.012	37.690	0.000	0.417	0.463
α_7	0.023	0.014	1.620	0.106	-0.005	0.052
α_8	0.204	0.011	19.250	0.000	0.183	0.225
α_9	0.214	0.015	14.770	0.000	0.186	0.243
α_{10}	0.163	0.016	9.970	0.000	0.131	0.195
β_1	0.003	0.002	1.400	0.160	-0.001	0.006
β_2	-0.006	0.002	-2.710	0.007	-0.011	-0.002
β_3	0.020	0.002	12.080	0.000	0.016	0.023
β_4	0.000	0.005	-0.050	0.956	-0.009	0.009
β_5	0.017	0.002	8.390	0.000	0.013	0.020
β_6	-0.111	0.006	-20.160	0.000	-0.122	-0.101
β_7	0.046	0.005	9.380	0.000	0.037	0.056
β_8	0.050	0.004	14.190	0.000	0.043	0.057
β_9	-0.007	0.006	-1.220	0.223	-0.018	0.004
β_{10}	-0.010	0.007	-1.450	0.146	-0.024	0.004
γ_{11}	0.626	0.109	5.770	0.000	0.413	0.839
γ_{12}	0.042	0.083	0.510	0.609	-0.120	0.205
γ_{13}	-0.063	0.059	-1.070	0.283	-0.178	0.052
γ_{14}	-0.239	0.084	-2.860	0.004	-0.403	-0.075
γ_{15}	-0.094	0.085	-1.110	0.265	-0.260	0.072
γ_{16}	-0.172	0.109	-1.580	0.114	-0.384	0.041
γ_{17}	-0.091	0.091	-0.990	0.320	-0.270	0.088
γ_{18}	0.023	0.070	0.330	0.741	-0.115	0.161

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Appendix 4.8.13: *continued*

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
γ_{19}	-0.039	0.086	-0.450	0.653	-0.207	0.130
γ_{110}	0.005	0.001	7.930	0.000	0.004	0.007
γ_{21}	0.042	0.083	0.510	0.609	-0.120	0.205
γ_{22}	-0.027	0.077	-0.350	0.726	-0.177	0.123
γ_{23}	-0.050	0.045	-1.100	0.272	-0.139	0.039
γ_{24}	0.017	0.065	0.260	0.797	-0.111	0.145
γ_{25}	0.091	0.061	1.490	0.137	-0.029	0.211
γ_{26}	0.214	0.076	2.820	0.005	0.065	0.364
γ_{27}	-0.044	0.074	-0.590	0.552	-0.188	0.101
γ_{28}	-0.205	0.047	-4.360	0.000	-0.297	-0.113
γ_{29}	-0.048	0.061	-0.770	0.438	-0.168	0.073
γ_{210}	0.008	0.001	8.770	0.000	0.007	0.010
γ_{31}	-0.063	0.059	-1.070	0.283	-0.178	0.052
γ_{32}	-0.050	0.045	-1.100	0.272	-0.139	0.039
γ_{33}	0.066	0.041	1.600	0.110	-0.015	0.147
γ_{34}	-0.071	0.042	-1.710	0.088	-0.153	0.011
γ_{35}	-0.004	0.038	-0.110	0.916	-0.079	0.071
γ_{36}	-0.079	0.058	-1.360	0.173	-0.192	0.034
γ_{37}	0.100	0.048	2.090	0.037	0.006	0.194
γ_{38}	0.017	0.035	0.490	0.626	-0.052	0.086
γ_{39}	0.075	0.044	1.700	0.089	-0.011	0.162
γ_{310}	0.008	0.001	9.600	0.000	0.007	0.010
γ_{41}	-0.239	0.084	-2.860	0.004	-0.403	-0.075
γ_{42}	0.017	0.065	0.260	0.797	-0.111	0.145
γ_{43}	-0.071	0.042	-1.710	0.088	-0.153	0.011
γ_{44}	0.153	0.061	2.510	0.012	0.033	0.272
γ_{45}	0.004	0.061	0.070	0.948	-0.115	0.123
γ_{46}	-0.212	0.087	-2.440	0.015	-0.382	-0.042
γ_{47}	0.147	0.068	2.160	0.030	0.014	0.280
γ_{48}	0.057	0.054	1.050	0.292	-0.049	0.164

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Appendix 4.8.13: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
γ_{49}	0.138	0.066	2.090	0.037	0.009	0.268
γ_{410}	0.006	0.001	8.860	0.000	0.005	0.008
γ_{51}	-0.094	0.085	-1.110	0.265	-0.260	0.072
γ_{52}	0.091	0.061	1.490	0.137	-0.029	0.211
γ_{53}	-0.004	0.038	-0.110	0.916	-0.079	0.071
γ_{54}	0.004	0.061	0.070	0.948	-0.115	0.123
γ_{55}	0.001	0.046	0.030	0.980	-0.090	0.092
γ_{56}	-0.151	0.075	-2.000	0.046	-0.298	-0.003
γ_{57}	-0.064	0.066	-0.970	0.333	-0.193	0.066
γ_{58}	0.148	0.048	3.070	0.002	0.054	0.243
γ_{59}	0.055	0.062	0.880	0.380	-0.067	0.176
γ_{510}	0.014	0.001	14.560	0.000	0.012	0.015
γ_{61}	-0.172	0.109	-1.580	0.114	-0.384	0.041
γ_{62}	0.214	0.076	2.820	0.005	0.065	0.364
γ_{63}	-0.079	0.058	-1.360	0.173	-0.192	0.034
γ_{64}	-0.212	0.087	-2.440	0.015	-0.382	-0.042
γ_{65}	-0.151	0.075	-2.000	0.046	-0.298	-0.003
γ_{66}	0.208	0.127	1.640	0.101	-0.041	0.457
γ_{67}	-0.011	0.080	-0.140	0.886	-0.168	0.145
γ_{68}	0.029	0.057	0.510	0.607	-0.082	0.140
γ_{69}	0.188	0.077	2.450	0.014	0.038	0.339
γ_{610}	-0.016	0.002	-7.340	0.000	-0.020	-0.011
γ_{71}	-0.091	0.091	-0.990	0.320	-0.270	0.088
γ_{72}	-0.044	0.074	-0.590	0.552	-0.188	0.101
γ_{73}	0.100	0.048	2.090	0.037	0.006	0.194
γ_{74}	0.147	0.068	2.160	0.030	0.014	0.280
γ_{75}	-0.064	0.066	-0.970	0.333	-0.193	0.066
γ_{76}	-0.011	0.080	-0.140	0.886	-0.168	0.145
γ_{77}	-0.211	0.084	-2.500	0.012	-0.376	-0.046
γ_{78}	0.137	0.050	2.770	0.006	0.040	0.235

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Appendix 4.8.13: *continued*

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
γ_{79}	0.031	0.068	0.460	0.648	-0.102	0.165
γ_{710}	0.005	0.003	1.450	0.148	-0.002	0.012
γ_{81}	0.023	0.070	0.330	0.741	-0.115	0.161
γ_{82}	-0.205	0.047	-4.360	0.000	-0.297	-0.113
γ_{83}	0.017	0.035	0.490	0.626	-0.052	0.086
γ_{84}	0.057	0.054	1.050	0.292	-0.049	0.164
γ_{85}	0.148	0.048	3.070	0.002	0.054	0.243
γ_{86}	0.029	0.057	0.510	0.607	-0.082	0.140
γ_{87}	0.137	0.050	2.770	0.006	0.040	0.235
γ_{88}	-0.382	0.059	-6.510	0.000	-0.497	-0.267
γ_{89}	0.201	0.045	4.450	0.000	0.112	0.289
γ_{810}	-0.027	0.002	-12.470	0.000	-0.031	-0.023
γ_{91}	-0.039	0.086	-0.450	0.653	-0.207	0.130
γ_{92}	-0.048	0.061	-0.770	0.438	-0.168	0.073
γ_{93}	0.075	0.044	1.700	0.089	-0.011	0.162
γ_{94}	0.138	0.066	2.090	0.037	0.009	0.268
γ_{95}	0.055	0.062	0.880	0.380	-0.067	0.176
γ_{96}	0.188	0.077	2.450	0.014	0.038	0.339
γ_{97}	0.031	0.068	0.460	0.648	-0.102	0.165
γ_{98}	0.201	0.045	4.450	0.000	0.112	0.289
γ_{99}	-0.586	0.075	-7.820	0.000	-0.733	-0.439
γ_{910}	-0.017	0.002	-9.690	0.000	-0.020	-0.013
γ_{101}	0.005	0.001	7.930	0.000	0.004	0.007
γ_{102}	0.008	0.001	8.770	0.000	0.007	0.010
γ_{103}	0.008	0.001	9.600	0.000	0.007	0.010
γ_{104}	0.006	0.001	8.860	0.000	0.005	0.008
γ_{105}	0.014	0.001	14.560	0.000	0.012	0.015
γ_{106}	-0.016	0.002	-7.340	0.000	-0.020	-0.011
γ_{107}	0.005	0.003	1.450	0.148	-0.002	0.012
γ_{108}	-0.027	0.002	-12.470	0.000	-0.031	-0.023
γ_{109}	-0.017	0.002	-9.690	0.000	-0.020	-0.013

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Appendix 4.8.13: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
γ_{1010}	0.012	0.002	6.930	0.000	0.009	0.016
λ_1	-0.001	0.000	-4.070	0.000	-0.001	0.000
λ_2	0.002	0.000	4.400	0.000	0.001	0.002
λ_3	-0.003	0.000	-14.440	0.000	-0.003	-0.002
λ_4	0.000	0.001	-0.530	0.593	-0.001	0.001
λ_5	-0.002	0.000	-8.930	0.000	-0.003	-0.002
λ_6	0.011	0.001	15.470	0.000	0.010	0.013
λ_7	0.004	0.001	5.590	0.000	0.002	0.005
λ_8	-0.009	0.000	-20.820	0.000	-0.010	-0.008
λ_9	-0.002	0.001	-2.570	0.010	-0.003	0.000
λ_{10}	0.001	0.001	0.870	0.387	-0.001	0.002

Source: own calculations

Appendix 4.8.14: Parameter estimates of the multivariate probit (first step) – Model V

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Organic bread / cereals						
Constant	-3.191	0.164	-19.470	0.000	-3.512	-2.869
Expenditure on all ten products	0.001	0.000	11.840	0.000	0.001	0.001
Logprice org. bread/cereals	-0.016	0.033	-0.500	0.616	-0.081	0.048
Logprice org. meat	0.088	0.033	2.630	0.008	0.022	0.153
Logprice org. milk products	0.117	0.016	7.510	0.000	0.087	0.148
Logprice org. fruit	0.040	0.024	1.680	0.093	-0.007	0.087
Logprice org. vegetables	0.046	0.023	2.060	0.040	0.002	0.091
Logprice conv. bread/cereals	0.231	0.027	8.630	0.000	0.179	0.284
Logprice conv. meat	0.235	0.028	8.250	0.000	0.179	0.290
Logprice conv. milk products	0.170	0.016	10.500	0.000	0.138	0.201
Logprice conv. fruit	0.106	0.024	4.440	0.000	0.059	0.153
Logprice conv. vegetables	0.067	0.023	2.870	0.004	0.021	0.112
Household size in equivalents	-0.045	0.030	-1.490	0.135	-0.105	0.014
Dummy(child 0-4 years)	0.067	0.033	2.050	0.040	0.003	0.131
Dummy(single female adult)	0.028	0.029	0.960	0.339	-0.029	0.085
Dummy(household with smoker(s))	-0.198	0.022	-9.000	0.000	-0.241	-0.155
Dummy(household receiving social benefits)	0.090	0.024	3.830	0.000	0.044	0.136
Dummy(household in German-speaking Switzerland)	0.287	0.022	13.330	0.000	0.245	0.330
Expenditure on food and non-alcoholic beverages	0.000	0.000	4.760	0.000	0.000	0.000

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Appendix 4.8.14: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Organic meat products						
Constant	-3.801	0.187	-20.330	0.000	-4.168	-3.435
Expenditure on all ten products	0.001	0.000	11.180	0.000	0.001	0.001
Logprice org. bread/cereals	-0.035	0.038	-0.930	0.354	-0.110	0.039
Logprice org. meat	0.139	0.036	3.910	0.000	0.070	0.209
Logprice org. milk products	0.138	0.017	7.940	0.000	0.104	0.172
Logprice org. fruit	-0.046	0.027	-1.700	0.089	-0.099	0.007
Logprice org. vegetables	-0.011	0.026	-0.410	0.679	-0.061	0.040
Logprice conv. bread/cereals	0.128	0.033	3.810	0.000	0.062	0.193
Logprice conv. meat	0.262	0.035	7.520	0.000	0.194	0.330
Logprice conv. milk products	0.150	0.020	7.580	0.000	0.112	0.189
Logprice conv. fruit	0.141	0.029	4.830	0.000	0.084	0.197
Logprice conv. vegetables	0.087	0.029	3.030	0.002	0.031	0.142
Household size in equivalents	-0.145	0.038	-3.820	0.000	-0.219	-0.071
Dummy(child 0-4 years)	0.142	0.039	3.620	0.000	0.065	0.218
Dummy(single female adult)	-0.012	0.037	-0.330	0.742	-0.084	0.060
Dummy(household with smoker(s))	-0.055	0.027	-2.040	0.042	-0.108	-0.002
Dummy(household receiving social benefits)	0.023	0.029	0.800	0.426	-0.034	0.080
Dummy(household in German-speaking Switzerland)	0.321	0.027	11.730	0.000	0.267	0.375
Expenditure on food and non-alcoholic beverages	0.000	0.000	5.920	0.000	0.000	0.000

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Appendix 4.8.14: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Organic milk products						
Constant	-3.885	0.169	-23.010	0.000	-4.216	-3.554
Expenditure on all ten products	0.000	0.000	6.590	0.000	0.000	0.000
Logprice org. bread/cereals	-0.043	0.034	-1.260	0.208	-0.109	0.024
Logprice org. meat	0.073	0.034	2.150	0.032	0.006	0.140
Logprice org. milk products	0.435	0.016	27.060	0.000	0.403	0.466
Logprice org. fruit	-0.032	0.024	-1.320	0.186	-0.080	0.015
Logprice org. vegetables	-0.002	0.023	-0.100	0.924	-0.047	0.042
Logprice conv. bread/cereals	0.159	0.027	5.810	0.000	0.105	0.213
Logprice conv. meat	0.298	0.029	10.270	0.000	0.241	0.355
Logprice conv. milk products	0.380	0.017	22.770	0.000	0.347	0.413
Logprice conv. fruit	0.152	0.024	6.230	0.000	0.104	0.199
Logprice conv. vegetables	0.023	0.024	0.980	0.330	-0.023	0.070
Household size in equivalents	-0.067	0.031	-2.160	0.031	-0.129	-0.006
Dummy(child 0-4 years)	0.155	0.033	4.650	0.000	0.090	0.220
Dummy(single female adult)	0.095	0.030	3.210	0.001	0.037	0.154
Dummy(household with smoker(s))	-0.198	0.022	-8.800	0.000	-0.242	-0.154
Dummy(household receiving social benefits)	0.094	0.024	3.910	0.000	0.047	0.141
Dummy(household in German-speaking Switzerland)	0.424	0.022	19.060	0.000	0.380	0.467
Expenditure on food and non-alcoholic beverages	0.000	0.000	8.190	0.000	0.000	0.000

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Appendix 4.8.14: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Organic fruit						
Constant	-2.894	0.166	-17.440	0.000	-3.219	-2.569
Expenditure on all ten products	0.001	0.000	11.360	0.000	0.001	0.001
Logprice org. bread/cereals	-0.075	0.034	-2.230	0.026	-0.141	-0.009
Logprice org. meat	0.050	0.033	1.490	0.136	-0.016	0.115
Logprice org. milk products	0.104	0.016	6.640	0.000	0.073	0.134
Logprice org. fruit	-0.064	0.023	-2.820	0.005	-0.108	-0.019
Logprice org. vegetables	-0.059	0.022	-2.620	0.009	-0.103	-0.015
Logprice conv. bread/cereals	0.130	0.028	4.720	0.000	0.076	0.184
Logprice conv. meat	0.233	0.029	8.020	0.000	0.176	0.290
Logprice conv. milk products	0.198	0.017	11.880	0.000	0.165	0.230
Logprice conv. fruit	0.187	0.024	7.650	0.000	0.139	0.235
Logprice conv. vegetables	0.062	0.024	2.600	0.009	0.015	0.109
Household size in equivalents	0.012	0.031	0.380	0.702	-0.049	0.073
Dummy(child 0-4 years)	0.125	0.033	3.780	0.000	0.060	0.190
Dummy(single female adult)	0.144	0.030	4.790	0.000	0.085	0.203
Dummy(household with smoker(s))	-0.186	0.023	-8.230	0.000	-0.231	-0.142
Dummy(household receiving social benefits)	0.052	0.024	2.130	0.033	0.004	0.099
Dummy(household in German-speaking Switzerland)	0.273	0.022	12.290	0.000	0.229	0.316
Expenditure on food and non-alcoholic beverages	0.000	0.000	7.080	0.000	0.000	0.000

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Appendix 4.8.14: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Organic vegetables						
Constant	-3.275	0.164	-19.940	0.000	-3.597	-2.953
Expenditure on all ten products	0.001	0.000	12.780	0.000	0.001	0.001
Logprice org. bread/cereals	-0.089	0.033	-2.670	0.007	-0.155	-0.024
Logprice org. meat	0.046	0.033	1.400	0.161	-0.019	0.112
Logprice org. milk products	0.145	0.015	9.370	0.000	0.115	0.175
Logprice org. fruit	-0.049	0.024	-2.050	0.040	-0.095	-0.002
Logprice org. vegetables	0.211	0.022	9.640	0.000	0.168	0.253
Logprice conv. bread/cereals	0.134	0.027	5.020	0.000	0.082	0.187
Logprice conv. meat	0.244	0.028	8.590	0.000	0.189	0.300
Logprice conv. milk products	0.255	0.016	15.740	0.000	0.224	0.287
Logprice conv. fruit	0.111	0.024	4.640	0.000	0.064	0.157
Logprice conv. vegetables	0.093	0.023	3.990	0.000	0.047	0.138
Household size in equivalents	-0.109	0.030	-3.580	0.000	-0.169	-0.049
Dummy(child 0-4 years)	0.210	0.032	6.460	0.000	0.146	0.274
Dummy(single female adult)	0.202	0.029	6.970	0.000	0.146	0.259
Dummy(household with smoker(s))	-0.120	0.022	-5.460	0.000	-0.162	-0.077
Dummy(household receiving social benefits)	0.079	0.024	3.350	0.001	0.033	0.125
Dummy(household in German-speaking Switzerland)	0.298	0.022	13.820	0.000	0.255	0.340
Expenditure on food and non-alcoholic beverages	0.000	0.000	7.930	0.000	0.000	0.000

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Appendix 4.8.14: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Conventional bread / cereals						
Constant	2.281	0.355	6.420	0.000	1.585	2.977
Expenditure on all ten products	0.003	0.000	19.160	0.000	0.003	0.004
Logprice org. bread/cereals	-0.099	0.081	-1.220	0.222	-0.258	0.060
Logprice org. meat	-0.011	0.071	-0.160	0.873	-0.150	0.128
Logprice org. milk products	-0.088	0.036	-2.480	0.013	-0.158	-0.019
Logprice org. fruit	-0.097	0.056	-1.720	0.086	-0.207	0.014
Logprice org. vegetables	-0.005	0.053	-0.090	0.931	-0.109	0.100
Logprice conv. bread/cereals	0.291	0.053	5.460	0.000	0.187	0.396
Logprice conv. meat	-0.194	0.056	-3.490	0.000	-0.303	-0.085
Logprice conv. milk products	-0.146	0.031	-4.740	0.000	-0.207	-0.086
Logprice conv. fruit	-0.171	0.045	-3.820	0.000	-0.259	-0.083
Logprice conv. vegetables	-0.193	0.043	-4.450	0.000	-0.277	-0.108
Household size in equivalents	0.138	0.077	1.790	0.073	-0.013	0.289
Dummy(child 0-4 years)	0.114	0.105	1.090	0.278	-0.092	0.321
Dummy(single female adult)	-0.114	0.051	-2.230	0.026	-0.215	-0.014
Dummy(household with smoker(s))	0.033	0.047	0.690	0.491	-0.060	0.125
Dummy(household receiving social benefits)	0.016	0.051	0.310	0.757	-0.084	0.115
Dummy(household in German-speaking Switzerland)	0.071	0.046	1.520	0.128	-0.020	0.161
Expenditure on food and non-alcoholic beverages	0.000	0.000	-2.170	0.030	0.000	0.000

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Appendix 4.8.14: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Conventional meat products						
Constant	1.802	0.302	5.980	0.000	1.211	2.393
Expenditure on all ten products	0.005	0.000	30.130	0.000	0.004	0.005
Logprice org. bread/cereals	0.061	0.061	1.000	0.316	-0.059	0.182
Logprice org. meat	-0.100	0.063	-1.600	0.110	-0.224	0.023
Logprice org. milk products	-0.098	0.029	-3.380	0.001	-0.154	-0.041
Logprice org. fruit	-0.158	0.044	-3.570	0.000	-0.244	-0.071
Logprice org. vegetables	0.006	0.043	0.130	0.897	-0.079	0.090
Logprice conv. bread/cereals	-0.207	0.043	-4.770	0.000	-0.292	-0.122
Logprice conv. meat	0.217	0.050	4.370	0.000	0.119	0.314
Logprice conv. milk products	-0.218	0.026	-8.410	0.000	-0.269	-0.167
Logprice conv. fruit	-0.213	0.038	-5.590	0.000	-0.288	-0.138
Logprice conv. vegetables	-0.101	0.036	-2.780	0.005	-0.172	-0.030
Household size in equivalents	-0.145	0.062	-2.360	0.018	-0.265	-0.024
Dummy(child 0-4 years)	-0.054	0.074	-0.730	0.465	-0.198	0.090
Dummy(single female adult)	-0.098	0.044	-2.240	0.025	-0.184	-0.012
Dummy(household with smoker(s))	0.240	0.042	5.730	0.000	0.158	0.322
Dummy(household receiving social benefits)	0.003	0.043	0.070	0.945	-0.081	0.087
Dummy(household in German-speaking Switzerland)	-0.113	0.041	-2.770	0.006	-0.192	-0.033
Expenditure on food and non-alcoholic beverages	0.000	0.000	-2.060	0.040	0.000	0.000

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Appendix 4.8.14: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Conventional milk products						
Constant	3.098	0.478	6.480	0.000	2.161	4.035
Expenditure on all ten products	0.005	0.000	17.170	0.000	0.004	0.005
Logprice org. bread/cereals	-0.333	0.114	-2.920	0.004	-0.557	-0.109
Logprice org. meat	0.001	0.095	0.010	0.992	-0.185	0.187
Logprice org. milk products	-0.119	0.051	-2.330	0.020	-0.218	-0.019
Logprice org. fruit	-0.170	0.072	-2.350	0.019	-0.311	-0.028
Logprice org. vegetables	-0.033	0.078	-0.420	0.672	-0.186	0.120
Logprice conv. bread/cereals	-0.073	0.070	-1.050	0.293	-0.209	0.063
Logprice conv. meat	-0.140	0.076	-1.830	0.067	-0.289	0.010
Logprice conv. milk products	0.128	0.044	2.930	0.003	0.042	0.214
Logprice conv. fruit	-0.245	0.058	-4.230	0.000	-0.358	-0.131
Logprice conv. vegetables	-0.171	0.055	-3.090	0.002	-0.280	-0.063
Household size in equivalents	0.010	0.096	0.100	0.917	-0.178	0.198
Dummy(child 0-4 years)	0.051	0.135	0.370	0.708	-0.214	0.315
Dummy(single female adult)	0.238	0.069	3.460	0.001	0.103	0.373
Dummy(household with smoker(s))	0.195	0.068	2.890	0.004	0.063	0.328
Dummy(household receiving social benefits)	-0.019	0.069	-0.270	0.784	-0.154	0.116
Dummy(household in German-speaking Switzerland)	0.048	0.063	0.750	0.451	-0.076	0.171
Expenditure on food and non-alcoholic beverages	0.000	0.000	-0.400	0.691	0.000	0.000

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Appendix 4.8.14: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Conventional fruit						
Constant	0.857	0.289	2.960	0.003	0.290	1.424
Expenditure on all ten products	0.003	0.000	22.640	0.000	0.003	0.003
Logprice org. bread/cereals	0.043	0.067	0.640	0.522	-0.088	0.174
Logprice org. meat	-0.077	0.059	-1.310	0.190	-0.192	0.038
Logprice org. milk products	-0.080	0.030	-2.640	0.008	-0.139	-0.020
Logprice org. fruit	0.003	0.051	0.070	0.947	-0.097	0.104
Logprice org. vegetables	0.009	0.045	0.200	0.839	-0.079	0.097
Logprice conv. bread/cereals	0.033	0.041	0.810	0.421	-0.047	0.113
Logprice conv. meat	-0.044	0.045	-0.980	0.328	-0.131	0.044
Logprice conv. milk products	-0.046	0.024	-1.880	0.060	-0.093	0.002
Logprice conv. fruit	0.083	0.040	2.070	0.039	0.004	0.161
Logprice conv. vegetables	-0.230	0.034	-6.710	0.000	-0.297	-0.163
Household size in equivalents	0.205	0.055	3.760	0.000	0.098	0.312
Dummy(child 0-4 years)	-0.034	0.065	-0.520	0.600	-0.162	0.093
Dummy(single female adult)	0.445	0.044	10.150	0.000	0.359	0.531
Dummy(household with smoker(s))	-0.298	0.034	-8.750	0.000	-0.365	-0.232
Dummy(household receiving social benefits)	-0.074	0.039	-1.920	0.055	-0.150	0.001
Dummy(household in German-speaking Switzerland)	0.102	0.036	2.850	0.004	0.032	0.172
Expenditure on food and non-alcoholic beverages	0.000	0.000	2.960	0.003	0.000	0.000

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Appendix 4.8.14: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Conventional vegetables						
Constant	1.225	0.350	3.500	0.000	0.540	1.911
Expenditure on all ten products	0.005	0.000	25.310	0.000	0.004	0.005
Logprice org. bread/cereals	0.039	0.079	0.500	0.620	-0.116	0.195
Logprice org. meat	-0.068	0.072	-0.940	0.348	-0.209	0.074
Logprice org. milk products	-0.042	0.037	-1.140	0.256	-0.114	0.030
Logprice org. fruit	-0.086	0.057	-1.510	0.132	-0.197	0.026
Logprice org. vegetables	-0.061	0.056	-1.090	0.278	-0.171	0.049
Logprice conv. bread/cereals	-0.017	0.049	-0.340	0.736	-0.113	0.080
Logprice conv. meat	-0.218	0.054	-4.050	0.000	-0.323	-0.112
Logprice conv. milk products	-0.034	0.029	-1.150	0.248	-0.090	0.023
Logprice conv. fruit	-0.252	0.043	-5.920	0.000	-0.336	-0.169
Logprice conv. vegetables	0.350	0.045	7.750	0.000	0.262	0.439
Household size in equivalents	0.241	0.069	3.490	0.000	0.106	0.377
Dummy(child 0-4 years)	0.006	0.092	0.060	0.950	-0.174	0.185
Dummy(single female adult)	0.543	0.052	10.430	0.000	0.441	0.645
Dummy(household with smoker(s))	0.090	0.046	1.950	0.051	0.000	0.179
Dummy(household receiving social benefits)	-0.017	0.049	-0.350	0.727	-0.112	0.078
Dummy(household in German-speaking Switzerland)	-0.114	0.047	-2.420	0.016	-0.206	-0.022
Expenditure on food and non-alcoholic beverages	0.000	0.000	-2.200	0.028	0.000	0.000

Source: own calculations

Appendix 4.8.15: Parameter estimates of the budget share equations (second step) - Model V

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
α_1	0.062	0.012	5.000	0.000	0.038	0.087
α_2	-0.047	0.047	-1.010	0.314	-0.139	0.045
α_3	0.055	0.012	4.640	0.000	0.032	0.079
α_4	0.020	0.017	1.210	0.228	-0.013	0.053
α_5	0.013	0.015	0.850	0.393	-0.016	0.042
α_6	0.457	0.012	38.540	0.000	0.434	0.480
α_7	0.116	0.018	6.310	0.000	0.080	0.152
α_8	0.139	0.012	11.580	0.000	0.115	0.163
α_9	0.224	0.016	14.420	0.000	0.194	0.255
β_1	-0.003	0.004	-0.660	0.507	-0.012	0.006
β_2	-0.023	0.009	-2.480	0.013	-0.041	-0.005
β_3	0.020	0.003	6.200	0.000	0.014	0.027
β_4	0.009	0.006	1.560	0.119	-0.002	0.021
β_5	0.025	0.004	6.300	0.000	0.018	0.033
β_6	-0.111	0.007	-16.510	0.000	-0.124	-0.098
β_7	0.026	0.007	3.900	0.000	0.013	0.039
β_8	0.061	0.004	14.290	0.000	0.052	0.069
β_9	-0.012	0.006	-1.970	0.049	-0.024	0.000
γ_{11}	0.726	0.107	6.790	0.000	0.517	0.936
γ_{12}	0.005	0.033	0.150	0.878	-0.060	0.070
γ_{13}	0.032	0.061	0.520	0.600	-0.088	0.152
γ_{14}	-0.033	0.078	-0.430	0.669	-0.186	0.119
γ_{15}	0.015	0.085	0.180	0.856	-0.150	0.181
γ_{16}	-0.128	0.175	-0.730	0.465	-0.471	0.215
γ_{17}	-0.567	0.173	-3.280	0.001	-0.906	-0.229
γ_{18}	0.006	0.122	0.050	0.961	-0.233	0.245
γ_{19}	-0.062	0.140	-0.440	0.659	-0.337	0.213
γ_{110}	0.005	0.002	2.780	0.005	0.002	0.009
γ_{22}	0.007	0.063	0.120	0.907	-0.116	0.131
γ_{23}	-0.069	0.051	-1.370	0.171	-0.168	0.030
γ_{24}	0.074	0.076	0.970	0.332	-0.075	0.223
γ_{25}	0.026	0.066	0.400	0.691	-0.103	0.155
γ_{26}	0.242	0.132	1.840	0.066	-0.016	0.501

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Appendix 4.8.15: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
γ_{27}	-0.115	0.128	-0.900	0.370	-0.365	0.136
γ_{28}	-0.121	0.082	-1.470	0.141	-0.283	0.040
γ_{29}	-0.083	0.100	-0.830	0.404	-0.279	0.112
γ_{33}	0.026	0.043	0.600	0.545	-0.058	0.110
γ_{34}	0.003	0.035	0.100	0.922	-0.065	0.072
γ_{35}	-0.065	0.035	-1.880	0.060	-0.134	0.003
γ_{36}	-0.056	0.081	-0.690	0.489	-0.215	0.103
γ_{37}	0.024	0.088	0.280	0.781	-0.148	0.197
γ_{38}	-0.002	0.055	-0.040	0.967	-0.110	0.106
γ_{39}	0.059	0.070	0.850	0.396	-0.077	0.196
γ_{44}	0.158	0.061	2.570	0.010	0.037	0.278
γ_{45}	-0.008	0.075	-0.100	0.917	-0.154	0.139
γ_{46}	-0.155	0.151	-1.020	0.306	-0.452	0.142
γ_{47}	-0.111	0.133	-0.830	0.405	-0.373	0.151
γ_{48}	-0.006	0.100	-0.070	0.948	-0.202	0.189
γ_{49}	0.116	0.138	0.840	0.401	-0.155	0.388
γ_{55}	0.038	0.051	0.750	0.456	-0.062	0.137
γ_{56}	0.111	0.119	0.930	0.350	-0.122	0.345
γ_{57}	-0.173	0.115	-1.500	0.133	-0.398	0.053
γ_{58}	0.044	0.078	0.570	0.569	-0.108	0.196
γ_{59}	0.011	0.096	0.110	0.909	-0.177	0.199
γ_{66}	0.175	0.122	1.440	0.150	-0.064	0.414
γ_{67}	-0.116	0.096	-1.210	0.226	-0.303	0.072
γ_{68}	-0.135	0.060	-2.230	0.026	-0.253	-0.016
γ_{69}	0.112	0.071	1.570	0.115	-0.027	0.252
γ_{77}	0.269	0.107	2.500	0.012	0.058	0.479
γ_{78}	0.049	0.065	0.760	0.446	-0.078	0.176
γ_{79}	0.036	0.074	0.490	0.627	-0.108	0.180
γ_{88}	-0.045	0.063	-0.720	0.469	-0.168	0.077
γ_{89}	0.161	0.046	3.490	0.000	0.071	0.252
γ_{99}	-0.365	0.075	-4.860	0.000	-0.512	-0.218
λ_1	-0.002	0.000	-3.470	0.001	-0.003	-0.001
λ_2	0.006	0.001	4.930	0.000	0.004	0.009
λ_3	-0.005	0.000	-11.250	0.000	-0.006	-0.004

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Appendix 4.8.15: ***continued***

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
λ_4	-0.003	0.001	-4.150	0.000	-0.004	-0.001
λ_5	-0.005	0.001	-9.560	0.000	-0.006	-0.004
λ_6	0.010	0.001	9.860	0.000	0.008	0.011
λ_7	0.004	0.001	5.580	0.000	0.003	0.006
λ_8	-0.008	0.001	-13.330	0.000	-0.009	-0.007
λ_9	-0.001	0.001	-1.810	0.070	-0.003	0.000
δ_1	0.018	0.003	6.150	0.000	0.012	0.023
δ_2	0.044	0.012	3.520	0.000	0.019	0.068
δ_3	-0.006	0.003	-2.160	0.031	-0.012	-0.001
δ_4	0.014	0.004	3.880	0.000	0.007	0.021
δ_5	-0.011	0.004	-2.770	0.006	-0.018	-0.003
δ_6	-0.028	0.017	-1.620	0.106	-0.062	0.006
δ_7	0.074	0.015	4.990	0.000	0.045	0.103
δ_8	0.511	0.029	17.360	0.000	0.453	0.569
δ_9	0.090	0.009	9.560	0.000	0.071	0.108
δ_{10}	-0.705	0.030	-23.200	0.000	-0.764	-0.645

Source: own calculations