Institute of Agricultural Policy and Market Research

Justus Liebig University Giessen

Obesity, Food Demand, and Models of Rational Consumer Behaviour – Econometric Analyses and Challenges to Theory

Dissertation to obtain the Doctoral Degree

at the Faculty of Agricultural Sciences, Nutritional Sciences and Environmental Management

Submitted by

Matthias Staudigel,

born in Schweinfurt

First Supervisor: Prof. Dr. Roland Herrmann

Second Supervisor: Prof. Dr. Ernst-August Nuppenau

Date of Disputation: March 27th, 2014

Danksagung

Viele liebe Menschen haben zum Gelingen der vorliegenden Dissertation beigetragen. An sie geht an dieser Stelle ein sehr herzliches Dankeschön.

Meinem Doktorvater, Herrn Prof. Dr. Roland Herrmann, möchte ich danken für die Freiheit, die ich bei der Erstellung genossen habe, ebenso wie für die Ermutigung bereits früh erste Artikel zu veröffentlichen. Seine wertvollen Ratschläge trugen entscheidend zum Erfolg und zur Anfertigung der Arbeit in kumulativer Form bei. Mein Dank gilt auch Herrn Prof. Dr. Ernst-August Nuppenau für die Übernahme des Zweitgutachtens. Seine gelegentlichen Einschübe forderten die eigene Perspektive manchmal heraus und lenkten den Blick auf andere Ebenen.

Meinen derzeitigen und ehemaligen Kolleginnen und Kollegen an der Professur für Marktlehre möchte ich für die freundliche und kollegiale Arbeitsatmosphäre danken, für klare, offene Kritik und Anregungen am Morgen und heitere „Brot & Spiele“-Treffen am Abend. Ein großes Dankeschön geht auch an das Team des ZEU, das mich nach zwei Dritteln des Wegs sehr freundlich aufgenommen hat.

Meinen Eltern und meiner Familie danke ich für ihre bedingungslose Unterstützung während der Zeit meiner Promotion und während meines Studiums.

Ein riesiges Dankeschön geht schließlich an meine Anne für das Zuhören, Aufrichten, Ablenken, Ertragen, Gegenlesen, Loben, Kritisieren, Anspornen und alles, was das Leben auch während der Promotionszeit lebenswert gemacht hat.

Gießen, im Juli 2014 Matthias Staudigel

Table of Contents

List of Figures

List of Tables

List of Abbreviations

$	Dollar
€	Euro
BMI	Body Mass Index
bn	billion
CAP	Common Agricultural Policy
CEST	Cognitive-Experiential Self Theory
EU	European Union
FAFH	food away from home
g	grams
HFCS	High-Fructose Corn Syrup
HSE	Health Survey for England
HSE	Higher School of Economics
IAAE	International Association of Agricultural Economists
IGM	Initiative on Global Markets
IV	Instrumental Variables
kcal	large calorie (= 1,000 calories)
kg	kilograms
LA/AIDS	Linear Approximated Almost Ideal Demand System
lb	pound (US; ≈ 0.454 kg)
LES	Linear Expenditure System
m	meters
ml	mililiter
n/a	not applicable
NHANES	National Health and Nutrition Examination Survey
NLEA	Nutrition Labeling and Education Act
NSR	non-self-representing
OECD	Organization for Economic Co-operation and Development
PPS	probability-proportional-to-size
PSA	Primary Sampling Area
PSU	Primary Sampling Unit

RLMS	Russia Longitudinal Monitoring Survey
SR	self-representing
SRU	Sachverständigenrat für Umweltfragen
SSB	Sugar-sweetened beverages
SSU	Secondary Sampling Unit
US(A)	United States (of America)
WHO	World Health Organization
WTP	Willingness-to-pay

1 Introduction

1.1 The part of agricultural economics in the "fight" against obesity

High and rising numbers of overweight and obese people worldwide have increasingly raised calls for stronger regulation. According to official figures, about 1.4 billion people aged 20 years and older were overweight in 2008, of whom 500 million were obese. This relates to more than one third and more than one tenth of the world's adult population that are overweight and obese, respectively (WHO, 2013).

Overweight and obesity, "defined as abnormal or excessive fat accumulation" (WHO, 2013), are regarded as a serious threat to health that raises the risk of numerous non-communicable diseases (cardiovascular diseases, type-II diabetes, musculoskeletal disorders such as osteoarthritis and certain forms of cancers) (WHO, 2013). Therefore, public health specialists are raising the alarm. As softer measures such as information campaigns have shown only modest effects (e.g. MAZZOCCHI et al., 2009), demands are increasingly directed to more substantial instruments. Advertising restrictions, changes in agricultural policies and taxes on unhealthy food or ingredients are only some examples that are discussed by the media, public health experts and politicians.

A prominent example where politicians have taken their kid-gloves off is the case of New York City. Mayor Michael Bloomberg initiated a penny-per-ounce tax on carbonated soft drinks in 2010 and tried to impose a ban on the sale of soft drinks in large portion sizes in 2012 (THE NEW YORK TIMES, 2010; 2012). In Europe, Denmark has levied a tax of 2.30 € per kilogram saturated fatty acids on foods in order to curb the intake of animal fats deemed as harmful for health (FRANKFURTER ALLGEMEINE ZEITUNG, 2011). Also France and Hungary introduced taxes on carbonated soft drinks and junk food, respectively (SÜDDEUTSCHE ZEITUNG, 2011; SPIEGEL, 2011). The German Federal Minister of Food, Agriculture and Consumer Protection, Ilse Aigner, said that taxes on fatty or sugary food are not an option from her perspective (BILD, 2012). However, also in Germany some institutions advocate such measures. For instance, the German Advisory Council on the Environment (SRU) proposed taxes on saturated fatty acids similar to Denmark in order to reduce animal production that harms the environment (SRU, 2012).

Attempts to regulate food markets and steer consumer behaviour have provoked massive resentment in consumer groups and industry associations. For instance the initiatives launched by New York's Michael Bloomberg were immediately scrapped by the New York Supreme Court. Denmark abandoned its fat tax after consumers bought their milk and their butter over the border in Germany and producers blamed it for destroying thousands of jobs within the country. Moreover, the tax caused exorbitant administration costs (FRANKFURTER ALLGEMEINE ZEITUNG, 2012; 2013).

These examples give evidence of a heated discussion in society, politics and the media that urgently needs more information on the likely consequences of regulatory measures. In a keynote speech at the IAAE Conference 2006 in Australia, BARRY POPKIN, a renowned figure in obesity research, called upon the agricultural economics profession to engage themselves more strongly in this area:

> *"The effect of price policies and many other regulations need much more careful exploration prior to our being able to undertake massive shifts of a healthy nature in the structure of diet. Many other mechanisms available to the economic sector must be rigorously explored. This area is really one relatively ignored by the profession but one deserving of much more research." (POPKIN and NG, 2006, p.21)*

POPKIN suggested examining the impact of government actions on prices of more or less healthy food items, e.g. through agricultural policies. He further requested agricultural economists to provide more information about the effects of changing prices on nutrition patterns. Knowledge about estimates of own- and cross-price elasticities is necessary in order to "shift portion sizes and other eating behaviours toward more healthful ones" (POPKIN and NG, 2006, p.15).

Well, agricultural economists *did* intensify their research efforts on obesity over the last decade. However, the profession did not perceive themselves as mere suppliers of elasticities for public health experts who want to design optimal tax schemes. They rather approached the topic more fundamentally and discussed a much broader range of issues. A large number of empirical studies certainly investigated the influence of prices and other economic factors on the consumption of different foods as well as directly on body weight and obesity prevalence. These studies stressed that the equation "prices up = consumption down = body weight down" is oversimplified and that consumer behaviour is much more complex. Other authors took a more theoretical approach to the topic and discussed the

behavioural foundations of the rise in obesity and yet others elaborated on the existence of market failures that possibly justify substantial interventions in human behaviour.

The articles in this dissertation contribute to the international literature in this recently emerging research field entitled as “obesity economics”. They originated during the last five years and have steadily been influenced by the growing number of research publications as well as political and societal events. I will give an overview over the objectives of each paper and their main innovative contributions in the following pages. Additionally, I will provide some background on the sources of inspiration and the ideas that prompted me to pick up the respective topic.

1.2 Structure of the dissertation and contributions to the literature

The thesis’ outline assumes the form of a classic dissertation structure, divided into a literature review, an empirical part, a discussion, and a conclusion at the end. However, I took advantage of the freedom provided by a cumulative dissertation. Hence, the sequence of chapters and subchapters does not form a monolithic text similar to a classical large dissertation and the single parts can be read independently from each other. Therefore, some explanations are necessary on the objectives of each part and how it is related to the other sections. Table 1 presents the articles and the self-contained subchapters.

Two sections that give the reader a general overview, firstly on the research field of “obesity economics” and secondly the data set used in the analyses, precede the articles that are either published or under review.

Chapter 2 contains the extended literature review. It serves as a frame to relate the thesis’ articles to the international body of research and to help to evaluate their contributions. First, data and facts on the prevalence of obesity globally as well as within populations are presented. These empirical findings stress the relevance of research on obesity and point to certain features that particularly raise the interest of economists. Thereafter, I will sketch the economic ideas and approaches to explain those types of human behaviour that lead to increasing waistlines. Important lessons and conclusions emerge from these economic concepts for the public discussion on the reasons of increasing obesity prevalence and for possible solutions to it.

The presence of rational or irrational behaviour is important for the choice of adequate policy reactions. A summary of the discussion on likely rationales for policy interventions illustrates possible market failures and empirical evidence for their absence or presence. After discussing the arguments for and against interventions I will review the literature that empirically examines the effectiveness of certain instruments available to governments. With regard to the studies conducted for this dissertation, the focus is clearly on empirical evidence on price effects on food consumption and obesity. Thereby, issues of econometric estimation of these relationships, as well as data requirements are also covered. Moreover, a short part deals with the role of agricultural policies in the context of food prices and obesity.

Table 1: Articles of the dissertation

Chapter	Author(s)	Title	Published in…
2	STAUDIGEL, M.	Economic perspectives on obesity: identifying determinants and evaluating policies	Unpublished
3.1	STAUDIGEL, M.	The Russia Longitudinal Monitoring Survey (RLMS) - Plentiful data to analyse the life in transitional Russia in various facets	Unpublished
3.2	STAUDIGEL, M.	How (much) do food prices contribute to obesity in Russia?	*Economics and Human Biology* **9** (2011), 133-147.
3.3	STAUDIGEL, M.	How do obese people afford to be obese? Consumption strategies of Russian households	*Agricultural Economics* **43** (2012), 701-714.
3.4	STAUDIGEL, M. and R. SCHRÖCK	Food Demand in Russia – Heterogeneous Consumer Segments over Time	*Journal of Agricultural Economics* (2014), forthcoming.
4.1	STAUDIGEL, M.	On the application of household production theory to health and nutrition	*Schriften der GeWiSoLa e.V.* **48** (2013), 33-46.
4.2	STAUDIGEL, M.	Fettsteuern zum Wohle der Umwelt?	*Ökonomenstimme* (2012).

***Source*: Own compilation.**

Chapter 3 is devoted to the empirical analyses of health and nutrition behaviour in the Russian Federation. Before turning to the actual studies, I will provide a detailed description of the data from the Russia Longitudinal Monitoring Survey (RLMS) on which the empirical analyses are based (Section 3.1). The typically limited space in journal articles does not permit exhaustive assessments of such large household surveys. Therefore, this subchapter is aimed to give the reader an impression of the necessary effort to collect such comprehensive data for the world's largest country over more than one and a half decades. It discusses the sampling design as well as issues of attrition, replenishment, and weighting and presents the entire spectrum of variables that are included. The section concludes with an overview of a variety of studies that also use RLMS data and evaluates why these data are especially suitable for the kind of analyses conducted in this dissertation.

Section 3.2 contains the first empirical article, STAUDIGEL (2011), which joins a row of papers in examining direct effects of variations in food prices on changing body weights. This kind of studies estimates reduced-form price-weight relations with a weight indicator on the left-hand side and a set of price variables plus several controls for socio-demographics on the right-hand side. With this paper I contribute the following new results and insights to the literature.

Firstly, as one of the few studies using non-US data, STAUDIGEL (2011) expands the empirical evidence on food price impacts to other countries outside the United States. By investigating the case of Russia the analysis can rely on considerable changes in the relative price structure brought about by economic changes, restructuring of agricultural production, and increasing international commodity trade. These fluctuations allow insights into how people's weight and nutritional status adjust when they face severe economic turnovers. Secondly, the analysis is based on data from the Russia Longitudinal Monitoring Survey (RLMS), a large household survey that covers many variables on both health and economic aspects. Most of all, it collects explicit price data for many food products at the community level. This unique feature enables the researcher to precisely assign individuals and the variation in their body weights to those prices they actually face in everyday life while most other studies use either general aggregates of prices or price information for large administrative units like the federal states in the US. The longitudinal data of the RLMS allow estimation via fixed-effects panel methods to prevent bias by unobserved heterogeneity.

During the process of writing this first article, new questions emerged that inspired the second empirical paper. Since the explicit price data were not available at the beginning, an earlier version of the first article used unit values (i.e. average price per unit of a food group calculated as expenditures divided by quantity) as price information. One reviewer in the submission process for this paper pointed out that regressing a weight measure on those unit values would cause an endogeneity problem. When, for example, people of different weight choose a different quality (e.g. heavier persons bought cheaper food in order to get more quantity), reverse causality exists and coefficients will be biased. The question whether such behaviour really exists seemed worth examining in more detail.

STAUDIGEL (2012a) in Section 3.3 resulted from these considerations about the connection between obesity and demand for quality. The basic idea that I start from in this paper is that people can choose more than quantity when faced with altering economic incentives, especially in a differentiated food environment. Based on DEATON's framework for the demand for quality (DEATON, 1988; 1997), we can assume that when people's total budget changes they can change total expenditures and/or quantities and/or the quality of food and food items. These options available to consumers have not been linked to obesity yet although knowledge of such behaviour is crucial for the design of policies such as fat taxes. The effect of such policies on energy intake would be close to zero when consumers simply switch to a cheaper product within the same food group. Whereas most authors elaborate on substitution from one food group perceived as "unhealthy" (e.g. soft drinks, snack foods) to more "healthy" foods (e.g. water, juice, fruits and vegetables), STAUDIGEL (2012a) investigates other possible reactions in more detail.

It is examined in the empirical analysis whether households whose members differ considerably with respect to body weight also differ in their responses to resource changes. For this purpose the effects of total expenditures on food group expenditures, quantities and qualities are estimated. To test for household differences, dummy variables indicating the weight of household members are interacted with the total expenditures. Again, a fixed-effects panel specification takes into account unobserved heterogeneity.

The third empirical paper in Section 3.4 originated from collaboration with my colleague Miss Rebecca Schröck. In STAUDIGEL and SCHRÖCK (2014), we conduct a detailed demand-system analysis for food in Russia. The motivation for this paper arose from an observation that I made during my work on the earlier articles. Despite drastic structural shifts in

agricultural production, food trade and grocery retailing, literature on consumer behaviour and how it changed in the course of transition - especially with respect to demand elasticities - is very scarce. In order to address this gap, our paper provides a comprehensive set of own-price and expenditure elasticities yielded by a two-stage demand-system estimation. In the first stage, we estimate a Linear Expenditure System (LES) and distinguish between the six major expenditure groups of food-at-home, food-away-from-home, clothing, rent and utilities, recreation services, and other services. The second stage yields detailed demand elasticities for 13 individual food groups based on the linear approximated version of the Almost Ideal Demand System (LA/AIDS). By exploiting the extensive time range of RLMS data from 1995 to 2010 we estimate demand elasticities for three distinct time periods in order to trace changes over time. To take account of the disparities with respect to socio-economic status, geography, level of urbanisation, ethnicities or infrastructure we additionally derive elasticities of food demand for different consumer segments. A novelty at this point is that we use cluster analysis to generate those different segments based on food purchasing patterns.

The main contributions of our paper to the literature are the consistent use of the same data set and methodological approach. On this basis, we gain discrete estimates for different points in time. Moreover, our approach of using structure-discovering cluster analysis based on households' actual food purchasing patterns yields consumer segments that show interesting and meaningful differences with regard to various household characteristics and food demand behaviour. Stratification along single variables like income, level of urbanisation or household composition would not have delivered such a unique combination of characteristics present in each segment.

The demand-system analysis for food in Russia can be seen as an independent research contribution in its own right. However, the results from STAUDIGEL and SCHRÖCK (2014) also complement the findings from the first article. Where the reduced-form price-weight estimations in STAUDIGEL (2011) have left a black box with respect to actual food consumption patterns, the price and expenditure elasticities help to shed light on people's behaviour.

While Chapter 3 is concerned with specific research questions and empirical analyses, Chapter 4 serves to discuss some theoretical and methodological issues of the economic analysis of health and nutrition more fundamentally. Here, the core paper is STAUDIGEL (2013) in Section 4.1. Economists stress that the rise in obesity does not necessarily contradict

utility-maximising behaviour of individuals facing multiple restrictions. One framework often drawn on to illustrate the numerous ends subject to human decision and the means to achieve them is the household production theory by BECKER (1965). The theory acknowledges that health is only one of many elementary commodities that enter an individual's utility function. Households themselves produce these commodities on the basis of their knowledge and abilities, i.e. their specific "production technology", using time and market goods inputs. Depending on their available time, technology and prices of market goods, households can decide to give up some amount of health because the resources are utilised for the production of other commodities that provide more utility.

Although the general message conveyed by this framework is very important, it is often not clear along which lines the trade-offs between health and other commodities run and whether synergies can be realised in production processes, too. In STAUDIGEL (2013), I examine the relations of health to other basic commodities in more detail and discuss the likely existence of joint production as well as ways to substitute inputs in the household production process. Finally, I draw conclusions for data collection, behavioural modelling and the design of policies.

Section 4.2 presents a short contribution to the policy debate on fat taxes in Germany. STAUDIGEL (2012b) discusses the German Advisory Council on the Environment's suggestion to introduce taxes on saturated fatty acids in foods. This proposal aims at reducing the possibly harmful consequences of animal production in agriculture by making consumption of meat and dairy products more expensive. In the comments, I will elaborate the conditions that must be met by farmers, retailers and consumers in order for such a policy to be effective.

As will have become clear so far, this dissertation does not pursue a holistic approach where all relevant areas of consumer behaviour connected to body weight and obesity are treated all at once. Such a model including the whole chain from exogenous factors such as food prices and many other economic and non-economic variables, over food consumption and other behaviours to weight and health outcomes, including possible reciprocal processes, appear too complex to be analysed in a single model. Rather, the empirical work in this dissertation splits up the long chain from economic factors to final outcomes and focuses on relevant and very specific points. In putting them together afterwards just like in a puzzle, however, it is possible to draw important conclusions on how consumers behave related to

obesity and the likely effects of policy interventions based on fiscal measures. In the following, I will give such a synopsis of the results.

1.3 Synopsis of research findings

The empirical papers in this dissertation provide important and relatively clear results on food price effects on body weight and obesity and, thus, on the likely success of price-based policies to reduce obesity. The evidence for Russia confirms the findings by studies from other countries that taxes will have only very small effects on obesity, if any. A unique feature of this thesis is the explicit concentration on different elements of the chain from prices to weight outcomes that provides detailed results and illuminating insights for each stage.

My results from STAUDIGEL (2011) for the reduced-form price-weight effects show that prices do have a joint significant effect on Body Mass Index (BMI) but have poor explanatory power for the total variation in body weight over time. The price-weight elasticities are smaller than 0.01 in absolute terms and, thus, even lower than those found in comparable studies from the United States. Separate regressions by gender and income level revealed heterogeneous coefficients, indicating that the weights of medium- to high-income persons react more sensitively to price changes. This is clearly in contrast to the findings from the US, where it is the lower-income strata that show stronger reactions to prices. Among the single food items mainly the price coefficients of animal products were significant. Their signs, however, contradicted the common view of clear substitutional relations between products of high and low energy density. A negative sign of the chicken price, for example, suggests that falling relative chicken prices do lead to higher chicken consumption. However, the higher consumption of chicken can be seen as adding extra energy to the diet rather than substituting other more fatty kinds of meat.

In STAUDIGEL (2012a), I found interesting differences in consumption patterns across households of different weight categories. For this purpose, households were classified according to the weight of their members. Descriptive statistics over time reveal that "obese" households spend a larger share of their total budget on food than "normal-weight" households. They obviously place more value on food. Moreover, obese households purchase larger quantities of most food categories. Since this is also true for fruit and vegetables, their diet is not necessarily inferior regarding food diversity; they only have a

higher energy intake. While one strategy of obese households that allows them to purchase larger quantities is devoting a higher budget share to food, a second aspect is that they pay less on average, compared to normal-weight households, for each unit of food within most product groups.

Regression results show that Russian households can cope quite effectively with resource fluctuations. The total expenditure elasticity of energy intake is 0.07 implying a very inelastic response to variation in disposable incomes. Households were most likely to shift their consumption to foods that provide energy at lower costs per calorie. Accordingly, the total expenditure elasticity of quality (i.e. of the per-unit costs) is quite high at about 0.63. Especially obese households are more flexible in adjusting their per-unit expenditures. They show significantly higher elasticities of quality for many food groups that exceed those for normal-weight households by 15-20 %.

The empirical evidence provided by STAUDIGEL (2011) and STAUDIGEL (2012a) clearly indicates that altering food prices is not very likely to contribute to weight reduction. This holds true even when the basic price elasticities of demand for food are quite promising. In STAUDIGEL and SCHRÖCK (2014), we find a highly elastic response of food demand to variations in prices. Most of the unconditional own-price elasticities of food in total as well as of single food groups are close to or even above unity. Arguing that taxes are an appropriate measure to reduce energy intake and, in turn, decrease body weight of obese persons on the basis of own-price elasticities is strongly misleading. Even if consumption of one special food is reduced, numerous substitution effects cause shifts to other equally energy-dense food items, reducing the per-unit costs of food groups or expanding the budget for food. At the end of the day, when arriving at the weight outcome the momentum of the tax is too weak to have noticeable effects on weight.

The general findings from STAUDIGEL and SCHRÖCK (2014) allow comprehensive and illuminating insights into household food demand in transitional Russia. We receive high expenditure and own-price elasticities that mostly range around unity and suggest further growing food consumption in the future. Expenditure elasticities for meat, sugar and confectionery, alcohol, and beverages are especially high indicating that the share of these high-quality and luxury foods in the Russian food baskets will increase. Results indicate that food production at home loses in importance while especially more affluent households increase their demand for food consumption away from home.

In my discussion of the SRU's proposal to tax saturated fatty acids to reduce animal food consumption in STAUDIGEL (2012b), I conclude that the expert council makes assumptions that are by far too optimistic about the effect of such taxes aimed at consumers on production decisions at the farm level. The same arguments as given above on the transmission of price signals to final weight outcomes apply here to the discussion of fat taxes for the sake of environment in Germany. Firstly, it is questionable whether such taxes are able to raise consumer prices. Strong competition at the level of retailing and manufacturing imposes strong incentives for those firms not to fully pass the tax burden on to consumers in order to keep prices low. Secondly, even a significant increase in prices of animal products does not imply a straightforward shift of consumption from animal products to plant products. When consumers only substitute animal products of different prices for each other or alter just the quality but not the quantity they purchase, consumption of meat and dairy is not likely to decrease within the country. Thirdly, in a case where domestic consumption will actually decrease, producers still can export their products to other countries. Hence, a drop in production and possible beneficial effects on the environment seem unlikely.

The assessment of household-production-theory applications to health and nutrition provides some innovative suggestions on how to model consumer behaviour in this area. First of all, the review of articles using this framework found a quite ambiguous treatment of the principle to separate ends and means. Although the authors emphasise that humans pursue for more goals than health, they focus only on health and the related production processes later on, thereby neglecting other elementary commodities and the technologies and inputs that are necessary to produce them. STAUDIGEL (2013) argues that much could be gained by a more complex view. The two core aspects refer to joint production as well as substitutional processes. A common perception, for instance, is that "healthful" food is a positive input to health but operates negatively in the production of pleasure. Another example is sports or physical activity which is regarded to be beneficial for health on the one hand, but apart from that is seen to have mostly negative effects on utility via high discomfort (see e.g. HUFFMAN, 2011). However, daily life offers multiple examples in which healthy food and sports jointly cause good health and pleasure, excitement, social recognition and many other things. Examining the technologies that underlie such joint

production may be an important step to understand why some people follow a healthy lifestyle and others do not.

A wider view of ends and means would also offer a broader spectrum of substitution possibilities. The large part of the discussion centres on the question what should be changed within the health production process, e.g. substitute vegetables for fatty and sugary foods. However, also shifts in the production of other commodities are relevant. While many households produce the commodity "pleasure" perhaps through eating and drinking, music, sports, literature etc. also provide possible inputs that do not add calories to the energy balance.

A final evaluation and possible suggestions for future research will be presented in the concluding Chapter 5 of this thesis. The next section provides a comprehensive and timely review of the theoretical and empirical literature concerned with "obesity economics".

References

BECKER, G.S. (1965): A Theory of the Allocation of Time. *The Economic Journal* **75**, 493-517.

BILD (2012): Ernährungsministerin Ilse Aigner (CSU): Es wird keine Zucker- oder Fettsteuer geben! *Bild*, January 16, 2012. Available online at: http://www.bild.de/politik/inland/ilse-aigner/keine-zucker-und-fett-steuer-22084496.bild.html. Accessed 10.05.2013.

DEATON, A. (1988): Quantity, Quality, and Spatial Variation of Price. *American Economic Review* **78**, 418-430.

DEATON, A. (1997): The Analysis of Household Surveys. A Microeconometric Approach to Development Policy. The World Bank: Washington, D.C.

FRANKFURTER ALLGEMEINE ZEITUNG (2011): Dänemark erhebt Fettsteuer. *Frankfurter Allgemeine Zeitung*, October 6, 2011, p.13.

FRANKFURTER ALLGEMEINE ZEITUNG (2012): Dänen schaffen Fettsteuer ab. *Frankfurter Allgemeine Zeitung*, November 12, 2012, p.13.

FRANKFURTER ALLGEMEINE ZEITUNG (2013): Der unmündige Konsument. *Frankfurter Allgemeine Zeitung*, March 9, 2013, p.15.

HUFFMAN, W.E. (2011): Household Production Theory and Models. In: LUSK, J.L., J. ROOSEN and J.F. SHOGREN (eds.): The Oxford Handbook of Food Consumption and Policy. Oxford, 35-74.

MAZZOCCHI, M., W.B. TRAILL and J.F. SHOGREN (2009): Fat economics. Nutrition, health, and economic policy. New York: Oxford University Press.

POPKIN, B.M. and S.W. NG (2006): The Nutrition Transition in High and Low-Income Countries: What are the Policy Lessons? Invited paper prepared for presentation at the

International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006.

SPIEGEL (2011): Ungesunde Ernährung: Ungarn will Bürger mit Chips-Steuer erziehen. *Spiegel-online*, September 1, 2011. Available online at: http://www.spiegel.de/wirtschaft/soziales/ungesunde-ernaehrung-ungarn-will-buerger-mit-chips-steuer-erziehen-a-783873.html. Accessed 10.05.2013.

SRU (SACHVERSTÄNDIGENRAT FÜR UMWELTFRAGEN) (2012): Umweltgutachten 2012: Verantwortung in einer begrenzten Welt. Available online at: http://www.umweltrat.de/SharedDocs/Downloads/DE/01_Umweltgutachten/2012_06_04_Umweltgutachten_HD.html. Accessed 10.05.2013.

STAUDIGEL, M. (2011): How (much) do food prices contribute to obesity in Russia? *Economics and Human Biology* **9**, 133-147.

STAUDIGEL, M. (2012a): How do obese people afford to be obese? Consumption strategies of Russian households. *Agricultural Economics* **43**, 701-714.

STAUDIGEL, M. (2012b): Fettsteuern zum Wohle der Umwelt? *Ökonomenstimme*, July 19, 2012. Online available at: http://www.oekonomenstimme.org/artikel/von/matthias-staudigel/.

STAUDIGEL, M. (2013): On the application of household production theory to health and nutrition. In: Bahrs, E., Becker, T., Birner, R. et al. (eds.): Herausforderungen des globalen Wandels für Agrarentwicklung und Welternährung. Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e.V., Band 48. Münster: Landwirtschaftsverlag, 33-46.

STAUDIGEL, M. and R. SCHRÖCK (2014): Food Demand in Russia – Heterogeneous Consumer Segments over Time. Accepted for Publication in *Journal of Agricultural Economics*.

SÜDDEUTSCHE ZEITUNG (2011): Cola-Steuer gegen Fettleibigkeit. *Süddeutsche Zeitung*, December 29, 2011. Available online at: http://www.sueddeutsche.de/wirtschaft/frankreich-cola-steuer-gegen-fettleibigkeit-1.1246643. Accessed 10.05.2013.

THE NEW YORK TIMES (2010): Bloomberg Says a Soda Tax 'Makes Sense'. *The New York Times*, March 7, 2010. Available online at: http://www.nytimes.com/2010/03/08/nyregion/08soda.html. Accessed 10.05.2013.

THE NEW YORK TIMES (2012): New York Plans to Ban Sale of Big Sizes of Sugary Drinks. *The New York Times*, May 31, 2012. Available online at: http://www.nytimes.com/2012/05/31/nyregion/bloomberg-plans-a-ban-on-large-sugared-drinks.html?pagewanted=1&_r=1&hp. Accessed 10.05.2013.

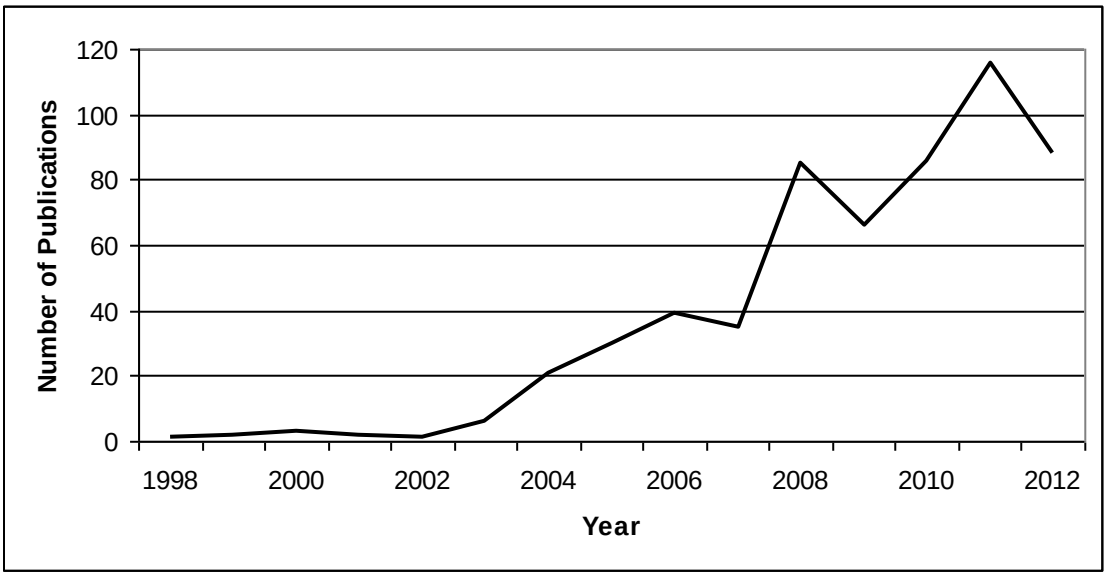
WHO (WORLD HEALTH ORGANIZATION)(2013): Obesity and Overweight. Fact Sheet No. 311, updated March 2013. Available online at: http://www.who.int/mediacentre/factsheets /fs311/en/index.html. Accessed 23.04.2013.

2 Economic perspectives on obesity: Identifying determinants and evaluating policies

2.1 Introduction

Almost one and a half decades ago the first papers dealing with economic aspects of obesity appeared in literature. They were both reactions to claims from the public health sector for financial measures to combat obesity as well as fundamental papers that set out the importance of economic research related to the topic (PHILIPSON, 2001). These articles inspired numerous economists to engage in research on obesity. A new branch titled as "Obesity Economics" emerged with an increasing output from year to year. The rise of this area is mirrored by the growing publications and papers over the years depicted in Figure 1.

Figure 1: Number of economic publications on obesity (EconLit), 1998-2012



Notes: The number of publications in each year refers to the results of an EconLit-search for the keywords "Overweight", "Obese", and "Obesity".

***Source*: Own composition inspired by CAWLEY (2011).**

What is fascinating about "Obesity Economics" is the broadness of its contributions that enhance the general scientific and public discussion on the drivers of the global obesity epidemic and possible solutions to it. On a theoretical basis, economists stress that overweight or obesity can be a rational choice that maximises individual utility. At the same time they investigate possible deviations from rational behaviour or the existence of market

failures that lead to welfare-decreasing outcomes. On the empirical side a strong focus lies on the investigation of causal relationships between economic and environmental factors, human behaviour and health outcomes. The instruments of modern econometrics and the increasing availability of large household data sets provide the basis for important insights into the structural pathways.

The present chapter's purpose is to provide a broad overview of the economic literature related to obesity. It is supposed to complement the core articles in the following parts of the dissertation. Despite having their own literature and theory sections, these papers targeted at scientific journals are naturally restricted in their length and their scope. Hence, the present review aims to illustrate economic perspectives and approaches to obesity more comprehensively.

The structure of this review is as follows. Section 2.2 presents some stylised facts characterising the development and the current structure of obesity across and within countries. Section 2.3 sketches the basic theory and the various extensions established by economists to explain the patterns shown by the data. These theories provide the basis for the discussion about the appropriateness of government interventions in Section 2.4. Section 2.5 is devoted to the special case of fiscal measures aimed at reducing obesity and presents theoretical considerations and empirical evidence about the effect of food prices on body weight and obesity prevalence. A concluding discussion highlights some research gaps that are addressed by the papers in this dissertation.

2.2 Stylised facts on structure and development of obesity

This section provides some stylised facts about the development of obesity and its distribution across countries and within populations. The observed patterns – especially the gradients along variables such as income, education or gender – clearly point to an important role of socioeconomic factors in the determination of obesity. Hence, an engagement of social sciences is necessary to explain trends and variation in the data that cannot be explained by genes or environmental toxins alone. However, prior to a closer look at the statistics, it deems appropriate to elaborate on the basic indicators of overweight and obesity in more detail.

The World Health Organization (WHO) defines overweight and obesity as "abnormal or excessive fat accumulation that may impair health" (WHO, 2012). The most common

indicator of excess body weight and fat is the Body Mass Index (BMI). It is calculated as an individual's weight in kg divided by its height squared in m^2. According to the WHO classification, a person is overweight, when her BMI is greater than or equal to 25. At a BMI greater than or equal to 30, she will be classified as obese.

However, the use of BMI as a measure of fatness is not free from critique (see, e.g. BURKHAUSER and CAWLEY, 2008). Firstly, the cut-off values that define overweight and obesity are often claimed to be set arbitrarily. Secondly, BMI should be considered "a rough guide" (WHO, 2012), because two persons that have the same BMI may have a completely different level or distribution of body fat. Despite these drawbacks, BMI refers to the easily measurable anthropometric variables height and weight and is widely available for many countries and over time. Hence, it is useful for epidemiological research but it may not be appropriate in the individual case (SASSI, 2010). In any case, the general patterns of rising obesity rates across and within countries and over time are highly relevant and pose interesting questions to (economic) research.

Patterns of overweight and obesity across countries

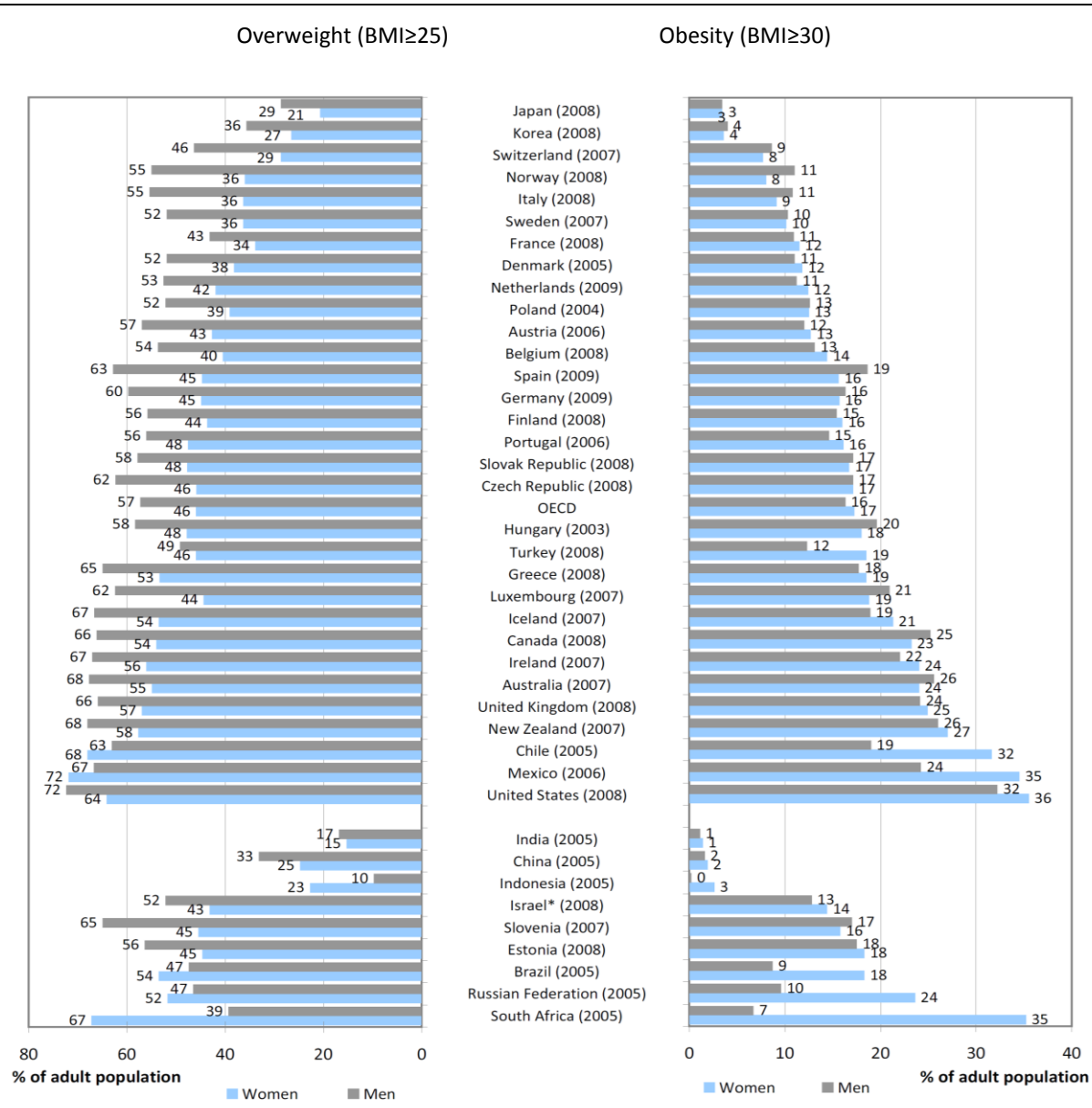
Figure 2 shows the percentage of adult populations that is overweight (including the obese) and obese for OECD countries as well as selected non-OECD countries. As revealed by the left panel, a considerable proportion (and often the majority) of people have a BMI larger than 25 in many countries. In the whole OECD, about one half of all people are overweight, while in the USA and Mexico more than two thirds are overweight. The Asian members, Korea and Japan, exhibit the lowest rates. Here, one third or less are overweight and obese.

However, overweight and obesity are not an exclusive problem of developed countries. Transition and developing countries show high prevalence of people with excess weight, too. In South Africa, the Russian Federation, and Brazil the proportion is around 50 %. Furthermore, the left panel indicates that overweight is more pronounced among men compared to women.

The figures for the obesity rates in the right panel show an almost identical ranking for the different countries, however, the cross-county differences are more pronounced. Whereas the USA have an about 2.5 times higher overweight prevalence than Japan the ratio is larger than ten with respect to the proportion of obese people. Remarkably, the gap between men

and women that is present on the left-hand side disappears or is reversed in some countries when looking at the right-hand side.

Figure 2: Overweight and obesity rates in OECD and selected non-OECD countries



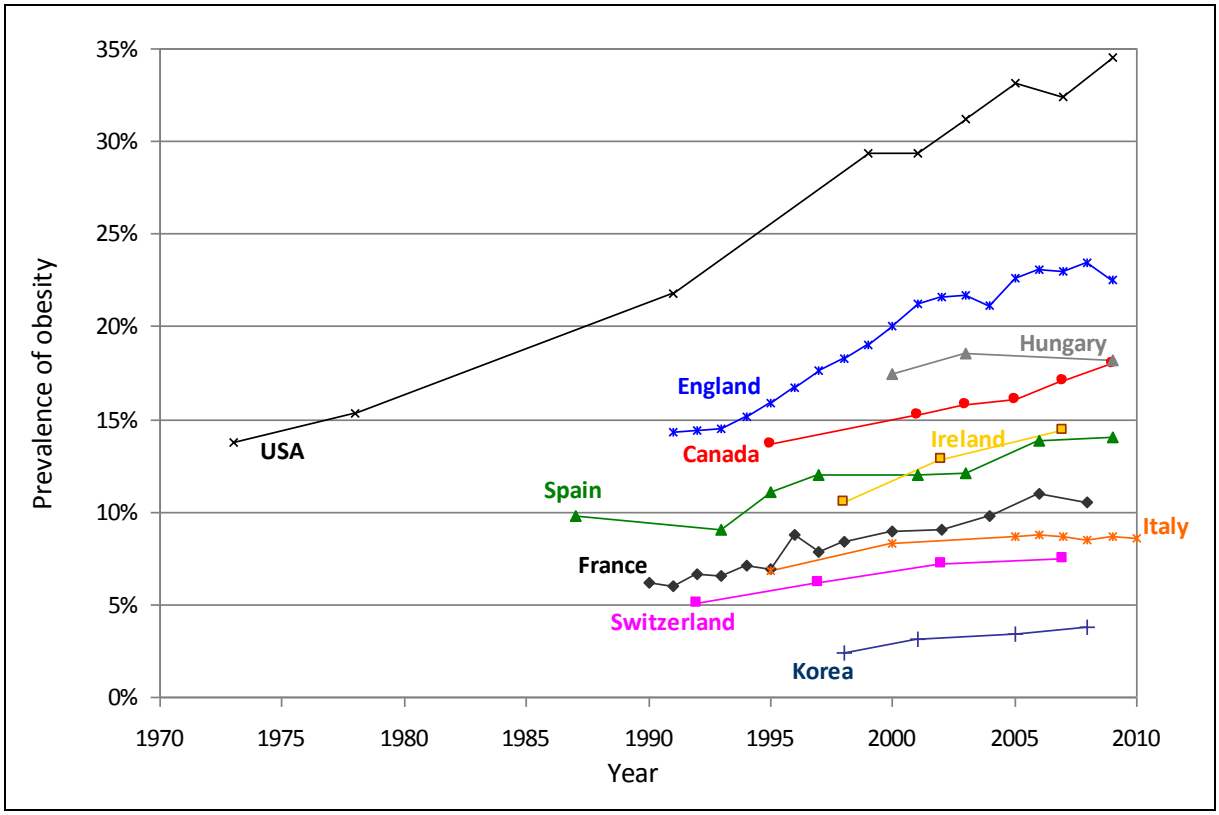
Note: For Australia, Canada, Czech Republic, Ireland, Japan, Korea, Luxembourg, Mexico, New Zealand, Slovak Republic, United Kingdom and United States, rates are based on measured, rather than self-reported, body mass index (BMI).

(*) The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

***Source*: SASSI (2010) based on OECD Health Data 2010, and WHO Infobase for Brazil, Chile, China, India, Indonesia, Russian Federation and South Africa.**

Figure 3 illustrates the development of obesity over time in selected countries. Although all countries experience rising rates of obesity there is substantial variation in the pace of this growth as well as in the initial and current levels. The gap between countries has widened over time with the USA consolidating its position as the country with by far the globally highest rates of obesity (SASSI, 2010). Additionally, the figure points out a fundamental obstacle to obesity research: for most countries except the US, robust data on measures of overweight and obesity do not go back further than the mid-1980s.

Figure 3: Prevalence of obesity over time for selected countries



***Source*: OECD (2012).**

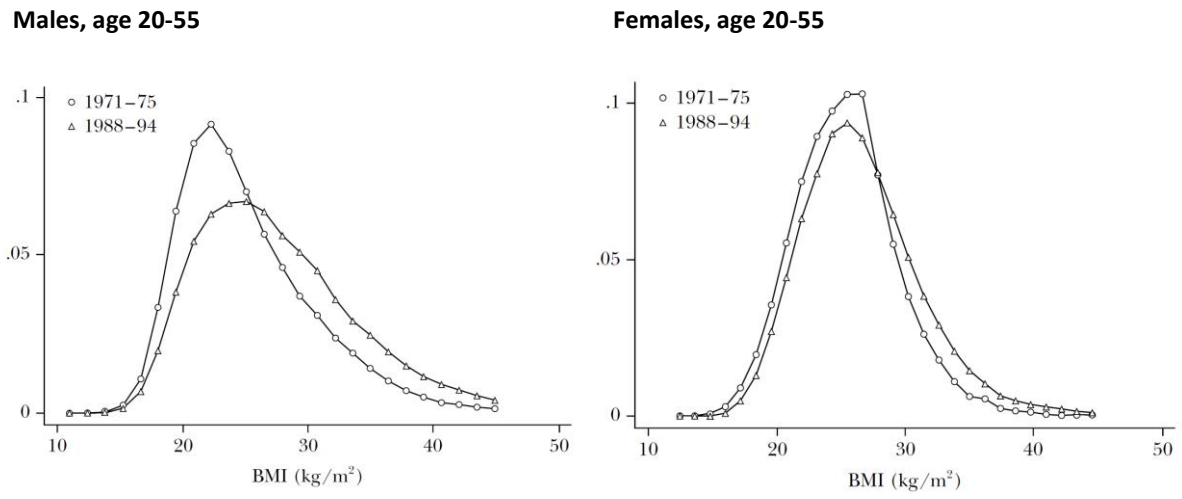
MAZZOCCHI et al. (2009) discuss possible reasons for the considerable variation in obesity rates across OECD countries. Higher obesity prevalence occurs in societies where "individualism" and "reliance on free markets" (like the US or Great Britain) is important compared to countries where "community involvement and regulation" are more strongly accepted (like in Japan, Korea, and Scandinavia)(ibid., p.14). A second aspect put forward by MAZZOCCHI et al. (2009) is that countries with a "strong food tradition" like France, Italy, Korea, or Japan, where "fewer dietary adjustments" have been made, show less obese populations. ALSTON et al. (2008) assess whether differences in agricultural policies can

explain some of the cross-country variation but do not find a clear pattern. Generally, in the presence of multiple possible confounders, such an analysis stays at a more or less speculative level. A closer look at the patterns and dynamics within populations seems more promising, especially, when large and informative data sets are at hand. For the study of obesity and the design of policies, it is also important whether weight gain is a phenomenon that concerns the whole population or whether there are subgroups that are particularly affected.

Within-country distribution of body weights

A closer look at micro data reveals that body weights do not shift uniformly within populations. Long-term time series document a general increase in average height-adjusted body weights during the whole 20th century (COSTA and STECKEL, 1995). Recently, the extreme weights at the right tail of the distribution show dynamics, in particular (PHILIPSON, 2001). Figure 4 shows the frequency distribution of BMI for males and females in the USA and how they have changed over time.

Figure 4: Distribution of BMI in the US population, 1971-1975 and 1988-1994



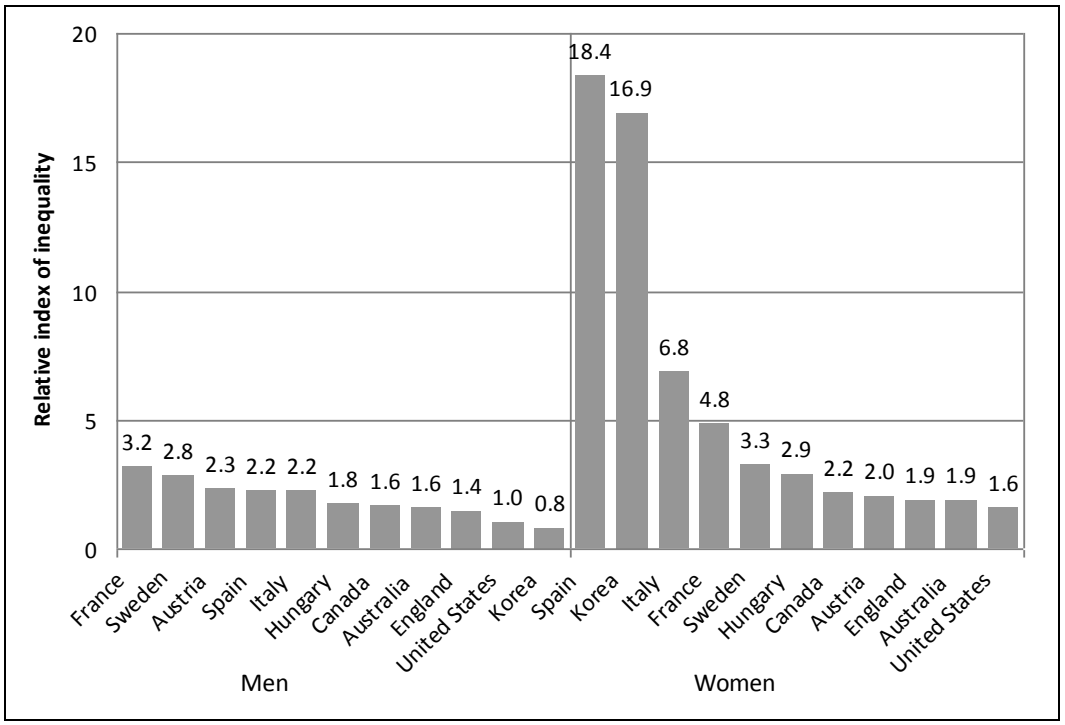
***Source*: CUTLER et al. (2003) based on NHANES-Data.**

Obviously, some population groups have put on more weight than others. Otherwise the curve would not have changed its shape but would just have shifted to the right. The right tails are more strongly pronounced today than in the past indicating that the weights of susceptible groups and thus the percentage of obese individuals have risen much more sharply than the weight of the average person (MAZZOCCHI et al., 2009). Based on data from the National Health and Nutrition Examination Survey (NHANES), CHOU et al. (2004) report

that between 1978 and 1991 the percentage of obese people in the US rose by over one half from 14 % to 22 %. In the same period, the mean BMI rose by 1.24 kg/m² which is only an increase by 5 %. Similar patterns can be found in other industrialised countries like England (see Figure A1 in the appendix) and to a lower degree also for transition countries like Russia (see Figure A2 in the appendix).

Statistics that link obesity to socio-demographic variables strengthen the picture of obesity as a phenomenon that varies strongly across population subgroups. Thereby, both levels as well as growth rates are subject to substantial heterogeneity. SASSI (2010) provides evidence on the social disparities of obesity prevalence that exist along age, socio-economic status (education, income), gender, and ethnicity. Again, higher obesity rates can be observed for women in most countries but pre-obesity (i.e. overweight) is much more common in men. Nevertheless, obesity is growing faster among males. Age and BMI show an inverse U-shaped relationship: BMI increases with age up to a certain level and then declines again slightly. Although the decline at higher ages could be explained by a loss of muscle tissue and general degradation processes (see e.g. ELMADFA and LEITZMANN, 2004, p.496), this finding should be interpreted with care. Cohort effects as well as higher mortality of obese people could also be possible reasons.

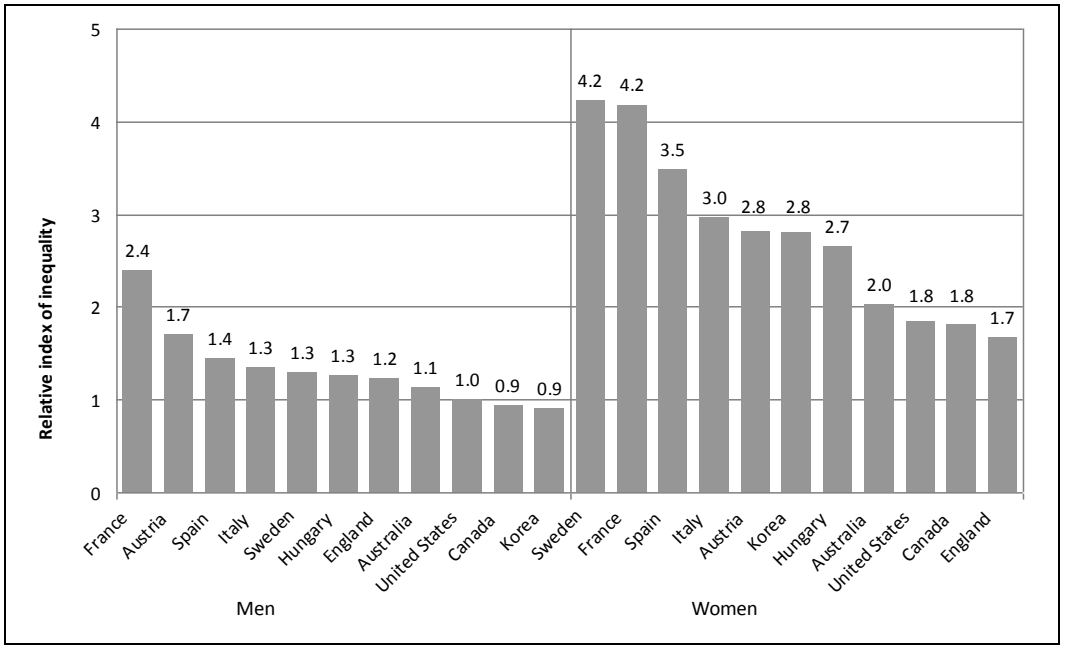
Figure 5: Disparities in obesity in consideration of educational level, selected OECD countries



***Source*: SASSI (2010).**

Obesity rates differ considerably for groups with different educational levels, too. Figure 5 depicts calculations of a relative index of inequality that show the relative probability to be obese for persons with the lowest education compared to the highest educated group (OECD, 2012). Better educated individuals are less often obese than persons with lower education. The spread in obesity prevalence between both groups varies across gender and different countries. For men, educational differences are less pronounced than for women. The left panel of Figure 5 shows factors around three at the maximum and an index of equal to or smaller than one for the United States and Korea (indicating that the higher educated that are equally or even more obese) for males. For women, the differences are huge. In Spain and Korea the least educated women are 18.4 times, respective, 16.9 times more likely to be obese compared to the highest educated. The ratios for income or social class, depicted in Figure 6, are less pronounced than for education but show a similar pattern.

Figure 6: Disparities in obesity in consideration of household income or occupation - based social class, selected OECD countries



***Source*: SASSI (2010).**

While an analysis of the OECD found that the social disparities "remained remarkably stable over time" (SASSI, 2010), CUTLER et al. (2003) draw a more complex picture. They present data on the BMI and obesity prevalence in the US across population groups for 1971-75 and 1988-94 (see Table 2). Many subgroups have different levels of obesity with the case of education being particularly interesting. For the period 1971-75 there is a strong gradient for women with 24 % obese in the lowest educated group and only 7 % obese in the highest educated.

Similarly, 15 % of the lowest educated men are obese and only 8 % in the highest educated group. Over time, the absolute differences for women have almost prevailed. Only the medium group experienced a higher increase of 20 % (versus 13 % to 14 % in the higher and lower groups). In contrast, the figures for men have nearly converged over time implying that the growth rates for the better educated (college or more) were considerably higher than for the lower educated.

Table 2: Weight increase in different population groups, USA, 1971-1994

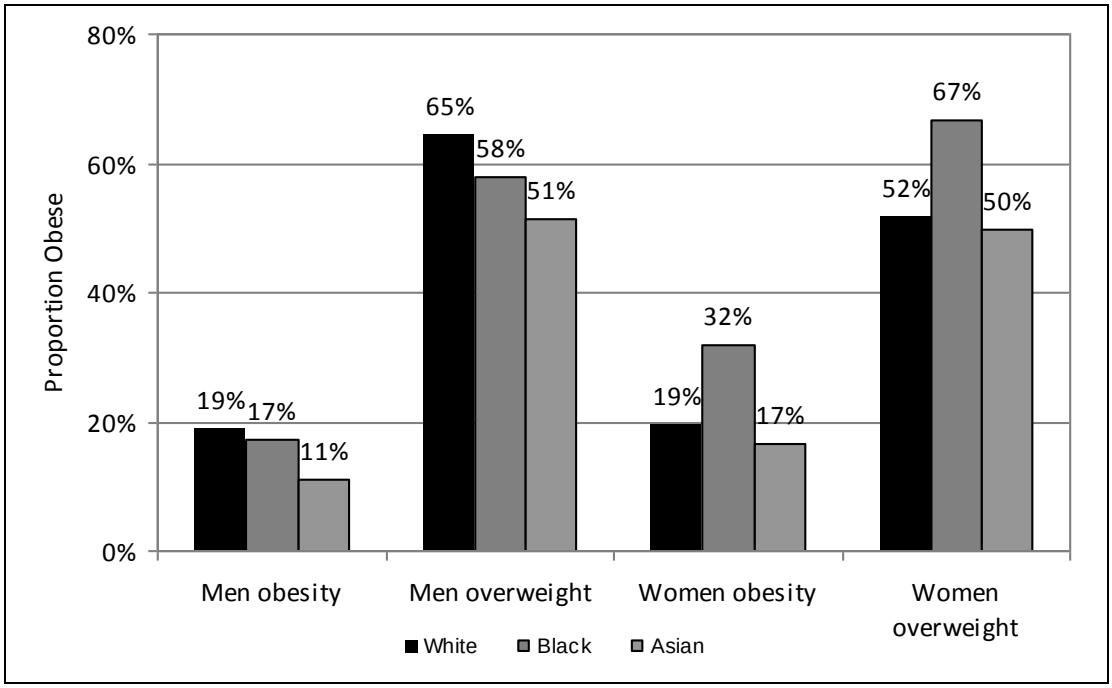
	Average BMI (kg/m²)		*Percentage Obese (BMI ≥ 30)*	
	1971-75	*1988-94*	*1971-75*	*1988-94*
Average	25.4	27.3	16	30
Adults				
All	25.0	27.1	15	28
Single male	24.4	25.5	9	18
Married male, nonworking spouse	25.6	27.1	13	26
Married male, working spouse	25.7	27.3	11	24
Single female	24.9	27.4	18	32
Married female, working	24.3	27.4	13	33
Married female, not working	24.9	28.0	16	36
Elderly				
All	26.1	27.6	19	32
Male	25.4	27.0	13	28
Female	26.7	25.4	25	36
Women aged 20+, by education group				
<High school	26.3	28.4	24	28
High School	24.2	27.5	13	33
College or more	22.8	25.4	7	20
Men aged 20+, by education group				
<High school	25.6	26.5	15	23
High School	25.7	26.7	13	24
College or more	25.2	26.4	8	21

Notes: Data are from the National Health and Nutrition Examination Survey (NHANES); the BMI is measured in kg/m².

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

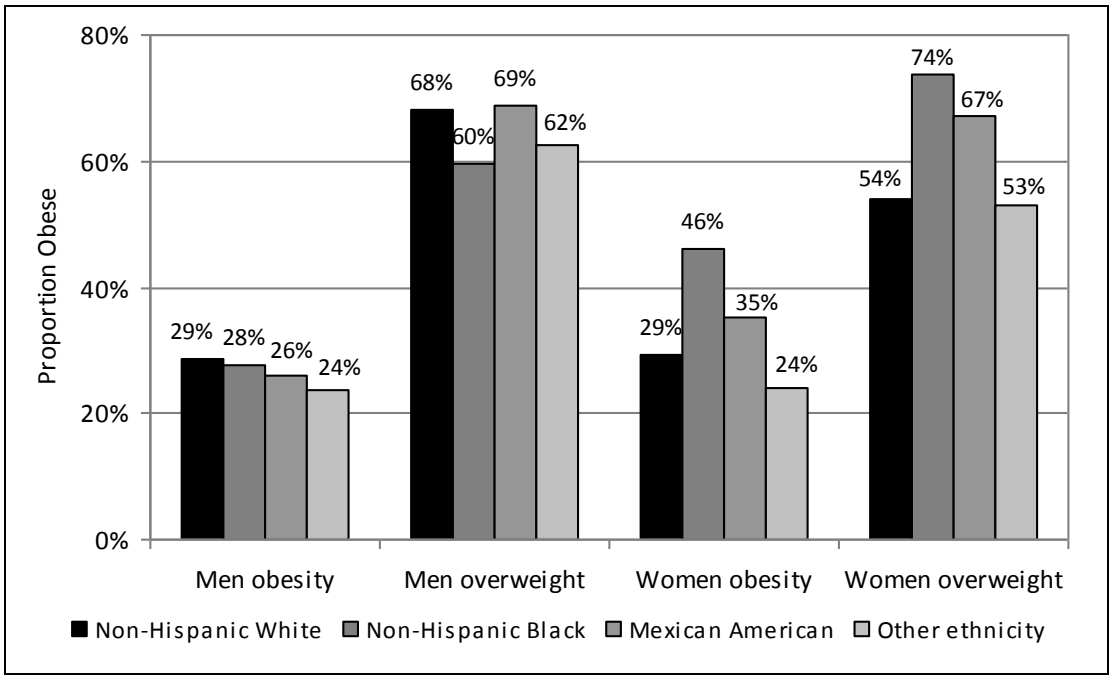
Disparities across ethnic groups are shown for England and the USA in Figures 7 and 8. In both countries, white men show the highest prevalence of obesity and overweight. Among females, it is the Black and Mexican American groups that have the highest rates. These differences prevail even after accounting for possible socio-economic correlates (SASSI, 2010). However, the BMI thresholds that define obesity in white/Caucasian men and women may not apply equally well to other ethnicities.

Figure 7: Obesity and overweight in different ethnic groups in England (adults)



***Source*: SASSI (2010), OECD analysis of Health Survey for England (HSE) data 1995-2007.**

Figure 8: Obesity and overweight in different ethnic groups in the United States (adults)



***Source*: SASSI (2010), OECD analysis of National Health and Nutrition Examination Survey (NHANES) data 1999-2008.**

2.3 Economic approaches to explain increasing obesity rates

Around the year 2000, economists took up the issue of rising obesity rates and set out an "economic research agenda" to identify determinants and possible avenues to address it (PHILIPSON, 2001). As the guiding principle, economists perceive the determination of body weight as the outcome of multiple individual choices. All decisions people make about what and how much to eat and drink or how active to be in their leisure time or at their working place affect their energy balance and, thus, their body weight. The numerous economic contributions presented below deal with the question whether these choices and obesity as a possible outcome are to be regarded as the result of rational decisions, irrational behaviour, or something in between.

In this regard, economists do not get tired of pointing out that the optimal body weight from an economic point of view may well differ from the optimal one proposed by medicines and public health specialists. Whereas the former is characterised as the state where the underlying behaviours maximise utility subject to the restrictions people face, the latter is concerned with the strict maximisation of health.

Given the shifts in obesity and overweight over time and between populations as sketched in Section 2.2, the natural reaction of economists is to look which conditions and incentives have changed that led people to alter their optimal behaviour in a weight-increasing way. The following review will first present the benchmark scenario of a rational individual that decides freely and autonomously on his or her body weight under given restrictions. Later on, possible deviations and irrationalities will find their way into the discussion.

2.3.1 Neoclassical interpretation: Technological change and shifts in relative prices

Researchers from a branch termed as "neoclassical theory of obesity" (PHILIPSON and POSNER, 2008, p.975) see welfare-enhancing technological change as the primary reason for the long-term increase in overweight and obesity within the last 150 years. Accordingly, both supply and demand side changes have contributed to increasing costs of physical activity and to decreasing costs of energy intake (LAKDAWALLA and PHILIPSON, 2009). Innovations in agriculture and food processing lowered the price of food while technological progress made work on the job and in the household less strenuous and energy-demanding. While workers in former societies "were paid to exercise", people are now considered to "pay to exercise" (LAKDAWALLA et al., 2005, p.253), firstly in a direct way by, for instance, joining fitness clubs

but also indirectly by investing their leisure time in physical activities. Additionally, modern entertainment technologies lowered the prices for sedentary leisure activities.

The proponents of the neoclassical view credit their interpretation to do "surprisingly well in explaining the observed trends" (LAKDAWALLA et al., 2005, p.253). By means of a simple model, they offer some interesting implications on offsetting effects of price changes for calorie intake and expenditure and the relationship of income and body weight. A more detailed presentation of the basic model below will illustrate both the unique contributions that economics provides to the analysis of obesity but also some weaknesses that arise from too-strict mathematical economic models.

As a basic feature of the neoclassical model of obesity, body weight *W* enters the utility function besides food intake *F* and alternative consumption *C* (PHILIPSON and POSNER, 1999):

(1) $U = U(W(F, S), F, C)$

Body weight, in turn, increases with energy intake from food *F* and decreases with strenuous energy expenditure *S*. For a growth in weight, *F* needs to exceed *S*. Furthermore, the marginal effects of *F* and *S* diminish with rising levels (i.e. $\partial^2 W/\partial F^2 \leq 0$ and $\partial^2 W/\partial S^2 \geq 0$). Also *F* and *S* are complementary, i.e. when an individual spends more energy the effect of energy intake gains in importance ($\partial^2 W/\partial F \partial S \geq 0$) (PHILIPSON and POSNER, 1999).

The crucial assumption of eq. (1) is that weight affects utility in a non-monotonic way. PHILIPSON and POSNER (1999) argue that every person has an ideal weight W_0 that may be either determined by 'objective' medical guidelines or subjective social norms or personal aesthetic values. Deviations from W_0 decrease utility at an increasing rate (i.e. $(\partial U/\partial|W_0 - W|) \leq 0$ and $(\partial^2 U/\partial|W_0 - W|^2) \leq 0$).

The main claim of economics in this context is that "neither subjective nor any objective weight W_0 is the preferred weight in the economic sense" (PHILIPSON and POSNER, 1999, p.8). To see this, consider the maximisation of *U* subject to an income constraint where the level of physical activity *S* is exogenously given:

(2) $max \;\; U = U(W(F, S), F, C) \qquad s.t. \;\; C + pF \leq I,$

where *p* is the price of energy from food and *I* is income. The first-order conditions of maximisation lead to:

$$(3) \qquad \frac{\frac{\partial U}{\partial W}\frac{\partial W}{\partial F}+\frac{\partial U}{\partial F}}{\frac{\partial U}{\partial C}} = p$$

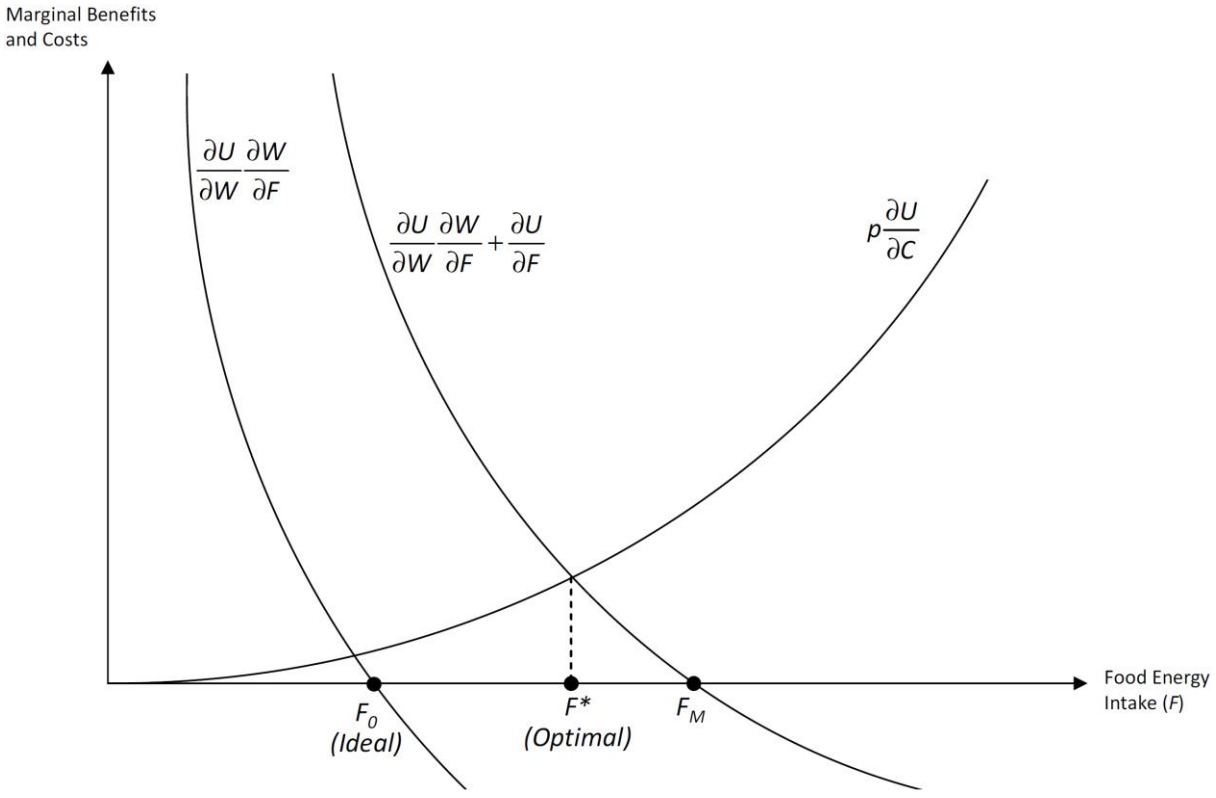
In the optimum, the ratio of the marginal utility of food intake (that occurs directly via "joy of eating" and indirectly via the weight effect) and the marginal utility of alternative consumption have to equal the price ratio (where the alternative price is the numeraire).

Alternatively, equation (3') illustrates the trade-offs that emerge between weight, food and other consumption.

$$(3') \qquad \frac{\partial U}{\partial W}\frac{\partial W}{\partial F}+\frac{\partial U}{\partial F} = p\frac{\partial U}{\partial C}.$$

The relevant relationships are shown in Figure 9 that plots energy intake against the marginal benefits and costs from it.

Figure 9: Ideal, optimal, and maximum weight



***Source*: PHILIPSON and POSNER (1999).**

For a given *S*, the indirect marginal benefit of food via weight $(\partial U/\partial W)(\partial W/\partial F)$ is positive as long as a person is below her ideal weight (W_0) and gets negative when her weight exceeds W_0. While food intake F_0 would maximise utility derived just by weight, the total marginal benefit of food intake $(\partial U/\partial W)(\partial W/\partial F)+(\partial U/\partial F)$ is larger since utility increases with food intake. Thus, a person's optimal level of food consumption lies at *F** where the total marginal benefit of food intake equals marginal costs of food consumption $p(\partial U/\partial C)$ that arise from the foregone consumption of alternative goods. This point also determines the optimal weight *W** that may or may not differ from W_0. How strong both weight points differ from each other depends on the food prices and the marginal utilities of food consumption, of deviation from ideal body weight, and of alternative consumption.

An increase (a decrease) in the price of food energy shifts $p(\partial U/\partial C)$ to the left (to the right) and causes body weight to decline (to rise), i.e. $(\partial W/\partial p)<0$. Also an increase in income would cause a rightward shift and higher body weight (i.e. $(\partial W/\partial I)>0$). Moreover, the more important other consumption *C* is to a person, the steeper is $p(\partial U/\partial C)$ which lowers body weight, too. A further important aspect is the marginal utility of direct food consumption. The larger $(\partial U/\partial F)$ the higher is the optimal body weight.[1]

Finally, PHILIPSON and POSNER (1999) emphasize that the model predicts the rise in body weight to be "self-containing". When the price of food energy approaches zero or income gains go to infinity food intake reaches an upper limit F_M. Here, the negative impact of weighing much more than W_0 would compensate the positive utility from eating.

PHILIPSON and POSNER (1999) as well as other authors provide further extensions and implications of the neoclassical model. LAKDAWALLA and PHILIPSON (2002; 2009) provide a dynamic version of the neoclassical theory. Additional features, for example non-monotonic effects of income, emerge from assuming that health is a normal good or as PHILIPSON and POSNER (1999) put it: "Wealthier or educated individuals care more about their weight for health or other reasons, and so they limit their weight more" (p.12). The result, an inverted U-shaped relationship of income and weight, matches the observation that weight rises with income in poorer countries whereas it declines with higher incomes in richer nations.

[1] However, this is not a sufficient condition for a higher deviation of *W** from W_0. At low incomes or very high food prices, that is, when the optimal body weight may be to the left of the ideal body weight, *W** and W_0 may be even more closely to each other.

However, it is likely that many factors correlated to income explain large parts of its weight effect. The work of SCHMEISER (2009) for instance shows that the negative effect of income on weight, which is especially pronounced for women, turns positive once the variation in income is controlled by instrumental variables. Thus, exogenous increases in income cause body weights to rise in wealthy countries, too. Among the factors that are linked to income (and certainly mask its positive effect) are education, motivation, abilities, but also social norms and competition for appearance that people in better-paying jobs have to face. Some of these effects will be discussed in the following sections.

Energy expenditure as endogenous choice

The model is also extended by introducing strenuousness *S* as a choice variable which acts through its impacts on weight and income. PHILIPSON and POSNER see a shift in the effect on income *I(S)* as crucial for the rise in obesity. They argue that in agrarian societies physical effort has raised income (i.e. $\partial I/\partial S > 0$), whereas in post-industrial societies physical effort lowers income ($\partial I/\partial S < 0$) and causes weight to rise. A further extension of the model would be to introduce recreational exercise *E*, that may mirror the jogging and gym "revolution" which is likely to offset the effects of less strenuous work at the job (PHILIPSON and POSNER, 1999, pp.16). PHILIPSON and POSNER (2008) regard this complementarity of energy intake and energy expenditure as the reason for the observed steady growth in body weight despite periods of falling energy consumption in the 20th century.

The framework of PHILIPSON and POSNER is more applicable to the general increase of weight observed over the last 100 years. However, the recent changes in the shape of the BMI distribution are the results of the likely interaction of declining food prices and increases in wealth with many other factors. Models based on the household production theory point to aspects of reduced time costs in cooking, increased labour force participation of women, or changes in skills and abilities connected to nutrition and food preparation. Alternatively, behavioural economics stress the role that exogenous cues and decision heuristics play in a changing food environment and emphasise irrational behaviours such as time inconsistencies. The next section discusses these arguments in more detail.

2.3.2 Household production theory

2.3.2.1 Basic concept

A very important stream of the economic literature on obesity relies on the household production theory that originates from BECKER (1965). This framework allows researchers to include the time that consumers have at their disposal as well as their knowledge and their abilities into the economic analysis of behaviour.

BECKER (1965) enhanced the neoclassic consumer theory by the notion that it is not the market goods which generate a person's utility in the first place but rather more elementary commodities, also called Z-goods (eq. 4). Examples of such Z-goods are health, love, or prestige.

(4) $U = u(Z_1,...,Z_n)$.

Household production theory treats households as small factories that produce these elementary commodities by combining market goods x_i and their non-market time t_i, as depicted in equation (5). The vector E describes the „state of the art of production" or the „level of technology of the production process" (MICHAEL and BECKER, 1973). It includes households' assets, their knowledge, and their abilities.

(5) $Z_i = f_i(x_i, t_i; E)$.

Hence, households are producers and maximise their utility at the same time. Consumers' demand for market goods is thus a derived demand analogous to a firm's demand for production factors (MICHAEL and BECKER, 1973).

A third innovation of household production theory is the extension of the narrow budget constraint in the conventional framework to a "full-income constraint". By allowing time to be freely convertible between direct use and income generation, the final restriction of the Becker model is the total time available (T).

(6) $S = wT + V = \sum_i (wt_i + p_i x_i)$.

Equation (6) shows the composition of a household's full income S. It can be described as the monetary value of T at the (constant) wage rate w plus non-labour income V. The income that is spent on each elementary commodity Z_i consists of the opportunity cost of time

necessary for its production (wt_i) plus the value of the market goods that are used ($p_i x_i$) (BECKER, 1965).

When households maximise their utility with respect to the full-income constraint and their production functions, they reach the following equilibrium:

$$(7) \qquad \frac{MU_i}{MU_j} = \frac{w\frac{dt_i}{dZ_i} + p_i\frac{dx_i}{dZ_i}}{w\frac{dt_j}{dZ_j} + p_j\frac{dx_j}{dZ_j}} \equiv \frac{\pi_i}{\pi_j}$$

The ratio of the marginal utilities, MU_i and MU_j, of two commodities Z_i and Z_j, must be equal to the ratio of their marginal costs, π_i and π_j. The marginal costs (i.e., dC/dZ_i) are the shadow prices of the Z-goods that depend on the wage rate w, the price vectors p_i and p_j of the market goods as well as the input-output relations of time and goods present in the production of the commodities (BECKER, 1965).

This framework allows the restrictions of human behaviour to be modelled more explicitly. It emphasises more general goals of households and separates the preferences for these from restrictions of time, knowledge and abilities, as well as the state of the consumption environment (MICHAEL and BECKER, 1973; POLLAK and WACHTER, 1975; SEEL, 2006).

GROSSMAN (1972) established the application of household production theory to health research. He considered health as an investment good that depreciates over time but can be recovered through health production processes. The concept of health capital is a basic concept in the field of health economics (see e.g. LEIBOWITZ, 2004; GROSSMAN, 1972). At the same time the development literature used it to analyse hunger and malnutrition in developing countries (STRAUSS and THOMAS, 1998). Also the emerging field of obesity economics has increasingly applied household production theory to research on overnutrition and body weight. The next section presents a concise overview of the aspects that have been discussed in that area.

2.3.2.2 Applications in literature

The literature that uses household production theory as a framework for analysing nutrition and obesity emphasises four main aspects. These are, analogous to the extensions of the theory, a) market-goods inputs and b) time inputs in the production of health as well as

c) productivity issues related to education or knowledge. A final point is d) the structure and relation of different variables within the process of modelling and empirical analysis.

CUTLER et al. (2003) see the main contribution of technological change to rising obesity in that it *reduced the time costs of food preparation*. This could especially explain the stronger shift at the right tail of the distribution, whereas the theory of PHILIPSON and POSNER (1999) is more applicable to the general increase in weight that occurred over the last hundred years. According to CUTLER et al., the time that women spend on preparing food and cleaning up after meals decreased by about 50 % between 1965 and 1995 (p.106). A further indication in favour of this view is that the growth of energy intake from 1977/8 to 1994/6, of men by 268 kcal and of women by 143 kcal, can be attributed in large parts to additional snacking. The share of additional energy intake attributable to snacks is 90 % for men and 112 % for women. Hence, the rise in food consumption was mainly driven by the number of meals rather than the energy intake per meal.

CHOU et al. (2004) focus on the effects that the availability of fast-food and full-service restaurants have on BMI and the prevalence of obesity. They argue that the rising number of such outlets dramatically reduced search and travel costs. Moreover, their analysis includes prices of meals in different types of restaurants and for food that is consumed at home, as well as prices for cigarettes and alcohol. These products are considered as inputs into the production of meals and health. The study of POWELL (2009) investigates the impact of fast-food prices and fast-food availability on adolescent BMI. Fast-food, other food items and time inputs are regarded as inputs into health production as well as a direct source of utility.

DRESCHER et al. (2009) examine the demand for healthy eating considering diversity of the consumed food products. Their innovative idea is that the combination of food inputs in the production of health, expressed as “healthy food diversity”, is an important aspect. HUFFMAN et al. (2010) analyse the impact of food prices on the aggregate demand for calories and the supply of health. They employ a broad range of variables, like prices for food and non-food, as well as of time. Additionally, they include indicators for education, the child dependency ratio, labour force participation, and for the performance of public health systems.

HAMERMESH (2007) assesses how the relation of time and goods inputs into the commodity “eating” has been affected by income and time prices over time. He finds increasing goods intensity, where both goods and time inputs increased with income but higher time prices

reduced time inputs. FERTIG et al. (2009) investigate how maternal employment affects childhood obesity. They find small positive effects of mothers' time inputs into the production of child health (like cooking or leisure time spent together). HAMERMESH (2009) examines the time spent on grazing (i.e. eating or drinking while pursuing another activity) in relation to the time that is spent on eating and drinking as the primary activity. He shows that the time spent on both is nearly equal, and that increasing wage rates imply increasing grazing.

NAYGA (2000) contributes to a better understanding of the role that education plays in the health production process. He finds that the effects of schooling on weight and risk of obesity are mediated by health knowledge that raises the allocative efficiency of health production. The study of VARIYAM et al. (1999) emphasises the potential endogeneity of health information variables assumed to impact productivity of health production. They reject the exogeneity of such variables statistically in most cases.

BEHRMAN and DEOLALIKAR (1988) and CHEN et al. (2002) contributed to structural issues related to household production of health. BEHRMAN and DEOLALIKAR present a comprehensive discussion of possibly endogenous and likely exogenous variables within a health production framework. CHEN et al. stress that variables collected in large-scale medical surveys like nutritional intakes are choice variables and, thus, endogenous. To receive unbiased estimates of their effect on health indicators, they should be instrumented by exogenous variables like prices of food and drugs.

2.3.3 Intertemporal choice

A growing number of authors examine the role that time preferences play in relation to the rise in obesity. The concept of time preferences refers to "decisions involving tradeoffs among costs and benefits occurring at different times" (FREDERICK et al., 2002, p.351). Intertemporal choice is not only important for questions such as how much money to save today to be able to spend it tomorrow but also for the trade-off between the benefits of eating today and the costs of overweight and lower health in the future.

The analysis of intertemporal choice in traditional economics is based on the discounted utility model by SAMUELSON (1937)[2]. The central parameter in this model is the discount rate

[2] FREDERICK et al. (2002, p.351) report that SAMUELSON had „manifest reservations about the normative and descriptive validity of the formulation", however, "the discounted utility model was accepted almost instantly".

that is considered to represent "all of the disparate motives underlying intertemporal choice" (FREDERICK et al., 2002, p.351). A discrete version of a person's intertemporal utility function is shown by equation (8):

$$(8) \qquad U^t(c_t,\ldots,c_T)=\sum_{k=0}^{T-t} D(k)\cdot u(c_{t+k}), \qquad \text{where} \quad D(k)=\left(\frac{1}{1+\rho}\right)^k.$$

Equation (8) can be interpreted as the utility a person derives from consumption at time *t+k* and *D(k)* as her discount function that shows how she weighs the utility gained in every period. The discount rate ρ "represents the individual's pure rate of time preference […] which is meant to reflect the collective effects of the 'psychological' motives" (FREDERICK et al., 2002, p.355) for the choice over time. Utility over a continuous time spectrum is expressed by equation (9):

$$(9) \qquad U^t(\{c_\tau\}_{\tau\in[t,T]})=\int_{\tau=t}^{T} e^{-\rho(\tau-t)}u(c_\tau).$$

The concept of intertemporal choice was adapted to the economics of health by GROSSMAN (1972) who analysed investments in health capital over an individual's life time. In his model, a households' utility function includes the commodity "health" which is produced by the households themselves.

The literature discusses several ways by which heterogeneous intertemporal choice behaviour has played a role in the rise of obesity. KOMLOS et al. (2004) argue for instance that individuals have become more impatient over time, i.e. *the rate of time preference* has increased. They propose a model where people's food consumption in each period provides immediate gratification whereas the benefits from investments in health affect utility in later periods. Hence, "as a population's rate of time preferences rises, so will expenditure on non-health-related consumption, whereas expenditure on health investments [including investments in a healthier weight] decreases" (ibid., p.212). To support their hypothesis, they provide some descriptive statistics relating obesity rates to saving rates over time and

across countries showing some correlations. However, the authors admit that this evidence based on “simple proxies” is not strong enough to establish causal relationships.

COURTEMANCHE et al. (2011, p.4) provide a short review of studies that do not support the hypothesis of a systematical change of time preferences in the course of time. ZHANG and RASHAD (2008) find a statistically significant relationship of BMI and time preference expressed by “willpower to lose weight”. However, their analysis is cross-sectional and the proxy that is used may be confounded with many other variables.

COURTEMANCHE et al. (2011) discuss a second way how time preferences could have influenced obesity prevalence. They take up the perception of lower food prices as a main driver of weight gain and augment it with the notion of a heterogeneous discount rate across the population. Since food prices affect the costs occurring in the present, those individuals with higher discount rates (i.e. for which the present has a relatively higher value) are expected to react more strongly to falling food prices and gain more weight. Such an effect could explain why especially the right tails of the BMI distribution have expanded overproportionally (see Section 2.2).

So far, these arguments do not contradict the neoclassical notion of rational reactions to changing economic incentives. The only difference is that people also shift consumption patterns over time. Many authors, however, claim that preferences over time are not fully consistent and preference relations change over time. Imagine a person thinking today about what to eat tomorrow. She may be not quite happy with her weight and decides to eat some salad, because she feels that she must do something for her health. When tomorrow then arrives and she actually has to choose what to eat, she may change her decision preferring a steak with French fries. Hence, her preferences of salad (“health”) over steak (“pleasure”) have changed, which is not consistent with the classical theory of discounted utility (FREDERICK et al., 2002). Such forms of behaviour where the discount rate depends on the time span between the evaluated event and the present are commonly termed “hyperbolic discounting” (LAIBSON, 1997, p.445).

CUTLER et al. (2003) argue that lower time costs of food preparation have an especially disastrous effect on people who show such hyperbolic discounting behaviour. While those persons derive immediate gratification from the consumption of food, the effects on health and body weight from eating too much will occur later. Reduced time costs of food

preparation affects those individuals the most who possess so called hyperbolic discount rates, i.e. those who have self-control problems and overrate immediate pleasure irrationally. This has important implications for welfare assessment. The welfare of rational consumers increases, when prices fall. However, for people with hyperbolic discounting, the welfare effect may be negative when the following relation holds true:

(10) $(\rho_S - \rho_H) \cdot \Delta W \cdot C_W > \Delta C_F$.

Here, ρ_S and ρ_H are the standard and hyperbolic discount rates, ΔW is the change in weight, C_W are the costs of weight and ΔC_F is the change in food costs (CUTLER et al., 2003). Equation (11) expresses the welfare effects in time units:

(11) $(\rho_S - \rho_H) \cdot T_{\Delta W} > T_{\Delta F}$,

where $T_{\Delta W}$ and $T_{\Delta F}$ are the time costs of losing the weight gained and the reduction in time costs of food preparation, respectively. If people act rationally, the first term becomes zero, the condition is not met and welfare increases (despite rising weights). Individuals with hyperbolic discount rates underestimate the weight change and its associated costs and put on more weight than rational persons would have done (CUTLER et al., 2003).

IKEDA et al. (2010) analyse the relationship between differences in time discounting and the BMI for a large Japanese household survey. Besides pure impatience (higher and lower discount rates), they also test for significant effects of hyperbolic discounting as well as for an asymmetric discounting behaviour (i.e. benefits are discounted more heavily than costs). Again, their data are cross-sectional and the analysis only explains the distribution at one point in time (if at all) and not the trends that have occurred. Moreover, discount rates stem from experiments using money values.

SCHARFF (2009) also examines hyperbolic discounting as a "possible reason for the *persistence*" of obesity. He highlights that certain situational influences (e.g. smoking colleagues at work who offer cigarettes or vending machines that sell donuts at work) may raise or lower the effective discount rate. Likewise, he argues (following CUTLER et al., 2003) that reductions in consumption time costs have "increased the effective discount rate of time preference used in food consumption decisions by hyperbolic agents" (p.8)[3]. SCHARFF

[3] One should be careful with the notion that the rate of time preference has increased, see also FREDERICK et al. (2002) for the issue of mixing up time preference, discount rate, discount factors etc.

also runs cross-sectional regressions of proxy variables on calorie intake stratified by body weight and gender and finds "that obese dieters display behaviour consistent with hyperbolic discounting". However, the proxies do not seem to really express the pure time preference. COURTEMANCHE et al. (2011) examine hyperbolic discounting, too. Their results suggest that obesity levels are partly due to rational intertemporal tradeoffs but also partly to time inconsistency.

RICHARDS and HAMILTON (2012) collect data on individual discount schedules for different amounts of money in an experimental setting. They conduct econometric tests for time-consistent behaviour of their respondents and for heterogeneous behaviour with respect to patterns of risky behaviour. Their results indicate "that discount functions are quasi-hyperbolic in shape, and that obesity and drinking are positively related to the discount rate" (p.181).

ETILÉ (2011) concludes that individuals who show hyperbolic discounting "do not receive in the long run the utility they would have received if they were to have been consistent" (p.729). Hence, the presence of hyperbolic discounting is said to justify interventions that help people overcome their self-control problems (BRUNELLO et al., 2009; SASSI, 2010; ETILÉ, 2011). One means to do so is a "sin tax" suggested by O'DONOGHUE and RABIN (2006). However, ETILÉ also warns to be "cautious, however, in labeling behaviors as 'irrational'" (p.728) and states that "absent good measures of time preferences in a large-scale food survey, hyperbolic discounting models are not yet testable." Also CUTLER and GLAESER (2005) argue that time preferences provide no consistent explanation for health behaviour. Time inconsistent behaviour as a rationale for policy interventions is also discussed in Section 2.4.3.

2.3.4 Rational addiction

Another branch of the literature utilises the "rational addiction approach" by BECKER and MURPHY (1988) to explain why persons stick to harmful behaviours like overeating or alcohol and drug abuse over time. BECKER and MURPHY claim that an addiction can be the result of "a consistent plan to maximize utility over time" (p.675). Central to their model is the concept of "consumption capital" S which can be regarded as a capital stock built by past consumption of the addictive good. This addictive stock affects utility directly as well as indirectly by altering the marginal utility derived from the addictive good's current consumption C.

The indirect property ($\partial^2 U/(\partial C \cdot \partial S) > 0$) implies under certain conditions a so called "adjacent complementarity" between consumption levels at different points in time. Adjacent complementarity entails *reinforcement*, which means increasing current consumption of the addictive good increases future consumption of it (BECKER and MURPHY, 1988).

The stock's direct effect on utility is related to the aspect of *tolerance* which is often observed for harmful addictions. Here, "the marginal utility of the addictive stock is negative [$\partial U/\partial S < 0$]" (CHALOUPKA and WARNER, 2000). Tolerance implies for harmful addictions that "higher past consumption lowers the present utility from the same consumption level" (BECKER and MURPHY, 1988, p.682). For beneficial addictions (to music, sports etc.), tolerance occurs when $\partial U/\partial S > 0$ (CAWLEY and RUHM, 2011).

The difference to traditional models of habit formation is that BECKER and MURPHY allow for forward-looking agents that maximise their lifetime utility (CAWLEY and RUHM, 2011). CAWLEY and RUHM point out that rational addicts might freely choose to become addicts because they have a high adjacent complementarity.

BECKER and MURPHY link their theory to overeating and obesity themselves. They point out that "people get addicted not only to alcohol, cocaine, and cigarettes but also to work, eating, music, television, news…" (pp.675) and later on also claim that their theory can explain binge eating and cycles of overeating and dieting. Also CAWLEY (1999) argues that people can get addicted to calories from food resulting in obesity.

Some empirical applications can be found in literature. RICHARDS et al. (2007) test whether rational addiction applies to consumption of macronutrients (fat, proteins, and carbohydrates) from snack foods and find "broad support for the rational addiction hypothesis" (p.322) with an especially "strong addiction to carbohydrates" (p.309). MILJKOVIC et al. (2008) examine whether rational addiction to sugar is a possible cause of rising obesity rates. They find that an "increase in future sweet prices leads to increased sugar consumption at [the] current period by overweight and obese people" (p.59) which contradicts the predictions of the rational addicts hypothesis. Only the results for normal-weight people are in line with rational addiction behaviour. LIU and LOPEZ (2012) apply the rational addiction model to carbonated soft drinks and find "strong evidence" for a rational

addiction based on significant effects from past and future consumption on current consumption.

2.3.5 Behavioural economics

The concepts of neoclassics and household production theory as outlined in Sections 2.3.1 and 2.3.2 assume that individuals always behave rationally and are fully aware of any factors that influence their decision processes. However, experimental studies from psychology and behavioural economics have shown that people often deviate from the behaviours we would expect from standard economic agents and make "choices that are demonstrably suboptimal" (JUST, 2011, p.99).

Several authors have pointed out such deviations from rational behaviour also occurring in the context of food consumption and obesity. A first aspect outlined is different *modes of decision making* where heuristics or simple rules are applied rather than complex, well-calculated optimisation processes. A second focus is on the *influence of situational factors* that affect the mode of decision making, the value of a decision's outcome as well as the monitoring of achieving the objective (WANSINK et al., 2009; JUST, 2011). The basic ideas will be briefly sketched on the following pages which are mainly based on JUST (2011) and WANSINK (2004) who provide more detailed reviews of behavioural (economics) aspects of food consumption.

Decision mode

The amount of cognitive resources available to a person at the moment he or she is making a decision is crucial for what that person's decision process looks like. In his Cognitive-Experiential Self Theory (CEST), EPSTEIN (1993) argues that people switch between modes of decision depending on those cognitive resources. When sufficient resources and time are available to individuals they evaluate stimuli via cognitive processes characterised by deliberative and rational thinking. Otherwise, people rely on an experiential system leading to faster decisions based on affect or emotion (JUST, 2011). Hence, individuals who are exposed to stress or face a number of other decisions at the same time are likely to show more impulsive behaviour. Then, their food decisions are not in accordance with their long-term objectives (e.g. concerning weight or health).

A second framework by LOEWENSTEIN (2004) highlights the impact of visceral factors like hunger or nervousness on time-inconsistent behaviour. While CEST assumes that people switch between modes of decision making, the visceral factors approach throughout regards humans as thinking rationally. However, the stronger the influence of visceral factors like hunger or thirst, the higher the utility that individuals get from the consumption of certain foods (JUST et al., 2007). Two propositions of LOEWENSTEIN's framework seem especially vicious. On the one hand, "people underestimate the effect of visceral factors on their own behavior", on the other hand, they "will forget the effect visceral factors played" after some time (JUST, 2011, p.105).

Also *prospect theory* (KAHNEMAN and TVERSKY, 1979) and *mental accounting* (THALER, 1980) have been used to explain food consumption decisions. These theories consider the findings that people relate their possible outcomes to a reference point and show a larger disutility from losses than utility from (equal-value) gains related to that reference point. Food marketers or policy makers could alter consumption behaviour by setting appropriate default options (JUST, 2011). However, defaults may be more or less successful as is shown by JUST and PRICE (2013). They examine the effect on consumption in cases where the standard offer of school lunches included vegetables and also in cases where not. Results indicated that "requiring a fruit or vegetable as part of the school lunch may increase waste substantially while only modestly increasing consumption of fruits and vegetables" (ibid., p.7).

JUST and WANSINK (2011) provide evidence that the behaviour of individuals in flat-rate price service contexts, also known as 'all-you-can-eat', is strongly related to the concept of *transaction utility* (i.e. "making a good deal"). The authors found that people who were randomly assigned to pay a higher price for the buffet consumed 38.6 % more pizza than those who had to pay lower prices. As the costs for eating are fixed and paid in advance, people should stop eating in both settings when their marginal utility of consumption is zero. However, the group with higher prices seemed to eat more to get their money's worth, as long as a positive 'transaction utility' from lowering the average cost per slice of pizza exceeds the negative utility from overeating and feeling full and uncomfortable. This kind of behaviour seems to suffer from the well-known *sunk cost fallacy* (JUST and WANSINK, 2011).[4]

[4] Interestingly, this kind of behaviour has already been described by the old Franconian saying: "Lieber'n Bauch verrenkt, als 'em Wirt was g'schenkt".

A further result of this study was that the quality of the food provided had an influence in flat-rate settings. When less tasty pizza was served, consumption increased, i.e. people ate more to justify the fixed price.

Impact of eating and food environment

When individuals switch between more cognitive and more affective or emotional modes of decision making, heuristics and reference points are of great importance. Then, environmental factors can considerably affect food choices. WANSINK and SOBAL (2007) argue that external factors can trigger in overserving and overeating when influencing *consumption norms* (i.e. what people think is the right amount to eat) and *consumption monitoring* (i.e. "how much they believe they eat" (ibid., p.109)). Typically, people are not aware that they are influenced in such ways, even when they are told (JUST, 2011). Environmental influences on food intakes can be categorised into the *eating environment* (e.g. atmosphere, lightning, effort to obtain the food, social interactions, secondary activities like TV and reading, other distractions) and the *food environment* (e.g. salience, structure, package or portion size, way of serving) (WANSINK and SOBAL, 2007; JUST, 2011).

Critics of the psychological or behavioural economical approach observe that the findings derived from controlled experiments in a closed setting may not be externally valid. MAZZOCCHI et al. (2009) address the example of increased portion sizes which are claimed to set higher reference points and lead to overeating (YOUNG and NESTLE, 2002). However, CUTLER et al. (2003) report a decrease in *average* calorie intake per meal that contradicts the small-scale findings on the macro level. Other findings from behavioural economics, though, might be better in line with the observational data. For instance, CUTLER et al. (2003) found that increased snacking is mainly responsible for larger calorie intakes. This would fit with the theory that the ubiquitous viewing of delicious food triggers impulsive eating behaviour. ANDERSON and MATSA (2011) analysed how the distance to fast-food outlets affects the BMI based on large-scale survey data. Controlling for possible reverse causality by using proximity to interstate highways as instrument, they found no significant effect on body weight.

2.4 Cases for policy interventions

The negative consequences of obesity for individuals and society have raised calls for political interventions to halt and reverse the rise in obesity (e.g. WHO, 2004; BROWNELL and FRIEDEN, 2009; POPKIN, 2009). Economists writing on this issue are mostly reluctant to support such measures without reservation even when they reduce obesity significantly. In the absence of market failures, most economists are convinced that the behaviour of rational and informed individuals acting on free markets maximises individual utility as well as social welfare (CAWLEY, 2011). Governments should not become active until a market failure is identified (CASH and LACANILAO, 2007). Even a high prevalence of obesity and its doubtlessly severe monetary and psychological consequences are not sufficient in their own right to justify interventions (KUCHLER and GOLAN, 2004).

As seen in Sections 2.3.1 and 2.3.2, the neoclassical and household production models of consumer behaviour explicitly include the possibility that a high proportion of overweight and obese people exists within a population. Rational and informed agents weigh the immediate as well as all future benefits and costs of their actions to reach the maximum achievable utility. “In such a setup, food-related chronic diseases are only private health problems and, a priori, the market will be efficient at supplying health inputs, be they junk foods or diets” (ETILÉ, 2011, p.727). Hence, when no market failures exist, any intervention by governments would draw the market result away from the socially optimal equilibrium.

However, if there is a market failure, “the equilibrium prices and quantities do not capture the total social costs and benefits” (MAZZOCCHI et al., 2009) and the government can improve the outcome. To be feasible, though, any intervention needs to pass a second criterion: Its benefits have to outweigh its costs (CASH and LACANILAO, 2007). Thereby, the success of political interventions is not evaluated according to the reduction of obesity, but “by how well they fix the market failure they were designed to repair” (CAWLEY, 2011, p.133).

The economic literature concerned with obesity has identified some possible causes of market failure which will be reviewed and discussed in the following.

2.4.1 Externalities

A market failure often referred to in the context of obesity is the existence of *externalities*. Externalities occur when economic agents do not include the full costs or benefits of their

actions into their decisions and deviate from the behaviour they would have shown had they taken all consequences into account. Inefficiencies in the allocation of resources and suboptimal social welfare will be the result (BRUNELLO et al., 2009; MAZZOCCHI et al., 2009). In particular, literature pays attention to two possible external effects, one related to health insurance and the other to labour markets (SASSI, 2010).

Central to the case of insurances are the medical costs that obesity and its co-morbidities impose on health care systems. The literature that attempts to estimate the costs of obesity for health care systems as well society in total has grown steadily over the last one and a half decades. Recent reviews of studies are provided by MÜLLER-RIEMENSCHNEIDER et al. (2008), VON LENGERKE and KRAUTH (2011), and WITHROW and ALTER (2011).

MÜLLER-RIEMENSCHNEIDER et al. (2008) conclude that "obesity appears to be responsible for a substantial economic burden in many European countries" (p.499) that ranges from 0.09-0.61 % of the respective countries' gross domestic product. WITHROW and ALTER's (2011) review of English language articles finds estimated shares of obesity in a country's total healthcare expenditures of 0.7-2.8 %. The authors report further that the relationship between the degree of obesity and health costs is non-linear with morbidly obese people (BMI ≥ 40 kg/m²) causing particularly high costs. For the case of Germany, VON LENGERKE et al. (2006) found that severely obese persons of classes II and III (BMI > 35) induce average annual costs of 2,572 €. These numbers are significantly higher than those for normal-weight (847 €), overweight (830 €) and moderately obese persons of class I (30 ≤ BMI < 35) with 1,080 €.

VON LENGERKE and KRAUTH (2011) stress that costs of obesity differ among groups of various socio-economic and demographic characteristics. Their review also includes one study that takes a lifetime approach and finds lower lifetime costs of obese people due to lower life expectancy and lesser need for long-term care (RAPPANGE et al., 2009). All reviews note the considerable heterogeneity in the methodology to estimate the costs of obesity and call for increased standardisation to improve the comparability across studies and countries.

Table 3 summarises important results for selected studies on the annual total and direct costs of obesity. The term "direct costs" refers to the treatment of obesity and its attributable shares of associated co-morbidities like type-II diabetes, cardiovascular diseases arthrosis, cancer, hypertension, and psychosocial complications. Direct costs estimates

typically include costs of hospitalisation and surgical interventions, medication, and visits to doctors. Total costs are the sum of direct costs and indirect costs. Indirect costs account for losses in value added caused by absence from work, morbidity and premature mortality (see e.g. KNOLL, 2010).

Table 3: Estimates of annual total and direct costs of obesity for different countries.

Authors	Country	Year	Cost estimates	Share in Health Care Expenditures
KATZMARZYK and JANSSEN (2004)	Canada	2001	4.3 bn $ (total costs) 1.6 bn $ (direct costs)	2.2 % of total health care costs
EMERY et al. (2007)	France	2002	2.1-6.2 bn € (total)	1.5-4.6 % of total health care costs
KNOLL (2010)	Germany	2003/04	12.8-13.0 bn € (total) 11.4 bn € (direct)	n/a
SANDER and BERGEMANN (2003)	Germany	2001	2.7-5.7 bn € (total) 1.3-2.7 bn € (direct)	0.6-1.2 % of total health care costs
MCCORMICK, STONE and CAT (2007)	England	2002	3.3-3.7 bn £ (total) 0.9-1.1 bn £ (direct)	2.3-2.6 % of total health care costs
WOLF and COLDITZ (1998)	USA	1995	99.2 bn $ (total) 51.6 bn $ (direct)	5.7 % of total health care costs
FINKELSTEIN et al. (2003)	USA	1998	78.5 bn $ (total)	6.5 % of total health care costs
FINKELSTEIN et al. (2009)	USA	2008	147 bn $ (total)	9.1 % of total health care costs

***Source*: Own composition.**

Most health care systems in developed countries are publicly funded and do not require the premium a person pays to be differentiated according to her weight. In a case of differing risks and corresponding costs in the population but equal premiums for individuals, a "positive subsidy for some individuals and a negative subsidy for others" emerges (BRUNELLO et al., 2009, p.572). However, the existence of such an insurance subsidy is only a necessary condition. Only when the subsidy induces a change in behaviour, i.e. there is a so- called *ex ante* moral hazard problem, is it suitable to speak of an insurance externality (BRUNELLO et al., 2009; ETILÉ, 2011). BRUNELLO et al. (2009) describe a scenario where body weight is determined during childhood and remains more or less fix during adulthood. Here, the characteristics of the health care systems would have no influence on efficiency but rather on equity.

The empirical evidence indicates that a possible health externality is rather small. BHATTACHARYA and SOOD (2007) also emphasise that both the subsidy to obese individuals *and* the sensitivity of body weight to this subsidy are relevant for the size of the welfare loss in the case of pooled insurance. They "estimate that the welfare loss due to the obesity externality in the US is about $ 150 per capita (in 1998 dollars)" and stress that "this estimate [..] is much smaller than the difference in medical expenditures between the obese and non-obese that is typically found in the literature" (p.281). Likewise, BRUNELLO et al. (2009) conclude that the obesity externality is likely to be small. However, their assessment is based on a simple comparison between the US and Europe with a lower degree of pooling but higher obesity rates in the former against a higher degree of pooling but lower obesity rates in the latter.

Apart from examining whether there actually is an insurance externality many authors discuss the question of the adequate policy reaction. "The generally accepted rule for achieving an optimal social outcome in the face of negative externality is to tax the damaging activity at a rate equal to the marginal external cost at the optimal level of provision" (CASH and LACANILAO, 2007, p.175). However, there is much controversy about the appropriate tax. Taxing unhealthy foods would be questionable, because of the difficulties to determine the marginal damage of one unit of "unhealthy" food, which may be zero for many consumers (CASH and LACANILAO, 2007). Other suggestions like taxing body weight (or adjusting insurance premiums according to weight) (ETILÉ, 2011) or taxing overall dietary composition (CASH and LACANILAO, 2007) would be similarly questionable. Such scenarios would disregard the fact that the impact of the BMI on health can be very heterogeneous and also the effect of physical activity that plays a great role in determining health would not be considered.

A second branch of possible externalities of obesity is concerned with possible negative effects of a high BMI on employment, wages or schooling outcomes. ETILÉ (2011) emphasises that the empirical evidence on such relationships "may not reflect a causal effect" (p.725). Other factors (genetic and non-genetic) are most likely to affect labour market outcomes and obesity at the same time.

To sum up, externalities with respect to the health system may exist to a certain degree. However, their magnitude is most likely considerably lower than portrayed in the public discussion and the media. Another question in this respect is whether rising medical costs of

obesity result from growing obesity prevalence or from the use of increasingly costly therapies to treat obesity and its related diseases.

2.4.2 Lack of information

Another market imperfection possibly arises from *insufficiently informed consumers*. The assumption of the standard model on buyers that "understand all their options and they understand the consequences of their actions" (MAZZOCCHI et al., 2009, p.68) may then no longer hold. The literature discusses four areas where individuals possibly lack information: 1) people are not aware of the health consequences that emerge from obesity, 2) it is unclear how lifestyles (eating and physical activity) affect body weight, 3) information on the characteristics of purchased foods such as calorie content and other ingredients is lacking, 4) the subjective perception of the healthiness of one's own weight differs from objective medical classifications (MAZZOCCHI et al., 2009; BRUNELLO et al., 2009).

The existence and the degree of these information problems are highly controversial. SASSI (2010) notes that "many would argue that most individuals today possess the basic knowledge required for them to broadly discriminate between more and less healthy options" (p.125). Also KUCHLER and GOLAN (2004) find it "difficult to believe that many Americans are not conscious of the relationship between a healthful diet and obesity" (p.42). They support their argument by referring to the omnipresence of diet and health topics in the media, government information programs, nutrition labels, and product health claims. Empirical evidence is provided by BRUNELLO et al. (2009) based on data from the EUROBAROMETER survey. They find that in most European countries more than 80 % of the population knows that high body weight may have a deteriorating effect on health. Moreover, they find little evidence in favour of the argument that the information that reaches consumers is "fragmented or even conflicting" (CASH and LACANILAO, 2007, p.175). On average, less than 9 % of European adults feel that they lack information to follow a healthy diet (BRUNELLO et al., 2009).

VARIYAM and BLAYLOCK (1998) report that the majority of US citizens have basic nutrition knowledge. VARIYAM (2008) examines how the introduction of the Nutrition Labeling and Education Act (NLEA) in 1990 affected nutritional behaviour in the US. He finds an increasing effect on iron and fibre intakes but no changes in total fat, saturated fatty acids and cholesterol intakes. VARIYAM and CAWLEY (2006) present estimates that suggest a decreasing

effect of the NLEA on obesity among white females by 2.36 %. There is some evidence that people fail to correctly evaluate their body weight as healthy or unhealthy (BRUNELLO et al., 2009). Moreover, KUCHLER and VARIYAM (2002) emphasise that information on food sold at restaurants and fast-food outlets may be insufficient. They call for targeted information to population subgroups that also takes into account the perceptions of people about their own weight status. SEIDERS and PETTY (2004) provide a more detailed overview of many points of criticism regarding marketing and information practices for food.

MAZZOCCHI et al. (2009) point out that "suppliers of healthy foods have incentives to provide verifiable information on the positive characteristics of their products" (p.71). The means of signalling healthy attributes enables them to differentiate their products.

2.4.3 Irrational behavior

A third important rationale for governments to intervene is *lack of rationality* in human beings. There are some areas where economists assume that individuals do not act fully rationally, such as in the presence of inconsistent time preferences or susceptibility to environmental cues. ETILÉ (2011) deems it "wise to be cautious, however, in labeling behaviors as 'irrational'" (p.728) and CAWLEY (2011) points out that "irrationality is in the eye of the beholder" (p.132).

Some authors like CAWLEY (2011) advance the view that "society may trust adults to accurately weigh the costs and benefits of a high-calorie diet or a sedentary lifestyle" (p.132). Paternalistic interventions may be justified though in the case of children who are "unable to take into account the future consequences of their actions" (CAWLEY, 2004, p.122).

However, many authors also regard time-inconsistent behaviour as an argument in favour of political intervention since "people overeat, despite substantial evidence that they want to lose weight" (CUTLER et al., 2003, p.112). Empirical support to this view is given by BRUNELLO et al. (2009) who find that a high proportion of adolescents fail in their attempts to lose weight. The economic theory behind time-inconsistency assumes quasi-hyperbolic discounting as the causal factor behind such behaviour. In that case, discount rates for events are lower, the further they are in the future (see Section 2.3.3). "People who suffer from lack of self-control do not make a rational choice which maximizes their overall lifetime welfare" and "their utility can be increased by their not being allowed to indulge in short-

sighted behavior" (MAZZOCCHI et al., 2009, p.65). O'DONOGHUE and RABIN (2006) show that "sin taxes" may support people to stick to their long-term plans. Moreover, if individuals suffer from physical or psychological addiction, there clearly is a role for government (MAZZOCCHI et al., 2009).

Another area where non-rational behaviour is assumed is the case of environmental cues like the view or smell of tasty food that "trigger uncontrollable shifts in preferences" (ETILÉ, 2011, p.730). Hence, "cue-based strategies that firms use to encourage consumers' purchases have negative externalities: They lead to overconsumption and favour addiction" (ibid., p.730).

GLAESER (2006) perceives policies aimed at self-control problems as questionable because "paternalistic interventions always involve trading off the welfare of people at one point in time with people at some other point in time, and this requires tricky social welfare decisions. Second, the first-best response to self-control problems is always to increase the availability of technologies or contracts that facilitate private self control, which cannot really be called paternalism because these policies increase, rather than decrease, the choice set" (p.136).

2.4.4 Other welfare considerations

In addition to the three classical rationales described above, the literature discusses further reasons for government intervention such as opposition to the food industry and equity issues.

KUCHLER and GOLAN (2004) raise the question whether "producers are not responsive to consumer demand and do not supply the types of food desired by consumers" (p.41). They doubt, however, that "a business strategy that disregards consumer preferences could succeed for long" and conclude that the "wide variety of food products on grocery store shelves reflects the willingness and ability of the industry to adapt to consumer preferences" (p.41). They list multiple examples like the provision of 'low-carb' or 'low-fat' products, the existence of over 40.000 food products available and the multiple outlets that provide almost any food type one could think of. Also CAWLEY (2004) claims that it is the natural objective of the food industry to produce and sell "the goods or services that yield the highest profit. […] To the extent that consumers want to be more physically active, eat

healthier foods, and weigh less, private industry has a profit incentive to help them do it" (p.123).

Based on the observation that obesity is more prevalent among groups of lower socioeconomic status, many authors see "a strong basis for intervention on equity grounds" (BRUNELLO et al., 2009, p.552). Obesity is associated with unemployment, low income, poor education or social isolation and "it is of particular concern to some governments that disadvantaged socioeconomic groups and ethnic minorities appear to take up less healthy lifestyles in increasing proportions, and they appear to be less responsive than other groups to interventions aimed at improving lifestyles" (SASSI, 2010, p.155). Whether socioeconomic status affects BMI or vice versa or whether both are simultaneously affected by underlying factors is difficult to determine (BRUNELLO et al., 2009; ETILÉ, 2011). With regard to socioeconomic differences, obesity would be one objective that would be tackled together with many others by a general policy that would enhance the opportunities of disadvantaged social groups. Specific inequities pointed out by CAWLEY (2004) are the existence of food deserts (grocery stores in African-American neighbourhoods sell less low-fat products or fruits and vegetables) or the lack of safe environments for physical activities in poor inner city neighbourhoods compared to wealthier suburbs. Further concerns related to equity issues are possible regressive effects of fiscal measures to reduce obesity rates (ETILÉ, 2011). These will be discussed in Section 2.5.

2.5 Potential of fiscal measures to reduce obesity

While Section 2.4 deals with the question whether governments *should* intervene to reduce obesity, the present section discusses whether they actually *can* do something about it. Thereby, a clear focus lies on fiscal measures to alter relative market prices, since most of the other papers in this dissertation are concerned with price issues.

The initial proposal of price measures came from public health experts. Taxes on energy-rich foods or foods high in fat or sugar were supposed to reduce consumption of more "unhealthy" food items while subsidies on fruits and vegetables, for instance, would favour higher intakes of more "healthy" produce (BROWNELL, 1994; BATTLE and BROWNELL, 1997). However, only very high taxes could possibly reach such outcomes what lead some authors to doubt their political "feasibility and desirability" (JACOBSON and BROWNELL, 2000, p.854). Therefore, small taxes that do not necessarily change consumption behaviour but generate

substantial revenues were regarded as an alternative. For example, JACOBSON and BROWNELL (2000, p.857) "suggest that public health professionals consider recommending snack taxes [on soft drinks, candy, gum, and snack foods] as a means of funding healthy eating and physical activity programs". According to their estimates, a national tax in the US of 1 cent per 12 ounces of soft drink would generate $ 1.5 billion per year.

The early debate on food taxes naturally drew the attention of (agricultural) economists and initiated an ever growing number of studies that investigated the relationship between food prices, consumption patterns, and body weight as well as possible outcomes of fiscal measures to promote healthier lifestyles.

2.5.1 Empirical evidence

There are already several reviews of empirical studies that assess relations between food prices and obesity and their implications for taxes and subsidies (POWELL and CHALOUPKA, 2009; POWELL et al., 2013; FAULKNER et al., 2011; POWELL and CHRIQUI, 2011; ANDREYEVA et al., 2010; THOW et al., 2010). Thus, the plan here is not to provide another review but present the essence of the research results. This leaves room to put more emphasis on methodological issues and policy implications.

2.5.1.1 Price-BMI relationships

One stream of the literature analyses reduced-form relationships between prices of selected food products and BMI and, respectively, the probability of being obese. POWELL et al. (2013) conclude that "overall, the evidence on the extent to which changes in food and beverage prices may significantly impact weight outcomes remains mixed" (p.122). Although some studies find significant price effects on body weight, the received elasticities are mostly smaller than 0.1 in absolute values.

The study of CHOU et al. (2004) finds an elasticity of BMI with respect to prices in fast-food restaurants of -0.05 and to food-at-home prices of -0.04. Moreover, they find that the prevalence of obesity falls by 0.6-0.7 percentage points when (any) food prices rise by 10 %. POWELL (2009) finds a similar fast-food price elasticity of BMI of -0.08 for adolescents. POWELL and BAO (2009) report price-weight elasticities for adolescents for fruit and vegetable prices of 0.07 (total population) and 0.14 (low-income households) as well as for fast-food prices of -0.26 (but only for low-income households). Estimations by subgroups suggest significantly

higher elasticities of -0.31 for teenage children in middle-income households. Results of STURM and DATAR (2005; 2008) indicate that a difference of one standard deviation in prices for fruits and vegetables between two areas would cause a 0.11 points higher BMI in children by the third grade and a 0.2 points higher BMI by the fifth grade. HAN and POWELL (2011) found no significant effect of food prices on the prevalence of obesity among young women. They do report a significantly negative effect of fast-food prices on obesity for young men in a random-effects model that could not be confirmed, however, in a fixed-effects specification. HAN et al. (2012) found some unexpected positive coefficients of fast-food prices with respect to weight.

FLETCHER et al. (2010a; 2010b) analyse the effects of state-level soft drink taxes on BMI and find statistically significant coefficients. Their magnitude is however small: Increasing the tax rate by one percentage point lowers the BMI by 0.003 kg/m² and decreases the prevalence of obesity and overweight by 0.01 and 0.02 percentage points, respectively. SCHROETER and LUSK (2008) report a positive elasticity of food-at-home prices with respect to weight of 0.1, indicating that a decrease in the price of food at home would also decrease weight. However, the food-at-home-price elasticity with respect to BMI is negative, which is inconsistent. The conclusion that can be drawn from those studies is that there may be significant effects of food prices on BMI. Of course, this is what one would expect, when acknowledging that prices have an impact on food consumption and food consumption, in turn, has an impact on body weight. However, the magnitude of the price effect on weight is very small due to many other variables and substitutive relationships.

2.5.1.2 Demand systems

According to ETILÉ (2011), studies that just examine price-weight outcomes "cannot, however, inform the construction of price policies because they do not consider the whole pattern of substitution between products" (p.731). One could argue, of course, that all those substitution processes finally culminate in body weight. Hence, such analyses *can* inform policy makers to a certain degree. What they cannot achieve, however, is to provide a picture of the expectable consumption patterns after a policy change and their impact on budgets and nutrient patterns that have important implications for welfare and health aspects. To answer such questions, demand-system analyses are the preferable means

because they give explicit information on own- and cross-price effects and substitutive relationships (ETILÉ, 2011).

Studies that examine effects of food taxes and subsidies via demand systems indeed reveal important insights into possible shifts regarding nutrient intakes. ALLAIS et al. (2009) estimate a complete demand system using scanner data for French households. Based on the resulting price elasticities they compute nutrient elasticities to assess the effect of price changes on nutrient intakes. They simulate higher value-added-taxes on cheese/butter/cream, sugar-fat-products, and/or prepared meals and conclude that "a fat-tax policy is unsuitable for substantially affecting the nutrients purchased by French households and leads to ambiguous effects" (p.243) such as lower intakes of important nutrients as several vitamins and minerals nutrients (ALLAIS et al., 2009). A further result is that such a fat tax would generate substantial revenues, but is also highly regressive.

CHOUINARD et al. (2007) examine likely effects of taxing the percentage of fat in food items and estimate a demand system for dairy products. They find that a 10 %-tax on fat content would reduce fat consumption by less than 1 %. The estimates of CHOUINARD et al. mark such a fat tax as extremely regressive with higher welfare losses for elderly and poor people.

NORDSTRÖM and THUNSTRÖM (2011) analyse the effects of targeted food taxes and subsidies "aimed at redirecting grain consumption to healthier levels" (p.267). Based on previous demand-system results they simulate revenue-neutral policy reforms for several population subgroups. Results indicate that, regarding tax payments, such reforms are progressive. The authors point out, however, that policies directed at other food groups may have different welfare effects. With respect to health effects, the authors find that it is the highest income group that benefits the most from the proposed reforms by increasing their fibre consumption by 38 %. At the same time, "the increase in fibre intake is accompanied by substantial increases in the intake of the unhealthy nutrients, though, making the net health effects difficult to evaluate" (p.9). This example mirrors an often pronounced view that policies aimed at altering the consumption of one target nutrient (e.g. saturated fats) or energy may have negative effects on intakes of other nutrients.

KUCHLER et al. (2005) estimate single demand equations for snack foods like chips and other salty snacks to assess likely effects of a tax on these food items. Their estimates suggest that taxes would have only minor effects on dietary quality but would generate large revenues.

In the course of the debate about food taxes, many researchers especially in the US identified soft drinks as a promising target for taxes. They are perceived as the single largest contributor to energy intake with low nutritional value (BROWNELL et al., 2009). Literature reports quite high own-price elasticities of around 0.8-1.0 in absolute values that promise substantial reductions in consumption when taxes raise prices (ANDREYEVA et al., 2010). However, other studies point out that possible shifts to energy-rich substitutes compensate for the decrease in soft-drink consumptions. FLETCHER et al. (2010b) show that there are possible counterintuitive effects of sin taxes on sugar-sweetened beverages. Analysing the effects of soft-drink taxes on child and adolescent soft drink consumption, they find that "moderate reductions in soft drink consumption from current soda tax rates" are "completely offset by increases in calories from other beverages" (p.968) mainly whole milk.[5] FLETCHER (2011) adds that although soda taxation may not be able to achieve its primary goal, i.e. reduction of obesity, it can have positive side effects on health through more nutritious substitutes. Juices and milk, for instance, contain comparable levels of energy but are in addition sources of valuable vitamins and minerals.

SMITH et al. (2010) employ household scanner data to estimate a demand system for eight beverage categories. The received elasticities were applied to actual individual intake data to simulate energy-intake and body-weight effects of a tax on sugar-sweetened beverages (SSB). They found that a 20 % tax on SSB would reduce net daily energy intake from all beverages by 37 kcal for adults and 43 kcal for children. Translated into body weight these changes would result in a loss of 3.8 pounds and 4.5 pounds, respectively. The authors conclude that there is a certain potential of taxes on SSB to reduce the prevalence of obesity and overweight in the US. However, they also point out that much of the effect depends on the reactions of manufacturers and retailers and how much they allow the tax to be fully passed forward to consumers. From a methodological point of view the elasticities received from household scanner data should be treated with care. Since beverages often are subject to price promotions, received elasticities are likely to mirror short-term purchasing behaviour and, thus, are higher in absolute values than long-term elasticities.

[5] The large effect of whole milk is quite surprising at first. However, these results were obtained for a sample of children and adolescents, where substitution of soft drinks by milk is surely more likely than in the case of adults.

POWELL et al. (2013) provide a compilation of estimated own-price elasticities from studies that are related to food taxes to reduce obesity (see Table 4). Although the mean values are quite high, especially for beverages, the size of the estimated coefficients varies strongly.

Table 4: Mean estimates of own-price elasticities of demand for selected beverages, fast food, and fruits and vegetables, 2007-2012

Food and beverage category	Mean price elasticity estimate	Range	No. of estimates
(a) Sugar-sweetened beverages (SSBs and soft drink beverages)			
SSBs overall	-1.21	-0.71 to -3-87	12
SSBs	-1.08	-0.87 to -1.26	3
Regular carbonated soft drinks	-1.25	-0.71 to -2.26	4
Sports drinks	-2.44	-1.01 to -3.87	2
Fruit drinks	-1.41	-0.69 to -1.91	3
Soft drinks	-0.86	-0.41 to -1.86	4
(b) Fast food			
Fast food	-0.52	-0.47 to -0.57	2
(c) Fruits and vegetables			
Fruits	-0.49	-0.26 to -0.81	4
Vegetables	-0.48	-0.26 to -0.72	4

***Source*: POWELL et al. (2013, p.117).**

2.5.1.3 The role of substitution effects

SCHROETER et al. (2008) provide a detailed discussion of substitution effects that can occur when certain food items are taxed. They derive theoretical conditions that have to be fulfilled, when a tax or a subsidy should have a weight-reducing effect. Starting from a simple utility function that includes weight W, a high-calorie food product F^H, a low-calorie food product F^L, physical exercise E, and other consumption goods, where weight depends on F^H, F^L, and E, they arrive at equation (12):

$$(12) \qquad \frac{\varepsilon_{WF^L}}{\varepsilon_{WF^H}} \cdot \varepsilon_{F^L p^H} < \left| \varepsilon_{F^H p^H} \right| .$$

Equation (12) needs to be fulfilled when a tax should reduce body weight. ε_{WF^H} and ε_{WF^L} are the elasticities of weight W with respect to the intakes of F^H and F^L, respectively, $\varepsilon_{F^L p^H}$ is the cross-price elasticity of F^L with respect to the price of F^H and $\varepsilon_{F^H p^H}$ is the own-price elasticity

of F^H. The ratio of the weight elasticities is by definition smaller than one. SCHROETER et al. (2008) now discuss the relationships between those products: When F^L and F^H are complements, the cross-price elasticity is smaller than one and weight will decrease. When F^L and F^H are substitutes the outcome is less clear and depends on the relative energy content of the two food items. The condition in eq. (12) holds, when the energy content of F^H substantially exceeds that of FL and $\varepsilon_{WF^L} / \varepsilon_{WF^H}$ reaches zero. However, when both food products have quite similar energy contents, the ratio approaches unity. Additionally, when $\varepsilon_{F^L p^H} > \left| \varepsilon_{F^H p^H} \right|$, eq. (12) is no longer fulfilled and weight will increase. Analogous conditions can be derived for income, exercise and for the case of multiple products.

Using food-price elasticities from literature and calculating food-weight elasticities via energy accounting, SCHROETER et al. (2008) simulate different tax scenarios. They find a weight-reducing effect of soft-drink taxes, a smaller weight-decreasing effect of subsidies on diet soft drinks and weight-increasing effects of taxes on food consumed away from home and subsidies on food eaten at home.

The studies presented so far have assessed probable welfare effects of food price interventions only with respect to the changes of consumption and expenditure and classical welfare calculations. They found that taxes are highly regressive because individuals of lower socioeconomic status consume relatively more of the products in question and experience higher welfare losses when these products are taxed. However, some authors argue that these groups are also likely to enjoy the highest health benefits from weight reduction as a result of an intervention.

LUSK and SCHROETER (2012) propose a simple way to explicitly include the weight loss into a welfare analysis and examine the net welfare effect of a food price measure. Their analysis builds on the model in SCHROETER et al. (2008) where weight is explicitly included in the utility function. They use the indirect utility function to model the welfare effect of a tax t on the basis of an individual consumer's equivalent variation EV and arrive at equation (13):

$$EV = p^H t \left(F^{H*} + WTP^W \left(\frac{\partial W^*}{\partial p^H} \right) \right). \quad (13)$$

The welfare effect of a fat tax is expressed by means of the equivalent variation, the amount of money that must be given to or taken from the consumer to keep him on the same utility

level as before the tax. The tax would increase his welfare when *EV* is negative and decrease his welfare when *EV* is positive. The welfare-decreasing effect would be higher the higher the tax *t* and the consumption level of the taxed food F^{H*} are. A welfare-increasing effect arises from the inclusion of weight: $\partial W^* / \partial p^H$ measures the weight change resulting from an increase in the price of high-calorie food and is smaller than zero, and WTP^W is the individual's willingness to pay to reduce weight by one pound. Hence, the consumer benefits from a tax, when $EV < 0$ or $F^{H*} < -WTP^W \left(\partial W^* / \partial p^H \right)$.

Based on actual consumption data and the price-weight elasticities calculated in SCHROETER et al. (2008), LUSK and SCHROETER (2012) estimate how large a person's willingness to pay for weight reduction should be to realise a welfare gain from a fat tax. The most optimistic scenario suggests that an individual should be willing to pay $760 per pound weight lost to benefit from a tax. This amount is far higher in comparison to empirical values for WTP to lose weight that range around $13/lb to $33/lb (NARBO and SJÖSTRÖM, 2000; CAWLEY, 2004).

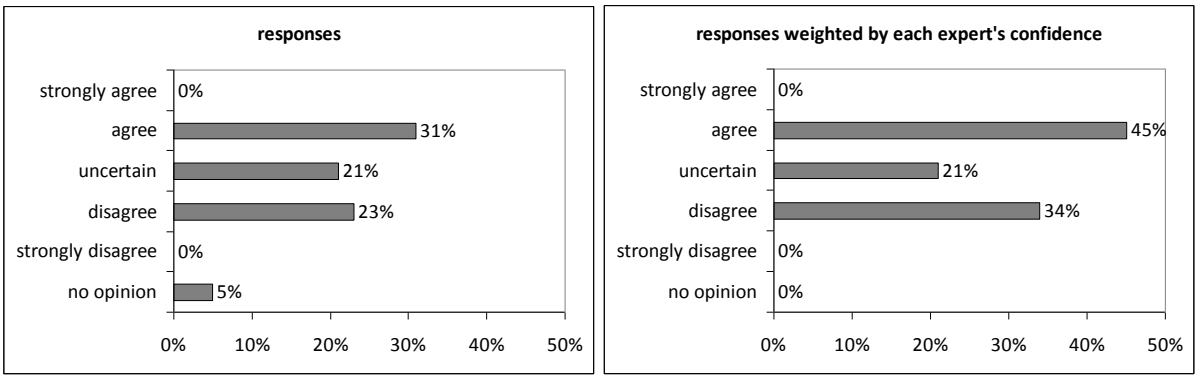
The effect of taxes on consumption and weight are likely to depend on food culture and the perception of what the relevant substitutes for consumers are. While in Europe the closest substitute to sugary soft drinks may be diet soft drinks, water or juice spritzer, consumers in the US will shift to sweetened milk drinks or gallons of juice.

2.5.1.4 Divided opinions about the implications of the empirical results

At this juncture the economic profession is divided whether fiscal measures significantly affect body weight and obesity prevalence. A poll of the IGM Economic Experts Panel among "distinguished experts with a keen interest in public policy from the major areas of economics" (IGM, 2013) revealed that a slight majority agrees to the statement: "Taxes or bans on large bottles of soft drinks containing sugar are not likely to have a significant effect on obesity rates because people will substitute towards consuming excessive calories in other ways". The explicit results are shown in Figure 10.

FAULKNER et al. (2011) conducted a Delphi survey among leading researchers in the field of obesity economics. These experts were asked to evaluate different policy measures according to several outcomes such as impact on consumption, physical activity, obesity, cost-effectiveness, unintended consequences, equity issues and political feasibility. The results of this Delphi survey are shown in Table 5.

Figure 10: Results of IGM economic expert panel on soft drinks taxes



Note: Responses (in %) to the statement „Taxes or bans on large bottles of soft drinks containing sugar are not likely to have a significant effect on obesity rates because people will substitute towards consuming excessive calories in other ways".

***Source*: IGM (2013).**

The participants evaluated the effectiveness of most interventions as "low" to "moderate". FAULKNER et al. (2011) report that three-quarters of the panel supported the introduction of a tax on sugar-sweetened beverages. This judgement seems to be based less on the moderate impacts on consumption or obesity but rather on the possible "powerful impact over time ", where the tax functions as a signal for other "tax, legislative, and educational initiatives to address obesity" (p.8) where certain food items are stigmatised. As these expectations are not really based on sound scientific evidence, the conclusions drawn by FAULKNER et al. (2011) are highly questionable:

> *"Overall, the evidence is not sufficiently strong to provide clear policy direction. Additionally, the nature of the experiments needed to provide definitive evidence supporting certain policy directions is likely to be complex and potentially unfeasible. However, these are no reasons to take no action. It is likely that policies need to be implemented in the face of an incomplete evidence base" (ibid., p.1).*

Table 5: Results of a delphi survey on likely effects of intervention to reduce obesity

	Impact on consumption		Impact on PA		Impact on obesity		Cost-effective		Unintended benefit		Unintended harm		Equitable		Politically feasible	
Intervention	**Mean**	**IQD**	**Mean**	**IQD**	**Mean**	**IQD**	**Mean**	**IQD**	**Mean**	**IQD**	**Mean**	**IQD**	**Mean**	**IQD**	**Mean**	**IQD**
Beverage tax	2.9	0			2.1	0	2.9	0.5	2.5	1	2.4	1	2.3	1	2.5	1
Food tax	2.7	1			2.2	0.5	2.8	0.5	2.4	1	2.8	1	1.9	0	2.1	0
Fruits & Vegetables subsidies	2.9	0			2.1	0	2.3	1	2.9	0	2.1	1.5	2.5	1	2.5	1
Child fitness tax credit			2.3	1	2.1	0.5	2.1	0.5	2.8	0.5	2.0	0	2.1	1	3.2	1
Adult fitness tax credit			2.3	1	1.8	0	2.0	0	2.5	1	2.0	0	2.0	0.5	2.9	0.5
Public transit tax credit			2.1	0	2.0	0	2.2	0	3.1	0.5	1.9	0.5	2.7	1	3.2	1
Sporting equipment tax credit			1.9	0	1.7	1	1.7	1	2.3	0.5	1.9	0	2.1	0	2.6	1
Subsidised PA programs			2.5	1	2.0	0	2.1	0	2.6	1	2.1	0	2.3	0	2.5	1
Road congestion tax			2.1	0	1.7	1	2.5	1	3.4	1	1.9	0	2.4	1	2.3	1
Income transfer unrestricted	2.0	1.5	1.7	1	1.9	1	1.8	1.5	2.9	0.5	2.7	1	2.0	1.5	2.5	1
Income transfer healthy food	2.9	0.5			2.1	0	2.6	1	2.8	0.5	2.3	0.5	2.4	1	2.8	0.5
Income transfer PA			2.3	1	1.9	0	1.9	0	2.5	1	2.0	0	2.3	1	2.2	1
Agricultural subsidies	2.4	1			2.3	0.5	2.9	0.5	2.9	1.5	2.6	1	2.1	1	1.7	1
Agricultural R&D rebalance	2.4	1			2.2	0.5	2.5	1	2.9	0.5	2.3	1	2.8	0.5	2.7	1

Notes: Not at all/None = 1; Low = 2; Moderate = 3; High/A lot =4.
PA = Physical Activity; IQD = Inter Quartile Deviation; indicates the distance between the 25th and the 75th percentiles. A smaller IQD represents greater consensus.

***Source*: FAULKNER et al. (2011).**

2.5.1.5 Econometric challenges for inference on food price effects

Since many of the factors influencing and influenced by body weight "are usually not subject to experimental manipulation" (AULD and GROOTENDORST, 2011, p.237), research on relationships between economic variables and body weight mainly relies on observational data. The attempt to infer causal effects related to obesity and overweight, however, faces various challenges regarding estimation methods and data quality (AULD and GROOTENDORST, 2011). Especially "the exogeneity of food prices is an important identification challenge" (LAKDAWALLA and ZHENG, 2011, p.465).

A main concern is the problem of endogeneity causing bias in the parameters that should show the causal effects of one variable on another. Endogeneity exists when the independent variables in least-squares regressions are correlated with the error term and can have three different sources that most probably exist in many obesity research questions. 1) The relation between independent and dependent variable is not unidirectional but is rather characterised by reverse causality. 2) Important factors that affect the independent variable are not included in the regression equation (unobserved heterogeneity, omitted variables). When correlated with an independent variable, the coefficients will be biased. 3) Independent variables are measured with error (AULD and GROOTENDORST, 2011).

One example where endogeneity probably plays a role is the relationship between the prevalence of obesity in a certain area and the number of fast-food outlets there. Statistics show a very similar development of restaurant density and obesity over time, leading numerous researchers to establish a causal relationship. However, whether more restaurants cause higher obesity rates is questionable (ANDERSON and MATSA, 2011). We could as well suppose a reverse causality (people eat fast-food more often when the density of outlets is higher and gain weight but fast-food restaurants settle in areas with higher obesity prevalence) but also confounding factors like the tendency of obese people and fast-food outlets to locate in lower-income areas (AULD and GROOTENDORST, 2011). Another example would be obesity and schooling, where both variables can be assumed to be affected by other factors simultaneously (like motivation, abilities, family background, or discipline) (AULD and GROOTENDORST, 2011). Likewise, "food prices might be higher in areas with higher demand for food and during periods with higher demand for food" (LAKDAWALLA and ZHENG,

2011, p.465). Moreover, the measurement of food prices can be subject to substantial errors, especially, when aggregate food prices are employed (LAKDAWALLA and ZHENG, 2011).

Possible solutions to these problems are randomized controlled trials, adjustments of covariates, the use of instrumental variables and the application of panel data methods. However, LAKDAWALLA and ZHENG (2011) point out that all of the different approaches to identification "suffer from one or more key weaknesses" (p.466). The gold standard to identification are *randomized experiments*, where the influencing factor (*x*) can be controlled by the researcher independent to any other influencing factor on the dependent variable (*y*) (ANGRIST and PISCHKE, 2009). "Since controlled experiments are frequently costly or infeasible, obesity researchers commonly use observational data to infer causation" (AULD and GROOTENDORST, 2011, p.240). To reduce omitted-variable bias or confounding, the analyst should integrate as many possible variables that affect obesity as possible. However, some factors that lead to heterogeneous outcomes simply are not observed or cannot be observed. Additionally, "covariate adjustment does not correct for other types of endogeneity, i.e. measurement error and reverse causality" (AULD and GROOTENDORST, 2011, p.240).

A third approach to endogeneity is the use of Instrumental Variable (IV) techniques. Here, the researcher employs so-called instruments, one or more variables that affect *x*, are not correlated with the error term and their impact on *y* is exclusively through their impact on *x*. Thus, the part of the variation in *x* caused by the instruments is independent from any other source and of a "quasi-experimental" nature (AULD and GROOTENDORST, 2011). However, IV estimators are subject to strong reservations either because of weak instruments (they explain only little of the variation in *x*) or because they are correlated with the error term. A variable proposed to instrument food prices are relative food taxes (LAKDAWALLA and PHILIPSON, 2002) that, however, vary very little over time. Fast food availability is instrumented by proximity to interstate highways (ANDERSON and MATSA, 2011). A drawback here is the very small effect of interstate location on restaurant utilisation (LAKDAWALLA and ZHENG, 2011).

A fourth and frequently applied tool are panel data models. The use of longitudinal data that include several observations for the same individuals or households over time allows at least some potential endogeneity source to be avoided. It is assumed that important but usually immeasurable determinants on obesity (like culture, discipline, motivation) that are

correlated to regressors (like prices, age, and education) are constant over time. Hence, estimators considering only the varying factors (like fixed-effects models or differenced models) are not subject to this kind of endogeneity. Therefore, "the most common approach to identification is to control for area and time fixed-effects in panel data" (LAKDAWALLA and ZHENG, 2011, p.465). This allows avoiding endogeneity caused by unobserved regional factors (like eating habits, culture tradition, and infrastructure) that affect BMI and are correlated with food prices. Possible difficulties could arise when time trends are not homogeneous across all areas (LAKDAWALLA and ZHENG, 2011).

In their review of studies analysing the effect of food prices on BMI, POWELL et al. (2013) report that "longitudinal estimation methods" are increasingly used. "Studies that provided both cross-sectional and longitudinal estimates revealed that the associations mostly but not always remained statistically significant in the longitudinal models. However, the longitudinal fixed-effects estimates showed that the cross-sectional estimates often overestimated the associations highlighting the importance of controlling for individual-level unobserved heterogeneity" (ibid., p.124).

AULD and GROOTENDORST (2011) stress that most of the regressions that analyse the determinants of obesity have very low R^2 values - usually around 0.1. Many of the commonly included socioeconomic and environmental factors apparently explain only little of the total variation in body weight. It follows that those variables may be insufficient to influence body weight substantially. Moreover, the usefulness of IV techniques is limited in such a case.

A final challenge to the econometric analysis of obesity is the dynamic formation of body weight. From such a perspective, body weight is a stock variable determined by the flow of net energy intake/expenditures in the past (AULD and GROOTENDORST, 2011). Measuring all the possible economic and non-economic factors as well as incorporating them into a model is close to impossible. "An additional challenge in this line of research is that very small changes in behaviour can produce large changes in weight over time" (AULD and GROOTENDORST, 2011, p.249).

2.5.1.6 Issues of policy design

POWELL and CHRIQUI (2011) discuss in which manner pricing policies should be designed to yield the best outcomes. With respect to the *size* of a tax, the obviously inelastic reactions of energy intake and body weight to price changes should be taken into account. High tax rates

would be necessary to induce a shift in behaviour that leads to a reduction in body weights. When the objective is to raise revenues, smaller taxes should be preferred since they "hold tremendous potential" (POWELL and CHRIQUI, 2011) for generating government revenues. This widely expressed view is, however, not necessarily consistent with the theory of an optimal tax. In the case of an inelastic demand, the revenue maximising tax rate actually may substantially reduce consumption *and* generate very high revenues. One remaining argument for small taxes is that they seem to be more feasible from a political perspective (e.g. JACOBSON and BROWNELL, 2000). Moreover, the public is more likely to accept such taxes, when the revenues are earmarked for other measures, like information campaigns, to reduce obesity (e.g. KUCHLER et al., 2005). Governments, however, are usually not obliged to exclusively use these revenues for targeted purposes.

Another issue regarding the design of taxes is finding a suitable *tax base*. POWELL and CHRIQUI (2011) argue that taxing specific groups of food would be easier with respect to legislative and administration efforts compared to taxing ingredients or nutrient content of food items. Public health experts target especially those food groups with low nutritional value like soft drinks (BROWNELL et al., 2009; CARAHER and COWBURN, 2005).

In contrast, CHOUINARD et al. (2007) compare taxing certain food groups such as soft drinks or snack foods to reduce sugar or fat intakes to "taxing electricity consumption – regardless of the source – to reduce air pollution" (p.1). Such a tax scheme would cause no substitutions away from products with high contents of the unhealthy nutrient to products with lower contents within the food groups. They advocate taxes on the proportion of fat or sugar in food items, analogous to taxing carbon to reduce greenhouse gas emissions because "such a tax would fall unequally on food according to their fat content" (p.1). MAZZOCCHI et al. (2009) point out that such "taxes on ingredients would trigger various repercussions" (p.139). Taxing ingredients rather than food groups would eventually cause food manufacturers to reformulate their products, e.g. decreasing the contents of the unhealthy ingredients. However, products that contain high levels of substances deemed as unhealthy often contain considerable amounts of healthy ones. Examples are dairy products that are rich fat *and* calcium or fruit juices rich in sugar *and* vitamins.

According to LEICESTER and WINDMEIJER (2004), taxes on nutritional content will cause high monitoring costs and may have unintended effects on other nutrients. High costs of administration, for instance, were one of the reasons to remove the fat tax in Denmark (see

also the Introduction). PHILIPSON and POSNER (2008) argue that "probably, any feasible tax response to obesity would cost more to enforce than it would be worth in reducing the social costs of obesity" (p.615).

US literature further discusses whether fat taxes should be levied on federal or state level. From a European perspective the question would be rather whether these apply within single countries or within the Union. The case of Denmark has shown for instance that people went increasingly shopping for their butter etc. in neighbouring countries, to the disadvantage of local producers and retailers.

Finally policy makers have to consider the appropriate form of the tax, i.e. whether sales or excise taxes should be favoured. POWELL and CHRIQUI (2011) argue that excise taxes have some advantages over sales taxes: 1) as a part of the shelf price, excise taxes are more obvious to consumers; 2) the location of purchase (stores, vending machines, restaurants) would not matter in case of an excise tax; 3) if an excise tax was applied, there would be no possibility to lower the tax rate per unit of the product compared to possible effects of volume discounts on sales taxes (e.g. by selling large containers). BROWNELL et al. (2009) add that sales taxes may lead consumers to switch to lower-priced brands. However, different views exist whether a higher visibility of a tax would be an advantage or a disadvantage. CASH et al. (2008) suggests that the act of taxation not only alters prices but conveys additional information and thereby puts a stigma on the taxed products that may trigger stronger consumer reaction.

CASH et al. (2005) emphasise that individuals can follow a healthy diet even if they consume snack foods or soft drinks sometimes because they like them. Such persons would be penalised by a tax without a reason. A more differentiated tax only on excessive consumption of certain foods, for instance, would, however, be impracticable.

CARAHER and COWBURN (2005) propose to draw the focus of fat taxes away from consumers. They argue that taxes and subsidies on raw materials at the manufacturer level may encourage the production of healthier food. Additionally, price measures in "closed systems such as schools and the workplace" (ibid., p.1242) may be more promising compared to a general intervention. BROWNELL et al. (2009) favour a threshold approach for sugar-sweetened beverages of 1 g of sugar per ounce (30 ml) to "encourage manufacturers to reformulate products" (p. 1602).

2.5.1.7 Conditions of successful tax policies

ALLAIS et al. (2009) expect reactions to taxes from the food industry such as product reformulations and discuss two possibilities. On the one hand, producers can lower the nutritional quality of their products to keep prices relatively constant. An opposite strategy would be to raise the value of the product by adding "more expensive ingredients and/or implementing new processes". The resulting product would be less affordable to low-income consumers. Hence, both strategies would decrease nutritional quality among households of lower socio-economic levels. Also ETILÉ (2011) points out that an important underlying assumption for the simulation of changes in nutrient intakes is that the "nutritional composition of products is unaffected by price changes" (p.733). When this condition holds true, researchers are able to simulate how prices affect demanded food quantities and, in turn, the nutrient intakes as for instance done by BEATTY and LAFRANCE (2005) (ETILÉ, 2011).

2.5.2 Discussion about agricultural policies

Some authors from the public health field have blamed the agricultural production system as well as agricultural policies for contributing to the obesity epidemic. In the US, for instance, POLLAN (2003) points out that "while one hand of the federal government is campaigning against the epidemic of obesity, the other hand is actually subsidizing it, by writing farmers a check for every bushel of corn they can grow" (p.2). Additionally, the race of farmers to increase yields and output by innovations in agricultural technology in order to hold up revenues in times of decreasing prices was a "sure-fire recipe for overproduction" (p.2). For the case of the EU, SCHÄFER ELINDER (2005) argues that it is "important to tackle the oversupply of food, driven by agricultural subsidies" (p.1333) provided by the Common Agricultural Policy (CAP) of the European Union (EU). To illustrate her arguments, she gives two examples from the milk sector where "production levels at 20 % above the domestic demand" are maintained, "at prices twice as high as on the world market" (p.1334). Some of the surplus milk is "sold with subsidies to the food industry, which turns it mainly into ice cream and cakes" another is used for the school milk program. The first case would result in additional 1.5 kg of butter per person and year; the second translates into 1.5 kg saturated fats per child and year, so the calculations of SCHÄFER ELINDER (2005).[6]

[6] This calculation, however, does not consider likely compensatory effects, e.g. drinking less milk at home.

Naturally, these reproaches have prompted agricultural economists to analyse the likely effects of agricultural policies on food prices and (over)consumption in more detail. ALSTON et al. (2008) acknowledge the possibility that "farm subsidies contribute to lower relative prices and increased consumption of fattening foods by making certain farm commodities more abundant and therefore cheaper" (p.472). For this to happen, however, they formulate three preconditions that must be met: 1) subsidies must significantly decrease the prices of farm commodities that serve as inputs to "fattening" foods, 2) a decrease in the prices of those inputs must translate to lower prices of the final food products at the retail level, 3) lower prices of the end products must significantly increase the consumption of these foods.

The effect of subsidies on commodity prices is regarded as rather small. Prices of some commodities like food and feed grains (used for the production of cereals, pasta, bread or livestock) experienced a decreasing effect by subsidies. However, an increase in production and consumption has been restricted by "additional policies that restricted acreage or production" (ALSTON et al., 2008, p.472). Other commodities like sugar, dairy products, and orange juice are subject to import restrictions that increase the price and reduce consumption (ALSTON et al., 2008). Several authors have estimated the effects of eliminating US farm programs and conclude that commodity prices, except for corn and wheat, would decrease and, in turn, would trigger higher consumption (MCDONALD et al., 2006). Larger effects could be expected from eliminating subsidies for subsectors like crops or corn (ALSTON, 2007; SUMNER, 2005).

Examining the special case of sweetener crops, BEGHIN and JENSEN (2008) conclude that "the current link between US sweetener consumption and farm policy is weak" (p.480). Mainly the low farm value share in sweetened foods is responsible for the low influence of policies targeted at the farm sector on the final retail products. The situation may have been different in earlier times and especially public expenditures on research and development have substantially lowered the price of corn and feed costs in the production of meat, poultry and dairy products. Likewise, High Fructose Corn Syrup (HFCS) is obtained from corn which constitutes an input for most soft drinks and sweets.

In response to SCHÄFER ELINDER and others, SCHMIDHUBER and SHETTY (2010) asses how Europeans' diets have changed and what contribution the Common Agricultural Policy made to this change. From the 1960s to the 2000s energy supply increased and also the share of

lipids in diet increased. The share of sugar remained nearly constant, with declines in the North and rising intakes in the South. However, it is remarkable that simple carbohydrates like added sugar and refined flour "have not significantly replaced in large measures foods rich in complex carbohydrates" (p.133). The intake of refined carbohydrates is substantially higher in other countries, first and foremost the US (more than twice as much) but also Egypt, Lebanon and other countries in the Near East (SCHMIDHUBER and SHETTY, 2010).

The availability of fruits and vegetables is far more than the recommended 400 g per day and person though real intakes are much lower. The authors report that the CAP has "significantly raised primary food prices" (p.144), in particular of sugar, milk and dairy products, and meat. Thus, especially the "bad" nutrients like saturated fats, cholesterol and sugar have been taxed. High margins and low rates of vertical price transmission hindered a significant impact of the CAP on final consumer prices. "If anything, the main instruments of the CAP should even have curbed food consumption, rather than stimulated it, notably of saturated fats and sugar" (p.145). SCHMIDHUBER and SHETTY conclude that the CAP has not been and would not be an efficient tool for changing food consumption and point to other more relevant factors like increases in income and the availability of food, female labour-force participation and growing food-away-from-home (FAFH) consumption. However, the authors concede that the CAP may have substantially affected consumption patterns in countries outside the EU. Especially in the region of the Near East and North Africa, export subsidies and resulting lower prices combined with lower margins to the final product "may have stimulated over-consumption, and contributed to the region's growing overweight and obesity problem" (p.145).

The key piece in the empirical evidence is the share of farm products in the total production costs of food at the retail level. On average this share is about 20 % (ALSTON et al., 2008) and much lower for highly processed foods that are prominently blamed for overweight and obesity. According to BEGHIN and JENSEN (2008), the share of HFCS amounts to only 1.6 % of the value of soft drink sales. Hence, even large price changes at the farm-gate level would result in negligible changes in food prices faced by consumers. MILLER and COBLE (2007) compared direct payments to producers and total food expenditures of consumers. Between 1960 and 2003 the subsidies were on average 1.1 % of consumer expenditures implying a very low effect on consumption decisions.

While the impact of farm policies/programs on the change in food consumption patterns seems to be limited, public investments in research and development probably played a more important role (ALSTON et al., 2008; BEGHIN and JENSEN, 2008). ALSTON et al. provide figures according to which food prices have decreased substantially since the 1950s (for livestock by 54 %, field crops by 72 %, vegetables by 28 % and fruits and nuts by 23 %). They conclude that "these price changes are sufficient to have had meaningful impacts on the cost of food and the prices paid by consumers for food products" (p.477). A reversal of the technological change would increase the price of final food products by 20 %, which would trigger a significant demand response.

RICKARD et al. (2013) simulate effects of US agricultural policies on calorie intake based on a comprehensive model that takes into account both the market for primary commodities as well as for processed food products. They conduct their simulations for three different time periods as well as for different commodity categories. RICKARD et al. (2013) find that "holding all other policies constant - removing US subsidies on grains and oilseeds in the three periods would have caused caloric consumption to decrease minimally whereas removal of all US agricultural policies (including barriers against imports of sugar and dairy products) would have caused total caloric intake to increase" (p.316). Moreover, they report a decreasing policy impact on energy in the course of time that approaches zero.

BONNET and REQUILLART (2011) analyse how the EU sugar policy reform affects the consumption of sugar. Using the example of the soft drink market, they estimate that sugar prices will fall by 36 % which reduces soft drink prices by 3 %. These lower prices would cause higher soft drink consumption and an additional sugar intake of 124 g per person per year.

2.6 Some open questions and their relation to the articles in this dissertation

This chapter provided a comprehensive review of the economic literature on obesity. It showed that economic research addresses many important and relevant aspects concerning our view of consumer behaviour, uses innovative econometric techniques to analyse behaviour related to health and nutrition and contributes to the public discussion on policies to halt and reduce the increasing prevalence of obesity worldwide. This review also revealed, however, that the case of obesity is very complex and that many research questions remain open.

At this point I do not want to give a general discussion of implications for policies and future research as regards contents and methodology. This is left to the final Chapter 5 together with conclusions from the articles in Chapters 3 and 4. However, I do want to elaborate here on some main aspects that are missing or have been neglected by literature and which became the central themes of this dissertation.

First of all, *heterogeneity* plays an eminent role. The descriptive statistics in Section 2.2 clearly show large gradients of obesity prevalence based on age, sex, income, education and other socio-economic characteristics. The development of the BMI distribution further indicates that some groups are especially vulnerable to changed environments. Consequently, we would expect considerable variation in consumer behaviour such as different reactions to prices. Moreover, studies that analyse such behaviour urgently need to consider heterogeneity in order to facilitate targeted policy-making. All empirical papers presented in Sections 3.2, 3.3, and 3.4 consider to some degree differential behaviour. In STAUDIGEL (2011), I examine different reactions to food prices across gender and income groups. While such strata have also been included by other authors (e.g. POWELL, 2009), the subsequent papers come up with novel approaches to segment consumers and assess deviating behaviours.

The analysis in STAUDIGEL (2012) focuses on differences in food demand across households whose members differ in their weight. Although some authors assume that people of different weight possibly react differently to variation in prices or income (mostly with regard to welfare considerations of fat taxes or thin subsidies), no one has yet examined whether this is actually the case. In STAUDIGEL and SCHRÖCK (2014), we obtain food demand parameters based on system estimation for five consumer segments. We receive those segments by applying cluster analysis on actual food purchases of households. This procedure yields consumer groups that show similar consumption patterns in terms of price and income reactions.

A second aspect that I missed in the existing literature is a consideration of *food quality*. Theoretical discussions about effects of fat taxes or thin subsidies exclusively focus on the substitution of one product (group), for instance meat, by another, let's say vegetables. In the presence of increasing product differentiation and supply of various quality levels, however, it might well be that taxing a certain product results in consumers still buying that

product but at a lower price and quality level. I address this totally neglected demand behaviour for the first time in STAUDIGEL (2012) in the context of overweight and obesity.

A third challenge for analysing interrelationships between body weight or other health indicators and economic determinants concerns *econometric methodology and adequate data*. The discussion in Section 2.5.1.5 stressed that fixed-effects estimation methods based on longitudinal data is an important and widely used tool to control for other variables that are omitted or unobservable. It is also necessary to have access to exogenous and detailed price data. Both conditions are met by the Russia Longitudinal Monitoring Survey (RLMS) which is used for the empirical analyses. Additionally, these data provide a unique combination of economic as well as health variables so that analyses can be conducted with data from a single source. Access to this Russian data set was one of the main reasons why the issue of obesity is addressed in large parts of this dissertation by means of econometric analyses of micro-data. I will describe the RLMS in more detail in Chapter 3.1.

The fourth central issue, the *focus on Russia* in the empirical analyses, results from the choice of the data set. Also the "natural experiment" of transforming a centrally planned economy to a free market and the effects on economic and health status of Russian households makes the case of Russia particularly interesting. Since the overwhelming part of empirical literature on obesity is devoted to the USA, empirical evidence for other countries, especially transition countries, enriches the literature. Chapter 2.2 showed that industrialised countries still have the highest obesity prevalence but emerging economies all over the world are about to catch up with richer nations.

A fifth and final focus lies on the theoretical treatment of human behaviour related to health and nutrition. I actually found the *emphasis on the trade-offs between different utility-generating objectives* subject to budget or other constraints very appealing (see Sections 2.3.1 and 2.3.2). This is exactly the core of decisions that human beings face every day. However, when reading papers that used those theoretical concepts especially of household production theory, I always found that important aspects are lacking, neglected or deliberately left out in order to get a smooth and simple theoretical model. The paper in Chapter 4.1, STAUDIGEL (2013), resulted from specifying and classifying my points of criticism and attempts to suggest extensions and improvements.

The next chapter presents the empirical analyses conducted for this dissertation. It starts with a description of the data that were used in the studies that follow. The first paper examines impacts of food prices on body weight and the probability of being obese. The second paper is concerned with the structure of food consumption across households segmented by their member's weight classification. It investigates how these differing households react to resource changes with respect to expenditures on food as well as the quantity and quality of food. The third paper presents expenditure and own-price elasticities for food in Russia in the course of time as well as for different consumer segments.

References

ALLAIS, O., P. BERTAIL and V. NICHÈLE (2009): The Effects of a Fat Tax on French Households' Purchases: A Nutritional Approach. *American Journal of Agricultural Economics* **92**, 228-245.

ALSTON, J.M. (2007): Benefits and beneficiaries from U.S. farm subsidies. AEI Agricultural Policy Series: The 2007 Farm Bill and Beyond. Washington, DC: American Enterprise Institute.

ALSTON, J.M., D.A. SUMNER and S.A. VOSTI (2008): Farm Subsidies and Obesity in the United States: National Evidence and International Comparisons. *Food Policy* **33**, 470-479.

ANDERSON, M.L. and D.A. MATSA (2011): Are Restaurants Really Supersizing America? *American Economic Journal: Applied Economics* **3**, 152-188.

ANDREYEVA, T., M. LONG and K.D. BROWNELL (2010): The impact of food prices on consumption: A systematic review of research on price elasticity of demand for food. *American Journal of Public Health* **100**, 216–222.

ANGRIST, J.D. and J.-S. PISCHKE (2009): Mostly Harmless Econometrics. An Empiricists Companion. Princeton: Princeton University Press.

AULD, M.C. and P. GROOTENDORST (2011): Challenges for Causal Inference in Obesity Research. In: CAWLEY, J. (ed.): The Oxford Handbook of the Social Science of Obesity, New York: Oxford University Press, 237-253.

BATTLE, E.K. and K.D. BROWNELL (1997): Confronting a rising tide of eating disorders and obesity: Treatment vs. prevention and policy. *Addictive Behav*iors **20**, 755-765.

BEATTY, T.K. and J.T. LAFRANCE (2005): United States Demand for Food and Nutrition in the Twentieth Century. *American Journal of Agricultural Economics* **87**, 1159-1166.

BECKER, G.S and K.M. MURPHY (1988): A Theory of Rational Addiction. *Journal of Political Economy* **96**, 675-700.

BECKER, G.S. (1965): A Theory of the Allocation of Time. *The Economic Journal* **75**, 493-517.

BEGHIN, J.C. and H.H. JENSEN (2008): Farm Policies and Added Sugars in US Diets. *Food Policy* **33**, 480-488.

BEHRMAN, J.R. and A.B. DEOLALIKAR (1988): Health and Nutrition. In: Chenery, H. and T.N. Srinivasan (eds.): Handbook of Development Economics, Volume I, Amsterdam: North Holland, 631-711.

BHATTACHARYA, J. and N. SOOD (2007): Health insurance and the obesity externality. In: Bolin, K. and J. Cawley (eds.): The Economics of Obesity. Advances in Health Economics and Health Services Research. Amsterdam: Elsevier, Volume 17, 279-318.

BONNET, C. and V. REQUILLART (2011): Does the EU Sugar Policy Reform Increase Added Sugar Consumption? An Empirical Evidence on the Soft Drink Market. *Health Economics* **20**, 1012-1024.

BROWNELL, K.D. (1994): Get Slim with Higher Taxes. *The New York Times*, December 15, 1994.

BROWNELL, K.D. and T.R. FRIEDEN (2009): Ounces of Prevention – The Public Policy Case for Taxes on Sugared Beverages. *The New England Journal of Medicine* **360**, 1805-1808.

BROWNELL, K.D., T. FARLEY, W.C. WILLET et al. (2009): The Public Health and Economic Benefits of Taxing Sugar-Sweetened Beverages. *The New England Journal of Medicine* **361**, 1599-1605.

BRUNELLO, G., P.-C. MICHAUD and A. SANZ-DE-GALDEANO (2009): The Rise of Obesity in Europe: An Economic Perspective. *Economic Policy* **24**, 551-596.

BURKHAUSER, R. V. and J. CAWLEY (2008): Beyond BMI: The Value of More Accurate Measures of Fatness and Obesity in Social Science Research. *Journal of Health Economics* **27**, 519-529.

CARAHER, M. and G. COWBURN (2005): Taxing Food: Implications for Public Health Nutrition. *Public Health Nutrition* **8**, 1242-1249.

CASH, S.B. and R.D. LACANILAO (2007): Taxing Food to Improve Health: Economic Evidence and Arguments. *Agricultural and Resource Economics Review* **36**, 174-182.

CASH, S.B., D.L. SUNDING and D. ZILBERMAN (2005): Fat Taxes and Thin Subsidies: Prices, Diet, and Health Outcomes. *Food Economics – Acta Agriculturae Scandinavica, Section C* 2, 167-174.

CASH, S.B., R.D. LACANILAO, W.L. ADAMOWICZ and K. RAINE (2008): An Experimental Investigation of the Impact of Fat Taxes: Prices Effects, Food Stigma, and Information Effects on Economics Instruments to Improve Dietary Health. Research Project Number CMD-08-06. Consumer and Market Demand – Agricultural Policy Research Network. Edmonton: University of Alberta

CAWLEY, J. (1999): Rational Addiction, the Consumption of Calories and Body Weight. Ph.D. Dissertation, Department of Economics, University of Chicago.

CAWLEY, J. (2004): An Economic Framework for Understanding Physical Activity and Eating Behaviors. *American Journal of Preventive Medicine* **27**, 117-125.

CAWLEY, J. (2011): The Economics of Obesity. In: CAWLEY, J. (ed.): The Oxford Handbook of the Social Science of Obesity, New York: Oxford University Press, 120-137.

CAWLEY, J. and C. J. RUHM (2011): The Economics of Risky Health Behaviors. In: Pauly, M.V., T.G. McGuire and P.P. Barros (eds.): Handbook of Health Economics, Volume 2, Amsterdam: North Holland, 95-199.

CHALOUPKA, F.J. and K.E. WARNER (2000): The Economics of Smoking. In: Culyer, A.J. and J. Newhouse: Handbook of Health Economics. Amsterdam: Elsevier, 1539-1627.

CHEN, S.N., J.F. SHOGREN, P.F. ORAZEM and T.D. CROCKER (2002): Prices and Health: Identifying the Effects of Nutrition, Exercise, and Medication Choices on Blood Pressure. *American Journal of Agricultural Economics* **84**, 990-1002.

CHOU, S., M. GROSSMAN and H. SAFFER (2004): An economic analysis of adult obesity: results from the behavioral risk factors surveillance system. *Journal of Health Economics* **23**, 565–587.

CHOUINARD, H.H., D.E. DAVIS, J.T. LAFRANCE and J.M. PERLOFF (2007): Fat Taxes: Big Money for Small Change. *Forum for Health Economics & Policy* **10**, Article 2.

COSTA, D.L. and R.H. STECKEL (1995): Long-Term Trends in Health, Welfare, and Economic Growth in the United States. NBER Historical Working Papers 0076, National Bureau of Economic Research, Inc.

COURTEMANCHE, C. J., G. HEUTEL and P. MCALVANAH (2011): Impatience, Incentives, and Obesity. NBER Working Paper No. 17483, October 2011.

CUTLER, D.M. and E.L. GLAESER (2005): What Explains Differences in Smoking, Drinking, and Other Health-Related Behaviors? *American Economic Review* **95**, 238-242.

CUTLER, D.M., E.L. GLAESER and J.M. SHAPIRO (2003): Why Have Americans Become More Obese? *Journal of Economic Perspectives* **17**, 93-118.

DRESCHER, L., S. THIELE, R. ROOSEN and G.B. MENSINK (2009): Consumer Demand for healthy eating considering diversity – an economic approach for German individuals. *International Journal of Consumer Studies* **33**, 684-696.

ELMADFA, I. and C. LEITZMANN (2004): Ernährung des Menschen. 4. Auflage, Stuttgart: Verlag Eugen Ulmer.

EMERY, C. J. DINET, A. LAFUMA, C. SERMET, B. KHOSHNOOD and F. FAGNANI (2007): Évaluation du coût associé à l'obésité en France. *La Presse Médicale* **36**, 832-840.

EPSTEIN, S. (1993): Emotion and Self-Theory. In: M. Lewis and J.M. Haviland (eds.): Handbook of Emotions. New York: Guilford, 313-326.

ETILÉ, F. (2011): Food Consumption and Health. In: LUSK, J.L., J. ROOSEN and J.F. SHOGREN (eds.): The Economics of Food Consumption and Policy, New York: Oxford University Press, 716-746.

FAULKNER, G.E.J., P. GROOTENDORST, V.H. NGUYEN et al. (2011): Economic Instruments for Obesity Prevention: Results of a Scoping Review and Modified Delphi Survey. *International Journal of Behavioural Nutrition and Physical Activity* **8**, 109.

FERTIG, A., G. GLOMM and R. TSCHERNIS (2009): The connection between maternal employment and childhood obesity: inspecting the mechanisms. *Review of the Economics of the Household* **7**, 227-255.

FINKELSTEIN, E.A., I.C. FIEBELKORN and G. WANG (2003): National medical spending attributable to overweight and obesity: how much, and who's paying? *Health Affairs* **W3**, 219-26.

FINKELSTEIN, E.A., J.G. TROGDON, J.W. COHEN and W. DIETZ (2009): Annual Medical Spending Attributable To Obesity: Payer-And Service-Specific Estimates. *Health Affairs* **28**, 822-831.

FLETCHER, J.M. (2011): Soda Taxes and Substitution Effects: Will Obesity Be Affected? *Choices* **26**.

FLETCHER, J.M., D. FRISVOLD and N. TEFFT (2010a): Can soft drink taxes reduce population weight? *Contemporary Economic Policy* **28**, 23–35.

FLETCHER, J.M., D.E. FRISVOLD and N. TEFFT (2010b): The Effects of Soft Drink Taxes on Child and Adolescent Consumption and Weight Outcomes. *Journal of Public Economics* **94**, 967-974.

FREDERICK, S., G. LOEWENSTEIN and T. O'DONOGHUE (2002): Time Discounting and Time Preference: A Critical Review. *Journal of Economic Literature* **40**, 351-401.

GLAESER, E.L. (2006): Paternalism and Psychology. *The University of Chicago Law Review* **73**, 133-156.

GROSSMAN, M. (1972): On the Concept of Health Capital and the Demand for Health. *Journal of Political Economy* **80**, 223-255.

HAMERMESH, D.S. (2007): Time to Eat: Household Production under Increasing Income Inequality. *American Journal of Agricultural* Economics **89**, 852-863.

HAMERMESH, D.S. (2009): Grazing, Goods and Girth: Determinants and Effects. IZA Discussion Paper No. 4378. Institute for the Study of Labor, Bonn, Germany.

HAN, E. and L.M. POWELL (2011): Effect of food prices on the prevalence of obesity among young adults. *Public Health* **125**, 129-135.

HAN, E., L.M. POWELL and Z. ISGOR (2012): Supplemental nutrition assistance program and body weight outcomes: The role of economic contextual factors. *Social Science and Medicine* **74**, 1874-1881.

HUFFMAN, W.E., S.K. HUFFMAN, K. RICKERTSEN and A. TEGENE (2010): Over-Nutrition and Changing Health Status in High Income Countries. *Forum for Health Economics & Policy* **13**, Article 2.

IGM (INITIATIVE ON GLOBAL MARKETS) (2013): Economic Experts Panel on "Obesity and Soft Drinks". Available online at: http://www.igmchicago.org/igm-economic-experts-panel/poll-results?SurveyID=SV_b8XjwMayOL0r58V. Accessed 02.06.2013.

IKEDA, S., M. KANG and F. OHTAKE (2010): Hyperbolic discounting, the sign effect, and the body mass index. *Journal of Health Economics* **29**, 268-284.

JACOBSON, M.F. and K.D. BROWNELL (2000): Small Taxes on Soft Drinks and Snack Foods to Promote Health. *American Journal of Public Health* **90**, 854-857.

JUST, D.R. (2011): Behavioral Economics and the Food Consumer. In: LUSK, J.L., J. ROOSEN and J.F. SHOGREN (eds.): The Economics of Food Consumption and Policy, New York: Oxford University Press, 99-118.

JUST, D.R. and J. PRICE (2013): Default options, incentives and food choices: evidence from elementary-school children. *Public Health Nutrition*, First View Article, DOI: http://dx.doi.org/10.1017/S1368980013001468.

JUST, D.R. and B. WANSINK (2011): The Flat-Rate Pricing Paradox: Conflicting Effects of "All-You-Can-Eat" Buffet Pricing. *The Review of Economics and Statistics* **93**, 193-200.

JUST, D.R., L. MANCINO and B. WANSINK (2007): Could Behavioral Economics Help Improve Diet Quality for Nutrition Assistance Program Participants? United States Departement of Agriculture, Economic Research Service, Report Number 43, June, 2007.

KAHNEMAN, D. and A. TVERSKY (1979): Prospect Theory: An Analysis of Decision under Risk. *Econometrica* **47**, 263-292.

KATZMARZYK, P.T. and I. JANSSEN (2004): The economic costs associated with physical inactivity and obesity in Canada: An update. *Canadian Journal of Applied Physiology* **29**, 90-115.

KNOLL, K.-P. (2010): Kosten der Adipositas in der Bundesrepublik Deutschland. Dissertation, Technische Universität München. Available online at: d-nb.info/1009040197/34. Accessed 28.08.2013.

KOMLOS, J., P.K. SMITH and B. BOGIN (2004): Obesity and the Rate of Time Preference: Is there a Connection? *Journal of Biosocial Science* **36**, 209-219.

KUCHLER, F. and E. GOLAN (2004): Is There a Role for Government in Reducing the Prevalence of Overweight and Obesity? *Choices* Fall 2004, 41-45.

KUCHLER, F. and J.N. VARIYAM (2002): Misperceptions in self-assessed weight status vary along demographic lines. *Food Review* **25**, 27-33.

KUCHLER, F., A. TEGENE, and J.M. HARRIS (2005): Taxing Snack Foods: Manipulating Diet Quality or Financing Information Programs? *Review of Agricultural Economics* **27**, 1-17.

LAIBSON, D. (1997): Golden Eggs and Hyperbolic Discounting. *Quarterly Journal of Economics* **112**, 443-478.

LAKDAWALLA, D. and T. PHILIPSON (2002): The Growth of Obesity and Technological Change: A Theoretical and Empirical Examination. NBER Working Paper 8946.

LAKDAWALLA, D. and T. PHILIPSON (2009): The Growth of Obesity and Technological Change. *Economics and Human Biology* **7**, 283-293.

LAKDAWALLA, D. and Y. ZHENG (2011): Food Prices, Income and Body Weight. In: CAWLEY, J. (ed.): The Oxford Handbook of the Social Science of Obesity, New York: Oxford University Press, 462-479.

LAKDAWALLA, D., T. PHILIPSON and J. BHATTACHARYA (2005): Welfare-enhancing Technological Change and the Growth of Obesity. *American Economic Review* **92**, 253-257.

LEIBOWITZ, A.A. (2004): The demand for Health and Health Concerns after 30 Years. *Journal of Health Economics* **23**, 663-671.

LEICESTER, A. and F. WINDMEIJER (2004): The 'fat tax': economic incentives to reduce obesity. IFS Briefing Notes BN49. London: Institute for Fiscal Studies.

LIU, X. and R. LOPEZ (2012): Evidence of rational addiction to carbonated soft drinks? *China Agricultural Economic Review* **4**, 300-317.

LOEWENSTEIN, G. (2004): Out of Control: Visceral Influences of Behavior. In: Camerer, C.F., G. Loewenstein and M. Rabin (eds.): Advances in Behavioral Economics. Princeton: Princeton University Press, 689-724.

LUSK, J.L. and C. SCHROETER (2012): When Do Fat Taxes Increase Consumer Welfare? *Health Economics* **21**, 1367-1374.

MAZZOCCHI, M., W.B. TRAILL and J.F. SHOGREN (2009): Fat economics. Nutrition, health, and economic policy. New York: Oxford University Press.

MCCORMICK, B., I. STONE and CORPORATE ANALYTICAL TEAM (2007): Economic costs of obesity and the case for government intervention. *obesity reviews* **8** (S1), 161–164

MCDONALD, D., R. NAIR, T. PODBURY, B. et al. (2006): U.S. agriculture without farm support. Research Report 06.10. Canberra: ABARE (Australian Bureau of Agricultural and Resource Economics).

MICHAEL, R.T. and G.S. BECKER (1973): On the New Theory of Consumer Behavior. *Swedish Journal of Economics* **75,** 378-396.

MILJKOVIC, D., W. NGANJE and H. DE CHASTENET (2008): Economic factors affecting the increase in obesity in the United States: Differential response to price. *Food Policy* **33**, 48-60.

MILLER, J.C. and K.H. COBLE (2007): Cheap Food Policy: Fact or Rhetoric? *Food Policy* **32**, 98-111.

MÜLLER-RIEMENSCHNEIDER, F., T. REINHOLD, A. BERGHÖFER and S.N. WILLICH (2008): Health-economic burden of obesity in Europe. *European Journal of Epidemiology* **23**, 499-509.

NARBO, R. and L. SJÖSTRÖM (2000) Willingness to pay for obesity treatment. International *Journal of Technology Assessment in Health Care* **16**, 50-59.

NAYGA, R.M.JR. (2000): Schooling Health Knowledge and Obesity. *Applied Economics* **32**, 815-822.

NORDSTRÖM, J. and L. THUNSTRÖM (2011): Can targeted food taxes and subsidies improve the diet? Distributional effects among income groups. *Food Policy* **36**, 259-271.

O'DONOGHUE, T. and M. RABIN (2006): Optimal sin taxes. *Journal of Public Economics* **90**, 1825-1849.

OECD (ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT) (2012): Policy Brief OECD Obesity Update 2012. Available online at: http://www.oecd.org. Accessed 27.03.2012.

PHILIPSON, T. (2001): The World-wide Growth in Obesity: An Economic Research Agenda. *Health Economics* **10**, 1-7.

PHILIPSON, T. and R. POSNER (1999): The Long-run Growth in Obesity as a Function of Technological Change. NBER Working Paper 7423.

PHILIPSON, T. and R. POSNER (2008): Is the Obesity Epidemic a Public Health Problem? A Review of Zoltan J. Acs and Alan Lyles's *Obesity, Business and Public Policy*. *Journal of Economic Literature* **46**, 974-982.

POLLAK, R.A. and M.L. Wachter (1975): The Relevance of the Households Production Function and Its Implications for the Allocation of Time. *Journal of Political Economy* **83**, 255-277.

POLLAN, M. (2003): The (Agri)Cultural Contradictions of Obesity. The New York Times Magazine, October 12.

POPKIN, B.M. (2009): The World is Fat. The Fads, Trends, and Policies that are Fattening the Human Race. New York: Avery.

POWELL, L.M. (2009): Fast food costs and adolescent body mass index: Evidence from panel data. *Journal of Health Economics* **28**, 963-970.

POWELL, L.M. and Y. BAO (2009): Food prices, access to food outlets and child weight. *Economics and Human Biology* **7**, 64-72.

POWELL, L.M. and F.J. CHALOUPKA (2009): Food Prices and Obesity: Evidence and Policy Implications for Taxes and Subsidies. *The Milbank Quarterly* **87**, 229-257.

POWELL, L.M. and J.F. CHRIQUI (2011): Food Taxes and Subsidies: Evidence and Policies. In: CAWLEY, J. (ed.): The Oxford Handbook of the Social Science of Obesity, New York: Oxford University Press, 639-664.

POWELL, L.M., J.F. CHRIQUI, T. KHAN et al. (2013): Assessing the Potential Effectiveness of Food and Beverage Taxes and Subsidies for Improving Public Health: A Systematic Review of Prices, Demand and Body Weight Outcomes. *Obesity Reviews* **14**, 110-128.

RAPPANGE, D.R., W.B. BROUWER, R.T. HOOGENVEEN and P.H. VAN BAAL (2009): Healthcare costs and obesity prevention: drug costs and other sector-specific consequences. *PharmacoEconomics* **27**, 1031-1044.

RASCHKE, C. (2012): Food stamps and the time cost of food preparation. *Review of the Economics of the Household* **10**, 259-275.

RICHARDS, T. J. and S.F. HAMILTON (2012): Obesity and Hyperbolic Discounting: An Experimental Analysis. *Journal of Agricultural and Resource Economics* **37**, 181-198.

RICHARDS, T.J., P.M. PATTERSON and A. TEGENE (2007): Obesity and Nutrient Consumption: A Rational Addiction? *Contemporary Economic Policy* **25**, 309-324.

RICKARD, B.J., A.M. OKRENT and J.M. ALSTON (2013): How Have Agricultural Policies Influenced Caloric Consumption in the United States? *Health Economics* **22**, 316-339.

SAMUELSON, P. (1937): A Note on Measurement of Utility. *Review of Economic Studies* **4**, 155-161.

SANDER, B. and R. BERGEMANN (2003): Economic Burden of Obesity and its Complications in Germany. *European Journal of Health Economics* **4**, 248-253.

SASSI, F. (2010): Obesity and the Economics of Prevention. Fit not Fat. Paris: OECD Publishing.

SCHÄFER ELINDER, L. (2005): Obesity, Hunger, and Agriculture: The Damaging Role of Subsidies. *British Medical Journal* **331**, 1333-1336.

SCHARFF, R.L. (2009): Obesity and Hyperbolic Discounting: Evidence and Implications. *Journal of Consumer Policy* **32**, 3-21.

SCHMEISER, M.D. (2009): Expanding Wallets and Waistlines: The Impact of Family Income on the BMI of Women and Men Eligible for the Earned Income Tax Credit. *Health Economics* **18**, 1277-1294.

SCHMIDHUBER, J. and P. SHETTY (2010): The European Union's Common Agricultural Policy and the European Diet: Is There a Link? In: Hawkes, C. et al. (eds.): Trade, Food, Diet, and Health: Perspectives and Policy Options, Oxford: Wiley-Blackwell, 131-146.

SCHROETER, C. and J. LUSK (2008): Economic Factors and Body Weight: An Empirical Analysis. *Journal of Agricultural and Applied Economics* **40**, 523–538.

SCHROETER, C., J. LUSK and W. TYNER (2008): Determining the Impact of Food Price and Income Changes on Body Weight. *Journal of Health Economics* **27**, 45-68.

SEEL, B. (2006): Haushaltsökonomik – Grenzgänge zwischen Wissenschaftsparadigmen. *Hauswirtschaft und Wissenschaft* **54**, 112-119.

SEIDERS, K. and R.D. PETTY (2004): Obesity and the Role of Food Marketing: A Policy Analysis of Issues and Remedies. *Journal of Public Policy & Marketing* **23**, 153-169.

SMITH, T.A., B.-H. LIN and J.-Y. LEE (2010): Taxing Caloric Sweetened Beverages - Potential Effects on Beverage Consumption, Calorie Intake, and Obesity. Economic Research Report No. 100. Economic Research Service/USDA.

STAUDIGEL, M. (2011): How (much) do food prices contribute to obesity in Russia? *Economics and Human Biology* **9**, 133-147.

STAUDIGEL, M. (2012): How do obese people afford to be obese? Consumption strategies of Russian households. *Agricultural Economics* **43**, 701-714.

STAUDIGEL, M. (2013): On the application of household production theory to health and nutrition. In: Bahrs, E., Becker, T., Birner, R. et al. (eds.): Herausforderungen des globalen Wandels für Agrarentwicklung und Welternährung. Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e.V., Band 48. Münster: Landwirtschaftsverlag, 33-46.

STAUDIGEL, M. and R. SCHRÖCK (2014): Food Demand in Russia – Heterogeneous Consumer Segments over Time. Accepted for Publication in *Journal of Agricultural Economics*.

STRAUSS, J. and D. THOMAS (1998): Health, Nutrition, and Economic Development. *Journal of Economic Literature* **36**, 766-817.

STURM, R. and A. DATAR (2005): Body mass index in elementary school children, metropolitan area food prices and food outlet density. *Public Health* **119**, 1059–1068.

STURM, R. and A. DATAR (2008): Food prices and weight gain during elementary school: 5-year update. *Public Health* **122**, 1140–1143.

SUMNER, D.A. (2005): Boxed in: Conflicts between U.S. farm policies and WTO obligations. Trade Policy Analysis 32. Washington, D.C.: Cato Institute.

THALER, R.H. (1980): Toward a Positive Theory of Consumer Choice. *Journal of Economic Behavior and Organization* **1**, 39-60.

THOW, A.M., S. JAN, S. LEEDER and B. SWINBURN (2010): The Effect of Fiscal Policy on Diet, Obesity and Chronic Disease: A Systematic Review. *Bulletin of the World Health Organization* **88**, 609-614.

VARIYAM, J.N. (2008): Do Nutrition Labels Improve Dietary Outcomes? *Health Economics* **17**, 695–708.

VARIYAM, J.N. and J. BLAYLOCK (1998): Unlocking the mystery between nutrition knowledge and diet quality. *Food Review* **21**, 21-28.

VARIYAM, J.N. and J. CAWLEY (2006): Nutrition Labels and Obesity. NBER Working Paper No. 11956.

VARIYAM, J.N., J. BLAYLOCK and D. SMALLWOOD (1999): Information, endogeneity, and consumer health behaviour: application to dietary intakes. *Applied Economics* **31**, 217-226.

von LENGERKE, T. and C. KRAUTH (2011): Economic costs of adult obesity: A review of recent European studies with a focus on subgroup-specific costs. *Maturitas* **69**, 220-229.

VON LENGERKE, T., P. REITMEIR and J. JOHN (2006): Direkte medizinische Kosten der (Starken) Adipositas: ein Bottom-u-Vergleich über- vs. normalgewichtiger Erwachsener in der KORA-Studienregion. *Gesundheitswesen* **68**, 110-115.

WANSINK, B. (2004): Environmental Factors that Increase the Food Intake and Consumption Volume of Unknowing Consumers. *Annual Review of Nutrition* **24**, 455-479.

WANSINK, B. and J. SOBAL (2007): Mindless Eating: The Daily Food Decisions We Overlook. *Environment and Behavior* **39**, 106-123.

WANSINK, B., D.R. JUST and C.R. PAYNE (2009): Mindless Eating and Healthy Heuristics for the Irrational. *American Economic Review* **99**, 165-69.

WHO (2004): Global Strategy on Diet, Physical Activity and Health. Available online at: http://www.who.int/dietphysicalactivity/strategy/eb11344/en/index.html. Accessed 01.06.2013.

WHO (2012): Obesity and overweight. WHO Fact sheet No. 311. Available online at: http://www.who.int/mediacentre/factsheets/fs311/en/index.html#. Accessed 28.03.2012.

WITHROW, D. and D. A. ALTER (2011): The economic burden of obesity worldwide: a systematic review of the direct costs of obesity. *obesity reviews* **12**, 131–141

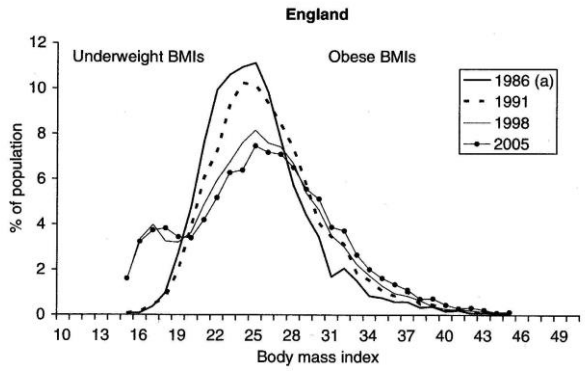
WOLF, A.M. and G.A. COLDITZ (1998): Current Estimates of the Economic Cost of Obesity in the United States. *Obesity Research* **6**, 97–106.

YOUNG, L.R. and M. NESTLE (2002): The Contribution of Expanding Portion Sizes to the US Obesity Epidemic. *American Journal of Public Health* **92**, 246-249.

ZHANG, L. and I. RASHAD (2008): Obesity and Time Preference: The Health Consequences of Discounting the Future. *Journal of Biosocial Science* **40**, 97-113.

Appendix

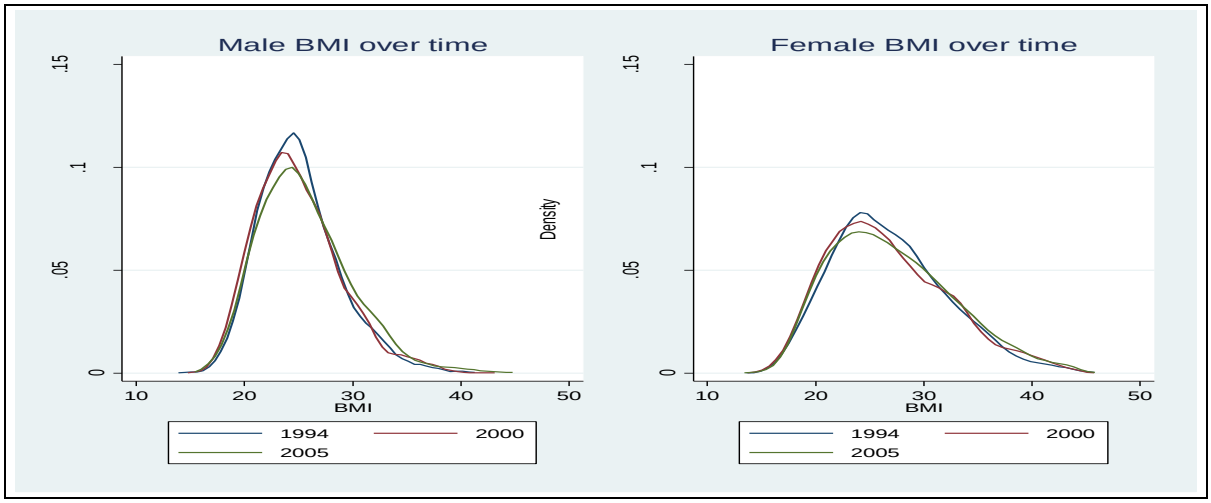
Figure A1: Distribution of BMI in England, 1986-2005



Data for 1986 refer to Britain and for 1991-2005 to England.

***Source*: MAZZOCCHI et al. (2009) based on data from the DNS Britain (1986/7) and from Health Survey of England.**

Figure A2: Distribution of BMI in the Russian Federation, 1994-2005



***Source*: Own presentation from RLMS data, 1994-2005.**

3 Empirical evidence on consumer behaviour related to health and nutrition in the Russian Federation

3.1 The Russia Longitudinal Monitoring Survey (RLMS) - Plentiful data to analyse life in transitional Russia in various facets

3.1.1 Introduction

A basic lesson from Chapter 2 is that analysing the relationships between economic variables and health status is a complex and interdisciplinary task. In order to draw meaningful conclusions based on empirical analyses, researchers require comprehensive data on many economic and non-economic aspects of human behaviour. Only few datasets exist globally that measure economic indicators and health conditions of households and individuals at the same time. One of the few exemptions is the dataset used for the empirical papers in this dissertation.

The Russia Longitudinal Monitoring Survey (RLMS) aims to observe the effects of the economic and social transition in the Russian Federation on various fields such as income changes, consumption behaviour, social security systems, demography, labour markets and health status. Hence, the RLMS includes a wide range of different variables that cover the basic economic and environmental conditions of households, individuals, and the communities they live in, their behaviour as well as numerous outcomes related, for instance, to health, education and labour markets. Moreover, the sample – basically constructed as a repeated cross-section – also includes a longitudinal component that permits multivariate and panel-data methods at a micro-level.

Usually, concise journal articles offer little space to describe such rich data sets in every detail. Additionally, many readers may wonder how to sample the world's largest country accurately. The present chapter's objective is thus to provide a more comprehensive overview over the RLMS. The following section presents the design and the sampling procedure of the study. Section 3.1.3 discusses aspects of attrition, replenishment and sample weights. Section 3.1.4 gives an overview over the survey's content and the included variables. The fifth section summarises the main research fields that have used RLMS-data so far. Finally, a short evaluation will point out the main advantages and some drawbacks of this data set.

3.1.2 Sampling design

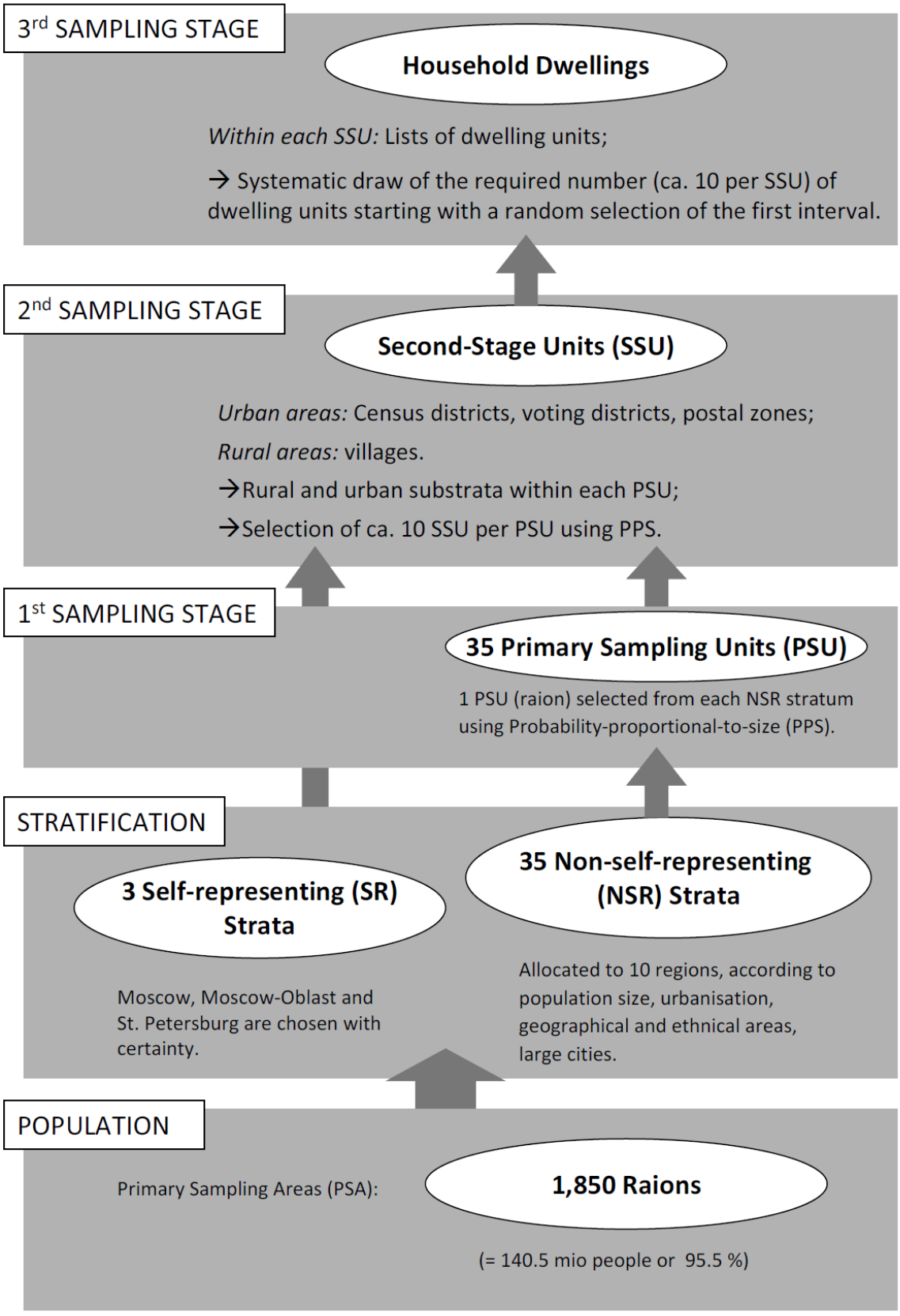
The RLMS actually consists of two different surveys, Phase I and Phase II. The rounds 1 to 4 of the first phase were conducted in the years 1992 and 1993 and had the objective to initialise and, accordingly, to restore monitoring systems for economic, social, and health issues at the household level. Phase II started with its first round (i.e. Round 5) in 1994 and is still ongoing.[7] This second phase placed more focus on "providing timely, high-quality information" (RLMS, 2013a). The following overview concentrates solely on Phase II that is the basis for the upcoming empirical papers in this dissertation as well as in most of all other studies.

The RLMS is basically a sample of households defined as "a group of people who live together in a given domicile, and who share common income and expenditures" (SWAFFORD and KOSOLAPOV, 2002, p.2). Moreover, the survey collects data on the individuals living in the sampled households, as well as characteristics of the communities those households reside in. Technically, the RLMS is a stratified multi-stage probability sample where (almost)[8] "all households and individuals in the Russian Federation had a calculable, non-zero chance of being selected" (SWAFFORD and KOSOLAPOV, 2002, p.2).

Figure 11 gives an overview of the sampling design which SWAFFORD and KOSOLAPOV (2002) describe in more detail. The sampling frame was the census of 1989 and the target sample size was 4,000 households.[9] *Raions* were chosen as the primary sample areas (PSA), which are similar to the US *counties* or the German *Landkreise*. The investigators consolidated the original 2,788 raions where, for instance, independent cities were situated within the borders of a raion or where one large city was divided into several raions. This procedure yielded 2,029 modified raions. Of these, some areas like Kamchatka (very low population density), Chechnya (armed conflict), as well as Kaliningrad and Sakhalin Island were deliberately excluded. The remaining sample comprised 1,850 modified raions with about 140.5 million people representing 95.5 % of the Russian federation's population[10] (SWAFFORD and KOSOLAPOV, 2002).

[7] No surveys were conducted in 1997 and 1999, however.
[8] Institutionalised people, e.g. in the army or in prisons, were not considered.
[9] Since a certain amount of non-responses was expected, especially in large cities, the actual sample size was 4,718 households.
[10] Based on the 1989 census.

Figure 11: The sampling design of the RLMS



***Source*: Own composition based on SWAFFORD and KOSOLAPOV (2002).**

Like many other household surveys, the RLMS uses stratification. This procedure ensures that certain population subgroups are represented with "enough observations to permit estimates for each of these groups" (DEATON, 1997, p.13). Three large areas (Moscow, Moscow Oblast, and St. Petersburg) were given the status as *self-representing* (SR) strata, "i.e. they were put in the sample automatically" (SWAFFORD and KOSOLAPOV, 2002, p.5). All other *non-self-representing* (NSR) PSA were stratified, i.e. they were grouped according to geographical and ethnical criteria, level of urbanisation or their status as big cities. For example, the Volga Basin Region was divided into four strata, namely 1) the Tatar Republic, 2) Oblast centres with more than 900,000 inhabitants (Volgograd, Kuibyshev, and Saratov), 3) all other PSA with an urban population of ≥ 70 %, 4) all other PSA with an urban population of < 70 %. This procedure was similarly applied to the other federal regions resulting in 35 NSR strata of an approximately equal size around 3.4 million people (see Table 6).

Table 6: Allocation of NSR strata to ten geographical regions

	People (1000s)	No. of Strata	Average People in Strata (1000s)
Northern region (plus Kostroma Oblast)	6,928	2	3,464
Northwestern region	3,250	1	3,250
Central region (minus Kostroma Oblast)	13,866	4	3,466
Volga-Viatsky region (plus Penzen Oblast)	9,969	3	3,323
Central Black Earth region (minus South Voronezh Oblast)	6,877	2	3,438
Volga Basin region (minus Astrakhan and Penzen oblasts and Kalmyk)	13,578	4	3,394
North Caucasus region (plus Astrakhan and South Voronezh oblasts and Kalmyk)	17,527	5	3,505
Ural region	20,239	6	3,373
Western Siberian region	13,585	4	3,396
Eastern Siberian and Far East regions	14,063	4	3,516
Total (excluding SR strata)	**119,882**	**35**	**3,425**

***Source*: SWAFFORD and KOSOLAPOV (2002).**

Stratification of a sample serves the purpose of enhancing the sampling estimates' precision. The reason for this improvement is that the fraction of households drawn from each stratum is constant. Thus, the variance of estimates over several replications of the survey depends

only on the sampling variance within the strata caused by different households drawn each time. In contrast, when a simple random sample without stratification is drawn, the fraction of households located in a certain (virtual) stratum also varies and therefore increases the sample variability (DEATON, 1997).

The RLMS further shares a second feature of many household surveys. Often, no reliable and complete list of households or individuals is available for an entire country. In these cases, a common strategy is to apply a two-stage design. On the first stage, clusters are drawn for which such household lists exist or for which they can be (more) easily compiled. In the second stage, the households are finally drawn from these within-cluster lists (DEATON, 1997). The RLMS actually pursues a three-stage strategy that is explained in the following.

In the first sampling stage, one modified raion was drawn as Primary Sampling Unit (PSU) from each NSR stratum. The selection was random and employed the probability-proportional-to-size (PPS) procedure, i.e. the probability that a certain raion was chosen was proportional to the number of its inhabitants. Such a design is called “self-weighting” and ensures that even in the case of two-stage sampling each household’s chance of being selected is equal (DEATON, 1997). Each NSR-PSU was assigned 108 dwelling units on average to be drawn in the next steps (SWAFFORD and KOSOLAPOV, 2002). Figure 12 illustrates the location of the survey sites on a map of Russia. Obviously, most PSU are situated in the European part of Russia which is consistent with the distribution of the country’s population.

At stage two of the selection process, Second-Stage Units (SSU) were drawn from the 35 NSR-PSU as well as from the three SR strata. In urban areas, census or voting districts as well as postal zones constituted the set of SSU, whereas villages served as SSU in rural areas. The selection used PPS again in the rural PSU and in the urban PSU where the SSU were formed by the voting districts. In contrast, those areas where census districts or postal zones were used as SSU, PPS was not necessary, since these are of roughly equal size. About 10 SSU were drawn in the NSR strata, whereas the numbers for the three SR strata were higher (St. Petersburg: 16, Moscow: 26, Moscow Oblast: 19) (SWAFFORD and KOSOLAPOV, 2002).

Figure 12: Map of RLMS, Phase II, survey sites

***Source*: Own illustration based on DEDERING (2013), SWAFFORD and KOSOLAPOV (2002), RLMS (2013g).**

At the final sampling stage, household dwellings were selected from the SSU chosen in Stage 2. For each village, census district, postal zone or voting district, a list of enumerated dwelling units was obtained or established. From these lists, "the required number of dwelling units was drawn systematically, starting with a random selection in the first interval" (SWAFFORD and KOSOLAPOV, 2002, p.12).

3.1.3 Time schedule, response rates, and sample weights

Table 7 shows the time periods of data collection as well as the final number of observations for each round. In most years, the interviews took place from September to December.

Table 7: Time schedule and numbers of observations of RLMS-Phase II

		Numbers of observations		
			Individuals	
	Collection dates	*Households*	*Adults*	*Children*
Round V	11/94 to 12/94	3,975	8,893	2,397
Round VI	10/95 to 12/95	3,783	8,417	2,249
Round VII	10/96 to 12/96	3,750	8,342	2,123
Round VIII	10/98 to 1/99	3,830	8,699	1,976
Round IX	9/00 to 12/00	4,006	9,074	1,901
Round X	9/01 to 12/01	4,528	10,098	2,023
Round XI	9/02 to 12/02	4,668	10,499	2,024
Round XII	9/03 to 12/03	4,718	10,636	2,020
Round XIII	9/04 to 12/04	4,715	10,670	1,981
Round XIV	9/05 to 12/05	4,572	10,337	1,900
Round XV	9/06 to 12/06	5,545	12,491	2,199
Round XVI	9/07 to 12/07	5,427	12,301	2,217
Round XVII	9/08 to 12/08	5,314	11,864	2,164
Round XVIII	9/09 to 12/09	5,331	11,816	2,175
Round XIX	10/10 to 3/11	7,923	17,810	3,533

***Source*: RLMS (2013d;e;f).**

Some caution is necessary regarding the numbers of households and individuals over time that decrease from Round 5 to 7 and increase from then on. The reason is that from Round 7 on, those families that moved away from their dwellings were followed and those families that moved into the dwelling (which are the final and crucial sampling units) were included. Likewise, households that split up into two or more were included as several households in the next round (RLMS, 2013b).

Only those families inhabiting the original sample dwellings are included in the representative cross-sectional sample. Interviewers "returned to each Round-V-dwelling even if the household in the dwelling had refused to participate during previous rounds, and even if they found out that the household whom they interviewed in previous rounds had moved to a new dwelling prior to the interview" (RLMS, 2013c). All moving households can just be used for longitudinal panel analyses (RLMS, 2013b).

The RLMS investigators report response rates for the sample of dwelling units (i.e. without the households that moved and were followed). These were 87.6 % in Round 5, 82.1 % in Round 6, 79.4 % in Round 7, 77.7 % in Round 8, 75.3 % in Round 9, 57.9 % in Round 10, 57.3 % in Round 11, 54.8 % in Round 12, 54.3 % in Round 13, and 50.8 % in Round 14. In each round, over 97 % of the individuals living in the interviewed households responded. The strong decline in response rates from Round 9 to 10 is due to a replacement of the complete sample in Moscow and St. Petersburg because of high attrition rates.[11] The response rates for the sample excluding these two areas are considerably higher also in later rounds. In Round 14, for example, questionnaires were obtained from still 72.2 % of the original dwellings (RLMS, 2013b). As in Round 10 for Moscow and St. Petersburg, the sample was renewed for other big cities because of attrition in Round 15. This is indicated by the rise in observations depicted in Table 7.

Missing information on the actual size of census districts led to slightly unequal probabilities of selection of households in urban areas. Here, the SSU were not sampled using PPS, since the investigators assumed equal district size. This proved to be wrong afterwards. Additionally, response rates across PSU and SSU differed and some urban areas (Moscow and St. Petersburg) were oversampled. To adjust for these drawbacks, design weights are provided together with the data that correct for these effects. Moreover, post-stratification weights adjust the sample observations to match the characteristics of the total population given by census results. Up to Round 12, this adjustment is based on the 1989 census and the micro census of 1994, respectively. A census in 2002 provided new results that were used from Round 13 on (SWAFFORD and KOSOLAPOV, 2002; RLMS, 2013b).

[11] This is mirrored by the increase in observations from Round 10 on, see Table 7.

3.1.4 Content and variables available in the RLMS

The present section aims to briefly illustrate the breadth and variety of variables included in the RLMS data. The overview first presents the household questionnaires, followed by those on individuals and communities.

Household questionnaires

Most of the RLMS waves comprise over 1000 variables for the household level alone that can be categorised as shown in Table 8. A considerable part of these variables is devoted to the *household roster*. The roster comprises the demographic characteristics of each household member and how these persons are related to each other. Furthermore, the interviewers note precisely how the household composition has changed since the last interview.

Table 8: Contents of household questionnaires

- **Household composition**

  Relationships among all members, date of birth, marital status, sex, number of months in family during the last 12 months.

- **Housing conditions**

  Ownership, structure, conveniences, utilities, supplemental housing, possession of consumer durables, sale of durables.

- **Agriculture and animal husbandry**

  Access to land, payment for land, production and disposition of crops and animals

- **Expenditures**

  On food during 7 days, on clothes and major durables for 3 months, on various other items and services for 30 days, savings, transfer payments, and other transfers.

- **Income**

  From all non-wage sources, transfer payments estimate of total wages and total income.

***Source*: RLMS (2013h).**

The second part of the household questions is concerned with the *living conditions* of the family. Households are asked about characteristics of their residence (size, ownership), the utilities that are present (central heating/hot water supply, gas/electricity, sewerage, and telephone), as well as the assets owned by the household (cooking devices, electric equipment like freezer, refrigerator, TV, etc., cars or other vehicles, ownership of a garden

cottage or a dacha). Finally, households should state whether they have sold any of their assets to receive money for food and clothing during the last 3 months.

A third set of questions investigates *farming and animal keeping* activities of the household. Households specify whether and how much land they use, to whom it belongs and whether the family has paid for using the land. A whole series of items queries various crops from potatoes to flowers and whether the family has harvested any of them, how much they harvested and which shares of the harvest were consumed, given away to relatives or others or were sold. A similar set of questions was related to animal products. Finally, families were asked to state their money income from selling those products within 30 days before the interview (RLMS, 2013h).

In the *expenditures* section the households were requested to specify the quantities and the expenditures for 56 food products during the last seven days before the interview. These variables are naturally of particular interest for studies in agricultural and food economics and play a central role in the empirical analyses of this dissertation. Additionally, expenditures for clothes and shoes as well for durables within the last three months before the survey are recorded as well as expenditures for services, housing, utilities, medicine, vacations etc. within the last 30 days. A final set of questions investigates activities related to money lending and saving (RLMS, 2013h).

The last section examines various sources of *family income* like subsidies, gifts from others, labour income, transfers (pensions, stipends, unemployment benefits, etc.), as well as credits, dissaving and selling of shares or other securities (RLMS, 2013h).

Individual questionnaires

The individual questionnaires are even more voluminous as shown by Table 9. Each individual of 14 years and older is interviewed personally. Substitutional answers by others were only given for children.

After having stated their origin and language, individuals answer an extensive set of questions on all possible facets of *working life*. Besides various characteristics of their profession and the enterprises they work in, the family members also provide detailed information on their educational background, self ratings of well-being and social status,

evaluations of society and politics, and reception or arrear of pensions and unemployment benefits.

Table 9: Contents of individual questionnaires

• **Identity** Place of birth, language, ethnic identity.
• **Work, education, and social status** Many aspects of primary and secondary employment; entrepreneurial activity and other independent labor activity; education; unemployment and pensioner status; self-ratings of well-being; status, relationships with others, and satisfaction; employment experience; marital status, evaluation of society and political situation.
• **Medical services** Use of service and of medicines, payment for medical services; insurance.
• **Health assessment** Includes personal service for the handicapped, as well as drinking smoking; medications; drinking water; waste removal; chronic illness; memory test; smoking and drinking; exercise.
• **Women** Child-bearing, miscarriages, abortions, and birth control; plans
• **Time budget** Recall covering one week.
• **Food consumption on the previous day**
• **Measurement of respondent's height, weight, and girth**
• **Children** School attendance and expenses; physical education; reading and video activities; child care arrangements for this child;

***Source*: RLMS (2013h).**

A second part on *medical services* covers issues such as whether the respondent has a medical insurance, whether and where he or she visited a physician during the last 30 days, about the waiting time there, and whether the visit had to be paid for. Moreover, individuals are asked if they stayed at a hospital during the last 3 months, the reasons for hospitalisation, and payments. Other questions are related to medical check-ups and the use of medicine.

The third section gathers information on the *health of individuals*. First, people are requested to state their weight and height, and to give an evaluation of their health status. Then, difficulties to carry out certain activities (running/walking different distances, standing

up from a chair, getting out of bed unaided, climbing stairs, etc.) are recorded. A further issue covered is whether the person took medicines or nutritional supplements. The investigators also requested information on surgical operations, where they were carried out, about their costs and about the treatment afterwards. Subsequently, people are questioned on a whole series of illnesses (diabetes, myocardial infarction, pain in the rib cage, stroke, anaemia, hearing, eyesight, etc.). The interviewers asked about the measures undertaken to treat these illnesses if present.

The part on personal health also includes a memory test as well as some algebra questions. Moreover, some health behaviours of individuals are surveyed. These include whether the person drinks tea, coffee or alcohol and whether he or she smokes but also what kind of physical activities he or she pursues how long and how often. A final set of questions is concerned with ecological issues in the individual's surrounding such as quality of drinking water, air, and trash disposal.

A special section only answered by *women* asks very personal questions on menstruation, pregnancies and births. Women are also asked about their family plans, birth control methods and what kind of medical service and medicines they utilise.

The RLMS also includes questions on the *time use* of individuals. Information is gathered on whether and how much time was spent in the last 7 days for work, commuting, work on the dacha/land plots, purchasing food items, housework, childcare, caring for older people, and sleeping. Although not used in this dissertation, empirical studies employing time-use data are on the rise and the RLMS may be a very interesting data source in this respect.

A *diet section* captures people's food intake via a 24-hour-recall. These data, however, are only available as constructed variables that state the respondent's total energy intake and the share of fat and of proteins therein.

Finally the interviewers conduct *medical measurements* of the individual's height, weight, as well as their waist and thigh circumference. These explicit measures are a great advantage of the RLMS data, since self-stated height and weight in particular are problematic and often exhibit measurement errors.

Community questionnaires

The clustered nature of the RLMS allows the collection of information on the communities where sample households live at relatively low costs (DEATON, 1997). The data are gathered by the interviewers that are responsible for the respective SSU. Table 10 gives an overview of the issues that are covered.

Table 10: Community infrastructure and food prices

- Size and area;
- Rights to land and entrepreneurial use of building;
- Distance from governmental centres and large cities;
- Types of housing available;
- Transportation and community infrastructure;
- Health care facilities;
- Public dining;
- Employment opportunities;
- Educational institutions;
- Banking;
- Fire and police;
- Utilities such as water, sewage, electricity;
- Governmental social support;
- **Prices of approximately 100 food items**.

***Source*: RLMS (2013h).**

Of special interest is the last point concerning prices of approximately 100 food products. The selected stores where prices are collected "shouldn't be expensive stores where the price level is substantially higher than the average prices in this population centre" (RLMS, 2013i). The observers are instructed to select stores that they and their families use themselves (when they live in the survey areas) or that the observed families in the population centre typically use. Observations are made during a certain week. This week is explicitly recorded and available in the data to account for the very high inflation. In the selected stores prices are collected for fixed quantities (e.g. 1 litre or 1 kilogram). Also, observers should collect the lowest and the highest price in case there is more than one product that fits the respective category. The products for which prices are collected cover the whole range of food products from dairy products, meat, meat products, bread, pasta, cereals, sugar, fruits and vegetables, canned foods, chocolate, confectionery, beverages, alcohol, and cigarettes.

3.1.5 Use of RLMS data in scientific studies

The HIGHER SCHOOL OF ECONOMICS (HSE) (2013), a major member of the RLMS working group, lists more than 400 international and a roughly equal number of Russian studies that use RLMS data. This scientific work impressively mirrors the variety and comprehensiveness of the survey.

As expected, the majority of studies focus on issues concerning pressing problems of the Russian Federation during the transition period. A large branch of research examines the situation and changes on labour markets. Here, wage-differentials by gender (e.g. REILLY, 1999), worker flows (GROGAN, 2003) and attachment to work places (e.g. FRIEBEL and GURIEV, 2005), wage arrears (e.g. EARLE and SABIRIANOVA, 2002), returns to education (e.g. GORODNICHENKO and SABIRIANOVA PETER, 2005; CHEIDVASSER and BENITEZ-SILVA, 2007) and moonlighting activities (e.g. GUARIGLIA and KIM, 2004; 2006) are prominent examples.

Also the level of poverty and the dynamics of inequality are subject to several studies (e.g. KLUGMAN and BRAITHWAITE, 1998; MROZ and POPKIN, 1995; LOKSHIN and POPKIN, 1999; GRAHAM, 2002). The changes in social systems are examined with respect to the provision of health care (e.g. BALABANOVA et al., 2003) and the effect of public transfers on the dynamics of poverty (e.g. CLÉMENT, 2007; NOTTEN and GASSMANN, 2008). LOKSHIN and RAVALLION (2008) examine the existence of an economic gradient with respect to health.

The large fluctuations in incomes and the economic turmoil led researchers to investigate the strategies of households to cope with them. GREGORY et al. (1999) for example analyse saving behaviour and the papers of SKOUFIAS (2003), MU (2006), GERRY and LI (2010), LOKSHIN and YEMTSOV (2004) as well as NOTTEN and DE CROMBRUGGHE (2012) analyse consumption smoothing behaviour in Russia.

Apart from the economic changes that Russia has undergone during transition, the country experienced a demographic disaster with life expectancy decreasing tremendously. Many articles thus analyse determinants of mortality and risky behaviours employing RLMS data (e.g. BRAINERD and CUTLER, 2005; PERLMAN and BOBAK, 2008; DENISOVA, 2010). Another demographic issue is the decline in fertility, examined for example by KOHLER and KOHLER (2002) and GROGAN (2006).

Connected to the mortality issue is a broad range of studies that examines health status and health-related behaviours. ZOHOORI (1997), BALTAGI and GEISHECKER (2006), TAPILINA (2007),

TREISMAN (2010) analyse patterns and determinants of drinking behaviour. MCKEE et al. (1998), OGLOBIN and BROCK (2003) as well as LANCE et al. (2004) study patterns of smoking and factors that influence smoking decisions. Issues of diet and nutritional status are e.g. examined by KOHLMEIER et al. (1998), DORE et al. (2003), and JAHNS et al. (2003). STILLMAN and THOMAS (2008) analyse nutritional status during the economic crisis in 1998. Moreover, LEVIN et al. (1999) examine physical activity as health determinants.

Some studies address the result of unbalanced diet and activity: overweight and obesity. HUFFMANN and RIZOV (2007) analyse general determinants. DOAK et al. (2000) as well as DOAK et al. (2005) set the rise in obesity that is also spreading over developing and transition countries in an international context.

A final set of studies uses the variables on self-rated social and economic status as well as on life satisfaction to analyse subjective well-being of Russians (e.g. NAZAROVA, 2008; GRAHAM and PETTINATO, 2002; RICHTER, 2006; EGGERS et al., 2006; FRIJTERS et al., 2006).

3.1.6 Use of RLMS data in the empirical analyses of this thesis

The present chapter on the design and scope of the Russia Longitudinal Monitoring Survey illustrated the possibilities provided by these data. The richness of the variables enables researchers to analyse the effects of the "natural experiment" (MROZ and POPKIN, 1995) taking place in transitional Russia on multiple outcomes.

Some features are especially valuable for the kind of studies conducted in this dissertation. There is first of all the unique composition of variables. Individual weight and height is measured allowing to compute each participant's Body Mass Index. The BMI serves as dependent variable in Section 3.2 and as classification criterion in Section 3.3. Household income or total expenditure are used on the one hand to determine their impact on BMI (Section 3.2) and on food consumption (Sections 3.3 and 3.4) as well as to stratify and characterise population subgroups. The detailed information about both household expenditure and purchased quantities of single food items was very helpful for the analyses of Russian food consumption patterns in Sections 3.3 and 3.4.

The detailed food prices collected at typical stores were used in Section 3.2 for the analyses of price effects on body weight and obesity. A clear advantage is that these prices are arguably exogenous and represent precisely those prices that the interviewed households

have to pay at their community. Thus, this data source provides unique price data that help to overcome two major critical points in other comparable studies which are the possible endogeneity of unit values or prices that apply to large areas (e.g. the state level in the US). During the work on the demand system analysis in Section 3.4, we were confronted with a drawback that arose from the choice of food products for which prices were collected. This list of products deviates considerably from those products for which quantities and expenditure are reported and forced us to apply the unit value approach in STAUDIGEL and SCHRÖCK (2014).

Besides those core variables I employ many variables more to account for individual characteristics (like age, sex, education, employment status, marital status), the impact of household composition and characteristics (e.g. assets like refrigerators, freezers or a car as well as whether households own and cultivate of land) and finally community characteristics that may be relevant for health and nutrition behaviour (presence of restaurants, food stores, and sport facilities).

In addition to the broad range of variables from one single source - something many other studies lack - a further advantage of the RLMS is the longitudinal nature of the data allowing the application of panel-data methods. As pointed out in Chapter 2.5, the estimates on the determinants of body weight received by cross-sectional models are often flawed by confounding. The ability to conduct fixed-effects regressions is a clear improvement to this.

References

BALABANOVA, D. C., J. FALKINGHAM and M. MCKEE (2003): Winners and Losers: Expansion of Insurance Coverage in Russia in the 1990s. *American Journal of Public Health* **93**, 2124-2130.

BALTAGI, B. H. and I. GEISHECKER (2006): Rational Alcohol Addiction: Evidence from the Russia Longitudinal Monitoring Survey. *Health Economics* **15**, 893-914.

BRAINERD, E. and D. M. CUTLER (2005): Autopsy on an Empire: Understanding Mortality in Russia and the Former Soviet Union. *Journal of Economic Perspectives* **19**, 107-130.

CHEIDVASSER, S. and H. BENITEZ-SILVA (2007): The Educated Russian's Curse: Returns to Education in the Russian Federation during the 1990s. *Labour* **21**, 1-41.

CLÉMENT, M. (2007): Tentative Evaluation of the Impact of Public Transfers on the Dynamics of Poverty: The Case of Russia. *International Social Security Review* **60**, 59-80.

DEATON, A. (1997): The Analysis of Household Surveys: A Microeconometric Approach to Development Policy. Published for the Worldbank. Baltimore: The John Hopkins University Press.

DEDERING, U. (2013): Location Map of Russia. Available online at: http://wiki.verkata.com/de/wiki/Datei:Russia_edcp_location_map.svg. Accessed: 04.04.2013.

DENISOVA, I. (2010): Adult mortality in Russia. *Economics of Transition* **18**, 333-363.

DOAK, C. M., L. S. ADAIR, C. MONTEIRO and B. M. POPKIN (2000): Overweight and Underweight Coexist within Households in Brazil, China and Russia. *Journal of Nutrition* **130**, 2965-71.

DOAK, C. M., L. S. ADAIR, M. BENTLEY, C. MONTEIRO and B. M. POPKIN (2005): The Dual Burden Household and the Nutrition Transition Paradox. *International Journal of Obesity* **29**, 129-136.

DORE, A. R., L. S. ADAIR and B. M. POPKIN (2003): Low Income Russian Families Adopt Effective Behavioral Strategies to Maintain Dietary Stability in Times of Economic Crisis. *Journal of Nutrition* **133**, 3469-3475.

EARLE, J. and K. SABIRIANOVA (2002): How Late to Pay? Understanding Wage Arrears in Russia. *Journal of Labor Economics* **20**, 661-707.

EGGERS, A., C. GADDY and C. GRAHAM (2006): Well-Being and Unemployment in Russia in the 1990s: Can Society's Suffering Be Individuals' Solace? *Journal of Socio-Economics* **35**, 209-242.

FRIEBEL, G. and S. GURIEV (2005): Attaching Workers through In-Kind Payments: Theory and Evidence from Russia. *World Bank Economic Review* **19**, 175-202.

FRIJTERS, P., I. GEISHECKER, J.P. HAISKEN-DENEW and M.A. SHIELDS (2006): Can the Large Swings in Russian Life Satisfaction Be Explained by Ups and Downs in Real Incomes? *Scandinavian Journal of Economics* **108**, 433-458.

GERRY, C. and C. LI (2010): Consumption Smoothing and Vulnerability in Russia. *Applied Economics* **42**, 1995-2007.

GORODNICHENKO, Y. and K. SABIRIANOVA PETER (2005): Returns to Schooling in Russia and Ukraine: A Semiparametric Approach to Cross-Country Comparative Analysis. *Journal of Comparative Economics* **33**, 324‑350.

GRAHAM, C. (2002): Mobility, Opportunity and Vulnerability: The Dynamics of Poverty and Inequality in a Global Economy. *Journal of Human Development and Capabilities* **3**, 57-94.

GRAHAM, C. and S. PETTINATO (2002): Frustrated Achievers: Winners, Losers, and Subjective Well Being in New Market Economies. *The Journal of Development Studies* **38**, 100-140.

GREGORY, P.R., M. MOKHTARI and W. SCHRETTL (1999): Do the Russians Really Save That Much?- Alternate Estimates from the Russian Longitudinal Monitoring Survey. *The Review of Economics & Statistics* **81**, 694-703.

GROGAN, L. (2003): Worker Flows in Russian Economic Transition: Longitudinal Evidence from Four Cities. *Economic Development and Cultural Change* **51**, 399-425.

GROGAN, L. (2006): An Economic Examination of the Post-Transition Fertility Decline in Russia. *Post-Communist Economies* **18**, 363-397.

GUARIGLIA, A. and B.-Y. KIM (2004): Earnings Uncertainty, Precautionary Saving, and Moonlighting in Russia. *Journal of Population Economics* **17**, 289-310.

GUARIGLIA, A. and B.-Y. KIM (2006): The Dynamics of Moonlighting in Russia: What Is Happening in the Russian Informal Economy? *Economics of Transition* **14**, 1-45.

HIGHER SCHOOL OF ECONOMICS (2013): Publications based on RLMS data. Available online at: http://www.hse.ru/rlms/publ_all. Accessed 11.04.2013.

HUFFMAN, S. K. and M. RIZOV (2007): Determinants of Obesity in Transition Economies: The Case of Russia. *Economics and Human Biology* **5**, 379-931.

JAHNS, L., A. BATURIN and B. M. POPKIN (2003): Obesity, Diet, and Poverty: Trends in the Russian Transition to Market Economy. *European Journal of Clinical Nutrition* **57**, 1295-302.

KLUGMAN, J. and J. BRAITHWAITE (1998): Poverty in Russia During the Transition: An Overview. *World Bank Research Observer* **13**, 37-58.

KOHLER, H.P. and I. KOHLER (2002): Fertility Decline in Russia in the Early and Mid 1990s: The Role of Economic Uncertainty and Labour Market Crises. *European Journal of Population* **18**, 233-262.

KOHLMEIER, L., M. MENDEZ, S. SHALNOVA et al. (1998): Deficient Dietary Iron Intakes among Women and Children in Russia: Evidence from the Russian Longitudinal Monitoring Survey. *American Journal of Public Health* **88**, 576-580.

LANCE, P.M., J.S. AKIN, W.H. DOW and C.-P. LOH (2004): Is Cigarette Smoking in Poorer Nations Highly Sensitive to Price? Evidence from Russia and China. *Journal of Health Economics* **23**, 173-189.

LEVIN, S., B.E. AINSWORTH, C.W. KWOK, C.L. ADDY and B.M. POPKIN (1999): Patterns of Physical Activity among Russian Youth: The Russian Longitudinal Monitoring Survey. *European Journal of Public Health* **9**, 166-173.

LOKSHIN, M. and B.M. POPKIN (1999): The Emerging Underclass in the Russian Federation: Income Dynamics 1992-96. *Economic Development and Cultural Change* **47**, 803-829.

LOKSHIN, M. and R. YEMTSOV (2004): Household Strategies for Coping with Poverty and Social Exclusion in Post-Crisis Russia. *Review of Development Economics* **8**, 15-32.

LOKSHIN, M. and M. RAVALLION (2008): Testing for an Economic Gradient in Health Status Using Subjective Data. *Health Economics* **17**, 1237-1259.

MCKEE, M., M. BOBAK, R. ROSE et al. (1998): Patterns of Smoking in Russia. *Tobacco Control* **7**, 22-26.

MROZ, T. and B.M. POPKIN (1995): Poverty and the Economic Transition in the Russian Federation. *Economic Development and Cultural Change* **44**, 1-31.

MU, R. (2006): Income Shocks, Consumption, Wealth, and Human Capital: Evidence from Russia. *Economic Development and Cultural Change* **54**, 857-892.

NAZAROVA, I. B. (2008): Labor Market Participants: Structure and Sense of Well-Being. *Sociological Research* **47**, 33-65.

NOTTEN, G. and D. DE CROMBRUGGHE (2012): Consumption Smoothing in Russia. *Economics of Transition* **20**, 481-519.

NOTTEN, G. and F. GASSMANN (2008): Size matters: poverty reduction effects of means-tested and universal child benefits in Russia. *Journal of European Social Policy* **18**, 260-274.

OGLOBIN, C. and G. BROCK (2003): Smoking in Russia: The 'Marlboro Man' Rides but without 'Virginia Slims' for Now. *Comparative Economic Studies* **45**, 87-103.

PERLMAN, F. and M. BOBAK (2008): Socioeconomic and Behavioral Determinants of Mortality in Posttransition Russia: A Prospective Population Study. *Annals of Epidemiology* **18**, 92-100.

REILLY, B. (1999): The Gender Pay Gap in Russia during the Transition, 1992-96. *Economics of Transition* **7**, 245-264.

RICHTER, K. (2006): The Well-Being of the Elderly and Wage Arrears in Russia. *Journal of the European Economic Association* **4**, 116-152.

RLMS (2013a): About the Study. Available online at: http://www.cpc.unc.edu/projects/rlms-hse/project/study. Accessed 02.04.2013.

RLMS (2013b): Frequently Asked Questions. Available online at: http://www.cpc.unc.edu/projects/rlms-hse/data/documentation/faq. Accessed 02.04.2013.

RLMS (2013c): Sampling Overview. Available online at: http://www.cpc.unc.edu/projects/rlms-hse/project/sampling. Accessed 02.04.2013.

RLMS (2013d): Survey Schedule. Available online at: http://www.cpc.unc.edu/projects/rlms-hse/project/scheduling. Accessed 02.04.2013.

RLMS (2013e): Household Data. Available online at: http://www.cpc.unc.edu/projects/rlms-hse/data/documentation/householddata. Accessed 02.04.2013.

RLMS (2013f): Individual Data. Available online at: http://www.cpc.unc.edu/projects/rlms-hse/data/documentation/individualdata. Accessed 02.04.2013.

RLMS (2013g): Map of Phase II. Available online at: http://www.cpc.unc.edu/projects/rlms-hse/project/phase2. Accessed 04.04.2013.

RLMS (2013h): Project overview: Procedures. Available online at: http://www.cpc.unc.edu/projects/rlms-hse/project/project-overview/view. Accessed 09.04.2013.

RLMS (2013i): Community Questionnaire, Round 8. Available online at: http://www.cpc.unc.edu/projects/rlms-hse/data/questionnaires/r8comm.pdf. Accessed 11.04.2013.

SKOUFIAS, E. (2003): Consumption Smoothing in Russia. *Economics of Transition* **11**, 67-91.

STAUDIGEL, M. and R. SCHRÖCK (2014): Food Demand in Russia – Heterogeneous Consumer Segments over Time. Accepted for Publication in *Journal of Agricultural Economics*.

STILLMAN, S. and D. THOMAS, D. (2008): Nutritional Status during an Economic Crisis: Evidence from Russia. *The Economic Journal* **118**, 1385-1417.

SWAFFORD, M.S. and M.S. KOSOLAPOV (2002): Sample Design, Response Rates, and Weights in The Russia Longitudinal Monitoring Survey, Rounds 5 to 10: An Abbreviated Description. Unpublished Technical Report, Paragon Research International, Inc. and Institute of Sociology of the Russian Academy of Sciences, May 2002.

TAPILINA, V. S. (2007): How Much Does Russia Drink: Volume, Dynamics and Differentiation of Alcohol Consumption. *Russian Social Science Review* **48**, 79-94.

TREISMAN, D. (2010): Death and Prices: The Political Economy of Russia's Alcohol Crisis. *Economics of Transition* **18**, 281-331.

ZOHOORI, N. (1997): Recent Patterns of Alcohol Consumption in the Russian Elderly, 1992-1996. *American Journal of Clinical Nutrition* **66**, 810-814.

3.2 How (much) do food prices contribute to obesity in Russia?

by Matthias Staudigel

Published in *Economics and Human Biology* **9** (2011), 133-147, reprinted with kind permission from Elsevier.
Original publication available at: http://dx.doi.org/10.1016/j.ehb.2010.11.001

How (much) do food prices contribute to obesity in Russia?

Abstract

High BMI and obesity contribute to the Russian health crisis. Previous studies have shown that weight status varies along socioeconomic lines but remains largely unaffected by economic shocks over time. This study is the first that explicitly analyses the impact of food prices on adult BMI and obesity in the Russian Federation. Using panel data from the Russia Longitudinal Monitoring Survey from 1994 to 2005, that included 10.551 urban respondents over 18 years, a reduced form weight demand function is estimated. Controlling for individual heterogeneity by a fixed-effects model, price-weight elasticities are derived. The main result is that food prices are not the essential determinants of BMI and obesity in Russia. Elasticities of BMI with respect to single food prices are low and show absolute values smaller than 0.01. However, some products like chicken meat, milk, onions and butter show significant price effects on body mass. A 20 % increase in the price of chicken meat would cause a reduction in body weight of 112 g on average. In contrast to the United States, it is mainly high-income households that show significant weight reactions to food prices in Russia. Separate regressions by gender showed significant effects of milk and butter prices on male BMI and of onion prices on female BMI. The risk of being obese is even less affected by price.

Keywords: Russia; Obesity; BMI; Food Prices; Fixed-Effects Model.

1 Introduction

Overweight, obesity and related diseases play a major role in the Russian health crisis. The average life expectancy of 65 years in 2003 was 14 years below the average in EU countries. Cardiovascular diseases, accidental injuries, serious neuropsychiatric conditions and many other factors led to a life expectancy for men of only 58 years compared with 72 for women (WHO, 2005). High Body Mass Index (BMI)[1], high blood pressure, and high cholesterol levels are among the leading risk factors causing disease. Globally, the Commonwealth of

[1] BMI (Body Mass Index) is defined as weight in kg divided by height in m squared. Individuals with a BMI>25 are classified as overweight and individuals with a BMI>30 are classified as obese.

Independent States reveals one of the highest levels of obesity related disease (Knai et al., 2007). From 1992 to 2000 the number of overweight Russians remained constant but the proportion of obese people increased (Jahns et al., 2003). In 2002, 31.5 % of adult Russians were overweight (males 33.4 %, females 29.9 %) and 21.1 % were obese. Russian women reveal remarkably higher rates of obesity (28.1 %) than men (12.7%) (WHO, 2005).

Bearing in mind that the traditional Russian diet consists largely of foods high in fat and energy as well as alcohol, these figures do not seem surprising. However, the years of transformation entailed a dramatic decline and restructuring of agricultural production, increasing foreign trade and economic shocks like the ruble crisis in 1998 (Sedik et al., 2003). This raises the question whether, and to what degree, economic factors have influenced the nutrition and body weight of the Russian population. So far, the literature has identified two main points.

Firstly, studies provide empirical evidence that the availability of food energy remained nearly constant (Sedik et al., 2003; Ulijaszek and Koziel, 2007). Generally, most Russian households have coped with economic hardship by adopting appropriate strategies to lower the costs of per capita energy intake. For example, they shifted their diet from animal products to starches or increased the preparation of foods at home (Jahns et al., 2003; Mroz and Popkin, 1995). Thus, short-term fluctuations in income are not likely to have an immediate impact on nutritional status measured in BMI or energy intake; it is mainly the longer-term resources of households that are crucial (Stillman and Thomas, 2008).

Accordingly, the extent to which households reacted (and were able to react) and the extent to which nutritional outcomes like weight status have been influenced vary along socioeconomic lines (Shkolnikov et al., 1998). Given increasing economic inequality (Lokshin and Popkin, 1999), it is predominantly households with children and handicapped or unemployed members who suffer economic hardship resulting in malnutrition (Mroz and Popkin, 1995). Several studies report an income gradient for the intake of energy, food groups and weight status. Based on the Russia Longitudinal Monitoring Survey (RLMS), Jahns et al. (2003) find that the development of energy intake and overweight differs by income for men but not for women. Obesity increased among women from all income groups, whereas it increased among men only within the high-income group. Investigating the food situation of Russian children over time, Dore et al. (2003) find less consumption of meat and poultry as well as a constant energy intake for children in low-income households. In

contrast, children from high-income families consumed more eggs and dairy products and their energy intake increased. Additionally, they also reported larger shifts to home production for lower income households. However, different reactions to economic conditions occur not only between but also within households, leading to the possible coexistence of underweight and overweight (Doak et al., 2000). Such patterns are a "result of intra-household food distribution or cohort differences in the acceptability and desirability of specific foods" in the course of nutrition transition (Popkin, 1994) that first occurs in urban high-income households.

Only a small number of studies examine the role of price as an economic parameter affecting overweight and obesity in the Russian Federation. However, the work of Philipson and Posner (2003), Cutler et al. (2003) and Lakdawalla and Philipson (2009) has linked the global rise in obesity to lower food prices resulting from technological change. Especially in the case of Russia, it seems worthwhile to examine food prices. Russian regions "vary substantially in geography, economic development, public resources and health indicators" (Mroz and Popkin, 1995), and prices and market baskets differ across regions. Moreover, economic change, restructured agricultural production and international commodity trade have influenced the relative price structure in the course of time, which is most likely to impact nutrition and body weight.

Huffman and Rizov (2007) examine the effects of diet and other demographic and economic variables on obesity in Russia for the years 1994 and 2004. They find a strong positive effect of diet/calorie intake on weight and BMI. Further results show big changes in the consumption of many foods. The authors expect "that Russian households have responded to income and price shocks by shifting the composition of their diets toward cheaper foods as the households in other transition economies did." Support for the price sensitivity of Russians is provided by Honkanen and Frewer (2009) who state that "price is an important factor" in Russian consumers' motives for food choice. Additionally, they find that price-sensitive consumers have the least healthy choice of food.

However, no-one has yet undertaken a study that investigates the explicit impact of food prices on overweight and obesity in the Russian Federation. The present paper aims to fill this gap by estimating a reduced-form demand function for BMI and obesity. The key regressors are prices for the most important food products controlled for individual, household, and community characteristics. The use of longitudinal data from the RLMS

enables us to employ panel data methods to control for possible individual fixed effects. Given the differences between obesity in women and men, separate estimates by gender are presented. The paper proceeds as follows. Section 2 provides the theoretical framework; Section 3 presents the data set and describes the development of prices over time; Section 4 presents the regression results; Section 5 discusses these results and draws conclusions.

2 Theoretical Background

To model the relationship between food prices and body weight, this study draws on Becker's (1965) household production theory. This concept has been widely used and adapted to health and also weight issues (see e.g. Chen et al., 2002; Cawley, 2004; Schroeter et al., 2008; Powell, 2009). Based on utility maximization and resulting marginal costs and benefits, demand equations for body weight are derived that specify individual behaviour and its outcomes depending on market prices, environmental factors and household assets and characteristics as well as individual abilities and characteristics.

Equation (1) depicts a resulting health demand function in a commonly used form:

(1) $H = h(p, X, Z, C; \Omega)$,

where *H* is individual health status (body weight in this case), depending on a vector of food prices p, individual characteristics X, household characteristics Z, and characteristics of the environment *C*. Ω stands for factors that contribute to body weight but could not be or have not been observed (e.g. metabolism, genetics, motivation, abilities, community tradition).

The focus in this study is on the effect of food prices on body weight. When modelling and interpreting these effects, it is crucial to discuss issues of substitution and price response. Price coefficients derived from the reduced-form equation in (1) only provide information on the direct impact of a change in the price of food product *j* on the change in body weight. However, any interpretation should, of course, consider that this particular price change does not only affect consumption of the respective product. Rather, a number of substitutive and complementary processes have to be taken into account. This is emphasized by Chen et al. (2002), who split the direct impact of a change in the price of food item *j* (dP_j) on the change of health (weight) status (dH) according to equation (2).

(2) $$\frac{dH^*}{dP_j} = \sum_{i=1}^{k} \left(\frac{dH}{dF_i} \frac{dF_i}{dP_j} \right).$$

Hence, a more detailed view should include firstly the marginal effect of P_j on consumption of the food item *i* (F_i) and secondly the marginal effects of consumption of food *i* on health (weight) (dH/dF_i). As a result, predicting and analysing price effects on BMI becomes much more complex. Moreover, as Schroeter et al. (2008) show, the strength and the relative energy density of substitutes and complements are of great importance. When the price of doughnuts rises but not that of cinnamon rolls, which are equally energy dense, then "the large degree of substitutability would imply little or no reduction in weight." Similarly, decreases in the price of fruit and vegetables lower BMI, not because people eat more fruit and vegetables but because they move away from more energy-dense foods.

However, one could also imagine that if people's diet consists of an energy-dense base (e.g. meat and starches) decreasing prices for fruit and vegetables would lead to eating more of them in addition to the base, yet with total calories remaining nearly constant. Finally, multiple prices affect eating behaviour in concert. A simultaneous price rise in energy-dense products might cause a higher reduction in body weight than if one product became more expensive. But how do we integrate these aspects in reduced-form BMI equations?

The design and implementation of price variables used in earlier studies that estimate price-weight (nutrition) relationships vary substantially. Some use general indices for real food prices (Mazzocchi and Traill, 2007); others include a real price index for non-foods (Huffman et al., 2010) or separate indices for food items prepared at home and for food away from home (Schroeter and Lusk, 2007). More detailed analyses focus on special food items. Chou et al. (2004) use the price of food at home and add prices in full-service restaurants, fast-food restaurants and the price of cigarettes (as a substitute for eating), as well as the price of alcohol. Sturm and Datar (2005) apply four price indices for fruit and vegetables, meat, dairy and fast-food. Powell (2009), as well as Powell and Bao (2009), includes indices for fruit and vegetables and for fast-food. Finally, Gelbach et al. (2007) argue that it is not only lower prices of food as a whole that are partly responsible for overweight but also a stronger decrease in the prices of unhealthy foods compared with healthy foods, and consequently they include a ratio between two price indices, one for healthy and one for unhealthy foodstuffs. The present analysis takes into account substitutive effects as well as effects of

multiple prices by testing price ratios and interactions for specific prices. Section 3.4 presents price movements on which hypotheses for interactions and ratios are established.

3 Data

3.1 Russia Longitudinal Monitoring Survey

The Russia Longitudinal Monitoring Survey (RLMS) has been implemented to measure the impact of the transition and accompanying reforms on living conditions in the Russian Federation. It consists of a series of repeated cross-section surveys that collect detailed data on, for example, individual health and nutrition, expenditures, assets and sociodemographic characteristics of households as well as community-level food prices and infrastructure.

The present analysis uses data from the ten Phase II Rounds 5 to 14 covering the years 1994 to 2005.[2] In order to get a nationally representative sample, the RLMS was designed as a stratified three-step cluster sample. Households were the target units, defined as a group of people “dwelling together and sharing a common budget (Zohoori et al., 1998)”. In each of the eight federal regions, the basis for the number of primary sampling units (PSU) was the level of urbanization.[3] Within each of the 38 PSU that were finally selected, the population was stratified into urban and rural substrata, and initially the target sample size was allocated proportionately. However, to partially offset potential bias because of non-response over the years emerging from attrition in the urban areas, these have been slightly over-sampled (Jahns et al., 2003). Round 5, the first Phase II survey, was self-weighting, but the following surveys used post-stratification weights adjusted to the 1989 census and the 1994 micro-census. Starting with Round 13, the investigators used the 2002 census results to calculate the post-stratification weights (RLMS, 2010).

Random sampling error and changes in the distribution since the 1989 census naturally hinder perfect correspondence. Nevertheless, there is usually a difference of only one percentage point or less between the two distributions. However, comparison of the RLMS sample with the micro-censuses of 1994 and 1997 still showed quite similar prevalence of

[2] Altogether Phase II includes waves 5 to 17 that were conducted in the last quarter of 1994, 1995, 1996 and 1998 and from 2000 to 2008 respectively. In 1997 and 1999, no surveys were conducted.

[3] Three very large population units were assured of selection: Moscow city, Moscow Oblast and St. Petersburg city each constituted a self-representing (SR) stratum. The remaining raions (counties), which were not self-representing (NSR), were allocated to 35 strata of roughly equal size. One raion was then selected from each NSR stratum using the method "probability proportional to size" (PPS). That is, the probability that a raion in a given NSR stratum was selected was directly proportional to its measure of population size (RLMS, 2010).

various sizes of urban and rural households as well as age, gender and education (Heeringa, 1997; Swafford and Kosolapov, 2002; Jahns et al., 2003). From Round 7 onwards, the RLMS, in anticipation of a supplementary follow-up study, started whenever possible to gather data on households that had moved to new addresses (RLMS, 2010). Due to high attrition, the Moscow and the St. Petersburg sample in Round 10 was replaced by a new sample and, starting with 2001, the Moscow and St. Petersburg observations from the 1994 sample have been excluded from the cross-sectional RLMS sample (RLMS, 2010). They still, however, remained in the follow-up addresses and can be used for longitudinal analysis.

Some critical issues emerge from the attempt to conduct a longitudinal analysis using RLMS. Only the (weighted) cross-sections are nationally representative, but there is a longitudinal component that allows a panel to be created that consists of those households that have been interviewed in two or more consecutive rounds. These longitudinal data show what has happened to households and individuals with given characteristics over time. Such an analysis is based on households that 1) were in the original sample and were interviewed for two or more rounds, 2) were in the original sample, moved away, but were still interviewed at their new place of residence, 3) moved into sampled addresses and answered several rounds. Estimated parameters from this kind of panel could possibly be due to selection bias when the reasons for moving or non-response are correlated with the depending variable (Heeringa, 1997) or old and new households differ significantly in their characteristics and behaviour (Stillman and Thomas, 2008). A sensitivity analysis in Section 4.4 assesses whether coefficients change due to panel dynamics.

Finally, the RLMS contains post-stratification weights for unbiased (e.g. nationally representative) estimation of descriptive statistics for cross-sections. However, the present analysis does not use sample weights as it is longitudinal and includes follow-up households from the non-cross-sectional part who have sample weights zero (RLMS, 2010).[4]

[4] Heeringa (1997) points out that there "…is considerable debate over the value of using weights in multivariate analysis. Some statisticians argue that using weights is not necessary if the fixed effects that explain the variation in weights are included in the model. In RLMS data, the household characteristics that explain the greatest variation in weights are the geographic region and the urban/rural character of the civil division in which the dwelling is located. Variation in individual weights will reflect the geographic effects for households as well as differentials due to post-stratification of the sample by major geographic regions, age, and sex".

3.2 Description of the Sample

The panel used in the analysis comprises ten rounds (5 to 14) of the RLMS with a total of 25,008 respondents. Of these, 18,701 were interviewed in at least two consecutive rounds. As the analysis concentrates on the adult population, children below 18 years are excluded. Also those households that live in rural areas are excluded from the analysis below, as farmers (the majority of households in rural areas are farmers) are most likely not to be affected by price fluctuations in their usual diet because they rely on home-produced goods. After a purge of missing and implausible values, the analytical sample includes 10,551 respondents and 56,311 person-year observations. About 19 % of the respondents were interviewed in two waves, 17 % in three, 13 % in four, 10 % in five, 8 % in six, 8 % in seven, 6 % in eight, 7 % in nine, and 13 % in all 10 waves. Table A1 in the Appendix shows summary statistics for the full sample as well as for those respondents interviewed in Round 5. Both groups show quite similar statistics. There are about 43 % males in Round 5 and 42 % in the full sample and the mean BMI is around 26.1. A shift can be observed between the groups of the overweight and the obese. Whereas in Round 5 34 % were overweight and 19 % obese, the full sample shows 32 % overweight and 21 % obese. This is in line with the findings cited above, namely that the obese group recruited new members out of the overweight group. Differences also occur in terms of education. The full sample includes more individuals with higher education and fewer with lower education, partially due to attrition. Another major difference is that the share of respondents from Moscow and St. Petersburg is higher in the full sample, which may be due to the replacements in the sample in Round 10.

3.3 Dependent variables: BMI and obesity

Table 1 depicts the mean BMI and the prevalence of obesity over time and by gender. Mean body mass varies only a little for both men and women, indicating that energy intake and weight do not on average react strongly to economic shocks. In contrast, the variation in obesity rates appears to be larger. The share of obese women first increased from 1994 to 1998, before falling back to the initial level and then increasing again to 2005. Male obesity rates rose continuously by nearly a half from 10 % in 1994 to almost 15 % in 2005.[5] These

[5] Of course, the longitudinal nature of the data may cause an overestimation of the increase in obesity and BMI, when weight is a positive function of age. But as it is not a pure panel, these effects might be dampened by replenishment to some degree.

differences in both level and development raise the question whether men's and women's price reactions also differ and will be subject to analysis in the empirical section.

Table 1: Development of BMI and obesity rate from 1994 to 2005 in total and by gender

	Mean BMI			Percentage obese		
Year	Female	Male	Total	Female	Male	Total
1994	26.87	25.05	26.09	26.0%	10.2%	19.3%
1995	26.75	24.91	25.96	25.8%	10.0%	19.1%
1996	26.90	25.11	26.15	27.2%	10.9%	20.3%
1998	26.83	24.99	26.04	27.4%	10.4%	20.1%
2000	26.74	24.91	25.96	26.6%	11.0%	19.9%
2001	26.63	25.04	25.95	26.0%	12.0%	20.1%
2002	26.87	25.21	26.16	27.8%	12.8%	21.4%
2003	26.84	25.29	26.18	27.8%	13.5%	21.8%
2004	26.91	25.32	26.23	27.9%	13.7%	21.8%
2005	27.08	25.51	26.42	29.2%	14.6%	23.1%

Source: RLMS, 1994-2005.

Table 2: Development of BMI and obesity rate from 1994 to 2005 by income tertile

	Mean BMI			Percentage obese		
Year	Low	Medium	High	Low	Medium	High
1994	25.73	26.51	26.12	17.5 %	22.0 %	18.6 %
1995	25.45	26.47	26.09	16.3 %	23.0 %	18.5 %
1996	25.66	26.44	26.46	17.6 %	22.3 %	21.4 %
1998	25.62	26.45	26.16	18.3 %	22.4 %	20.0 %
2000	25.58	26.28	26.11	18.3 %	21.9 %	20.0 %
2001	25.56	26.30	26.09	18.7 %	21.6 %	20.3 %
2002	25.77	26.43	26.36	19.4 %	23.3 %	22.0 %
2003	25.88	26.45	26.30	19.6 %	24.1 %	22.1 %
2004	25.84	26.51	26.45	19.6 %	23.5 %	22.9 %
2005	26.06	26.59	26.72	20.9 %	24.6 %	24.6 %

Source: RLMS, 1994-2005.

As shown by Table 2, weight generally rises in line with income in Russia. People in the bottom income tertile reveal lower BMI than in the medium or top tertiles and are less likely to be obese. In the course of time, the top tertile experienced considerably stronger increases in BMI and obesity. Hence, the empirical section will examine whether poor and rich households also react differently to changes in the price of food.

3.4 Price variables

The RLMS collects the prices of about 90 food products at the community level. In case there are products of the same sort that have different prices, the interviewers were instructed to report the lowest and the highest price.[6] The final price variables were derived following a

[6] As prices are collected in a typical shop at each location, transport costs, taxes, margins, etc., are already included. This is important for the analysis, as they represent those prices actually experienced by consumers.

procedure that is used by the RLMS investigators.[7] First, prices were deflated using the monthly consumer price index for food (2005=100) in the Russian Federation, that is provided by Goskomstat and is available on the statistics database of the OECD (2010). Next, the average of the highest and the lowest price of one product was taken. Where price values were missing, the following rule was applied: 1) if prices for one community are missing, take the median within the PSU, 2) if there is no value for the PSU, take the median within the federal region, 3) if there is no median for the region either, take the median of the whole sample.[8]

Table A2 in the Appendix lists the available prices which are quite numerous. The present analysis focuses on the prices of the 20 most important food products, that were selected applying the following criteria.[9] Those products were chosen that firstly were purchased by the largest number of households and secondly accounted for a high proportion in terms of quantity and expenditure. Summary statistics of the price variables are provided in Table A3.

Showing price developments from 1994 to 2005, Figure A1 in the Appendix confirms that food prices have shifted substantially in the course of time. The ruble crisis in 1998 in particular caused both a considerable drop in prices (bread, flour, milk, meat) and a substantial increase (tobacco, fruits, vegetables, butter, vegetable oils). Longer-term upward trends have been experienced by the prices of milk, tobacco and vodka, the latter probably caused by tax hikes. The price of pork and beef also went up, in contrast to chicken, whose price fell slightly over the whole period. Clear downward trends can be observed for butter, vegetable oil, vegetables and confectionery.

Sugar and fats like vegetable oils and butter are especially interesting in relation to overweight and obesity. An enormous decline in sugar and vegetable oil prices from 1994 to 1996 was followed by a nearly symmetrical increase, and then prices dropped again up to 2005 (with a small increase around 2002). Additionally, the price of butter fell over time, implying that the cost of purchasing energy dense food high in fat generally decreased. In the case of sugar, it is questionable whether price fluctuations have significant effects on

[7] They need to construct food prices for computing the value of home-produced food.
[8] Fortunately, it has seldom been necessary to apply rule number 2) and never number 3).
[9] The food products that have been chosen are: white bread, wheat flour, potatoes, cabbage, onions, oranges, apples, beef, pork, chicken, sausages, fresh milk, butter, cheese, vegetable oil, sugar, cookies, fresh fish, vodka and cigarettes.

body weight. One reviewer put forward the example of people being unlikely to change the amount of sugar they put in their coffee or tea.

Revealing results are obtained for the price of meat and meat products. After falling in 1998, the price of beef and pork rose enormously (which is perhaps due to higher quality cuts). The only exception is chicken meat, which shows stable prices over time, most likely due to imports. This could be a source of the substitution and consumption of more chicken relative to other kinds of meat. As chicken is usually leaner, this would have a positive impact on the overweight situation. But also boiled sausages are interesting, as they had higher prices than pure meats at the beginning and lower prices at the end of the observation period. This is perhaps due to the higher degree of processing and decreasing processing costs in the course of time. Assuming that processed meat products contain a higher proportion of fat, substituting these products should have the effect of increasing body weight.

Baltagi and Geishecker (2006) report that tobacco and alcohol are complements and are both negatively correlated to BMI. Vodka prices rose drastically in 2002/2003, most probably due to tax hikes. The cost of tobacco increased during the economic crisis but then fell again afterwards. Alcohol is rich in energy but has to be considered with caution. On the one hand, higher consumption may increase BMI, when people eat and drink a lot at the same time; on the other hand, people could just drink and degenerate. As smoking is seen to reduce BMI for by lowering the metabolic rate and suppressing the appetite, the price of cigarettes is also likely to influence body weight.

4 Results

4.1 Estimation Strategy

Equation (3) specifies the estimable reduced-form demand function for body weight that is the basis for the empirical analysis:

(3) $$BMI_{it} = \beta \cdot p_{ct} + \gamma \cdot X_{it} + \delta \cdot Z_{ht} + \varepsilon \cdot C_{ct} + \alpha_t + \alpha_r + u_{it},$$

where *I* indexes individuals, *h* households, *c* communities, *t* time and *r* regions. The vector p_{ct} contains the 20 food price variables described in Section 3.4. X_{it} is a vector of individual characteristics including gender (in the RE model), age, education and marital and work status. Household characteristics Z_{ht} control for household size and per-capita real

expenditure of the household. C_{ct} is a set of community characteristics that are likely to influence eating and physical activity patterns related to weight, namely the presence of public baths and restaurants, whether TV programs can be received, as well as the median income at the community level. Year and region (in the RE model) fixed effects are included to absorb unobserved variation over time and across regions. This approach follows Stillman and Thomas (2008), who state that with "these controls, variation in observed prices reflects differences in the relative prices of the commodity."

Moreover, unobserved heterogeneity in individuals, households or communities plays a major role in the genesis of overweight and obesity and is a potential source of bias in econometric analyses when correlated with exogenous variables. Unobservable individual characteristics like metabolism or community level factors other than food prices, such as the availability of shops, infrastructure, tradition or eating habits are likely to influence BMI. This results in a confounding bias when they are not explicitly controlled for. To avoid this, the analysis uses panel-data methods to control for individual specific fixed effects. Hence, the error term becomes $u_{it} = \mu_i + v_{it}$ where μ_i represents individual specific effects that are constant over time and v_{it} captures unobserved heterogeneity. Individual-specific-effects models in the form of (3) can be estimated as fixed-effects (FE) or random-effects (RE) models. In the FE model the μ_i are permitted to be correlated with the regressors. Consistent estimates of marginal effects can still be obtained provided the regressor is time-varying. The RE model assumes that μ_i is purely random. The RE yields estimates of all coefficients, but estimates are inconsistent if the FE is appropriate (Cameron and Trivedi, 2009). For the present data, Hausman tests reject the null hypothesis of identical parameters at the 0.1 % significance level and identify the FE model as appropriate. Therefore, identification of price effects relies solely on the within variance over time, meaning that estimates for the effects of spatial price variation on BMI cannot be obtained. Moreover, regressors of interest here are the prices at the community level making it necessary to control for possible error correlation among individuals within states. Cluster-robust standard errors allow for correlation within communities, relaxing the usual requirement that the observations are independent (Cameron and Trivedi, 2009).

4.2 Results of the fixed-effects model

The first column in Table 3 presents the price coefficients from the fixed-effects BMI regressions for the full sample. Prices contribute little to the explained variation in BMI. The R^2 of 9.67% decreases to 9.56% when prices are omitted. When prices are the only variables, the R^2 is 4.01%. A Wald test for the joint significance of all food price variables revealed significance at the 0.1%-level. Hence, food prices do significantly contribute to explaining the BMI in Russia.

Since prices and BMI appear in logarithms, the coefficients represent price elasticities for body mass. Mainly animal products seem to have a significant impact on BMI. The coefficients show low absolute values and amount to -0.006 for onions, -0.007 for chicken meat, -0.003 for fresh milk and 0.006 for butter. To assess the plausibility of these low values, consider the trends of prices and quantities in Figures A1 and A2. While prices show substantial variation over time, quantities reveal smoother curves. Thus, when food consumption reacts rather weakly to price changes, we would not expect body mass to show stronger reactions.

The signs for chicken and fresh milk seem plausible when we assume that an increase in their prices will lead to a decrease in quantity consumed and a decrease in energy intake. This interpretation is supported by the trends in prices and quantities. The price of milk increases over time and its quantity decreases. The price of chicken remains constant, leading to a much smaller decline in the consumption of poultry. The result for chicken prices refutes the hypothesis that increased consumption of chicken meat could lower overall energy intake by replacing other more energy-dense meat products Rather it seems that households add chicken meat to their diets without replacing other foods. In consequence, overall energy intake will be raised by lower relative prices for chicken.

The negative sign for onion prices is reasonable when we think of onions as a basic part of the daily diet, especially in combination with such main products as meat and potatoes and all types of salads. Relatively stable quantities over time (see Figure A2) support this assumption. When households have to pay lower prices for onions, they can spend the money that is released on other food products and possibly increase their energy intake. Additionally, complementary effects provide alternative explanations. When onions are

eaten mainly together with meat or roasted in butter, a lower price would cause a higher consumption of fats at the same time, leading to higher body mass.

Table 3: Price elasticities of BMI in Russia (Fixed-effects model) for the full sample and by gender

	Total		Male		Female	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Bread, white	-0.0002	(0.0014)	0.0004	(0.0016)	-0.0007	(0.0019)
Wheat flour	0.0010	(0.0016)	0.0030	(0.0023)	-0.0004	(0.0022)
Potatoes	0.0002	(0.0014)	-0.0006	(0.0014)	0.0008	(0.0018)
Cabbage	-0.0013	(0.0017)	-0.0017	(0.0021)	-0.0010	(0.0018)
Onions	-0.0055***	(0.0016)	-0.0030	(0.0027)	-0.0072***	(0.0022)
Oranges	0.0005	(0.0028)	-0.0015	(0.0038)	0.0020	(0.0030)
Apples	0.0001	(0.0011)	0.0009	(0.0017)	-0.0004	(0.0014)
Beef	0.0014	(0.0034)	-0.0044	(0.0039)	0.0053	(0.0044)
Pork	-0.0045	(0.0042)	-0.0023	(0.0044)	-0.0059	(0.0049)
Chicken	-0.0070**	(0.0029)	-0.0079*	(0.0040)	-0.0063*	(0.0033)
Sausages	-0.0014	(0.0037)	0.0023	(0.0050)	-0.0039	(0.0041)
Milk, fresh	-0.0032*	(0.0019)	-0.0062**	(0.0026)	-0.0009	(0.0020)
Butter	0.0058**	(0.0026)	0.0110***	(0.0033)	0.0018	(0.0031)
Cheese	0.0020	(0.0016)	0.0038	(0.0025)	0.0008	(0.0019)
Vegetable oil	0.0012	(0.0009)	0.0015	(0.0013)	0.0010	(0.0011)
Sugar	0.0028	(0.0029)	0.0052	(0.0034)	0.0012	(0.0035)
Cookies	-0.0007	(0.0015)	0.0007	(0.0012)	-0.0018	(0.0021)
Fish, fresh	0.0004	(0.0011)	0.0013	(0.0012)	-0.0002	(0.0012)
Vodka	0.0003	(0.0012)	-0.0003	(0.0013)	0.0007	(0.0012)
Cigarettes, domestic	0.0007	(0.0011)	-0.0000	(0.0011)	0.0012	(0.0015)
ln per-cap. expenditures	0.0039***	(0.0007)		0.0039***	(0.0007)	
N	56311			56311		
R^2	0.0967			0.0988		

* Significant at the 10 %-level. ** Significant at the 5 %-level. *** Significant at the 1 %-level.

Note: Cluster-robust standard errors control for correlation within communities. Regressions control for respondent's age, marital status, work status, household size, pregnancy, education (university and higher, incomplete higher, technical/medical school, secondary, vocational, reference is primary and less), year fixed effects, and community infrastructure related to eating and physical activity (public bath, restaurants, TV reception) as well as median per-capita income at the community level.

Source: RLMS, 1994-2005.

A positive sign for butter does not seem plausible. When butter prices rise we can expect a decline in butter consumption and, consequently, in energy intake and BMI. However, Figures A1 and A2 show a decrease in both the price of butter and the quantity consumed. At the same time, the price of the input factor milk even increases (although with some fluctuations). These developments indicate that butter has generally become less important in the Russian diet, making it less fattening and causing prices and quantities to decrease in the course of time.[10]

[10] Those who remember the pictures of Russian people queuing for huge blocks of butter can imagine how important butter used to be in the early 1990s.

Substantial differences between men and women in terms of both the level and the development of BMI and obesity raise the question whether they react differently to price changes. The second and third columns in Table 3 report separate coefficients for men and women and show that there are actually differences in price effects.[11] Only chicken prices remain significant for both. Men show a stronger reaction, with an elasticity of about -0.008 compared with -0.006 for women. Furthermore, men – but not women – react significantly to fresh milk and butter with elasticities of -0.006 and 0.011 respectively. Male BMI tends to react more strongly to the price of animal products, possibly because their diets include a higher amount of meat and dairy produce. The price coefficient of butter is still positive and even larger. If the above hypothesis on the diminishing importance of home-made energy-dense products holds true, this result is plausible, as men have a higher rate of participation in the labour force. Significant coefficients for onion prices prove true for women only. Based on the explanation that lower vegetable prices liberate resources, one could suggest that it is women who benefit most. This is a reasonable assumption, bearing in mind that women are usually responsible for purchasing and preparing food for the household.

Regressions stratified by income tertiles presented in Table 4 reveal that poor and rich households actually differ in their BMI's response to food prices. High-income households in particular react to changes in meat prices. Beef (0.009), chicken (-0.010), sausages (-0.012) and fish (0.003) show significant coefficients. The sign for chicken further strengthens the view expressed above that the own-price effect on additional quantity is important. Fatty sausages and lean fish show the expected signs; only the case of beef is puzzling. From Figures A1 and A2 we see that beef prices have risen, and the quantity consumed has declined enormously. Therefore consumers might have substituted more fatty meat products like sausages for beef. Descriptive statistics stress the role of meat in the development of overweight and obesity among high-income households: in those households that have at least one member who is obese, weekly per-capita consumption of all meats is 1.0kg for low-income and 1.8kg for high-income households. Households that have neither obese nor overweight members consume 0.9kg (low-income) and 1.4kg (high-income) respectively.

[11] Separate coefficients were obtained by the interaction of each price variable with the gender dummy. Separate coefficients by income tertile in Table 4 were obtained in the same way.

Table 4: Price elasticities of BMI in Russia (Fixed-effects model) by income tertile

	Low		Medium		High	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Bread, white	0.0015	(0.0022)	-0.0008	(0.0019)	-0.0012	(0.0020)
Wheat flour	0.0006	(0.0026)	-0.0005	(0.0024)	0.0025	(0.0021)
Potatoes	-0.0010	(0.0021)	0.0015	(0.0021)	0.0008	(0.0021)
Cabbage	-0.0029	(0.0024)	-0.0006	(0.0022)	-0.0005	(0.0014)
Onions	-0.0021	(0.0023)	-0.0082***	(0.0017)	-0.0062**	(0.0025)
Oranges	-0.0051	(0.0045)	0.0029	(0.0055)	0.0020	(0.0037)
Apples	0.0008	(0.0019)	-0.0001	(0.0018)	0.0015	(0.0020)
Beef	-0.0041	(0.0048)	0.0028	(0.0040)	0.0090**	(0.0041)
Pork	-0.0019	(0.0056)	-0.0042	(0.0043)	-0.0051	(0.0049)
Chicken	-0.0049	(0.0032)	-0.0074*	(0.0040)	-0.0096**	(0.0047)
Sausages	0.0047	(0.0057)	0.0022	(0.0060)	-0.0117**	(0.0052)
Milk, fresh	-0.0023	(0.0026)	-0.0027	(0.0024)	-0.0019	(0.0032)
Butter	0.0070**	(0.0027)	0.0014	(0.0044)	0.0032	(0.0039)
Cheese	-0.0000	(0.0024)	0.0014	(0.0027)	0.0042	(0.0025)
Vegetable oil	0.0022	(0.0015)	0.0023*	(0.0012)	-0.0014	(0.0013)
Sugar	0.0071*	(0.0039)	0.0070	(0.0043)	-0.0052	(0.0033)
Cookies	-0.0014	(0.0025)	0.0002	(0.0021)	-0.0007	(0.0014)
Fish, fresh	0.0008	(0.0016)	-0.0021	(0.0016)	0.0031*	(0.0016)
Vodka	0.0005	(0.0013)	-0.0004	(0.0016)	0.0006	(0.0022)
Cigarettes, domestic	0.0008	(0.0014)	-0.0012	(0.0015)	0.0024*	(0.0012)
ln per-cap. expenditures	0.0038***	(0.0007)	0.0038***	(0.0007)	0.0038***	(0.0007)
N	56311		56311		56311	
R^2	0.0989		0.0989		0.0989	

* Significant at the 10 %-level. ** Significant at the 5 %-level. *** Significant at the 1 %-level.

Note: Cluster-robust standard errors control for correlation within communities. Controls are the same as listed below Table 3.

Source: RLMS, 1994-2005.

In contrast, low-income households show significant coefficients for butter (0.007) and sugar (0.007). Surprisingly, both are positive and (together with vegetable oil prices that show a positive sign for the medium-income group) suggest that there is a certain pattern behind the price effects of homogenous, energy-rich food products that are fundamental to household production. All of their prices decrease over time, as do the quantities consumed (see Figures A1 and A2). Hence, the price effects that are detected in the regression might stem from an overall loss in importance. This is also supported by the fact that their prices are significant for poor individuals, since they probably use these goods more often in home production, as described in the introduction.

Further estimations that are not shown here tried to test whether multiple price changes affect BMI. For this purpose, several interaction terms have been implemented. One tested whether the prices of foods high in energy, namely butter, vegetable oil and sugar, have a common impact that might be stronger than the effects of the single prices. Similarly,

another interaction among meats (beef, pork, chicken and sausages) should evaluate whether simultaneous price changes within the meat group have significant effects. Although these interaction terms were significant the absolute values of their coefficients were below 0.0005 and thus almost negligible. A third interaction term that tested for the effects of simultaneous price changes of vodka and cigarettes was not significant.[12]

Table 5: Changes in body mass in grams caused by a 10% and 20% price change

		Body mass change in g		
	Price change	**Total**	**Men**	**Women**
Onions	10 %	-44.00		-59.19
	20 %	-88.00		-118.37
Chicken	10 %	-56.00	-60.83	-51.79
	20 %	-112.00	-121.67	-103.58
Milk	10 %	-25.60	-47.74	
	20 %	-51.20	-95.49	

Note: Changes in body mass evaluated at sample means (26.12 for the full sample, 25.14 for men and 26.84 for women). Height assumed 1.75 metres.

Source: RLMS, 1994-2005.

Table 5 translates the price coefficients for onions, chicken and fresh milk into actual weight changes induced by price changes of 10 % and 20 % respectively. The low figures stress that prices do not seem to have substantial impacts on Russians' body weight. For example, a price increase of 20 % in the case of chicken would result in a lower body mass of 112 g for the full sample, 122 g for men and 104 g for women. Taking into account that median real chicken prices decreased by about 20 % from 1994 to 2005, this effect is almost negligible. However, it is important to note that these computations are based on sample means. They provide no information on reactions at the tails of the distribution.

Knowledge of own-price and cross-price elasticities for foods in Russia could help to interpret the findings of the price-BMI regressions. For example, when chicken or milk had low own-price and cross-price elasticities, we would not expect a price change to have substantial impacts on energy intake and BMI. However, there are only a few studies that have estimated demand systems and reported reliable results. Soshnin et al. (1999) analysed the demand for imported meats in Russia and found that meat imports from Western countries decreased when real incomes in Russia declined. Their estimates indicate further that chicken belongs to the group of luxury goods in Russia. Elsner (1999) used Round 7 of

[12] The results of these regressions are available from the author upon request.

the RLMS to estimate expenditure and own-price elasticities. She found that Russian households tend to react quite elastically to price changes of single products. Uncompensated cross price elasticities for poultry and milk amounted to -0.91, and -1.27 respectively. But food as a whole reacts weakly to price shift and showed an own-price elasticity of -0.41, thus strengthening the argument that consumption smoothing avoids huge shifts in energy intake or body mass. Unfortunately, no cross-price elasticities are reported that would allow statements on substitutive and complementary effects.

4.3 Results of the logit model

As Section 3.3 has already indicated, the mean BMI of Russians has not varied substantially. Rather it was found that a shift occurred from the overweight group to the obese group. To analyse whether food prices affect the probability of being obese, the initial model is estimated as a fixed-effects logit model with the binary outcome obese or not as dependent variable. Table 6 shows the results for the full sample, as well as separately for men and women. Even fewer prices revealed significant effects on the probability of obesity. There are no significant coefficients for the full sample. An increase in the price of milk significantly reduces men's obesity risk. For women, the probability of being obese decreases significantly when pork prices rise.

These results stress the importance of handling estimates for the conditional mean of BMI with care. What might be true for the whole distribution might not hold true for either its right or its left tail. Moreover, fewer significant price effects on obesity indicate that factors other than single food prices are more important in causing obesity. For example, Monteiro et al. (2001) show for another transition country, Brazil, that the economic situation determines body weight only to a certain degree. Beyond this threshold, other factors, in particular education, seem to be the main determinants. Moreover, the relationship between income or education and body weight and obesity is modified by gender and the level of economic development in the region. These "diversified, complex and dynamic patterns of social determination of obesity", characterised by "regional heterogeneity coupled with existing gender differences in the relationship between socioeconomic variables and obesity", (ibid., p.882) are likely to occur in the transition country of Russia, too. This is especially true when someone can already afford to be overweight or nearly obese.

Table 6: Price effects on obesity (Logit fixed-effects model)

	Total		**Male**		**Female**	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Bread, white	0.0000	(0.0780)	0.0171	(0.1263)	-0.0141	(0.0926)
Wheat flour	0.0012	(0.0947)	0.0527	(0.1575)	-0.0292	(0.1092)
Potatoes	-0.0345	(0.0867)	-0.1552	(0.1486)	0.0216	(0.1042)
Cabbage	0.1213	(0.0858)	0.1701	(0.1472)	0.0978	(0.1019)
Onions	-0.1467	(0.0944)	-0.1483	(0.1637)	-0.1393	(0.1106)
Oranges	0.0377	(0.1620)	-0.2325	(0.2691)	0.1774	(0.1903)
Apples	-0.0223	(0.0827)	0.1901	(0.1396)	-0.1390	(0.1008)
Beef	0.1072	(0.1936)	-0.0442	(0.3225)	0.1904	(0.2304)
Pork	-0.2133	(0.1846)	0.1164	(0.3161)	-0.3800*	(0.2212)
Chicken	0.1227	(0.1659)	0.2425	(0.2822)	0.0726	(0.1953)
Sausages	-0.0016	(0.0014)	-0.0027	(0.0023)	-0.0012	(0.0016)
Milk, fresh	-0.1493	(0.1002)	-0.4528***	(0.1734)	-0.0039	(0.1187)
Butter	0.2061	(0.1277)	0.1444	(0.2158)	0.2293	(0.1483)
Cheese	0.0155	(0.1185)	0.0851	(0.2040)	-0.0132	(0.1427)
Vegetable oil	-0.0385	(0.0634)	-0.1093	(0.1061)	-0.0031	(0.0758)
Sugar	0.1180	(0.1890)	0.1088	(0.2724)	0.1221	(0.2085)
Cookies	0.1179	(0.0762)	0.1787	(0.1250)	0.0899	(0.0906)
Fish, fresh	-0.0399	(0.0581)	0.1207	(0.1001)	-0.1145	(0.0704)
Vodka	0.0245	(0.0488)	0.0563	(0.0850)	0.0029	(0.0584)
Cigarettes	0.0160	(0.0504)	0.0143	(0.0876)	0.0185	(0.0603)
ln per-cap. expenditures	0.1521***	(0.0380)	0.1539***	(0.0381)		
N	11578				11578	

* Significant at the 10 %-level. ** Significant at the 5 %-level. *** Significant at the 1 %-level.

Note: Cluster-robust standard errors control for correlation within communities. Controls are the same as listed below Table 3.

Source: RLMS, 1994-2005.

4.4 Sensitivity analysis

The dynamics of the underlying panel could be a source of possible parameter bias. It is the objective of Table 7 to test for this possibility. Table 7 presents separate regressions that firstly contain all the observations of people participating in the first round (P 5) and secondly all the observations of people who participated in the last round (P 14). Thus the first regression includes all respondents who were initially part of the sample, some of whom dropped out. The second regression comprises all respondents who took part in the last round and moved location in some previous rounds. Only the price coefficient for onions is significant for both subsamples and does not differ substantially in P 5, P 14 or in the model from Section 4.2. In P 5 pork and milk prices show significant coefficients, which is not the case in P 14. In contrast, chicken and butter show significant coefficients in P 14 but not in P5. On the one hand, this indicates a shift in importance of several foods for determining

BMI over time. On the other hand, it underlines the role of onions with a coefficient between -0.005 and -0.006.

Table 7: Regressions on subsamples to assess effects of panel dynamics

	Participants Round 5		**Participants Round 14**	
	Coefficient	SE	Coefficient	SE
Bread, white	0.0005	(0.0017)	0.0001	(0.0018)
Wheat flour	0.0010	(0.0020)	0.0000	(0.0014)
Potatoes	-0.0005	(0.0019)	-0.0009	(0.0014)
Cabbage	-0.0001	(0.0018)	-0.0026	(0.0018)
Onions	-0.0059***	(0.0017)	-0.0048**	(0.0021)
Oranges	0.0029	(0.0036)	0.0015	(0.0028)
Apples	-0.0002	(0.0016)	0.0008	(0.0009)
Beef	0.0045	(0.0039)	-0.0007	(0.0038)
Pork	-0.0094*	(0.0050)	-0.0019	(0.0045)
Chicken	-0.0048	(0.0033)	-0.0068**	(0.0034)
Sausages	-0.0014	(0.0044)	0.0027	(0.0036)
Milk, fresh	-0.0040*	(0.0023)	-0.0012	(0.0021)
Butter	0.0044	(0.0031)	0.0049*	(0.0024)
Cheese	0.0004	(0.0026)	0.0014	(0.0016)
Vegetable oil	0.0020	(0.0013)	0.0004	(0.0009)
Sugar	0.0053	(0.0035)	0.0031	(0.0028)
Cookies	-0.0002	(0.0015)	-0.0022	(0.0017)
Fish, fresh	0.0005	(0.0012)	0.0016	(0.0012)
Vodka	0.0015	(0.0013)	0.0013	(0.0013)
Cigarettes	0.0006	(0.0013)	0.0009	(0.0010)
N	35151		39060	
R^2	0.0893		0.1239	

* Significant at the 10 %-level. ** Significant at the 5 %-level. *** Significant at the 1 %-level.

Note: Cluster-robust standard errors control for correlation within communities. Controls are the same as listed below Table 3.

Source: RLMS, 1994-2005.

5 Discussion and Conclusion

This study examined the impact of food prices on body mass and obesity for an urban sample of adult Russians. Previous studies of economic determinants of nutrition and health suggested there is a connection. However, no explicit estimates have been provided so far. Food price effects on adult BMI were investigated within a fixed-effects panel model while taking into account unobserved individual heterogeneity in the determinants of BMI. Additionally, a logit model provided estimates of price effects on the probability of being obese. The analysis used data from the RLMS, a rich longitudinal data set for Russian households and individuals that also provides food prices at the community level. Furthermore, the study examined differential price reactions by gender and income tertiles.

The main result of this study is that food prices are not the essential determinants of BMI and obesity in the Russian Federation. Elasticities of BMI with respect to single food prices are low and show absolute values smaller than 0.01. Also, the present estimates are considerably lower than those found by studies conducted in Western countries, mainly in the United States. For example, Chou et al. (2004) reported price elasticities of adult BMI that amount to -0.04 for food at home, 0.03 for cigarettes, -0.02 for alcohol, and -0.05 for fast-food. An RE model for adolescents by Powell and Bao (2009) showed elasticities for fruit and vegetables and fast-food that are 0.07 and -0.12 respectively. Using a fixed-effects model, Powell (2009) found an elasticity of fast-food of -0.08. However, it is difficult to compare these coefficients directly, since different aggregation levels of food groups are likely to lead to different coefficients. Additionally, some food items were not considered - for example, there are no prices for fast-food in the RLMS. Moreover, Powell (2009) found that fixed-effects estimates tend to be lower than those from cross-sections.

However, all price coefficients are jointly significant at the 0.1 %-level and some indicate substitution and complementary effects that are relevant for body weight. The price coefficients of animal products, namely chicken meat and milk, are the most plausible and significant. When their prices increase, consumption decreases, and so does BMI. However, if chicken prices increased by 20 %, the mean body weight of Russians would decrease by just 110g. The analysis confirms that there are indeed gender differences in price reactions. While women tend to react more strongly to onions, men react more strongly to milk and butter. These effects could be due to intra-household allocation or different labour participation.

Reactions of BMI to price changes differ across income groups, too. The prices of meat products like beef, chicken, sausages and fish are especially significant at higher income levels. This indicates that wealthier households in Russia raise their energy intake, and in turn their body weight, by consuming an increasing amount of meat products. Different results have been found for the US: Powell and Bao (2009), as well as Powell (2009), report that the reactions of adolescent and child BMI to the prices of fruit and vegetables and fast-food are significantly stronger, both economically and statistically, among lower-income families. We might explain these findings by the inverted U-shaped relationship of income to body weight within countries that was proposed by Lakdawalla and Philipson (2009). At lower income levels body weight might increase, and at higher income levels body weight

might decrease, “due to the offsetting effects of demand for food, and the demand for an ideal body weight.” Section 3.3 shows that in Russia overweight and obesity actually occur among middle to high-income households, whereas in the US and Western European countries overweight and obesity are mainly observed in households of lower economic status (see e.g. Lakdawalla and Philipson, 2009). So we might well see households of low socio-economic status in the US and of higher status in Russia in a comparable position where favourable economic conditions generate large amounts of utility by the consumption of more and tastier energy-rich foods, especially meat products.

Estimates from the logit models showed a lower impact of prices on obesity indicating that other factors gain in importance. Only milk (for men) and pork (for women) showed significant coefficients. Hence, the results are in line with former studies like Stillman and Thomas (2008), which indicate that short-run economic shifts might alter consumption or diets but do not substantially affect body mass. Moreover, adding or removing animal products from the menu seems to be crucial for Russian households when they aim to change the cost of their diet.

The present study is subject to some limitations. Firstly, the data do not include prices for food away from home and fast-food. But this shortcoming does not seem so severe compared with studies of Western countries, since fast-food facilities were not that important in Russia during the transition. Secondly, the “black box” between prices and BMI or obesity allows only hypotheses on possible complementary or substitutive effects for single products. Here, estimates from demand systems on own-price and cross-price effects would provide deeper insights. Studies like those of Chouinard et al. (2007) and Kuchler et al. (2005), who analysed the impacts of prices on fat intake and snack consumption respectively, could serve as a base.

Finally, the present results suggest clear policy implications regarding price measures that aim to reduce overweight and obesity in Russia Given the fact that all the coefficients of price effects on body mass and obesity are small and few of them are significant, it does not seem likely that fat taxes or thin subsidies have a chance of success.

Acknowledgements

The author would like to thank the Carolina Population Center for making the data of the Russia Longitudinal Monitoring Survey available and the four anonymous referees for valuable comments and suggestions.

References

Baltagi, B.H., Geishecker, I. (2006). Rational addiction: evidence from the Russian longitudinal monitoring survey. Health Economics 15, 893-914.

Becker, G.S., 1965. A Theory of the Allocation of Time. The Economic Journal 75, 493-517.

Cameron, C.A., Trivedi, P.K., (2009). Microeconometrics Using Stata. Stata Press, College Station, Texas.

Cawley, J., 2004. An Economic Framework for Understanding Physical Activity and Eating Behaviors. American Journal of Preventive Medicine 27, 117-125.

Chen, S.-N., Shogren, J.F., Orazem, P.F., Crocker, T.D., 2002. Prices and Health: Identifying the Effects of Nutrition, Exercise, and Medication Choices on Blood Pressure. American Journal of Agricultural Economics 84, 990-1002.

Chou, S., Grossman, M., Saffer, H., 2004. An economic analysis of adult obesity: results from the Behavioral Risk Factors Surveillance System. Journal of Health Economics 23, 565-587.

Chouinard, H.H., Davis, D.E., LaFrance, J.T., Perloff, J.M., 2007. Fat Taxes: Big Money for Small Change. Forum for Health Economics & Policy 10(2).

Cutler, D.M., Glaeser, E.L., Shapiro, J.M., 2003. Why Have Americans Become More Obese? Journal of Economic Perspectives 17, 93-118.

Doak, C.M., Adair, L.S., Monteiro, C., Popkin, B.M., 2000. Overweight and underweight coexist within households in Brazil, China and Russia. Journal of Nutrition 130, 2965-2971.

Dore, A.R., Adair, L.S., Popkin, B.M., 2003. Low income Russian families adopt effective behavioral strategies to maintain dietary stability in times of economic crisis. Journal of Nutrition 133, 3469-3475.

Elsner, K., 1999. Analysing Russian Food Expenditure Using Micro-Data. Institute of Agricultural Development in Central and Eastern Europe (IAMO) Discussion Paper No. 23.

Gelbach, J.B., Klick, J., Stratman, T., 2007. Cheap Donuts and Expensive Broccoli: The Effect of Relative Prices on Obesity. Florida State University, College of Law, Public Law Research Paper No. 261.

Heeringa, S.G., 1997. Russia Longitudinal Monitoring Survey (RLMS). Sample Attrition, Replenishment, and Weighting in Rounds V-VII, available at http://www.cpc.unc.edu/projects/rlms/project/samprep.pdf. Access: July 15, 2008.

Honkanen, P., Frewer, L., 2009. Russian Consumers' motives for food choice. Appetite 52, 363-371.

Huffman, S.K., Rizov, M., 2007. Determinants of Obesity in Transition Economies: The Case of Russia. Economics and Human Biology 5, 379-391.

Huffman, W.E., Huffman, S.K., Rickertsen, K., Tegene, A., 2010. Over-Nutrition and Changing Health Status in High Income Countries. Forum for Health Economics and Policy 13(1), Article 2.

Jahns, L., Baturin, A., Popkin, B.M., 2003. Obesity, diet, and poverty: trends in the Russian transition to market economy. European Journal of Clinical Nutrition 57 1295-1302.

Knai, C., Suhrcke, M., Lobstein, T., 2007. Obesity in Eastern Europe: An overview of its health and economic implications. Economics and Human Biology 5, 392-408.

Kuchler, F., Tegene, A., Harris, J.M., 2005. Taxing Snack Foods: Manipulating Diet Quality or Financing Information Programs? Review of Agricultural Economics 27, 4-20.

Lakdawalla, D., Philipson, T.J., 2009. The Growth of Obesity and Technological Change. Economics and Human Biology 7, 283-293.

Lokshin, M., Popkin, B.M., 1999. The Emerging Underclass in the Russian Federation: Income Dynamics, 1992-1996. Economic Development and Cultural Change 47(4), 803-29.

Mazzocchi, M., Traill, W.B., 2007. Calories, Obesity and Health. Paper presented at the Agricultural Society's 81st Annual Conference, University of Reading, UK, April 2-4, 2007.

Monteiro, C.A., Conde, W.L., Popkin, B.M., 2001. Independent effects of income and education on the risk of obesity in the Brazilian adult population. Journal of Nutrition 131, 881S-886S.

Mroz, T.A., Popkin, B.M., 1995. Poverty and the Economic Transition in the Russian Federation. Economic Development & Cultural Change 44, 1-31.

OECD (Organization for Economic Co-Operation and Development), 2010. OECD.Stat Extracts, available at http://stats.oecd.org/index.aspx. Access: May 25, 2010.

Philipson, T.J., Posner, R.A., 2003. The Long-Run Growth in Obesity as a Function of Technological Change. Perspectives in Biology and Medicine 46, 87-107.

Popkin, B.M., 1994. The Nutrition Transition in Low-Income Countries: An Emerging Crisis. Nutrition Reviews 52, 285-298.

Powell, L.M., 2009. Fast food costs and adolescent body mass index: Evidence from panel data. Journal of Health Economics 28, 963-970.

Powell, L.M., Bao, Y., 2009. Food prices, access to food outlets and child weight. Economics and Human Biology 7, 64-72.

RLMS (Russia Longitudinal Monitoring Survey), 2010. Sampling Overview, available at http://www.cpc.unc.edu/projects/rlms/project/sampling.html. Access: May 19, 2010.

Schroeter, C., Lusk, J., 2007. The Impact of Economic Factors on Consumer Health. Selected Paper Presented at the WAEA Annual Meeting, Portland Oregon, July 29 – August 1, 2007.

Schroeter, C., Lusk, J., Tyner, W., 2008. Determining the Impact of Food Price and Income Changes on Body Weight. Journal of Health Economics 27, 45-68.

Sedik, D., Sotnikov, S., Wiesmann, D., 2003. Food Security in the Russian Federation. FAO Economic and Social Development Paper No. 153. FAO, Rome.

Shkolnikov, V.M., Cornia, G.A., Leon, D.A., Meslé, F., 1998. Causes of the Russian Mortality Crisis: Evidence and Interpretations. World Development 26, 1995-2011.

Soshnin, A.I., Tomek, W.G., de Gorter, H., 1999. Cornell University, department of Agricultural, Resource, and Managerial Economics Working Paper No. 99-19.

Stillman, S., Thomas, D., 2008. Nutritional status during an economic crisis: Evidence from Russia. The Economic Journal 118, 1385-1417.

Sturm, R., Datar, A., 2005. Body mass index in elementary school children, metropolitan area food prices and food outlet density. Public Health 119, 1059-1068.

Swafford, M.S., Kosolapov, M.S., 2002. Sample Design, Response Rates, and Weights in the Russia Longitudinal Monitoring Survey, Rounds 5 to 10: An Abbreviated Description.

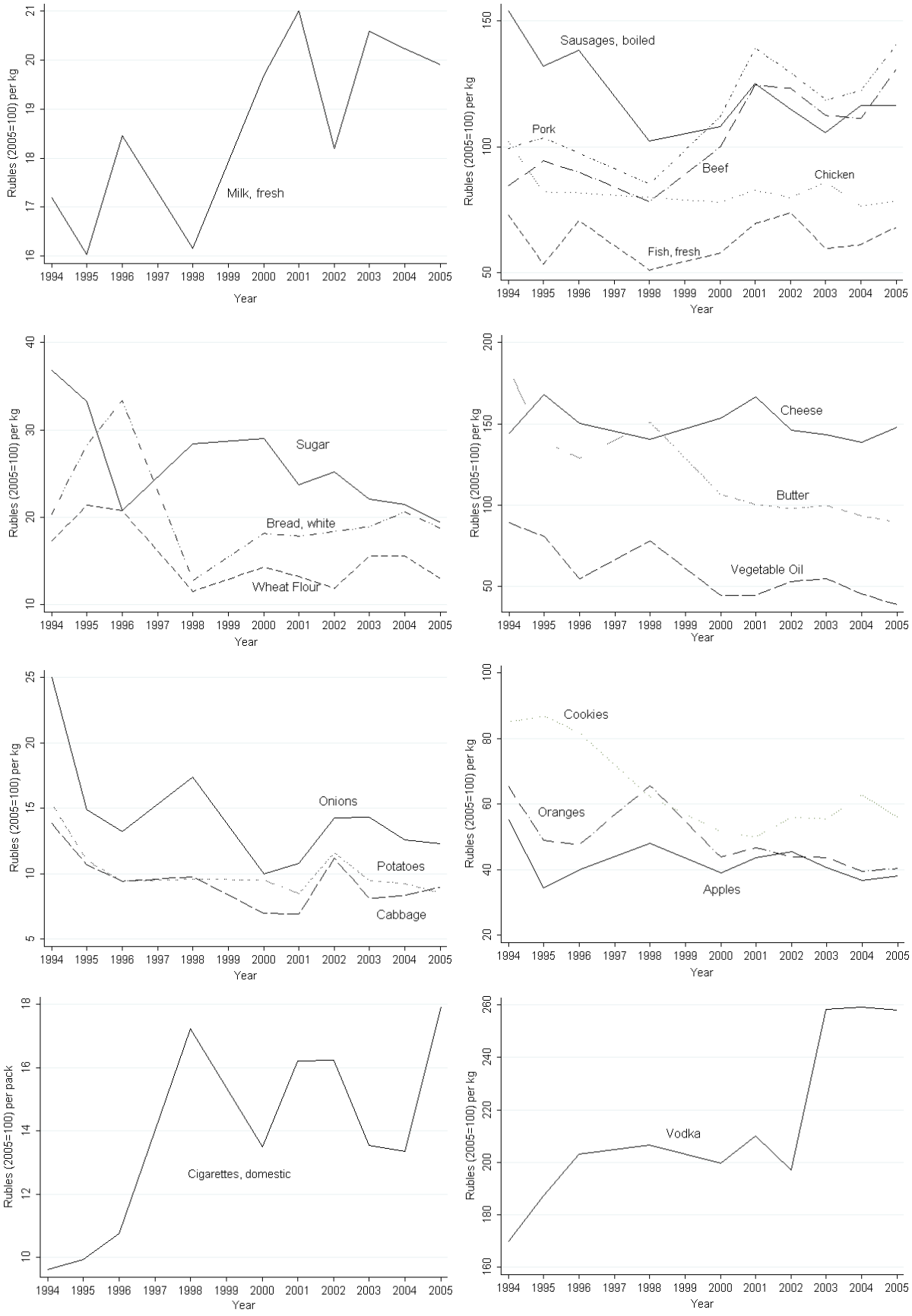
Ulijaszek, S.J., Koziel, S., 2007. Nutrition transition and dietary energy availability in Eastern Europe after the collapse of communism. Economics and Human Biology 5, 359-369.

WHO (World Health Organization), 2005. Highlights on Health in the Russian Federation. World Health Organization, Geneva.

Zohoori, N., Mroz, T.A., Popkin, B.M., Glinskaya, E., Lokshin, M., Mancini, D., Kozyreva, P., Kosolapov, M., Swafford, M., 1998. Monitoring the Economic Transition in the Russian Federation and its Implications for the Demographic Crisis – the Russian Longitudinal Monitoring Survey. World Development 26, 1977-1993.

Appendix

Figure A1: Median food prices in Russia from 1994 to 2005



Source: RLMS, 1994-2005.

Figure A2: Median weekly per-capita consumption of food products in Russia from 1994 to 2005

Source: RLMS, 1994-2005.

Table A1: Summary statistics for Round 5 and the full sample.

	Round 5		Full Sample	
	Mean	S.D.	Mean	S.D.
Male	42.5%	0.49	42.4%	0.49
BMI	26.09	4.77	26.12	5.05
Underweight	2.3%	0.15	2.8%	0.16
Normal	44.3%	0.50	44.4%	0.50
Overweight	34.1%	0.47	32.1%	0.47
Obese	19.3%	0.39	20.8%	0.41
Age in Years	45.55	16.77	45.47	17.28
Real per-capita household income	3,750	6,016	3,702	8,847
Real per-capita household expenditures	5,203	8,670	4,423	6,758
Household size	3.24	1.39	3.20	1.46
University & higher	19.6%	0.40	20.7%	0.41
Incomplete higher	2.4%	0.15	7.3%	0.26
Technical/Medical school	22.7%	0.42	20.7%	0.40
Secondary	12.4%	0.33	13.3%	0.34
Vocational	18.9%	0.39	16.4%	0.37
Primary & less	23.9%	0.43	21.6%	0.41
Partnership status	67.4%	0.47	65.9%	0.47
Work status	64.9%	0.48	63.8%	0.48
Year is 1994	100.0%	0.00	8.4%	0.28
Year is 1995	0.0%	0.00	9.2%	0.29
Year is 1996	0.0%	0.00	9.0%	0.29
Year is 1998	0.0%	0.00	9.1%	0.29
Year is 2000	0.0%	0.00	9.4%	0.29
Year is 2001	0.0%	0.00	10.5%	0.31
Year is 2002	0.0%	0.00	11.3%	0.32
Year is 2003	0.0%	0.00	11.4%	0.32
Year is 2004	0.0%	0.00	11.3%	0.32
Year is 2005	0.0%	0.00	10.3%	0.30
Moscow / St. Petersburg	11.1%	0.31	13.2%	0.34
North/Northwest	6.7%	0.25	5.9%	0.24
Central Black Earth	21.2%	0.41	20.6%	0.40
Volga/Volga Vaytski	19.8%	0.40	19.5%	0.40
North Caucasia	8.9%	0.28	8.7%	0.28
Ural	15.2%	0.36	15.9%	0.37
West Siberia	9.2%	0.29	8.2%	0.27
East Siberia/Far East	7.9%	0.27	7.9%	0.27
TV Reception	95.1%	0.22	90.7%	0.29
Restaurant	88.3%	0.32	82.1%	0.38
Public Bath	88.5%	0.32	85.4%	0.35
Median p.c. income at community level	2,787	722	2,909	1,162
Number of person-year observations	4,731		56,311	

Source: RLMS, 1994-2005.

Table A2: Products for which prices are collected in the RLMS community data.

Dairy	Milk, Cream, Curd, Kefir, Sour Cream, Butter, Hard Cheese, Ice Cream, Mayonnaise, Eggs, Condensed Milk, Powdered Milk
Vegetable Fats	Vegetable Oil**,** Margarine
Potatoes	
Bread	Wheat Bread (highest sort), Wheat bread (first sort), Rye Bread
Cereals	Wheat flour, Macaroni, Vermicelli, Rice, Buckwheat, Kidney Beans, Peas, Beans
Meat	Beef, Lamb, Pork, Chicken
Meat Products	Boiled sausages, Semi-smoked Sausages, Hard-smoked sausages, Lard, Ham, Wiener
Canned Meat & Fish	Stewed pork, canned, Stewed beef, canned, Ground sausage, canned, Canned fish in oil
Fish	Fresh fish, Frozen fish, Frozen Fish Fillets, Salted fish, Smoked fish
Sugar	Granulated sugar, Lump sugar
Confectionery	Caramels, Waffles, Cookies, Chocolate, Chocolate Candies, Cakes, Honey
Fruits	Apples, Grapes, Plums, Lemons, Melons, Pears, Peaches, Oranges, Watermelons
Vegetables	Garlic, Cucumbers, Tomatoes, Cabbage, Beets, Onions, Squash
Canned Fruits and Vegetables	Jam, Canned Peas, Canned fruits, Canned Vegetables
Coffee, Tea	
Hard Liquor	Vodka, Cognac
Wine	Fortified Wine, Table Wine
Beer	
Tobacco	Domestic Cigarettes, Imported Cigarettes

Source: Own compilation.

Table A3: Summary statistics of price variables.

	Mean	Median	Standard Deviation	Coefficient of Variation
Bread, white	22.80	19.68	11.34	0.50
Wheat flour	17.19	15.28	7.02	0.41
Potatoes	10.45	9.91	4.38	0.42
Cabbage	10.33	9.17	5.80	0.56
Onions	14.61	13.30	6.34	0.43
Oranges	48.90	44.98	13.06	0.27
Apples	42.34	41.04	14.62	0.35
Beef	110.18	108.14	30.50	0.28
Pork	118.65	116.97	31.92	0.27
Chicken	83.76	81.00	16.77	0.20
Sausages	124.54	121.35	29.70	0.24
Milk, fresh	19.34	19.31	6.65	0.34
Butter	120.24	112.49	40.86	0.34
Cheese	161.55	149.76	64.16	0.40
Vegetable oil	73.46	55.00	48.23	0.66
Sugar	26.65	24.49	8.07	0.30
Cookies	76.88	60.55	49.26	0.64
Fish, fresh	79.66	65.52	80.54	1.01
Vodka	300.61	209.67	277.49	0.92
Cigarettes	17.69	13.52	12.45	0.70
N	56311			

Source: RLMS, 1994-2005.

3.3 How do obese people afford to be obese? Consumption strategies of Russian households

by Matthias Staudigel

Published in *Agricultural Economics* **43** (2012), 701-714, reprinted with kind permission from Jon Wiley and Sons.

Original publication available at: http://onlinelibrary.wiley.com/doi/10.1111/j.1574-0862.2012.00613.x/pdf.

How do obese people afford to be obese? Consumption strategies of Russian households

Abstract

This article investigates the extent to which Russian households that differ in their members' weight status adjust their food consumption differently when their economic resources change. Using household-panel data from the Russia Longitudinal Monitoring Survey (RLMS) from 1995-2005, we estimate total expenditure elasticities of food expenditures, food quantities and food quality for normal-weight, overweight, and obese households, respectively. The expenditure elasticities of quality derived for obese households for meat, bread, fruits, and dairy were found to be 15-20 % higher than those of normal households. Hence, a change in economic resources causes obese households to adjust the quality of purchased foods significantly more flexibly than normal-weight households. Only few differences were found for quantity and expenditure reactions. Our results emphasise that policies aiming to reduce obesity should consider deviations in consumption behaviour of normal and obese consumers in terms of quality.

Keywords: obesity; food consumption; quality; fat tax; Russia; RLMS;

JEL-Classification: C23; D12; I10; I18; Q18;

1 Introduction

Economic prosperity has substantially contributed to the global rise in obesity rates by its impact on people's energy balance. On the one hand, decreasing real food prices (Philipson and Posner, 2003; Lakdawalla and Philipson, 2009) and lower costs of food preparation decreased the relative costs of energy intake. On the other hand, the relative costs of energy expenditure increased due to technological innovations that favored physically inactive lifestyles (Cutler et al., 2003). Some authors argue for policy options that use exactly these economic forces to halt and reverse the extension of waistlines (see e.g. Popkin and Ng, 2007; Brownell et al., 2009). Much discussion has centered on fat taxes and thin subsidies. Proponents expect these instruments to create a healthier eating behavior by increasing the price of "unhealthy" food items and reducing the price of "healthy" products. Moreover, tax

revenues could be used for information campaigns on healthier lifestyles (Kuchler et al., 2005). In contrast, critics counter that a point-of-purchase tax doesn't lead to efficient targeting and probably causes undesirable distributional effects (see Cash and Lacanilao, 2007, for an overview). Or as Smed et al. (2007) put it: "In principle, the introduction of economic regulation would result in the same changes in conditions for all consumers, and thus does not provide the possibility of targeting specific consumer segments […]".

One point that has been neglected so far is that consumers facing differentiated food products can choose more than quantity. Based on their respective preferences some households might spend a higher share of their total budget for food or purchase products of higher quality. Empirical evidence on how such behavior is related to obesity is surprisingly rare. A second point is whether the responsiveness to economic incentives varies across different consumer groups. Knowing the direction and the magnitude of such deviations is a necessary precondition for rational decisions on specific policies. Recently, a number of studies began to investigate the effects of fat taxes across consumer segments. The majority of them divided consumers into income groups and found that quantity and/or expenditure reactions vary along socio-economic lines in France (Allais et al., 2010), the United States (Cash et al., 2005; Chouinard et al., 2007; Powell, 2009; Powell and Bao, 2009), Sweden (Nordström and Thunström, 2011), and Denmark (Smed et al., 2007). Other studies point out that the degree to which people react to price changes depends on the amounts they currently purchase. For example, Gustavsen and Rickertsen (2011) found the highest absolute effect of an increase in Value Added Tax on sugar-sweetened carbonated soft drinks among high-purchasing households. Such a segmentation on the basis of income or purchased quantities allows statements on the behavior of consumer groups with higher or lower prevalence of overweight and obesity. However, an explicit distinction between obese and normal-weight consumers would yield even more and deeper insights into the interdependencies of economics and obesity.

In the present study we aim to shed some light on the consumption strategies of households regarding the expenditures, quantities and qualities of their purchased food items with a special focus on differences between obese and normal-weight households. Our goal here is to identify the main consumption patterns and to elaborate whether such behavioral differences matter. Hence, we do not conduct an in-depth analysis of the impact of single

food prices but rather concentrate on general responses to fluctuations in economic resources such as the households' total budget.

We are analyzing the case of Russia which provides two main advantages. First, the economic situation in Russia was characterized by strong fluctuations in the early years of transition and during the ruble crisis in 1998 (Sedik et al., 2003). Second, the Russia Longitudinal Monitoring Survey (RLMS) offers a unique combination of economic data as well as measures of anthropometry and health status that allows investigating consumption patterns for consumers of different body weight. This provides a natural basis to investigate the reaction of consumption strategies due to arguably exogenous variation in economic resources which has been used by a number of studies. Sedik et al. (2003) as well as Ulijaszek and Koziel (2007) report that the availability of food energy remained nearly constant in the course of transition. For example, Russian households shifted their diet from animal products to starches or increased the preparation of foods at home (Mroz and Popkin, 1995; Jahns et al., 2003). Stillman and Thomas (2008) found that it is mainly the longer-term resources of households that are crucial for the nutritional status measured as Body Mass Index (BMI)[1] or energy intake. Previous work on the effects of changing economic resources on consumption patterns using the RLMS was conducted by Stillman and Thomas (2008) and Manig and Moneta (2009). They found that shifts in consumption tended to occur more frequently between food groups with different per-calorie costs than between single products within food groups.

The rest of the article is organized as follows. In Section 2, we provide the theoretical framework and discuss possible strategies of food consumption for households of different weight status. We introduce the data and describe the weight classification of households according to their weight status in Section 3. Regression and statistical test results are presented in Section 4. Conclusions and implications of the findings are elaborated in the final Section 5.

[1] Body Mass Index (BMI) = weight in kg / height in m².

2 Theoretical Background

In this section, we argue that obese consumers can deviate from normal-weight consumers in their consumption strategy at three main points. They can spend a different part of their disposable income on food, purchase different quantities of food products or buy products of different quality. To illustrate this point, imagine a household that decides how to divide its total budget *X* between food and non-food. The total food expenditure X_F can be further allocated to expenditure for single product groups X_G such as meat, bread, fruit or vegetables:

(1) $X_F = \sum X_G$.

Expenditure on each food group X_G is the product of the quantity Q_G that is purchased and the unit value V_G which is the average price per unit that is paid by the household (Eq. 2). These unit values reflect the quality choice of the household since the products within one group are not homogeneous (Deaton, 1988).

(2) $X_G = Q_G \cdot V_G$.

V_G can be further decomposed into π_G, a scalar representing the price level in the region where the household lives and v_G, a quality index defined as the value of goods purchased by the household *at fixed reference prices* in relation to the physical quantity (for a more detailed version of the model, see Deaton, 1997). Hence, we can write equation (2) as:

(2') $X_G = Q_G \pi_G v_G$.

To analyze the reaction of households' food consumption to changes in economic resources we follow Behrman and Deolalikar (1987) and Manig and Moneta (2009) and differentiate (2') with respect to *X*:

(3) $\frac{dX_G}{dX} = \frac{\partial Q_G}{\partial X}\pi_G v_G + \frac{\partial \pi_G}{\partial X} Q_G v_G + \frac{\partial v_G}{\partial X} Q_G \pi_G$.

Since the local price level π_G is exogenous to changes in household resources, the second term on the right-hand side is zero. Using (2') we obtain:

(4) $$\frac{dX_G}{dX}\frac{X}{X_G} = \frac{\partial Q_G}{\partial X}\frac{X\pi_G v_G}{Q_G\pi_G v_G} + \frac{\partial v_G}{\partial X}\frac{X\pi_G Q_G}{v_G\pi_G Q_G}.$$

Or written as elasticities:

(5) $$\varepsilon_{X_G X} = \varepsilon_{Q_G X} + \varepsilon_{v_G X}.$$

In equation (5) the total expenditure elasticity of expenditure on food group *G*, $\varepsilon_{X_G X}$, is expressed as the sum of the total expenditure elasticity of quantity of group *G*, $\varepsilon_{Q_G X}$, and the expenditure elasticity of quality of group *G*, $\varepsilon_{v_G X}$. However, the error terms that are present in the empirical estimation will prevent an exact adding-up of the elasticities (Manig and Moneta, 2009).

In order to describe how food consumption reacts to a change in total expenditure, it is necessary to look at three aspects: a) How strong is the effect on total food expenditure and on expenditure for single food groups? b) How large is the shift in quantities of each food group? c) How strong is the effect on quality, i.e. the per-unit expenditure? The relative size of the elasticities of quantity and quality gives information on the intention of consumers. Large quantity effects would indicate that additional "physical needs" (i.e. provision of energy or satiation) are satisfied by higher incomes. In the case of large quality effects, consumers would serve "residual needs" (i.e. variety seeking, healthier diet, status value, taste, appearance, odor) (Manig and Moneta 2009).

The central question of this analysis is whether we can expect different reactions from obese and normal-weight consumers for any of these parameters. Regarding *total food expenditure*, an increase of total expenditure may cause obese households, in case they attach more importance to food, to spend a larger part of the additional money on food. In the case of declining wealth, however, the obese could show a smaller reaction when they give up other things before food. These considerations should also include the initial level of food expenditure which is likely to be higher for the obese in the beginning and are then reduced to a greater extent in times of decreasing resources, because all other expenditure is indispensable for life (such as rent, medicine, etc.). For *total calories* the effect is not clear *a priori* as the levels might be different from the beginning. The same holds true for *quantities of each food group* and the respective *expenditure*. The *quality elasticity* of obese consumers might be more flexible than those of normal-weight persons. In times of

hardship, obese consumers might show a larger decrease in their per-unit expenditure on food as well as for single food groups in order to maintain adequate quantities for repletion.

Whether or not obese households react differently with respect to their quantity and quality decisions has important implications for policies aiming to change consumption of healthy/unhealthy food products by fiscal measures. If they were more flexible in their quality decisions, obese households would simply reduce their spending on the extras but would not significantly change the quantity of foods and, thus, the calories they consume. We could think of an even less desirable scenario. When a shift to lower quality implies that households choose more energy dense foods their energy intake increases while the physical quantity remains the same. An example would be the substitution of lean and expensive cuts of meat by cheaper cuts high in fat. To investigate possible differences between normal and obese households in their consumption behavior we estimate the elasticities for group expenditure, quantity and quality as depicted in (5) separately for each household-weight type. Further, the panel structure of the data allows us to account for household fixed-effects that are likely to influence consumption decisions, as e.g. shown by Behrman and Deolalikar (1987). The classification of households is described in detail in Section 3.2 and the estimation strategy is presented in Section 4.2.

3 Data

3.1 RLMS

The Russia Longitudinal Monitoring Survey (RLMS) has been implemented to measure the impact of transition and accompanying reforms on living conditions in the Russian Federation. It comprises a series of repeated cross-section surveys that collect detailed data on, for example, individual health and nutrition, expenditure, assets and sociodemographic characteristics of households as well as community-level food prices and infrastructure. In order to get a nationally representative sample, the RLMS was designed as a stratified three-step cluster sample. Households were the target units, defined as a group of people "dwelling together and sharing a common budget" (Zohoori et al., 1998).[2] Additional to the (weighted) cross-sections that are nationally representative, there is a longitudinal component that allows us to create a panel that consists of those households that have been

[2] For more details on the design of the RLMS see e.g. Heeringa (1997); Swafford and Kosolapov (2002); Jahns et al. (2003).

interviewed in two or more consecutive rounds. These longitudinal data show what has happened to households and individuals with given characteristics over a period of time.

The present analysis uses household-level data from the nine Phase II rounds 6 to 14 covering the years 1995 to 2005.[3] This panel comprises a total of 8,951 responding households. 6,428 of these have been interviewed in at least two rounds. Observations with negative income and expenditure were excluded. Households located in rural areas were also excluded, as the consumption and shopping behavior of farming households might significantly differ from non-farming households because they rely on home-produced goods in their usual diet. After purging missing and implausible values, the analyzed sample includes 4,838 responding households and 24,106 household-year observations. Table 1 provides summary statistics for the longitudinal panel. About 22 % of the households responded in two waves, 17 % in three, 12 % in four, 9 % in five, 8 % in six, 7 % in seven, 7 % in eight, and 18 % in all nine waves.

Finally, the RLMS contains post-stratification weights for unbiased (e.g. nationally representative) estimation of descriptive statistics for cross-sections. In the present analysis we use sample weights only for the descriptive statistics that show the development of consumption patterns over time in Section 4.1 but not for the econometric analysis in 4.2. The latter is longitudinal and includes follow-up households from the non-cross-sectional part who have sample weights of zero (RLMS, 2011).[4]

Food expenditure and quantities are reported by households for the last 7 days before the interview. A total of 58 single food items were then aggregated to 15 food groups. Unit values were derived for each food group by dividing expenditure by quantity. Data on energy intake stem from a 24h recall of each participant's consumption and are less vulnerable to wastage and intra-household allocation bias compared to calculation from purchases. All monetary values were deflated using the monthly consumer price index for food (2005=100) in the Russian Federation that is provided by Goskomstat and is available from the statistics

[3] Altogether Phase II includes waves 5 to 17 that were conducted in the last quarter of 1994, 1995, 1996, and 1998 and from 2000 to 2008, respectively. In 1997 and 1999, no surveys were conducted.

[4] Heeringa (1997) points out that there "…is considerable debate over the value of using weights in multivariate analysis. Some statisticians argue that using weights is not necessary if the fixed effects that explain the variation in weights are included in the model. In RLMS data, the household characteristics that explain the greatest variation in weights are the geographic region and the urban/rural character of the civil division in which the dwelling is located. Variation in individual weights will reflect the geographic effects for households as well as differentials due to post-stratification of the sample by major geographic regions, age, and sex".

database of the OECD (2010).

Table 1: Summary statistics of independent variables (N=24,106)

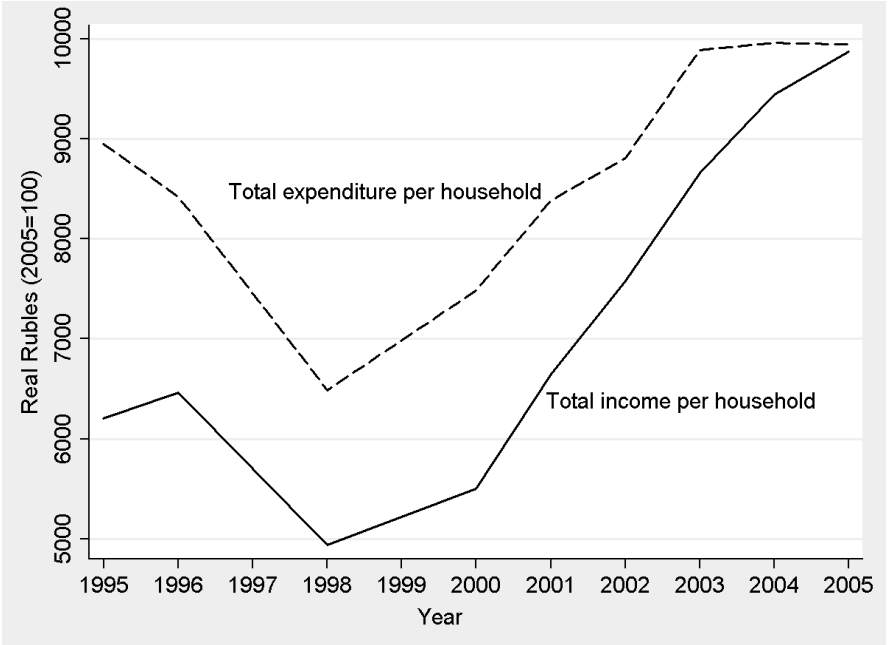
Variable	Mean	Std. Dev.
Household size	2.73	1.34
Share of female household members	0.59	0.27
Real total expenditure per capita	4,498.51	6,931.27
Household head's…		
Age	46.86	16.07
Work status	0.69	0.46
Gender (Male=1)	0.73	0.45
Education:		
Vocational	0.19	0.40
Technical/Medical School	0.15	0.36
Secondary School	0.18	0.38
Incomplete higher	0.07	0.25
University & higher	0.22	0.41
Household is…		
Normal weight	0.24	0.43
Overweight	0.46	0.50
Obese	0.30	0.46
Community food prices:		
Bread (white)	22.9	11.92
Flour	16.9	6.80
Potatoes	9.9	3.84
Cabbage	9.5	3.96
Onions	13.6	4.77
Oranges	47.1	11.70
Apples	41.1	12.85
Beef	112.2	29.93
Pork	119.9	31.34
Chicken	81.8	14.46
Sausages	120.7	25.18
Milk	19.4	6.48
Butter	112.6	28.87
Cheese	162.4	64.88
Vegetable Oil	71.3	49.08
Sugar & Confectionery	25.4	7.05
Cookies	74.9	49.04
Fish, fresh	73.3	41.73
Vodka	307.6	289.23
Cigarettes	18.2	12.64

Source: Own computation based on RLMS, 1995-2005.

In the light of Russia's special situation during the transition period, the search for an adequate measure of the economic situation of Russian households deserves particular attention. The obvious choice would be household income which, however, is problematic for several reasons. The incomes reported in the RLMS are below expenditures during the *whole* period under investigation (see Figure 1). According to local RLMS specialists, Russian

respondents tend to remember the amount of expenditures better than their income from different sources. Moreover, sometimes they might want to hide the information on incomes but are ready to reveal their expenditures (Bardsley, 2010). Related studies using the RLMS also point out this problem. Stillman and Thomas (2008) interpret per-capita expenditure on non-durables as "indicative of resource availability within the household" in Russia. They find that per-capita income is a noisier measure of economic resources and its use in econometric estimation possibly leads to biased coefficients. Manig and Moneta (2009) argue that income data in the RLMS are probably less informative due to wage arrears and delayed wage payment as well as misreporting: "Consequently, when expenditures are higher than money income (measured or reported), expenditures may be a better indicator for the living standard that the household can reach, even when taking into account formal and informal credit for consumption" (ibid., p.4). Hence, we consider per-capita expenditure to be a more reliable measure for the actual purchasing power of Russian households and choose it as the primary measure of economic resources. However, we did not fully abstain from using income in the analysis, especially when we assess robustness and sensitivity in Section 4.4.

Figure 1: Mean total expenditure and mean total income of Russian households from 1995-2005



Source: RLMS, 1995-2005.

3.2 Classification of Households

Expenditure, purchased quantities, and thus, unit values, are only observed at the household level. Therefore, we need to categorize households according to their members' weight status in order to test whether households that differ in the number of overweight and obese members also differ in their behavior. The present analysis follows a modification of the approach by Doak et al. (2000) and divides households into three weight categories: normal, overweight and obese. First, each adult member was classified using the BMI cut-offs BMI<25 (normal), 25≤BMI<30 (overweight) and BMI≥30 (obese). For the members of age 2 to 18 the age-adjusted percentile equivalents published by Cole et al. (2000) were used for classification. In the next step, households were classified as follows:

- *Obese*: any household with at least one obese member and a proportion of obese and overweight persons amounting to 50 % and higher;
- *Overweight*: any household that does not fulfill the requirements for the obese group with at least one overweight and/or obese person;
- *Normal*: neither obese nor overweight household members.

Of course, any such classification is arbitrary to a certain degree. The most important criterion for the present analysis is whether the distinction between normal and obese households is sharp enough to detect differences in their economic behavior. The results in Section 4.3 will allow to assess the usefulness of this classification. Additionally, the sensitivity analysis in Section 4.4 reports how the estimates will change for alternative classifications.

The characteristics of these household categories point to a successful and adequate classification: 30 % (N=7.308) of all household observations are classified as "obese" and almost 46 % (N=10.997) as "overweight". Only 24 % (N=5.781) of all household-year observations show neither obese nor overweight members. The mean BMI is higher for the obese (29.4) than for the overweight (25.5) and the normal group (22.1). Obese households have an average of 1.24 obese, 0.65 overweight, and 0.66 normal-weight members. This is clearly different from households classified as overweight (0.17 obese, 1.13 overweight, and 1.52 normal) and normal (2.13 normal members, as by definition: no obese and overweight members,). Households in the overweight group are the largest with 3 members on average followed by the obese (2.6 members) and the normal households (2.4 members). The

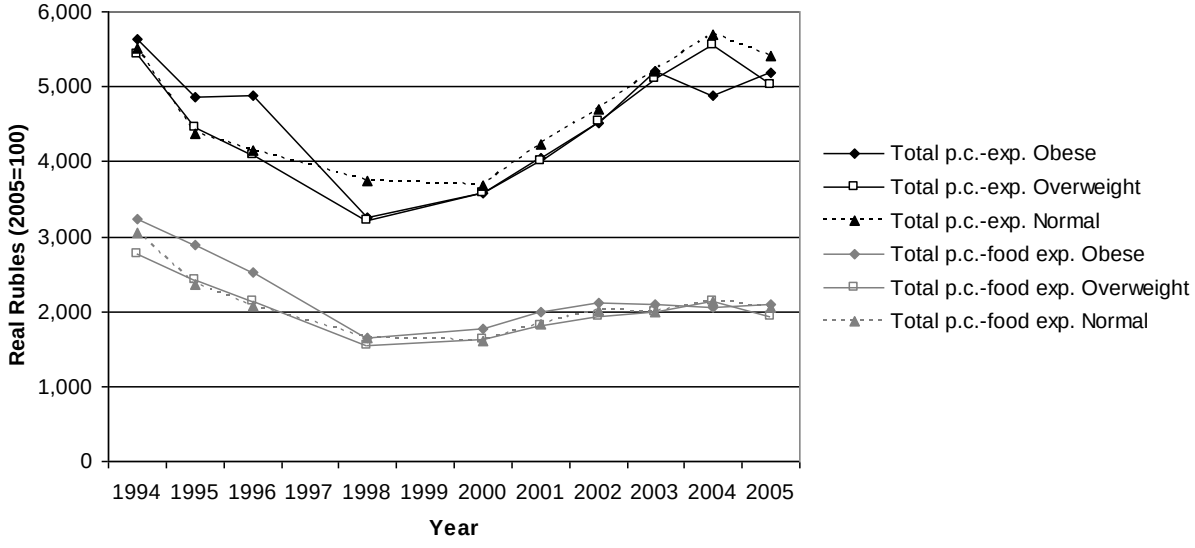
proportion of females is slightly higher in obese households. Furthermore, the weight groups are stable over time: in 85.8 % of all cases, a household classified as "obese" in one round will also be "obese" in the next round. The transition probabilities for "overweight" and "normal" households are, respectively, 74.8 % and 76.7 %.

4 Empirical Analysis

4.1 Food consumption patterns over time

Figure 2 illustrates the development of per-capita household expenditure in total and for food by the three household-weight groups. The graphs point out the slump of economic resources experienced by Russian households during the ruble crisis in 1998 as well as the subsequent recovery. Remarkably, food expenditure did not recover to the same degree as total expenditure did, and does not reach its pre-crisis level. Regarding the household-weight groups, we find a slight shift in the ranking of total expenditure. While obese households spent more in total *and* on food than normal-weight households before the crisis, they still show higher expenditure for food despite slightly lower total expenditure afterwards. Thus, the obese seem to set a higher value on food when they decide how to spend their budget. A more detailed look at quantities and per-unit expenditure should reveal further insights into what it is exactly that they value more.

Figure 2: Total expenditure per capita and total food expenditure per capita by household-weight groups, 1994-2005

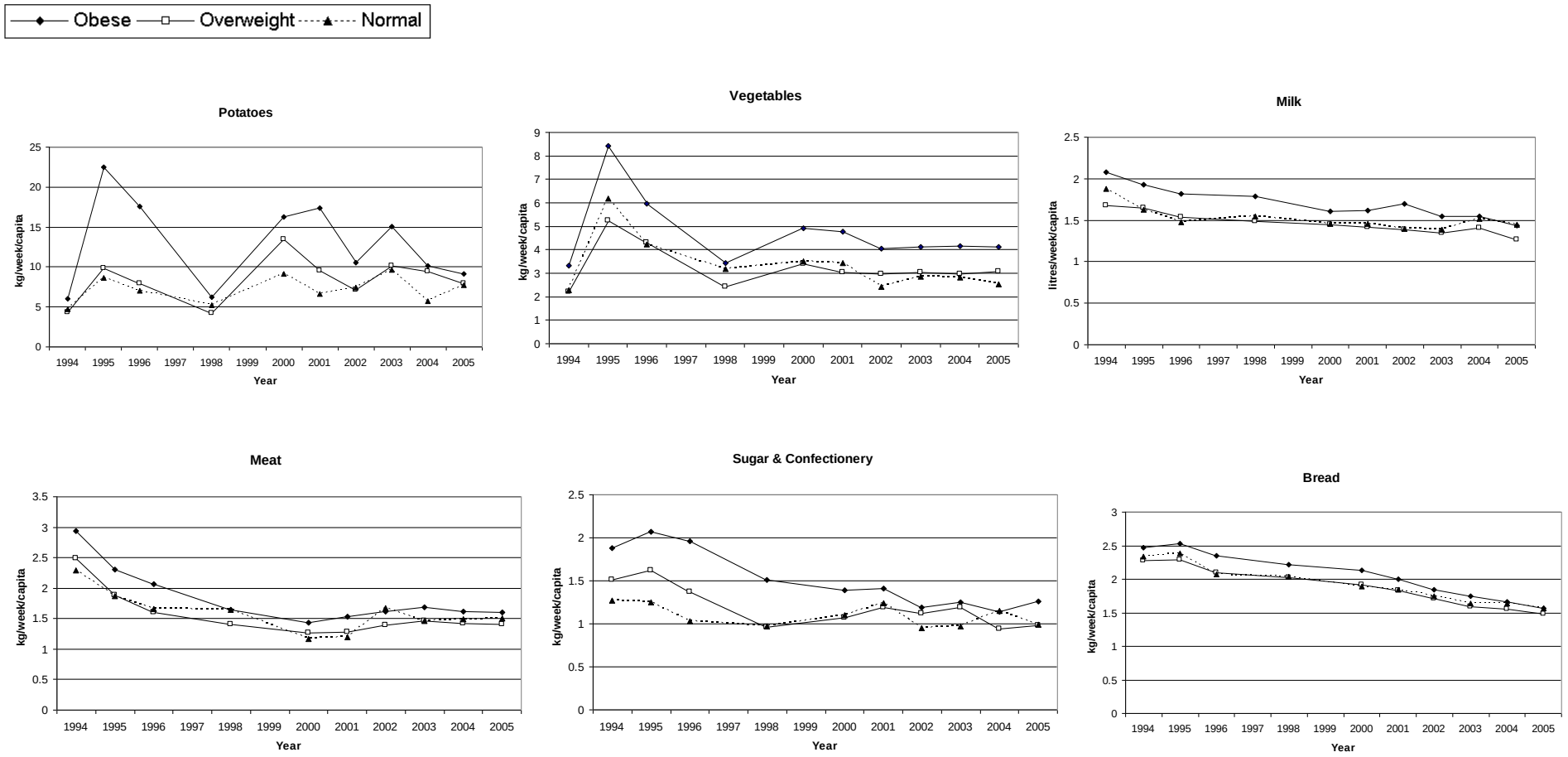


Source: RLMS, 1994-2005.

Figure 3 shows purchases by household-weight groups in the course of time for six important commodities, namely potatoes, vegetables, milk, meat, sugar and confectionery, and bread, in kg per week and per capita. Apparently, obese households purchase larger quantities of each food group with the highest deviations for potatoes, vegetables, and sugar and confectionery. The case of potatoes is striking, with differences of up to 10 kg between obese and normal households in 1995. Of course, these figures have to be interpreted with caution, since potatoes are bought at irregular intervals and in large amounts. Smaller investments in storage during times of crisis would also explain the observed volatility. Nevertheless, the continuous pattern of substantially higher purchases among obese households indicates that potatoes play a big part in the provision of energy especially for this weight group. Figure 3 also reveals that the obese households' appetite does not solely focus on those foods often branded as "unhealthy" like meat or sugar and confectionery, but also leads to higher intakes of vegetables and fruit (not shown here). Hence, obese households do not necessarily follow a diet that is inferior in quality compared to normal households in terms of the mixture of different food items in Russia. They do, however, show lower per-unit expenditure. This is depicted in Figure 4 that plots the unit values of the same product groups as in Figure 3 over time. Mainly potatoes, vegetables, milk, and, to a lesser extent, bread show lower unit values for obese than for normal-weight households. The differences are ambiguous for meat and sugar and confectionery, where obese and normal households alternate in showing higher and lower unit values.

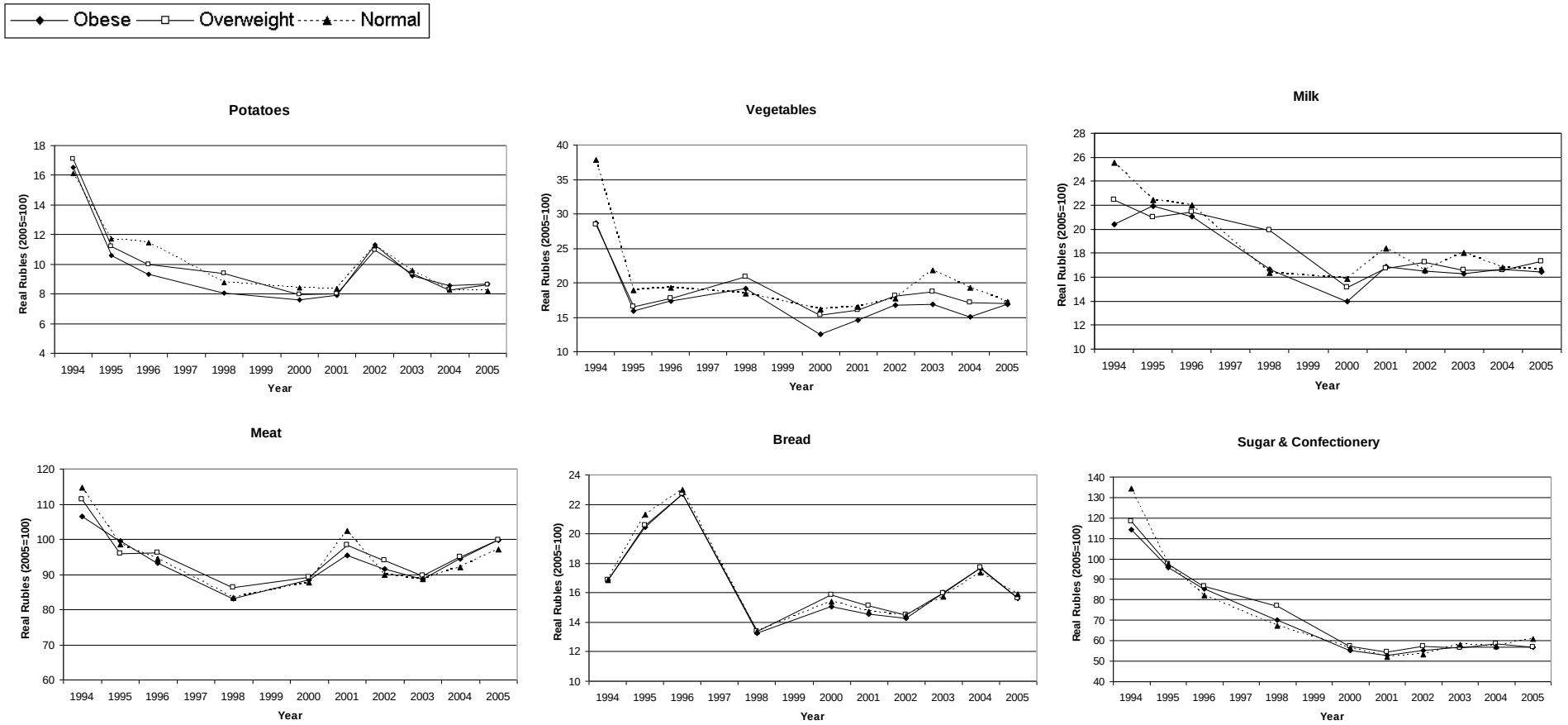
These figures, however, are based on repeated cross sections that are vulnerable to many confounding factors like prices, household characteristics and local environment. To make more exact statements on the behavior of obese and normal-weight households we apply a fixed-effects regression model in the next section to isolate the effects of expenditure.

Figure 3: Quantities of selected food groups purchased per capita and per week by household-weight groups, 1994-2005



Source: RLMS, 1994-2005.

Figure 4: Unit values of selected food groups in real rubles (2005=100) by household-weight groups, 1994-2005



Source: RLMS, 1994-2005.

4.2 Estimation Strategy

Our approach for the estimation of Engel curves especially for unit values, but also for food expenditure and food quantities, follows Deaton (1997) and Yu and Abler (2009) and is expressed for the example of unit values in equation (6):

$$(6)\quad \ln V_{Ght} = \beta \ln X_{ht} + \sum_j \theta_j S_{jht} + \gamma P_{ct} + \varepsilon_{Ght},$$

where *G* indexes product group, *h* households, *t* time, and *c* communities. The natural logarithm of V_{Ght} is regressed on the log of total household expenditure $\ln X_{ht}$, so that the coefficient β represents the total expenditure elasticity of quality. The log-linear functional form can be seen as first-order Taylor approximation to the unknown relationship (Yu and Abler, 2009). This relationship is estimated conditional on a set of household characteristics S_{jht}, namely household size, share of female household members, the household head's education, age, and gender, and a vector of 20 community food prices P_{ct} that controls for effects of price variation over time. The regressions for food group expenditure $\ln X_{Ght}$ and quantities $\ln Q_{Ght}$ use the same specification on the right-hand side.

Other household or community characteristics that are not explicitly controlled for are likely to affect expenditure, quantities or unit values. These comprise mostly unobserved or unobservable items like preferences, abilities, availability of shops, infrastructure or tradition and eating habits and will cause confounding bias when they are correlated with exogenous variables. Hence, the error term becomes $\varepsilon_{Ght} = e_{Gh} + u_{Ght}$. Hausman tests indicate that the regressors are correlated with individual-specific error terms e_{Gh}, so a fixed-effects model is appropriate.

We now want to test whether households of different weight status respond differently to changes in total expenditure, i.e. whether they are heterogeneous in β and we can assume different parameters β_1 for normal, β_2 for overweight, and β_3 for obese households, respectively. Therefore, we rewrite equation (6), following Gould (2002), and introduce two dummy variables W_2 (overweight = 1) and W_3 (obese = 1) for overweight and obese household groups, respectively:

$$(7)\quad \ln V_{Ght} = \beta_1 \ln X_{ht} + \beta_2^*(\ln X_{ht} \cdot W_2) + \beta_3^*(\ln X_{ht} \cdot W_3) + \sum_j \theta_j S_{jht} + \gamma P_{ct} + \varepsilon_{Ght}$$

In equation (7), we have $\beta_2^* = \beta_2 - \beta_1$ and $\beta_3^* = \beta_3 - \beta_1$, so that testing for $\beta_2^* = 0$ and $\beta_3^* = 0$ indicates whether parameters differ significantly.

4.3 Regression Results

Table 2 shows the total expenditure elasticities of group expenditure for 15 food groups as well as for total food expenditure. The first column presents the elasticity for normal-weight households; the second and third columns report the absolute deviations from the elasticities of overweight and obese households respectively. All elasticities are positive and smaller than unity and, thus, Engel's Law proves true for Russia in each of the weight groups. When total expenditure increases by 1 %, total food expenditure increases by 0.69 %.

Table 2: Fixed-effects regression estimates of the total expenditure elasticity of food group expenditure

	β_1			$\beta_2^* = \beta_2 - \beta_1$			$\beta_3^* = \beta_3 - \beta_1$			R^2
Total	0.688	(0.0108)	***	0.003	(0.0016)		0.005	(0.0020)	**	0.46
Meat	0.516	(0.0135)	***	0.002	(0.0024)		0.003	(0.0030)		0.20
Bread	0.093	(0.0073)	***	-0.001	(0.0017)		-0.001	(0.0022)		0.15
Cereals	0.259	(0.0150)	***	0.000	(0.0030)		0.001	(0.0039)		0.13
Potatoes	0.450	(0.0379)	***	0.018	(0.0067)	***	0.028	(0.0086)	***	0.13
Vegetables	0.408	(0.0225)	***	0.002	(0.0046)		0.004	(0.0058)		0.11
Fruits	0.347	(0.0172)	***	0.004	(0.0032)		0.006	(0.0044)		0.13
Milk	0.173	(0.0110)	***	0.005	(0.0025)	**	0.005	(0.0032)	*	0.08
Dairy	0.385	(0.0130)	***	0.001	(0.0025)		0.004	(0.0033)		0.13
Vegetable Fats	0.194	(0.0131)	***	-0.001	(0.0028)		-0.002	(0.0036)		0.21
Sugar & Confectionery	0.493	(0.0161)	***	0.004	(0.0032)		0.003	(0.0042)		0.13
Fish	0.360	(0.0337)	***	0.001	(0.0066)		0.001	(0.0082)		0.09
Coffee & Tea	0.271	(0.0168)	***	0.007	(0.0035)	**	-0.003	(0.0046)		0.12
Beverages	0.264	(0.0242)	***	-0.005	(0.0049)		-0.007	(0.0066)		0.13
Alcohol	0.344	(0.0275)	***	-0.001	(0.0049)		-0.003	(0.0063)		0.12
Tobacco	0.243	(0.0143)	***	-0.002	(0.0031)		0.003	(0.0041)		0.12

* Significant at the 10 %-level. ** Significant at the 5 %-level. *** Significant at the 1 %-level.

Note: Heteroscedasticity-robust Huber/White standard errors are reported in parentheses. All regressions control for household size, share of female household members, the household head's education, age, and gender as well as a set of community food prices.

Source: Own computation based on RLMS, 1995-2005.

The elasticities for single groups are slightly smaller. Among the product groups, bread, milk, and vegetable fats show the smallest elasticities with 0.09, 0.17, and 0.19 respectively. The highest values were found for meat (0.52), sugar and confectionery (0.49), and potatoes

(0.45). This indicates that the former constitute the basis on which the provision with energy is built and the latter represent product groups that provide additional benefits besides pure calorie supply. The high elasticity of potatoes, however, is quite surprising. We could possibly explain the volatility by the fact that people buy large amounts of potatoes at a certain time and then store them at home. Hence, when their money is scarce, households will not buy large amounts for storage purposes.

We can reject the hypothesis of equal elasticities for normal and obese households on the basis of the test results for expenditure on food in total, potatoes, and milk (as indicated by the significance of β_3^*). However, the differences in total food and milk expenditure are very small. Only the elasticity of potatoes is about 6 % higher for the obese group than for normal-weight households.

Table 3: Fixed-effects regression estimates of the total expenditure elasticity of quantity

	β_1			$\beta_2^* = \beta_2 - \beta_1$			$\beta_3^* = \beta_3 - \beta_1$			R^2
Energy	0.073	(0.0046)	***	0.002	(0.0010)		0.002	(0.0013)		0.05
Meat	0.481	(0.0137)	***	0.001	(0.0024)		0.002	(0.0031)		0.16
Bread	0.081	(0.0072)	***	0.000	(0.0017)		0.000	(0.0021)		0.06
Cereals	0.287	(0.0171)	***	0.000	(0.0035)		0.005	(0.0044)		0.08
Potatoes	0.433	(0.0397)	***	0.018	(0.0069)	***	0.027	(0.0089)	***	0.12
Vegetables	0.342	(0.0244)	***	0.003	(0.0053)		0.003	(0.0067)		0.07
Fruits	0.301	(0.0206)	***	0.007	(0.0040)	*	0.008	(0.0054)		0.10
Milk	0.119	(0.0111)	***	0.004	(0.0025)	*	0.008	(0.0032)	*	0.05
Dairy	0.345	(0.0137)	***	-0.001	(0.0027)		0.002	(0.0036)		0.10
Vegetable fats	0.177	(0.0137)	***	0.000	(0.0028)		0.002	(0.0036)		0.13
Sugar & Confectionery	0.397	(0.0180)	***	0.004	(0.0036)		0.003	(0.0047)		0.08
Fish	0.182	(0.0203)	***	0.000	(0.0042)		-0.002	(0.0054)		0.08
Coffee & Tea	0.183	(0.0148)	***	0.001	(0.0032)		-0.003	(0.0042)		0.12
Beverages	0.234	(0.0262)	***	-0.001	(0.0051)		0.003	(0.0069)		0.13
Alcohol	0.250	(0.0252)	***	0.000	(0.0044)		0.003	(0.0060)		0.11
Tobacco	0.159	(0.0128)	***	0.000	(0.0027)		0.001	(0.0035)		0.14

* Significant at the 10 %-level. ** Significant at the 5 %-level. *** Significant at the 1 %-level.

Note: Heteroscedasticity-robust Huber/White standard errors are reported in parentheses. Controls are the same as listed below Table 2.

Source: Own computation based on RLMS, 1995-2005.

The expenditure elasticities of quantity in Table 3 indicate that large parts of the changes in food group expenditure are generated by changes in quantities within the single groups. The elasticities are in the range of zero to unity and mark food products in Russia as necessities. No inferior or luxury goods were identified. The elasticity of total energy intake is very small with about 0.07. This result supports the findings of Stillman and Thomas (2008) that Russian

households shifted their consumption towards foods/food groups that provide energy at lower costs per calorie and kept their energy intake stable at the same time. Furthermore, obese and normal-weight households are equally insensitive to expenditure changes regarding their calorie intake in terms of elasticities. However, since the obese might start from a higher level they are likely to shift more in absolute terms. Again, we find obese households to react significantly more elastically in the groups of potatoes and milk with elasticities respectively, about 6 % and 7 % higher than those of normal households. These figures are computed as the relation of the deviation of overweight/obese households to the elasticity of normal households (e.g. for potatoes and obese: 0.027/0.433 = 0,062 = 6 %). The development of potato and milk quantities is illustrated in Figure 3. Particularly potatoes showed substantial differences between weight groups in 1995 and 1996 when the severe economic burden of early recession years was removed. These differences collapsed in the crisis of 1998 just to rise again afterwards.

Table 4: Fixed-effects regression estimates of the total expenditure elasticity of quality

	β_1			$\beta_2^* = \beta_2 - \beta_1$			$\beta_3^* = \beta_3 - \beta_1$			R^2
Energy	0.631	(0.0114)	***	0.002	(0.0019)		0.004	(0.0024)	*	0.35
Meat	0.066	(0.0077)	***	0.004	(0.0017)	**	0.012	(0.0022)	***	0.59
Bread	0.042	(0.0057)	***	0.004	(0.0014)	**	0.009	(0.0019)	***	0.58
Cereals	0.010	(0.0086)		0.003	(0.0018)	*	0.007	(0.0023)	***	0.41
Potatoes	0.028	(0.0168)	*	0.000	(0.0034)		0.001	(0.0043)		0.49
Vegetables	0.092	(0.0150)	***	0.002	(0.0037)		0.010	(0.0046)	**	0.37
Fruits	0.075	(0.0151)	***	0.004	(0.0031)		0.012	(0.0042)	***	0.29
Milk	0.082	(0.0093)	***	0.006	(0.0020)	***	0.008	(0.0026)	***	0.50
Dairy	0.071	(0.0100)	***	0.007	(0.0022)	***	0.013	(0.0028)	***	0.33
Vegetable fats	0.043	(0.0091)	***	0.003	(0.0020)		0.007	(0.0025)	***	0.47
Sugar & Confectionery	0.128	(0.0121)	***	0.003	(0.0026)		0.009	(0.0034)	***	0.26
Fish	0.188	(0.0273)	***	0.005	(0.0056)		0.013	(0.0069)	*	0.20
Coffee & Tea	0.117	(0.0172)	***	0.012	(0.0036)	***	0.011	(0.0049)	**	0.28
Beverages	0.050	(0.0213)	**	0.004	(0.0047)		0.006	(0.0062)		0.20
Alcohol	0.104	(0.0216)	***	0.004	(0.0045)		0.010	(0.0059)	*	0.24
Tobacco	0.105	(0.0120)	***	0.005	(0.0027)	*	0.016	(0.0037)	***	0.42

* Significant at the 10 %-level. ** Significant at the 5 %-level. *** Significant at the 1 %-level.

Note: Heteroscedasticity-robust Huber/White standard errors are reported in parentheses. Controls are the same as listed below Table 2.

Source: Own computation based on RLMS, 1995-2005.

The elasticities of quality are presented in Table 4. In contrast to the relatively high elasticity of 0.63 for the average cost per calorie, the elasticities for the single food groups turned out to be rather low. The highest elasticities could be found for fish (0.19), sugar & confectionery

(0.13), coffee & tea (0.12), alcohol (0.10), and tobacco (0.11), whereas the more basic food groups show somewhat lower values ranging from 0.01 for cereals to 0.09 for vegetables. Remarkably, nearly all of the elasticities are significantly higher for obese households. In percentage terms, these deviations are quite large: the obese show an 18 % higher elasticity of quality for meat, 21 % higher for bread, 16 % for fruit, and 18 % for dairy produce. This clearly points to a greater flexibility of obese households in the choice of quality. Although the absolute deviations are not very large, they are highly significant, and the relative differences are substantial. Figure 4 illustrates the typical pattern of unit values of meat and vegetables for obese, overweight and normal households over time. Although the differences are not large, there is a clear tendency of lower unit values for obese households.

4.4 Sensitivity Analysis

One concern with the econometric model above is that total expenditure *X* might possibly be endogenous to unit values, quantities or food group expenditure. A natural way to address this problem is the use of instrumental variables (IV). However, it is not always easy to find adequate instruments. For the estimation of elasticities of quality, Beatty (2007) used income as instrument for total expenditures, what is unfortunately not feasible in our case for the reasons discussed above. Results of studies employing IV techniques with RLMS data are rather ambiguous and not very promising. Skoufias (2003) uses three shock variables to instrument household income, namely whether any household member (i) was owed any wages, (ii) was on forced leave or (iii) was unemployed between two consecutive rounds. Stillman (2001) applies four variables of community shocks to instrument household income: (i) log real dollar spot price of European Brent crude oil interacted with the amount of fuel production in 1998, (ii) log real ruble-dollar exchange rate interacted with the log dollar value of total trade in 1998, (iii) average percentage of monthly earnings owed to workers in each community-year, (iv) average log real value of pensions paid to all elderly. He finds that "[w]hen all of the shocks are simultaneously used as instruments the results have greater precision, so it is very encouraging that together they are strong predictors of changes in household income" (p.18) and concludes about a "strong support for the validity of the instruments used in this paper." On the contrary, Stillman and Thomas (2008) instrumented resource fluctuations (here: total per-capita expenditures) by almost the same instruments

as in Stillman (2001) and concluded that "the instruments did a poor job of predicting resource fluctuations, suggesting that the instrumental variables estimates are likely biased" (p.1405). Based on these ambiguous results and facing the danger of biased estimation in the case of weak instruments (Cameron and Trivedi, 2009) we expect the potential gains by IV estimation to be limited.

As a possible way to evaluate the robustness of the estimates in the regressions above, we replace total expenditure by income. Although income has its disadvantages, as discussed in Section 3.1, we would not expect a direct reverse relationship of quantity, quality, and food group expenditure on income as it may theoretically exist for total expenditure. Our results show that the respective coefficients from the income and expenditure regressions deviate only slightly from each other. Also, the pattern of significant differences prevails. Tables 5, 6, and 7 present the income regressions in more detail.

Table 5: Fixed-effects regression estimates of the total income elasticity of food group expenditure

	β_1			$\beta_2^* = \beta_2 - \beta_1$			$\beta_3^* = \beta_3 - \beta_1$		
Total	0.150	(0.0084)	***	0.009	(0.0020)	***	0.013	(0.0027)	***
Meat	0.118	(0.0103)	***	0.004	(0.0026)		0.005	(0.0033)	
Bread	-0.016	(0.0065)	**	0.000	(0.0018)		-0.001	(0.0023)	
Cereals	-0.025	(0.0121)	**	0.000	(0.0031)		0.003	(0.0040)	
Potatoes	0.054	(0.0285)	*	0.017	(0.0068)	**	0.026	(0.0090)	***
Vegetables	0.088	(0.0181)	***	0.004	(0.0048)		0.006	(0.0060)	
Fruits	0.117	(0.0143)	***	0.003	(0.0034)		0.004	(0.0046)	
Milk	0.025	(0.0094)	***	0.005	(0.0025)	*	0.004	(0.0032)	
Dairy	0.095	(0.0109)	***	0.002	(0.0027)		0.005	(0.0035)	
Vegetable Fats	0.016	(0.0115)		-0.002	(0.0029)		-0.002	(0.0037)	
Sugar & Confectionery	0.111	(0.0134)	***	0.006	(0.0034)	*	0.005	(0.0045)	
Fish	0.134	(0.0274)	***	0.004	(0.0068)		0.001	(0.0083)	
Coffee & Tea	0.076	(0.0141)	***	0.007	(0.0037)	**	-0.003	(0.0049)	
Beverages	0.098	(0.0224)	***	-0.004	(0.0053)		-0.006	(0.0071)	
Alcohol	0.118	(0.0214)	***	-0.004	(0.0052)		-0.007	(0.0066)	
Tobacco	0.085	(0.0129)	***	-0.004	(0.0033)		0.003	(0.0044)	

* Significant at the 10 %-level. ** Significant at the 5 %-level. *** Significant at the 1 %-level.

Note: Heteroscedasticity-robust Huber/White standard errors are reported in parentheses. Controls are the same as listed below Table 2.

Source: Own computation based on RLMS, 1995-2005.

Specifically, we find that income elasticities of group expenditures and quantities are smaller than expenditure elasticities and the elasticities of bread and cereals become negative. The sizes of the coefficients show similar relations among products as in the expenditure regressions and significant differences for "total food" and "potatoes" between weight

groups persist. For the case of elasticities of quality, we find only small changes in the absolute value and no uniform change upwards or downwards. As for the expenditure elasticities, we observe highly significant differences between weight groups for the income elasticities.

Table 6: Fixed-effects regression estimates of the total income elasticity of quantity

	β_1			$\beta_2^* = \beta_2 - \beta_1$			$\beta_3^* = \beta_3 - \beta_1$		
Energy	0.030	(0.0040)	***	0.002	(0.0011)	**	0.003	(0.0014)	**
Meat	0.102	(0.0107)	***	0.003	(0.0026)		0.004	(0.0033)	
Bread	-0.023	(0.0064)	***	0.001	(0.0017)		0.001	(0.0022)	
Cereals	-0.007	(0.0137)		0.001	(0.0036)		0.006	(0.0045)	
Potatoes	0.042	(0.0294)		0.017	(0.0068)	**	0.027	(0.0091)	***
Vegetables	0.036	(0.0199)	*	0.006	(0.0055)		0.006	(0.0068)	
Fruits	0.087	(0.0168)	***	0.007	(0.0042)	*	0.007	(0.0055)	
Milk	0.007	(0.0094)		0.004	(0.0025)		0.007	(0.0033)	**
Dairy	0.083	(0.0115)	***	0.000	(0.0028)		0.003	(0.0038)	
Vegetable Fats	0.021	(0.0121)	*	-0.001	(0.0029)		0.001	(0.0037)	
Sugar & Confectionery	0.071	(0.0152)	***	0.006	(0.0037)		0.004	(0.0049)	
Fish	0.030	(0.0161)	*	0.000	(0.0044)		-0.003	(0.0056)	
Coffee & Tea	0.044	(0.0122)	***	0.001	(0.0033)		-0.004	(0.0045)	
Beverages	0.099	(0.0243)	***	0.000	(0.0053)		0.003	(0.0073)	
Alcohol	0.106	(0.0189)	***	-0.002	(0.0046)		0.000	(0.0062)	
Tobacco	0.045	(0.0107)	***	-0.001	(0.0028)		0.002	(0.0037)	

* Significant at the 10 %-level. ** Significant at the 5 %-level. *** Significant at the 1 %-level.

Note: Heteroscedasticity-robust Huber/White standard errors are reported in parentheses. Controls are the same as listed below Table 2.

Source: Own computation based on RLMS, 1995-2005.

We arrive at the conclusion that our results are robust and close to the true relationships. This judgement is based on the descriptive statistics, on the arguably strong impact of exogenous shocks to household resources illustrated by Figure 1, on the notion that we expect the impact of quantity and quality of single food groups on total expenditure to be rather low, and finally on the similar patterns of expenditure and income estimates.

To assess the sensitivity of our results with respect to different definitions of an obese household the above regressions were conducted twice with two alternative household-weight classifications. These alternative versions are (i) a broader definition of an obese household (obese = at least one obese member, but without the co-restriction of at least 50 % obese and/or overweight members) and (ii) a narrower version (obese = at least two obese members and at least 50 % obese and/or overweight). We find significant differences between the results above and those from scenario (i): When a broader definition of an

obese household is used, the elasticities are smaller and in large parts not significantly different from those of normal households. Applying the stricter second definition, the differences between the elasticities of normal and obese households showed a slight increase (by 0.002-0.005). However, most of the significances do not change. This leads to the conclusion that the behavior of households diverges as the number of obese members increases.

Table 7: Fixed-effects regression estimates of the total income elasticity of quality

	β_1			$\beta_2^* = \beta_2 - \beta_1$			$\beta_3^* = \beta_3 - \beta_1$		
Energy	0.139	(0.0089)	***	0.005	(0.0021)	**	0.008	(0.0029)	***
Meat	0.092	(0.0068)	***	0.003	(0.0017)	*	0.011	(0.0023)	***
Bread	0.080	(0.0054)	***	0.003	(0.0014)	*	0.008	(0.0019)	***
Cereals	0.065	(0.0078)	***	0.002	(0.0018)		0.007	(0.0024)	***
Potatoes	0.059	(0.0148)	***	-0.001	(0.0034)		0.000	(0.0044)	
Vegetables	0.128	(0.0134)	***	0.000	(0.0038)		0.008	(0.0047)	
Fruits	0.097	(0.0130)	***	0.003	(0.0032)		0.010	(0.0042)	**
Milk	0.094	(0.0084)	***	0.005	(0.0021)	**	0.007	(0.0027)	***
Dairy	0.085	(0.0085)	***	0.007	(0.0022)	***	0.012	(0.0029)	***
Vegetable Fats	0.078	(0.0077)	***	0.002	(0.0020)		0.005	(0.0025)	**
Sugar & Confectionery	0.117	(0.0109)	***	0.002	(0.0027)		0.008	(0.0035)	**
Fish	0.198	(0.0235)	***	0.007	(0.0058)		0.014	(0.0070)	**
Coffee & Tea	0.103	(0.0153)	***	0.012	(0.0037)	***	0.010	(0.0050)	**
Beverages	0.035	(0.0202)	*	0.004	(0.0048)		0.006	(0.0063)	
Alcohol	0.064	(0.0162)	***	0.003	(0.0046)		0.009	(0.0060)	
Tobacco	0.102	(0.0108)	***	0.004	(0.0027)		0.016	(0.0038)	***

* Significant at the 10 %-level. ** Significant at the 5 %-level. *** Significant at the 1 %-level.

Note: Heteroscedasticity-robust Huber/White standard errors are reported in parentheses. Controls are the same as listed below Table 2.

Source: Own computation based on RLMS, 1995-2005.

5 Discussion and Conclusion

The present analysis sought to identify whether households that have more overweight and obese members react differently to economic changes than their normal-weight counterparts. It is the first study that explicitly addresses changes in food expenditure, food quantities and food quality segmented by body weight. Using data from the Russia Longitudinal Monitoring Survey, households were classified into normal, overweight and obese, and expenditure elasticities of food expenditure, food quantities and food qualities were estimated for each group. The analysis accounted for unobserved household heterogeneity via fixed effects. Wald tests were applied to test for differences in the elasticities across weight groups. We found that obese households showed significantly

higher elasticities than normal-weight households, mainly with regard to their quality reactions. Obese households' expenditure elasticities of quality for meat, bread, fruit, and dairy produce were 15-20% higher than those of normal households. Differences among the elasticities of food expenditure and food quantities were less distinct. Obese households showed higher elasticities of total food expenditure as well as of expenditure and quantities for potatoes and milk. No differences were found between the elasticities of total energy intake for the different household types.

Although the magnitude of the differences is not very large, there is a clear tendency of obese households to react more flexibly to changes in their economic resources, mainly by altering the quality of food products that they purchase. Additionally, descriptive statistics indicate that obese households in Russia tend to pay less per unit for many food groups and seem to trade off quality for quantity.

However, these figures represent the situation in Russia, where obesity and overweight are more prevalent at higher-income levels at which households can afford purchasing more *and* better food. The situation might be different in industrialized societies, where obesity is more prevalent among low-income households. Possible deviations in behavior across countries should be subject to empirical analysis. However, further regressions stratified by income tertiles revealed similar patterns at all socio-economic levels. Further differences between Russia and Western economies might arise from the much higher degree of product differentiation in the West during the analyzed period that allows people to choose among plentiful products of different quality and price and make it easier to change the price per calorie under economic pressure. For Canada, Beatty (2007) reports expenditure elasticities of quality for beef of 0.09, for cheese (0.058), fresh fruits (0.127), and fresh vegetables (0.102) that are slightly higher than found in this paper for Russia. The only exception is milk with 0.07, which might be due to a higher standardization level in Canada.

The present results should raise awareness that people are heterogeneous in their consumption behavior. Under changing economic conditions they change not only the food quantities they purchase but also alter expenditures and quality. These aspects should be considered carefully prior to designing (fiscal) policy measures to reduce obesity. When people manage to maintain their energy intake during a severe crisis as it happened in Russia, fiscal instruments like fat taxes are not likely to have any considerable impact on

overweight and obesity. Especially obese households seem to be able to cushion changes in economic resources by switching to less expensive food items without changing their overall energy intake considerably. Then, less flexible normal-weight households would bear a higher burden imposed by such a tax as they won't change their per-unit expenditure as much as the obese. Although the responses to economic resource changes cannot, of course, be adopted wholesale to price shifts, the patterns found for the quality reactions should make decision makers cautious, at least. Moreover, the outcome that obese households adjust the per-unit expenditure more flexibly demands a more careful use of unit values as proxies for prices in analyses of economic effects on health or weight aspects. Estimated price effects on indicators of health or body weight may be biased when people of different weight or health status, respectively, show different adjustments to economic changes.

Acknowledgements

The author would like to thank the editor, Gerald Shively, and two anonymous referees for valuable comments and suggestions and the Higher School of Economics and ZAO "Demoscope" together with Carolina Population Center, University of North Carolina at Chapel Hill and the Institute of Sociology RAS for making the data of the Russia Longitudinal Monitoring Survey, RLMS-HSE, available.

References

Allais, O., Bertail, P., Nichèle, V., (2010). The Effects of a Fat Tax on French Households' Purchases: A Nutritional Approach. *Am. J. Agr. Econ.* **92**, 228-245.

Bardsley, P., 2010. Information on the discrepancy between income and expenditures in RLMS data. Personal communication via E-Mail received on February 16th, 2010.

Beatty, T.K.M., 2007. The Scope of the Unit Value Problem. Consumer and Market Demand Agricultural Policy Research Network, Project Report Number CMD-07-06. Department of Rural Economy, University of Alberta, Edmonton, Canada.

Behrman, J.R., Deolalikar, A.B., 1987. Will Developing Country Nutrition Improve with Income? A Case Study for Rural South India. *J. Polit. Econ*. **95**, 492-507.

Brownell, K.D., Farley, T., Willett, W.C., Popkin, B.M., Chaloupka, F.J., Thompson, J.W., Ludwig, D.S., 2009. The public health and economic benefits of taxing sugar-sweetened beverages. *New Engl. J. Med.* **361**, 1599-1605.

Cameron, C.A., Trivedi, P.K., 2009. Microeconometrics Using Stata. Stata Press: College Station, Texas.

Cash, S.B., Lacanilao, R.D., 2007. Taxing Food to Improve Health: Economic Evidence and Arguments. *Agr. Res. Econ. Rev.* 36, 174-182.

Cash, S.B., Sunding, L., Zilberman, D., 2005. Fat taxes and thin subsidies: Prices, diet, and health outcomes. *Acta Agr. Scand. C–F E* **2**, 167-174.

Chouinard, H.H., Davis, D.E., LaFrance, J.T., Perloff, J.M., 2007. Fat Taxes: Big Money for Small Change. *Forum Health Econ. & Pol.* **10**(2), 1-28.

Cole, T. J, Bellizzi, M.C., Flegal K.M., Dietz, W. H., 2000. Establishing a standard definition for child overweight and obesity worldwide: international survey. *Brit. Med. J.* **320**, 1240-1243.

Cutler, D.M., Glaeser, E.L., Shapiro, J.M., 2003. Why Have Americans Become More Obese? *J. Econ. Perspect.* **17**, 93-118.

Deaton, A., 1988. Quantity, Quality, and Spatial Variation of Price. *Am. Ec. Rev.* **78**, 418-430.

Deaton, A., 1997. *The Analysis of Household Surveys. A Microeconometric Approach to Development Policy.* The World Bank: Washington, D.C.

Doak, C.M., Adair, L.S., Monteiro, C., Popkin, B.M., 2000. Overweight and underweight coexist within households in Brazil, China and Russia. *J. Nutr.* **130**, 2965-2971.

Gould, W. (2002), Chow tests. STATA FAQs. Available online: http://www.stata.com/support/faqs/stat/chow3.html. Access: August 17, 2010.

Gustavsen, G.W., Rickertsen, K., 2011. The effects of taxes on purchases of sugar-sweetened carbonated soft drinks: a quantile regression approach. *Appl. Econ.* **43**, 707-716.

Heeringa, S.G., 1997. Russia Longitudinal Monitoring Survey (RLMS). Sample Attrition, Replenishment, and Weighting in Rounds V-VII. Accessed February 2011, available at http://www.cpc.unc.edu/projects/rlms-hse/project/samprep.

Jahns, L., Baturin, A., Popkin, B.M., 2003. Obesity, diet, and poverty: trends in the Russian transition to market economy. *Eur. J. Clin. Nutr.* **57**, 1295-1302.

Kuchler, F., Tegene, A., Harris, J.M., 2005. Taxing Snack Foods: Manipulating Diet Quality or Financing Information Programs? *Rev. Agr. Econ.* **27**, 4-20.

Lakdawalla, D., Philipson, T.J., 2009. The Growth of Obesity and Technological Change. *Econ. Hum. Biol.* **7**, 283-293.

Manig, M., Moneta, A., 2009. More or better? Measuring Quality versus Quantity in Food Consumption. Papers on Economics and Evolution No. 09/13, Max Planck Institut of Economics, Jena, Germany.

Mroz, T.A., Popkin, B.M., 1995. Poverty and the Economic Transition in the Russian Federation. *Econ. Dev. Cult. Change* **44**, 1-31.

Nordström, J., Thunström, L., 2011. Can targeted food taxes and subsidies improve the diet? Distributional effects among income groups. *Food Policy* **36**, 259-271.

OECD (Organization for Economic Co-Operation and Development), 2010. OECD.Stat Accessed May 2010, available at http://stats.oecd.org/index.aspx.

Philipson, T.J., Posner, R.A., 2003. The Long-Run Growth in Obesity as a Function of Technological Change. *Perspect. Biol. Med.* **46**, 87-107.

Popkin, B.M., Ng, S.W., 2007. The nutrition transition in high- and low-income countries: what are the policy lessons? *Agr. Econ.* **37**, 199-211.

Powell, L.M., 2009. Fast food costs and adolescent body mass: Evidence from panel data. *J. Health Econ.* **28**, 963-970.

Powell, L.M., Bao, Y., 2009. Food prices, access to food outlets and child weight. *Econ. Hum. Biol.* **7**, 64-72.

RLMS (Russia Longitudinal Monitoring Survey), 2011. Sampling Overview. Accessed February 2011, available at http://www.cpc.unc.edu/projects/rlms-hse/project/sampling.

Sedik, D., Sotnikov, S., Wiesmann, D., 2003. Food Security in the Russian Federation. FAO Economic and Social Development Paper No. 153. FAO, Rome.

Skoufias, E., 2003. Consumption smoothing in Russia. Evidence from the RLMS. *Econ. Transit.* **11**, 67-91.

Smed, S., Jensen, J.D., Denver, S., 2007. Socio-economic characteristics and the effect of taxation as a health policy instrument. *Food Policy* **32**, 624-639.

Stillman, S., 2001. The Response of Consumption in Russian Households to Economic Shocks. IZA Discussion Paper No. 411.

Stillman, S., Thomas, D., 2008. Nutritional status during an economic crisis: Evidence from Russia. *Econ. J.* **118**, 1385-1417.

Swafford, M.S., Kosolapov, M.S., 2002. Sample Design, Response Rates, and Weights in the Russia Longitudinal Monitoring Survey, Rounds 5 to 10: An Abbreviated Description.

Ulijaszek, S.J., Koziel, S., 2007. Nutrition transition and dietary energy availability in Eastern Europe after the collapse of communism. *Econ. Hum. Biol.* **5**, 359-369.

Yu, X., Abler, D., 2009. The Demand for Food Quality in Rural China. *Am. J. Agr. Econ.* **91**, 57-69.

Zohoori, N., Mroz, T.A., Popkin, B.M., Glinskaya, E., Lokshin, M., Mancini, D., Kozyreva, P., Kosolapov, M., Swafford, M., 1998. Monitoring the Economic Transition in the Russian Federation and its Implications for the Demographic Crisis – the Russian Longitudinal Monitoring Survey. *World Dev.* **26**, 1977-1993.

3.4 Food demand in Russia - Heterogeneous consumer segments over time

by Matthias Staudigel and Rebecca Schröck

Accepted for publication in *Journal of Agricultural Economics* (2014), reprinted with kind permission from Jon Wiley and Sons.

Food Demand in Russia - Heterogeneous Consumer Segments over Time

Abstract

The Russian food system has undergone substantial changes. However, knowledge on how economic transition has affected structural parameters of food demand is lacking. Based on a two-stage LES-LA/AIDS model and annual panel data from the Russia Longitudinal Monitoring Survey (1995-2010), we provide a comprehensive set of food demand elasticities for Russia along two dimensions. First, we estimate demand parameters for three characteristic time periods in order to trace changes during transition. Second, to account for the Russian population's diversity, we derive elasticities for five different consumer segments. These groups are established by a cluster analysis based on households' food purchases. Our findings suggest that demand for food is far from satiated in Russia. We find generally high unconditional expenditure and own-price elasticities for food. Both expenditure and own-price elasticities show slight decreases in absolute terms over time. Low expenditure elasticities for staple foods like bread or cereals and high values for luxury goods such as meat, alcohol, and tobacco suggest considerable changes in the composition of food baskets with further income growth. Results indicate that food production at home loses in importance while especially more affluent households increase their demand for food consumption away from home.

Keywords: LA/AIDS; LES; food-demand; elasticities; Russia; transition; panel data; RLMS; consumer segmentation.

JEL-Code: D12; P36; Q13; Q18.

1 Introduction

As in many emerging economies, the Russian food system has experienced substantial changes during the last two decades. These developments have been characterised by a considerable decline in domestic agricultural production and increasing food imports (Liefert

et al. 2009). The entry of large international retail chains into the Russian market triggered the rise of modern retail concepts that spread from St. Petersburg and Moscow across the country. These shifts in the structure of grocery retailing and resulting expansion in product diversity have been associated with rapidly changing preferences of an increasing Russian middle class. These households benefitted from consistently high GDP growth rates since 2000 and their rising private incomes induced a "consumer boom" (USDA 2011).

Despite these serious economic changes surprisingly little comprehensive research has been conducted on changing consumer preferences and behaviour in the course of transition. To date empirical evidence on food demand in developing and transition economies is either irregularly published or lacking (Abler 2010). Mergenthaler et al. (2009) point out that "in spite of the hypothesised importance of both supply and demand side factors in the food system transformation, most available studies concentrate primarily on aspects of supply (p. 426)". Both shortfalls apply in the case of Russia. Existing studies on Russian food demand are either based on data from the mid-1990s (e.g. Qaim et al. 1997; Sheng 1997; Elsner 1999) or focus on narrowly defined food categories (e.g. Goodwin et al. 2003; Shiptsova et al. 2004).

The objective of this paper is to provide a comprehensive analysis of structural parameters of food demand in Russia over the course of its economic transition. In order to provide a detailed picture of consumer behaviour, we consider changes of demand elasticities over time as well as across the diversity of Russian consumers. Our approach is based on a two-stage demand system that distinguishes between the demand for food, food away from home, and four groups of non-food goods and services in the first stage. We subsequently analyse demand for 13 individual food groups in the second stage. The analysis employs comprehensive household panel data from the Russia Longitudinal Monitoring Survey (RLMS) over the period from 1995 to 2010.

Economic theory suggests that expenditure elasticities vary substantially both over time and across households, in light of differential impacts of economic growth and rising incomes for different groups of populations. Engel's Law predicts that food budget shares will decline as income rises. Moreover, Bennett's Law postulates changes in the composition of households' food baskets with increasing income. The proportion of starchy staples in total energy intake is presumed to decline, while relative and absolute consumption of animal products and of non-starchy vegetable products will increase (Bennett 1941).

In order to investigate whether Russian food demand elasticities confirm these expectations we estimate expenditure and price elasticities for distinct time periods. To capture the stark disparities within the Russian population, we assess demand elasticities for consumer groups clustered according to their food purchasing patterns.

This paper contributes to the literature in several ways. First, using the same data set and methodological approach in a consistent manner we are able to trace the development of consumer behaviour in the course of transition. So far, the time dimension of food demand elasticities in emerging economies has only been investigated by comparing estimates from studies that use data of different sample periods (e.g. Abler 2010). Second, we employ disaggregated household panel data that reflect consumer behaviour in more detail than cross-sectional or macro data used in previous studies. Third, our segmentation approach based on cluster analysis is able to reflect the complexity of consumer behaviour better than a one-dimensional classification by income or region. This is especially necessary for the Russian society marked by severe inequality with a consistently high GINI index between 0.40 and 0.45 (Worldbank 2013a). Diversity is not only reflected in income distribution but also in differences in geography, level of urbanisation, ethnicities and infrastructure.

The remainder of the paper is structured as follows: In the next section we provide a short background on the food system transformation and review the empirical literature on food demand analyses in Russia and other transition countries. Section 3 presents the dataset, the methodological approach and the estimation strategy. Section 4 reports the findings of the cluster analysis and the demand system estimations. Section 5 discusses the results and draws conclusions.

2 Background and literature review

2.1 Consumers and distribution of food in Russia

Despite continuous GDP growth and rising incomes, the majority of Russian households cannot be considered wealthy. Many individuals have at least two jobs to make ends meet. Three quarters of the Russian population live in urban areas, predominantly in small city flats with little storage space. Households typically own one to two big refrigerators for fresh produce. Long-life food products like tins or potatoes are often stored on the balcony. To leave their small residences in summer, many Russians own a dacha where they spend their free time (Schmid 2004). Russia exhibits mainly traditional household structures where

budgeting of household expenses and grocery shopping is the responsibility of women. Russian consumers increasingly place a high value on health, local origin and naturalness in their purchasing decisions. Exceptions are cigarettes, perfumes and other luxury items. Here, imported branded products are perceived to be of much higher quality (Schmid 2004). Honkanen (2010) reports strong preferences for meat and meat products among Russian consumers, as the consumption of animal-based foods is considered a status symbol.

Access to transportation and storage possibilities are crucial factors that influence shopping behaviour. Moreover, Honkanen and Frewer (2009) analysed food-choice motives that influence consumption decisions in Russia and found that availability and price are the most important motives for food choice besides sensory factors.

The average Russian family spends 35-40 % of its disposable income on food and beverages. The largest food expenditure share is meat (10.5 %), followed by bakery products (6.5 %), and milk and dairy products (4.9 %). Remarkably, only 25 % of the meat consumed in Russia is processed. Other important product groups are confectionery, a soft spot for many Russians, and potatoes, a traditional staple consumed in large quantities. While bread consumption is decreasing from traditionally high levels, spending on other bakery segments is increasing. Expenditure on prepared and processed foods is still low, however, and varies considerably by region (van Berkum et al. 2007).

A unique feature of the Russian food environment is the prevalence of home production. About 36 million Russian households (i.e. about 70 %) own small land plots which account for about 5 % of total agricultural land (Caskie 2000; OECD 2009). Differences in usage patterns exist between garden plots predominantly situated on the periphery of cities where people grow potatoes, vegetables, and fruits and larger land plots in rural areas where households often keep livestock, too (Caskie 2000; von Braun et al. 2000). The notion of subsistence food production being “an important private mechanism for coping with the transformation risk of market failures for many rural and urban households alike” (von Braun et al. 2000, p. 301) still prevails.

Similar to other post-soviet countries, the Russian food retailing sector has changed considerably over the past two decades. Dries et al. (2004) identified three distinct evolutionary stages: 1) In the *communist stage,* retailing and distribution were completely controlled by the state and competition was largely absent. Consumers purchased their

groceries in small supermarkets, kiosks, and street markets (USDA 2011). 2) During the *transition stage,* privatisation led to a fragmented retailing sector with many small domestic retail chains. Political and economic instability presented high obstacles for foreign investors. 3) The *globalisation stage* was initialised by a period of strong growth during which the Russian GDP grew 6 % to 7 % annually. This stage followed the rouble crisis of 1998 and was marked by significant and steady increases in wages and salaries (Worldbank 2013b; USDA 2011; Belaya and Hanf 2010). A "large newly-affluent urban population in Russia's cities provided a big boost to the development of the retail market" (USDA 2011). Traditional street markets and bazaars lost ground to new store types such as Hypermarkets or Cash & Carry-Markets with the influx of foreign retail chains (Dries et al. 2004). At the same time, the quantitative and qualitative variety of food products increased profoundly and provided consumers with better substitution possibilities. Retail structures and product differentiation, however, still differ by region and degree of urbanisation with poorer and rural households relying more strongly on open air markets that offer staple foods at lower prices.

2.2 Literature on food-demand elasticities in transition countries

Published studies on the pattern and development of food demand in Russia and other transition countries provide heterogeneous evidence with respect to methodology used, data sources, and country. Direct comparisons of results are difficult and assessments of structural changes over time are almost impossible.

Based on a small Russian household survey from 1995, Sheng (1997) estimated a linear expenditure system for six food groups. He found low expenditure elasticities for grains (0.38) and potatoes (0.51) and higher values for meat (0.79) and dairy products (0.95). Own-price elasticities showed a similar pattern, with inelastic responses of grain and potato consumption and higher absolute values for dairy and candy products. Elsner (1999) employed data from round VII of the RLMS for the year 1996 to estimate a three-stage demand system. She reported elastic unconditional expenditure elasticities for vegetables (1.40), potatoes (1.16), and dairy products (1.10). Cereal products and meat showed elasticities of less than unity. Most conditional own-price elasticities revealed high absolute values above unity.

Goodwin et al. (2003) and Shiptsova et al. (2004) investigated the demand for non-dairy protein sources and carbohydrate sources, respectively, based on survey data for eight metropolitan areas in Eastern Russia in 1996. Both studies reported conditional own-price elasticities and expenditure elasticities, as well as unconditional income elasticities for food in total and the investigated food categories. They found low income elasticities of around 0.2. Goodwin et al. (2003) compared their low income elasticities of demand for meat products (0.06-0.28) against those of a sample of U.S. households of poverty status (0.36-0.49). They argued that lower income elasticities for Russian households may be caused both by traditionally high pre-committed quantities of meat product consumption in Russia and a greater variety and availability of value-added meat products in the U.S. market.

Stillman and Thomas (2008), Staudigel (2012), and Notten and de Crombrugghe (2012) all reported more recent food-demand elasticities for Russia based on RLMS data. However, these studies derived elasticity estimates not from a demand system analysis but from single-equation approaches using panel-methods. There is some literature on price and expenditure elasticities in other middle and eastern European countries: Lithuania (Frohberg and Winter 2001), Latvia (Hossain et al. 2001), Slovenia (Turk and Erjavec 2001), Hungary (Brosig 2000), and the Czech Republic (Brosig and Ratinger 1999). However, substantial differences with respect to methodology and the aggregation of food categories make it difficult to compare these studies directly.

3 Data and methodology

3.1 The Russia Longitudinal Monitoring Survey (RLMS)

Our analysis uses a large set of household panel data from Phase II of the RLMS, covering the period from 1995 to 2010[1]. The RLMS was designed as a series of annual cross-section surveys that are nationally representative. Additionally, the RLMS interviews the households repeatedly each year. This longitudinal component is a major benefit for a consistent analysis and for comparable results over the course of transition. With its broad range of variables covering household financial aspects and consumption patterns, health and living conditions, household assets and community infrastructure, the RLMS is an excellent data base for analysing the dynamics of consumption behaviour in Russia over time.

[1] No surveys were conducted in 1997 and 1999.

The RLMS collects information on expenditure and quantities of all food products purchased by a household in a 7-day recall and expenditure on food away from home, non-food goods and services for the previous month. As recall methods typically do not capture complete expenditure on durable goods, total household budgets in this analysis only include expenditure on non-durables that, however, account for about 80 % of total reported expenditure.

Following Fan et al. (1995), we analyse household consumption for six broad aggregates of food and non-food in a first step and for single groups of food products in a second step. For the estimation of a linear expenditure system in the first stage, we augment the data by national price indices for the analysed budget groups, a method commonly applied in the context of household survey data where detailed price information is typically missing (e.g. Pollack and Wales 1978, Edgerton 1997, Michalek and Keyzer 1992, Fan et al. 1995). The Federal Statistical Bureau of the Russian Federation (Goskomstat 2013) is the only source of price information for the categories considered in the first budgeting stage, as the RLMS does not collect prices for non-food goods and services, nor does it provide quantities for the computation of unit values. Since monthly price indices at this aggregation level are available only from 1995 on, the demand analysis excludes Round V of the RLMS conducted in 1994.

For the second stage, we aggregate expenditure on 51 food items collected by the RLMS into 13 product groups. These are bread and bakery, cereals, potatoes, vegetables, fruits, meat and meat products (including fish), milk and dairy products, fats and oils, sugar and confectionery, tea and coffee, tobacco, alcohol, and beverages (see Table A1, Appendix). Observations with negative, zero total or zero food expenditure were excluded. To eliminate household-year outliers regarding extreme values for quantities and/or expenditure, we purged the top percentiles of the purchased quantities. The final sample includes 55,288 household-year observations. Detailed descriptive statistics are provided in Table 3 (Section 4.2.1).

The RLMS provides purchased quantities of single food products which facilitates generating price information for the second stage. In order to obtain per-unit values, we divide each household's expenditure for each food group by its respective quantity. Any variation in unit values for aggregate product groups is due to a combination of price differences and the direct result of household choice behaviour, reflecting the nature and quality of single item

purchases. To explicitly account for quality differences in the computation of price variables we employ the widely-used procedure of Cox and Wohlgenant (1986)[2]. Missing values for single observations were imputed by taking the respective median of the adjusted unit value for the community to which the household belongs. In few cases where the community-median was missing, we used the median unit value of the federal region.

3.2 Demand system estimation

We apply a two-stage budgeting approach, assuming that the consumer's utility maximisation decision can be decomposed into two steps. First, households are assumed to allocate their total budget *X* into expenditure on food*,* food away from home, clothing, rent and utilities, recreation services, and other services. Second, households allocate their food budget *F* ($F \in X$) to individual categories.

Given that the categories considered in the first stage are broad aggregates, demand parameters are estimated by the linear expenditure system (LES)[3]. The basic specification of the LES is shown in equation (1), where household expenditure on each category of goods $p \cdot q$ is a linear function of prices *p* and total budget *X* (Pollak and Wales 1992):

$$(1) \quad p_{it} q_{iht} = p_{it} a_i + b_i (X_{ht} - \sum_k p_{kt} a_k) + u_{iht} \ .$$

The subscript *i* indicates the category (*i=1,…,6*), *h* the household and *t* is the time period. The a_i's and b_i's are parameters to be estimated. In the LES, the b_i's, which represent the fractions of an additional ruble of total expenditure spent on each category, sum up to unity ($\sum_i b_i = 1$).

Since households do not necessarily purchase goods from each category the estimation of eq. (1) is complicated by problems of censoring. Following Heien and Wessels (1990) and Park et al. (1996) we derive factors correcting for censoring prior to the demand system estimation by conducting probit regressions on whether a household buys at least one product from a category or not. This binary (probit) decision is modeled as a function of

[2] Following Cox and Wohlgenant (1986), the deviations of each household's computed unit value from the mean unit value within the respective community are regressed on various food-quality attributes to separate actual price variation from variation induced by quality differences. As quality characteristics are usually unobserved it is a frequent practice to use household characteristics as proxy variables.

[3] The LES is especially suitable for household budget data covering a small number of periods and exhibiting little price variation (Pollak and Wales 1978). Since we use national price indices and split our sample in different time periods, these restrictions also apply to our first-stage analysis.

socio-demographic variables, a time trend and a dummy variable ('crisis') denoting the devaluation of the Russian Rouble in 1998.

Based on the results of the probit analyses, we derive the normal probability density function (ϕ_{iht}), the normal cumulative distribution function (Φ_{iht}) and the Inverse Mills Ratio *IMR*, which is the ratio of ϕ_{iht} to Φ_{iht} for consuming households and the ratio of ϕ_{iht} to (1-Φ_{iht}) for non-consuming households. The *IMR* enters the LES as a latent variable to correct for censoring (Heien and Wessels 1990). To avoid problems of heteroskedasticity, we estimate the first-stage LES in budget shares[4]. The final specification of the demand functions in the LES can be written as:

$$(1') \qquad w_{iht} = a_i \frac{p_{iht}}{X_{ht}} + b_i\left(1 - \sum_k a_k \frac{p_{kht}}{X_{ht}}\right) + c_i IMR_{iht} + u_{iht} \qquad .$$

We follow Pollak and Wales (1992) and derive elasticities based on the LES-estimates. Elasticities are evaluated at sample means.

In the second stage, households allocate their food budget *F* to individual food groups. In line with previous analyses of food demand in transition countries (e.g. Elsner 1999; Fan et al. 1995; Shiptsova et al. 2004), we estimate demand parameters for Russian households using an Almost Ideal Demand System (AIDS) (Deaton and Muellbauer 1980). We expand the AIDS by a vector of household demographics and socio-economic variables, a time trend and the *crisis* dummy variable. The specification of the second-stage AIDS is given in equation (2):

$$(2) \qquad w_{iht} = \alpha_i + \sum_j \gamma_{ij} \cdot \log p_{jht} + \beta_i \cdot log(F_{ht}/P_{ht}) + \varepsilon_{iht}$$

$$\text{with} \qquad \alpha_i = \alpha_{i0} + \alpha_{i1} \cdot t + \alpha_{i2} \cdot crisis_t + \sum_{k=3}^{K} \alpha_{ik} \cdot Z_{kht} \quad .$$

Where *p* is the price of the food product group *i* (*i = 1,…,13*). *P* denotes the price index for total food consumption and *Z* is a vector of demographic and socio-economic variables (*k = 3,…, K*). To reduce the computational complexity we use the Linear Approximated AIDS (LA/AIDS) which replaces the original translog price index *P* by the log-linear Stone Index P^*:

$$(3) \qquad \log P^*_{ht} = \sum_j \overline{w}_{jt} \log p_{jht} \quad ,$$

[4] We cluster observations to account for multiple observations coming from one household. We apply Huber-White estimators of variance which are robust to correlations among within-household observations (White 1980).

where $\overline{w}$ denotes the expenditure share at the sample mean. The parameters of the AIDS model satisfy the adding-up restriction, are homogeneous of degree zero in prices and total expenditure taken together, and satisfy the Slutsky symmetry condition. These properties of consumer demand theory are imposed as follows:

Adding-up $\sum_i \alpha_{i0} = 1, \ \sum_i \beta_i = 0, \ \sum_i \gamma_{ij} = 0, \ \sum_i \alpha_{i1} = 0, \ \sum_i \alpha_{i2} = 0, \ \sum_i \alpha_{ik} = 0,$

Homogeneity $\sum_j \gamma_{ij} = 0$,

Symmetry $\gamma_{ij} = \gamma_{ji}$.

To correct for censoring of the dependent variable in the second stage, we follow Shonkwiler and Yen (1999) by conducting probit regressions for each food product. The resulting probability and cumulative distribution functions enter the final specification of the LA/AIDS:

(2') $$w_{iht} = \left[\alpha_i + \sum_j \gamma_{ij} \cdot \log p_{jht} + \beta_i \cdot log(F_{ht}/P_{ht}) \right] \times \Phi_{iht} + \zeta_i \varphi_{iht} + \varepsilon_{iht}$$

with $$\alpha_i = \alpha_{i0} + \alpha_{i1} \cdot t + \alpha_{i2} \cdot crisis_t + \sum_{k=3}^{K} \alpha_{ik} \cdot Z_{kht} \ .$$

The adding-up restrictions and the property of the budget shares to sum up to one require the exclusion of one budget share equation (beverages). Equation (2') is thus estimated as a system with twelve equations via non-linear seemingly unrelated regressions (*nlsur*). We check that the estimated coefficients are stable regardless which equation is dropped.

Price and expenditure elasticities are computed at sample means using the approach suggested by Green and Alston (1990). The formulae are corrected by the density functions derived in the probit-regressions prior to the second-stage LA/AIDS estimations:

Conditional expenditure elasticity

(4) $$\eta_i^c = 1 + \frac{\beta_i}{\overline{w}_i} \cdot \Phi_i \quad ,$$

Conditional (uncompensated) own- and cross-price elasticities

(5) $$\varepsilon_{ij}^c = \Phi_i \cdot \left(\frac{\gamma_{ij} - \beta_i \overline{w}_j}{\overline{w}_i} \right) - \delta \ .$$

δ denotes the Kronecker Delta and is $\delta=1$ for $j=i$ and $\delta=0$ for $j\neq i$. We follow Edgerton (1997) in the calculation of unconditional elasticities; those are not conditional on food expenditure *F* but on total expenditure *X*, derived from first- and second-stage elasticity estimates:

Unconditional expenditure elasticity:

$$\eta_i^u = \eta_F \cdot \eta_i^c \,, \tag{6}$$

Unconditional (uncompensated) own- and cross-price elasticities:

$$\varepsilon_{ij}^u = \varepsilon_{ij}^c + \eta_i^c \cdot w_j (1+\varepsilon_F) \,. \tag{7}$$

η_F and ε_F are expenditure and own-price elasticity for food derived in the first-stage LES estimation. w_j is the second-stage expenditure share of food group *j* in total food budget *F*. The superscripts *u* and *c* identify unconditional and conditional elasticities, respectively.

The complete LES-LA/AIDS is estimated for three distinct time periods. We chose these periods deliberately in accordance with the transitional stages proposed by Dries et al. (2004). While the first interval from 1995-98 constitutes the years of early transition and economic turmoil, the second period from 2001-03 depicts the start of the consumer boom. The third period, 2008-10, covering the latest survey years available, represents a time of major structural changes in Russian food retailing. Using the same methodology across different sample periods allows us to estimate consistently how Russian household demand behaviour has changed over time.

3.3 Consumer segmentation based on cluster analysis

The majority of comparable demand system analyses that differentiate between consumer segments classifies consumers according to a single criterion such as income (e.g. Park et al. 1996; Huang and Lin 2000), region (e.g. Moro and Sckokai 2000), store type (e.g. Hoch et al. 1995; Mergenthaler et al. 2009) or the budget share of a select product group (e.g. Schröck 2012). Such classifications are based on the assumption that households belonging to separate categories behave differently and exhibit differential responses to changing prices and budgets. A more direct way to identify consumer segments according to their behaviour or the underlying attitudes and preferences is to use cluster analysis. This procedure is commonly applied in marketing sciences but has not been combined with a demand system analysis before. Honkanen and Frewer (2009) derived consumer segments for Russia based on food-choice motives and Honkanen (2010) uses food preferences as input variables for

his cluster analysis. Zhang et al. (2008) clustered a sample of Chinese consumers on the basis of their food purchasing patterns. All three studies confined themselves to a descriptive analysis of these clusters, though. Our study goes one step further by establishing consumer segments via cluster analysis and characterising them not only by socio-demographics but also by demand elasticities.

We first apply a principal component analysis of households' reported purchases of 51 food products to reduce the complexity of the items and to mitigate problems arising from zero observations in the subsequent cluster analysis. According to a Kaiser-Mayer-Olkin-criterion of 0.84, we establish the adequacy of the data sample for the purpose of a factor analysis. Values of the Measure-of-Sampling-Adequacy are larger than 0.6 and confirm that the single food purchase variables are suitable for inclusion. Based on the scree test, we chose to extract five factors to be interpreted as typical purchasing patterns in Russia (Backhaus et al. 2008). We identify distinct factor loadings which suggest that different foods form groups of goods that are often purchased in combination (e.g. fruits and vegetables; dairy and meat products; tobacco, alcohol and sweets; staple foods; non-perishables; see Table A2, Appendix).

Based on household factor scores we then conduct a cluster analysis to partition the total sample into consumer segments that differ in their purchasing behaviour. As the large number of observations (55,288) raises problems with computing power, we apply a two-step strategy for the clustering procedure (Zhang et al., 2008). First, a hierarchic cluster analysis on a randomly drawn subsample of 10 % of the total sample was expected to provide an idea of an appropriate number of clusters. Here, the Calinski/Harabasz-criterion strongly supports a five-cluster-solution. Based on this information, we applied k-means clustering to the total sample generating five clusters that amounted to 5.5 %, 16.3 %, 5.4 %, 53.2 %, and 19.7 % of the total sample, respectively. The socio-demographic characteristics of the identified consumer segments are described along with the respective demand elasticities in Section 4.2.

4 Results

4.1 Expenditure and own-price elasticities over time

Tables 1 and 2 present first- and second-stage estimates of expenditure elasticities and uncompensated own-price elasticities, respectively. Values of the adjusted R-squared from

0.23 to 0.88 (1st stage) and 0.05 to 0.43 (2nd stage) indicate generally satisfactory model fits. Expenditure coefficients are highly significant throughout all models as are price coefficients with just a few exceptions. Coefficients of demographic and socio-economic variables are significant to a lesser extent – especially in the second-stage demand system estimations[5].

Table 1: Unconditional expenditure elasticities over time and for the entire period

Time Period	1995-1998	2001-2003	2008-2010	Entire Period
1st Stage				
Food	0.98 ***	0.95 ***	0.93 ***	0.95 ***
FAFH	0.59 ***	0.92 ***	1.05 ***	0.90 ***
Clothing	1.19 ***	1.22 ***	1.20 ***	1.19 ***
Rent	1.23 ***	1.14 ***	1.01 ***	1.13 ***
Recreation	0.99 ***	1.05 ***	1.07 ***	1.07 ***
Other Services	0.99 ***	0.87 ***	1.00 ***	0.91 ***
2nd Stage				
Bread & Bakery	0.04 *	0.04	0.05	0.00
Cereals	1.09 ***	0.84 ***	0.76 ***	0.86 ***
Potatoes	0.98 ***	1.14 ***	1.02 ***	1.02 ***
Vegetables	0.95 ***	0.97 ***	1.04 ***	0.97 ***
Fruits	0.93 ***	1.00 ***	0.95 ***	0.97 ***
Meat	1.17 ***	1.23 ***	1.15 ***	1.16 ***
Milk & Dairy products	0.83 ***	0.84 ***	0.82 ***	0.80 ***
Fat & Oils	0.93 ***	0.81 ***	0.86 ***	0.86 ***
Sugar & Confectionery	1.21 ***	1.03 ***	1.03 ***	1.03 ***
Tea & Coffee	0.88 ***	0.87 ***	0.96 ***	0.87 ***
Tobacco	0.87 ***	0.96 ***	0.98 ***	0.94 ***
Alcohol	1.02 ***	1.15 ***	1.26 ***	1.11 ***
Beverages	1.93 *	1.37 ***	1.10 ***	1.28 ***
No. of households	4,497	5,314	8,031	12,972

* Significant at the 5 % level; ** Significant at the 1 % level; *** Significant at the 0.1 % level.

Source: Own estimates based on RLMS data, 1995-2010.

We find an expenditure elasticity for food in aggregate over the entire period of 1995-2010 of 0.95, indicating that food is a necessity for Russian consumers. Only small declines in the expenditure elasticity for food over time suggest that Russian food demand is far from satiated. Significant increases in elasticities for food away from home consumption (FAFH) point to a growing importance of eating out. Also the expenditure elasticity for recreational services increases slightly and supports the notion that Russia is becoming a service economy. In contrast, the expenditure elasticities for rent and utilities are declining. Our results for the total period indicate that the categories of clothing, rent and utilities, and

[5] Due to space constraints we do not report any detailed estimation output. We also focus on expenditure and uncompensated own-price elasticities and do not discuss compensated price elasticities. The latter are negative without exception, however. Model outputs are available upon request.

recreation are luxuries. Especially, the constantly high expenditure elasticities for clothing show that Russian consumers are ready to spend a large proportion of additional income on clothes.

The results of the second-stage analysis provide a more detailed picture of changes in the composition of Russian households' food baskets under the influence of increasing incomes during the country's economic transition. Expenditure elasticities for the entire time period clearly confirm Bennett's Law. Rising incomes and food budgets do not affect the demand for bread and bakery products at all (0.00). Results for other staple foods like cereals (0.86), milk and dairy products (0.80), and fats and oils (0.86) characterise them as normal goods that grow subproportionally. In contrast, luxury and indulgence goods such as meat (1.16), alcohol (1.11) and beverages (1.28) exhibit elastic expenditure elasticities. These categories benefit overproportionally from increasing incomes and are poised to become more important in the future.

Results over time do not reveal a uniform development of expenditure elasticities for the food groups in the second stage. We observe increasing values for vegetables, tea and coffee, tobacco, and alcohol. In contrast, estimates for cereals, sugar and confectionery, as well as beverages are decreasing. Changing elasticities point to shifts in the composition of the food basket in the course of transition. Drink and tobacco gain in importance at the expense of staple foods.

Unconditional Marshallian own-price elasticities for both estimation stages are presented in Table 2. The magnitudes of price elasticities in the first stage do not vary as strongly across categories as the expenditure elasticities, which might well reflect the low degree of variation in the national price indices used in the LES in the first stage. Regarding the entire period, all first-stage price elasticities are close to unity and the demand for food is slightly inelastic (-0.96). However, the estimates change substantially over time. While Russian households exhibit elastic responses for all first-stage categories in 1995-98 reactions to price changes become inelastic in 2008-10.

Price elasticities in the second stage are also high and vary considerably between food groups and over time. Our estimates are approximately comparable in magnitude to the price elasticities reported by Elsner (1999) and confirm Schmid (2004) in that Russian household food demand is price-sensitive. Bread and bakery products stand out showing the

lowest own-price elasticity of -0.5. As bread constitutes the essential basis of most Russians' diets, its demand seems to be less affected by price compared to other food categories. Similar to Elsner (1999) and Qaim et al. (1997), we find the highest own-price elasticity for cereal products of -1.27. This pronounced price responsiveness could reflect the category's long shelf life and Russian households' propensity to store long-life foods in larger quantities.

Table 2: Unconditional, uncompensated own-price elasticities over time and for the entire period

Time Period	1995-1998	2001-2003	2008-2010	Entire Period
1st Stage				
Food	-1.01 ***	-0.98 ***	-0.87 ***	-0.96 ***
FAFH	-1.04 ***	-1.01 ***	-0.85 ***	-0.98 ***
Clothing	-1.07 ***	-1.00 ***	-0.82 ***	-0.97 ***
Rent	-1.04 ***	-0.95 ***	-0.81 ***	-0.92 ***
Recreation	-1.05 ***	-0.99 ***	-0.84 ***	-0.96 ***
Other Services	-1.07 ***	-1.03 ***	-0.88 ***	-1.00 ***
2nd Stage				
Bread & Bakery	-0.64 **	-0.44 ***	-0.52 ***	-0.49 **
Cereals	-1.85 ***	-1.36 ***	-0.95 ***	-1.27 ***
Potatoes	-0.91 ***	-0.91 ***	-0.86 ***	-0.87 ***
Vegetables	-1.11 ***	-1.13 ***	-0.97 ***	-1.05 ***
Fruits	-0.98 ***	-0.97 ***	-0.85 ***	-0.91 ***
Meat	-1.02 ***	-0.90 ***	-0.78 ***	-0.88 ***
Milk & Dairy products	-0.98 ***	-0.98 ***	-0.93 ***	-0.97 ***
Fat & Oils	-0.94 ***	-0.97 ***	-0.98 ***	-0.99 ***
Sugar & Confectionery	-1.21 ***	-0.95 ***	-0.80 ***	-0.93 ***
Tea & Coffee	-0.86 ***	-0.73 ***	-0.72 ***	-0.74 ***
Tobacco	-0.73 ***	-0.91 ***	-0.97 ***	-0.87 ***
Alcohol	-0.88 ***	-0.94 ***	-0.89 ***	-0.90 ***
Beverages	-1.20 *	-0.76 ***	-0.42 ***	-0.71 ***
No. of households	4,497	5,314	8,031	12,972

* Significant at the 5 % level; ** Significant at the 1 % level; *** Significant at the 0.1 % level.

Source: Own estimates based on RLMS data, 1995-2010.

The magnitudes of unconditional own-price elasticities in the second stage decline over time, emulating the development in the first stage. Cereals, meat, sugar and confectionery as well as beverages reveal particularly pronounced declines. As these are the food groups with the highest absolute own-price elasticities during the 1990s, we conclude that the own-price elasticities for different food groups tend to converge over time. This result would suggest that consumers do no longer exhibit distinct demand reactions to price changes for individual food groups.

4.2 Results for consumer segments

4.2.1 Characterisation according to socio-economic variables

More detailed insights into the structural changes in Russian households' food demand can be obtained from the clustering analysis. We profile our five consumer segments on the basis of total household budgets, first- and second-stage budget shares, degree of urbanisation, household composition, demographic characteristics, and household endowments (Table 3). The cluster analysis results are validated by conducting a one-way ANOVA procedure and a series of Duncan's (1955) multiple range tests with adjustment for unequal sample sizes by using the harmonic mean. The results support the notion that clusters are well defined and differ from each other in terms of both demographic characteristics and the structure of (food) expenditure. By and large our household profiles echo the characterisation by Schmid (2004) discussed in Section 2.1.

Households in the first cluster are characterised by a medium total budget and relatively high food budget shares. They exhibit an above average proportion of urban residents (esp. Moscow and St. Petersburg). The average age of their household heads is the highest in the sample (50.7 years) and households in Cluster 1 exhibit a relatively low proportion of male household members. However, the main feature of this cluster is the low prevalence of home production (32 %). Consequently, households in this cluster purchase the by far largest quantities of potatoes and vegetables. We name this cluster **"Urban Non-growers"**.

Households in the second cluster are the wealthiest overall and exhibit the highest labour participation rates. They devote the lowest proportion of their total budget to food and possess the largest budget shares for FAFH, clothing, and other services. On average, these households have the youngest household heads (40 years), the highest share of male household members, and the highest vehicle possession rate (40 %). Beverages, alcohol, and tobacco play a prominent role in the consumption habits of this cluster, accounting for a striking 20 % of "food" expenditure. An apt label for this household cluster is **"Aspiring Hedonists"**.

Households belonging to the third cluster have relatively low income levels and by far the highest budget share devoted to food among all clusters (68 %). Characterised by a low degree of urbanisation (57 %) and the highest proportion of households that grow crops (74 %), this cluster relies more heavily on home production and home-meal cooking. Cereals,

fats and oils, as well as sugar and confectionery are important inputs into subsistence-oriented activities in terms of both quantities purchased and budget share. The lowest budget shares for eating out and for rent fit into this picture, too. The households in this cluster are appropriately described as **"Rural Home-Producers"**.

The majority of households (53.2 %) fall into the fourth cluster. They face tight household budget and food budget constraints that lead to some noticeable expenditure patterns. Although they have the lowest total budget their average food budget share of 0.52 is comparable to the shares of the relatively affluent clusters *Aspiring Hedonists* and *Quality Elite* (see below) which contradicts Engel's law. A possible explanation for this finding is that the households in the fourth cluster face binding economic constraints and thus have to spend large parts of their incomes on other necessity goods. An interpretation supported by the highest budget share for rent for households of the fourth cluster.

The remaining budget only allows these households to afford the cheapest and most essential foods. Reported food consumption figures support their tenuous financial situations, with the lowest quantities of animal proteins and the highest overall budget share for bread (16 %). Besides the smallest household size, a low share of male household members, and medium to low educational attainment, households in Cluster 4 report the fewest technical assets such as cars, freezers and refrigerators. We label this segment **"Restricted Majority"**.

Finally, the fifth cluster is comprised of relatively wealthy households which exhibit the highest level of educational attainment and of endowment in technical assets. The majority of households in this cluster live in urban areas (91 %). This group shows the highest consumption levels of milk and dairy products, meat, and fruits. A suitable name for this cluster is **"Quality Elite"**.

One concern with the clustering of households based on consumption patterns is that one household may belong to different clusters in different time period as food demand patterns change over time. However, as few households change between clusters over time, we do not regard this issue to be a threat to the explanatory power of our analysis. Since the cluster profiles show clear differences with respect to the profiling variables, the allocation of households to the clusters is not arbitrary but based on substantial underlying differences in shopping behaviour. However, it should be kept in mind that cluster analysis is a

structure-exploring procedure that provides a reasonable but not definitive picture of consumption patterns.

Table 3: Household characteristics of the five consumer segments (means of the entire period, 1995-2010)

		Urban Non-Growers	Aspiring Hedonists	Rural Home-Producers	Restricted Majority	Quality Elite	Total Sample
	Number of observations	3,021	9,026	2,982	29,403	10,865	55,288
	Share in total number of observations	0.055	0.163	0.054	0.532	0.197	1.00
Budget Shares	Total budget per hh.& month[1)]	8,607 [a]	**10,658** [b]	7,953 [c]	3,864 [d]	**10,239** [b]	8,825
	Food	0.62 [a]	0.50 [b]	**0.68** [c]	0.52 [d]	0.53 [e]	0.54
	FAFH	0.04 [a]	**0.06** [b]	0.03 [c]	0.04 [d]	0.05 [e]	0.05
	Clothing	0.06 [a]	**0.12** [b]	0.09 [c]	0.09 [d]	0.10 [d]	0.10
	Rent and utilities	0.09 [a]	0.09 [a]	0.05 [b]	**0.13** [c]	0.10 [d]	0.11
	Recreational services	0.12 [a]	**0.13** [b]	0.09 [c]	**0.13** [b]	**0.13** [b]	0.13
	Other services	0.07 [a]	**0.10** [b]	0.06 [c]	0.07 [b]	0.09 [d]	0.08
Demographics and Assets	Age of household head	**50.7** [a]	40.0 [b]	47.9 [c]	49.3 [d]	46.8 [e]	47.3
	Household size	2.59 [a]	3.17 [b]	**3.27** [c]	2.29 [d]	3.02 [e]	2.65
	Hh. located in urban areas	0.89 [a]	0.76 [b]	0.57 [c]	0.70 [d]	**0.91** [e]	0.75
	Working hh. members	0.44 [a]	**0.60** [b]	0.41 [c]	0.42 [c]	0.51 [d]	0.47
	Hh. engaged in home production	0.32 [a]	0.48 [b]	**0.74** [c]	0.51 [d]	0.51 [d]	0.51
	Hh. owning a car	0.23 [a]	**0.40** [b]	0.31 [c]	0.19 [d]	**0.40** [b]	0.28
	Hh. owning a freezer	0.07 [a]	0.08 [b]	0.08 [b]	0.05 [c]	**0.10** [d]	0.07
	Hh. owning a refrigerator	**0.76** [a]	0.65 [b]	**0.76** [a]	0.65 [b]	0.72 [c]	0.68
	Male hh. members	0.37 [a]	**0.49** [b]	0.43 [c]	0.36 [d]	0.42 [e]	0.39
	Share of Hh. members with diploma from…						
	…university	0.20 [a]	0.14 [b]	0.11 [c]	0.14 [b]	**0.24** [d]	0.16
	…technical/medical college	0.16 [a]	0.16 [a]	0.13 [b]	0.17 [a]	**0.19** [c]	0.17
	…secondary school	0.08 [a]	**0.14** [b]	0.09 [a]	0.10 [c]	0.08 [a]	0.10
	…vocational school	0.14 [a]	0.14 [a]	**0.17** [b]	0.16 [c]	0.11 [d]	0.15
	…primary school	0.34 [a]	0.34 [a]	**0.44** [b]	0.39 [c]	0.30 [d]	0.36
Food Budget Shares	Bread & bakery	0.06 [a]	0.07 [b]	0.08 [c]	**0.16** [d]	0.06 [b]	0.12
	Cereals	0.04 [a]	0.04 [b]	**0.17** [c]	0.06 [d]	0.04 [b]	0.06
	Potatoes	**0.11** [a]	0.01 [b,c]	0.01 [b]	0.02 [d]	0.01 [c]	0.02
	Vegetables	**0.16** [a]	0.02 [b]	0.02 [b,c]	0.03 [d]	0.03 [c]	0.03
	Fruits	0.06 [a]	0.06 [a]	0.04 [b]	0.05 [c]	**0.08** [d]	0.06
	Meat	0.25 [a]	0.30 [b]	0.26 [c]	0.26 [c]	**0.37** [d]	0.28
	Milk & dairy products	0.12 [a]	0.11 [a]	0.08 [b]	0.13 [c]	**0.21** [d]	0.14
	Fats & oils	0.06 [a]	0.05 [b]	**0.09** [c]	0.08 [d]	0.05 [e]	0.07
	Sugar & confectionery	0.07 [a]	0.11 [b]	**0.16** [c]	0.10 [d]	0.08 [e]	0.10
	Tea & coffee	0.02 [a]	**0.04** [b]	**0.04** [b]	0.03 [c]	0.02 [a]	0.03
	Tobacco	0.02 [a]	**0.08** [b]	0.03 [c]	0.05 [d]	0.02 [a,c]	0.05
	Alcohol	0.02 [a]	**0.09** [b]	0.02 [a]	0.03 [c]	0.02 [d]	0.04
	Beverages	0.01 [a]	**0.03** [b]	0.01 [c]	0.01 [d]	0.01 [e]	0.01

[1)] The figures for the budgets section refer to the respective median for each category and cluster and are expressed in real roubles (2005 = 100); [a, b, c, d, e] Mean values within a line (i. e. for one variable) with unlike superscript letters indicate a signicant difference among clusters ($p<0.05$).

Source: Own computations based on RLMS data, 1995-2010.

4.2.2 Price and expenditure elasticities across consumer segments

We estimate the complete LES-LA/AIDS separately for each of the five household clusters[6]. Table 4 reports unconditional expenditure elasticities and Table 5 presents the corresponding unconditional own-price elasticities for both model stages. Trends in price and expenditure elasticities for each cluster over time are summarised in Tables A3 and A4 in the Appendix.

Estimated demand parameters differ significantly across consumer segments, with each cluster exhibiting its own specific pattern. Our clustering approach thus successfully delivers distinct household groups as a basis to study relevant trends and differences in Russian consumer behaviour.

Table 4: Unconditional expenditure elasticities across the five consumer clusters (1995-2010)

	Urban Non-Growers *Cluster 1*	**Aspiring Hedonists** *Cluster 2*	**Rural Home Producers** *Cluster 3*	**Restricted Majority** *Cluster 4*	**Quality Elite** *Cluster 5*
1st Stage					
Food	0.90 ***	0.77 ***	0.91 ***	0.92 ***	0.85 ***
FAFH	1.24 ***	1.32 ***	0.90 ***	0.73 ***	1.29 ***
Clothing	1.41 ***	1.13 ***	1.25 ***	1.22 ***	1.28 ***
Rent	0.89 ***	1.14 ***	1.37 ***	1.19 ***	0.93 ***
Recreation	1.20 ***	1.36 ***	1.22 ***	1.08 ***	1.25 ***
Other Services	1.18 ***	1.21 ***	1.03 ***	0.95 ***	1.14 ***
2nd Stage					
Bread & Bakery	0.17 *	0.25 ***	0.14 ***	0.08 ***	0.24 ***
Cereals	0.75 ***	0.60 ***	0.61 ***	0.84 ***	0.73 ***
Potatoes	1.22 ***	0.84 ***	0.84 ***	0.95 ***	0.86 ***
Vegetables	0.33 ***	0.98 ***	0.92 ***	0.91 ***	0.94 ***
Fruits	0.85 ***	0.82 ***	0.81 ***	0.98 ***	0.82 ***
Meat	1.09 ***	1.02 ***	1.16 ***	1.25 ***	1.07 ***
Milk & Dairy products	0.79 ***	0.78 ***	0.77 ***	0.74 ***	0.35 ***
Fat & Oils	0.70 ***	0.84 ***	0.63 ***	1.03 ***	0.88 ***
Sugar & Confectionery	1.12 ***	0.73 ***	1.24 ***	1.05 ***	1.07 ***
Tea & Coffee	0.93 ***	0.71 ***	0.46 ***	0.95 ***	1.06 ***
Tobacco	0.84 ***	0.47 ***	1.07 ***	0.81 ***	0.89 ***
Alcohol	1.26 ***	0.57 ***	0.96 ***	1.03 ***	1.13 ***
Beverages	1.15 ***	0.71 ***	1.97 ***	0.98 ***	0.92 ***
% of observations	5.5	16.3	5.4	53.2	19.7

* Significant at the 5 % level; ** Significant at the 1 % level; *** Significant at the 0.1 % level.

Source: Own estimates based on RLMS data, 1995-2010.

[6] In our approach, we follow previous studies such as Smed et al. (2007) who point out that running separate regressions for different groups "instead of introducing socioeconomic variables by, for example, translation, scaling or Lewbel's modifying functions approach" (p. 630) can be commonly found in literature, e.g. Raper et al. (2002), Park et al. (1996) and Huang and Lin (2000).

Urban Non-Growers show quite elastic reactions of total food consumption with respect to expenditure in the first stage (0.90). Their second-stage expenditure elasticities for potatoes (1.22), sugar and confectionery (1.12), and alcohol (1.26), are among the most elastic. Since the households in this cluster exhibit rather low budget shares for the latter two luxury good categories, our results suggest that households increase their demand for sweets and alcohol in line with increasing incomes over time. Results for own-price elasticities indicate that the *Urban Non-Growers* try to keep the expenses for those categories that account for high budget shares as low as possible. Consequently, their reaction is rather elastic to price variations for cereals (-1.08), potatoes (-1.02), and fruits (-1.02). Since income elasticities tend to be generally lower for categories with high budget shares, ceteris paribus (i.e. for a given marginal budget share; see eq. 4), these price elasticities can be considered conservative.

Table 5: Unconditional, uncompensated own-price elasticities across consumer clusters (1995-2010)

	Urban Non-Growers *Cluster 1*	**Aspiring Hedonists** *Cluster 2*	**Rural Home Producers** *Cluster 3*	**Restricted Majority** *Cluster 4*	**Quality Elite** *Cluster 5*
1st Stage					
Food	-0.87 ***	-0.63 ***	-0.89 ***	-0.94 ***	-0.71 ***
FAFH	-0.93 ***	-0.42 ***	-0.88 ***	-0.98 ***	-0.57 ***
Clothing	-0.84 ***	-0.47 ***	-0.76 ***	-0.95 ***	-0.54 ***
Rent	-0.65 ***	-0.35 ***	-0.59 ***	-0.90 ***	-0.43 ***
Recreation	-0.85 ***	-0.51 ***	-0.77 ***	-0.94 ***	-0.59 ***
Other Services	-0.95 ***	-0.61 ***	-0.88 ***	-0.99 ***	-0.70 ***
2nd Stage					
Bread & Bakery	-0.37 ***	-0.43 ***	-0.52 ***	-0.55 ***	-0.43 ***
Cereals	-1.08 ***	-0.75 ***	-1.60 ***	-0.84 ***	-0.90 ***
Potatoes	-1.02 ***	-0.69 ***	-0.74 ***	-0.64 ***	-0.70 ***
Vegetables	-0.97 ***	-0.79 ***	-1.08 ***	-0.97 ***	-0.94 ***
Fruits	-1.02 ***	-0.90 ***	-0.79 ***	-0.93 ***	-0.84 ***
Meat	-0.87 ***	-0.80 ***	-1.01 ***	-0.90 ***	-0.81 ***
Milk & Dairy products	-0.89 ***	-0.91 ***	-0.90 ***	-0.98 ***	-0.78 ***
Fat & Oils	-0.93 ***	-0.89 ***	-1.04 ***	-1.03 ***	-0.88 ***
Sugar & Confectionery	-0.80 ***	-0.82 ***	-1.13 ***	-0.96 ***	-0.77 ***
Tea & Coffee	-0.79 ***	-0.73 ***	-0.94 ***	-0.65 ***	-0.64 ***
Tobacco	-0.89 ***	-0.84 ***	-0.78 ***	-0.72 ***	-0.69 ***
Alcohol	-0.84 ***	-0.84 ***	-0.68 ***	-0.75 ***	-0.81 ***
Beverages	-0.46 ***	-0.43 ***	-0.73 ***	-0.78 ***	-0.65 ***
% of observations	5.5	16.3	5.4	53.2	19.7

* Significant at the 5 % level; ** Significant at the 1 % level; *** Significant at the 0.1 % level.

Source: Own estimates based on RLMS data, 1995-2010.

Both expenditure and price elasticities found for *Aspiring Hedonists* confirm our assessment of these households as pleasure- and status oriented. We find an expenditure elasticity of

total food demand of 0.77, which is the lowest across all clusters. *Aspiring Hedonists* have strong preferences for FAFH and recreational activities, two categories with very high elasticities. Among individual foods, high expenditure elasticities for vegetables (0.98), meat (1.02), as well as milk and dairy products (0.78) indicate a pent-up demand with regards to fresh produce and animal products. Particularly interesting is the case of meat, where *Aspiring Hedonists* have the lowest expenditure elasticity across all clusters. Nonetheless, it is still in the elastic range, suggesting future growth towards satiation. Households in cluster 2 show relatively small magnitudes of expenditure elasticities for products with high budget shares, namely tobacco (0.47) and alcohol (0.57). Own-price elasticities in the first stage are very low throughout. In the second stage, *Aspiring Hedonists* seem to react more strongly to the prices of those products that characterise their lifestyle and make up a large proportion of their food expenditure like tobacco and alcohol. In contrast, their price responsiveness with respect to staple foods like bread and bakery, cereals and potatoes is particularly low.

Rural Home Producers show the second-highest expenditure elasticity for food at home (0.91) and the lowest elasticity for FAFH consumption (0.90) compared to all other clusters. This pattern emphasises the subsistence orientation of these households. As households in this cluster have the capacity to produce most staple foods themselves, additional income tends to be devoted to non-food goods and services or to necessity food products that cannot be produced at home. Accordingly, meat (1.16), sugar and confectionery (1.24), and tobacco (1.07) are classified as luxury goods, whereas expenditure elasticities for staples such as bread, cereals, potatoes, and fats and oils are low. Estimates of own-price elasticities for this cluster vary considerably across food groups. *Rural Home Producers* exhibit by far the highest own-price elasticity for cereals (-1.60). Also the values for meat (-1.01), fats and oils (-1.04), as well as sugar and confectionery (-1.13) are the most elastic estimates among all clusters. These results may reflect better storage opportunities in households of this cluster or by usage for animal feed.

Budget-constrained households in the *Restricted Majority* cluster exhibit the overall highest expenditure elasticity for food (0.92). This is in line with the predictions of Engel's law suggesting a higher share of additional income to be spent on food. However, the estimate is almost equivalent to those for Clusters 1 and 3 and close to that of the wealthier Cluster 5. A plausible explanation for this outcome is the constrained financial situation of *Restricted Majority* households, where unsatisfied needs for housing or clothing consume considerable

proportions of household budgets. These expenditures come at the expense of FAFH, recreation and other services for which *Restricted Majority* households show the lowest expenditure elasticities of all clusters. First-stage own-price elasticities are close to unity and are the highest across clusters.

In accordance with Engel's law households in the wealthy *Quality Elite* cluster have the second-lowest expenditure elasticity for food (0.85) and devote a disproportionately large share of additional income to FAFH, clothing, recreation, and other services. Other than food, expenditure elasticities for rent and utilities range below unity, which might be due to a growing share of home ownership.

Among the second-stage expenditure elasticities, the very low value for milk and dairy products (0.35) stands out, pointing to a largely satiated demand for dairy products. The opposite holds for meat, where the *Quality Elite* depicts the highest budget share (0.37) but still reacts elastically to changes in income (1.07). Further growth in demand is to be expected for sweets, tea and coffee, as well as alcohol. These products account for a small proportion of the food budget so far but their unconditional expenditure elasticities exceed unity. Households in the *Quality Elite* seemingly strive to catch up with other groups of society of comparable economic status, the *Aspiring Hedonists*, and expand their consumption of high-quality food and luxury goods as incomes rise.

Similar to *Aspiring Hedonists*, households in the *Quality Elite* react relatively inelastically to price increases, with an overall own-price elasticity of food demand of -0.71 in the first stage. All second-stage price-elasticities are also below unity. The most plausible explanation for this result is the relaxed budget situation of households in the fifth cluster. Consumption patterns and levels seem to consolidate at high levels and other, non-price determinants of consumption gain in importance.

The time trends in expenditure elasticities for each of the clusters mirrors the trends obtained for the total sample (see Table A3). However, disproportionately high or low differences between periods and for specific clusters are noticeable. For example, the expenditure elasticity of food decreased only slightly for the *Restricted Majority*, whereas other consumer segments experienced more pronounced drops. Also expenditure elasticities for FAFH show significant increases for Clusters 1 and 5, while at the same time the estimate for the *Restricted Majority* remain below unity.

A very important finding from this disaggregated analysis is that the second-stage expenditure elasticities in the last period are almost all below unity except for those of the *Restricted Majority*. This implies that the elastic food expenditure reactions seen for each cluster over the entire period (Table 4) are largely driven by consumption behaviour in earlier periods. Likewise, the elastic reactions of food expenditure observed in the last period for all households (Table 1) were a result of the behaviour of the Restricted Majority that accounts for almost half of all observations. These differences between clusters and periods have to be kept in mind, when projecting future demand patterns based on estimates from panel data.

5 Discussion and conclusion

We provide a comprehensive assessment of trends and patterns of food demand in the Russian Federation with special regard to structural shifts over time and heterogeneity across consumer segments. Based on RLMS-panel data from 1995 to 2010, we estimated a two-stage LES-LA/AIDS model for the entire sample period and three distinct time periods that correspond to different stages of the transition process that Russia has undergone over the past two decades. Our study is the first to document changes in expenditure and price elasticities for Russian households based on one consistent set of data and methodological approach. A second major contribution is the combination of cluster analysis and demand system estimation to investigate differences in demand patterns across sub-populations. We identify five distinct household clusters based on their food purchases and profile them by their socio-demographic characteristics, food and non-food expenditure, and demand elasticities.

Our results underscore the fact that food still plays a major part in the budget allocation decisions of Russian households. Although non-food categories such as clothing or recreational activities have gained in importance over time, the estimated total expenditure elasticities for food at home range between 0.77 to 0.98 across consumer segments and time periods; values that can be considered high in comparison to those typically found for consumers in most industrialised countries. Previous studies reported estimates of income or total expenditure elasticities between 0.14 and 0.66 for a series of European countries (Michalek and Keyzer 1992), 0.68 for Sweden (Edgerton 1997), 0.74 for Norway (Rickertsen 1998), and 0.37 for the U.S. (Blanciforti and Green 1983).

Following Engel, we conclude that demand for food is far from satiated in Russia and future growth in expenditures is to be expected. A slight decline in the expenditure elasticity for food at home over time as well as lower values for more affluent consumer segments also confirm Engel's prediction.

The analyses for specific food items in the second stage validate Bennett's law indicating considerable shifts in the composition of Russian food baskets. High-value products such as meat products, sugar and confectionery, alcohol, and beverages can be expected to further gain importance in consumer demand, while starchy staples such as bread and bakery, and cereals may lose ground. Such "trading-up" patterns in consumer food choices seem to be ubiquitous in almost every country experiencing economic transition and income growth (Fabiosa 2011), and Russia is no exception.

A category that has grown significantly is FAFH consumption. Stewart (2011) lists growing incomes, higher female labour participation, smaller households, and an increasing proportion of people with higher education as driving factors. These aspects raise the opportunity costs of time and, thus, lower the propensity to prepare meals at home, let alone to grow one's own food. A second driver may be a changing motive of food consumption over time from merely functional and nutritional necessity towards pleasure- and lifestyle-oriented goals. Michalek and Keyzer (1992) and Henning and Michalek (1992) label such reorientation as "innovative consumption" that leads to increasing expenditure elasticities over time – just as we observe here for FAFH. Finally, the increasing demand for FAFH is served by a growing supply and variety of FAFH. Particularly, the FAFH consumption of wealthier urban households is very income-elastic and promises growth potential for restaurants, fast- and convenience-food outlets, and canteens.

Establishing consumer segments by means of cluster analysis provides revealing insights and offers clear added benefits compared to standard segmentation by income or degree of urbanisation. Both *Urban Non-Growers* and the *Quality Elite* reveal high shares of urbanisation but differ substantially in consumption patterns and shopping behaviour. In this case, household size, access to a garden plot, and car ownership are variables of critical importance. The comparison of *Aspiring Hedonists* and the *Quality Elite* is a second example. Both clusters show similar demand behaviour in the first stage that is most likely determined by their relative affluence. Differences in the second stage, especially for indulgence goods

such as sweets, alcohol, or tobacco, reflect the conditioning variables like the share of males in the households, age of the household head, or household members' education.

The development of the clusters' shares in the total population over time allows some interesting conclusions (see Tables A3 and A4, last line). First, the clusters of *Urban Non-Growers* and *Rural Home Producers* are shrinking. Both segments are characterised by their level of home production; low for the former and high for the latter. Hence, their decline suggests that food purchasing patterns will be less and less affected by home production in the future. The diminishing role of home production may be driven by an improved provision of a variety of foods compared to the Soviet era or the early years of transition. When food shortages no longer pose a serious threat to households, growing one's own food loses importance for diet diversity.

Second, the cluster *Restricted Majority* accounts for almost half of the sample and even grew slightly. Low budget shares for food and high expenditure elasticities indicate considerable potential of rising demand for food within this consumer segment. The prospect of increasing wealth for these households can be expected to form a solid basis for future growth in demand for processed foods, imports, and modern retailing. Third, the two most affluent clusters of *Aspiring Hedonists* and *Quality Elite* have been growing fast and will gain in population share. Results indicate that these consumer groups will push the supply for food away from home, indulgence goods, and convenience options.

In order to relate our elasticity estimates for Russia to literature on other emerging economies, we draw on a comprehensive compilation of Abler (2010) who surveyed demand studies for Brazil, India, Indonesia, China, and Russia. A first striking issue is that only a small fraction of the reviewed studies reports income or total expenditure elasticities for the entire food aggregate. Many studies are restricted to the level of conditional elasticities for individual food groups that only allow for conclusions about shifts within the food budget. The lack of estimates for broad categories of goods and services underscores the contribution of the present analysis.

One of the few exceptions is the study by Fan et al (1995) who report an expenditure elasticity for food in China of 0.7. This compares quite well to our findings, especially to the values for the more affluent clusters. Also for China, Gale and Huang (2007) report an expenditure elasticity for FAFH of 1.2 which is close to our estimate for the last period.

Mergenthaler et al. (2009) analysed food demand in the context of the transformation of the Vietnamese food system. The authors find particularly high income elasticities (around or larger than 2) for products from modern supermarkets and for non-traditional imports.

Comparing elasticities for individual food groups is difficult, since the estimates show considerable variations across studies for the same or similar products (Abler 2010). Comparisons of demand studies are further complicated by differences in data sources, methodologies, or regional and cultural peculiarities of select study areas. Therefore, we concentrate on major trends identified by Abler (2010) for other BRIIC countries. These main findings are a) decreasing expenditure elasticities over time (except for meat), b) lower expenditure elasticities for urban households, c) high expenditure elasticities for meat and low elasticities for staple cereal foods. Our results largely confirm these broad trends. However, the analysis presented here reveals that different consumer segments do not adjust their consumption behaviour in the same manner and/or the same speed. Disaggregated analyses based on uniform, timely and comparable sampling and study designs could provide essential improvements for further research. In addition, substantial focus should be on FAFH and processed foods.

Some policy implications arise from our analysis. Results indicate that Russian diets develop in ways that largely follow the modern and unhealthy diets of many western countries, characterised by consumption of large quantities of meat, sweets, and alcohol, as well as increasing FAFH (including fast food) consumption. Given that energy-rich, fatty foods and spirits have traditionally played an important role in Russia, these emerging trends should raise the awareness of Russian public health and nutritional experts and policy makers alike. From a trade perspective, we should expect to see further growth in Russian imports of meat. Being already a significant net importer of meat[7], this development may – in combination with rising demand in other BRIC countries – further increase the pressure and competition on world markets.

[7] In 2011, the Russian Federation was the second largest importer by value of pork, the third largest importer of beef and also a major importer of poultry. The main supplier countries were Brazil, the USA and the EU (FAOSTAT 2014).

References

Abler, D. *Demand Growth in Developing Countries*. OECD Food, Agriculture and Fisheries Papers No. 29. (Paris: OECD Publishing, 2010).

Backhaus, K., Erichson, B., Plinke, W. and Weiber, R. *Multivariate Analysemethoden: Eine anwenderorientierte Einführung*. (Berlin: Springer, 2008).

Belaya, V. and Hanf, J.H. 'Influence of Foreign Direct Investment on Supply Chain Management in Russia', in: Stjepan Tanic (Ed.): Agribusiness and Agro-Industries Development in Central and Eastern Europe, (19th Annual World Forum & Symposium, Budapest, June 20-21, 2009), (2010) pp. 117-139.

Bennett, M.K. 'International Contrasts in Food Consumption', *Geographical Review*, Vol. 31, (1941) pp. 365-376.

Blanciforti, L. and Green, R.' An Almost Ideal Demand System Incorporating Habits: An Analysis of Expenditures on Food and Aggregate Commodity Groups', *The Review of Economics and Statistics*, Vol. 65, (1983) pp. 511-515.

Brosig, S. *A Model of Household Type Specific Food Demand Behaviour in Hungary*. Discussion Paper No. 30 (Halle: IAMO, 2000).

Brosig, S. and Ratinger, T. 'Shifts in Food Demand of Czech Households during Transition', in: European Association of Agricultural Economists (Ed.): European Agriculture Facing the 21st Century in a Global Context, Warsaw, (1999) pp. 314-332.

Caskie, P. 'Back to Basics: Household Food Production in Russia', *Journal of Agricultural Economics*, Vol. 51, (2000) pp. 196-209.

Cox, T.M. and Wohlgenant, M.K. 'Prices and Quality Effects in Cross-Sectional Demand Analysis', *American Journal of Agricultural Economics*, Vol. 68, (1986) pp. 908-919.

Deaton, A. and Muellbauer, J. 'An Almost Ideal Demand System', *American Economic Review*, Vol. 70, (1980) pp. 312-326.

Dries, L., Reardon, T. and Swinnen, J. 'The Rapid Rise of Supermarkets in Central and Eastern Europe: Implications for the Agrifood Sector and Rural Development', *Development Policy Review*, Vol. 22, (2004) pp. 525-556.

Duncan, D.B. 'Multiple Range and Multiple F tests', *Biometrics,* Vol. 11 (1955), pp. 1-42.

Edgerton, D.L. 'Weak Separability and the Estimation of Elasticities in Multistage Demand', *American Journal of Agricultural Economics*, Vol. 79, (1997) pp. 62-79.

Elsner, K. *Analysing Russian Food Expenditure Using Micro-Data*. Discussion Paper No. 23 (Halle: IAMO, 1999).

Fabiosa, J.F. 'Globalization and Trends in World Food Consumption', in: Lusk, J.L, Roosen, J., Shogren, J.F. (Eds.): The Economics of Food Consumption and Policy. (New York: Oxford University Press, 2011 pp. 591-611).

Fan, S., Wailes, E.J. and Cramer, G.L. 'Household Demand in Rural China: A Two-Stage LES-AIDS Model', *American Journal of Agricultural Economics,* Vol. 77, (1995) pp. 54-62.

FAOSTAT *Food and Agriculture Organization Corporate Statistical Database: Agricultural trade domain. Information on import quantities and values by commodity.* Available at http://faostat.fao.org/site/342/default.aspx. (Accessed January 2014)

Frohberg, K. and Winter, E. 'Functional Forms in Complete Demand Systems – Do They Matter for Policy Analysis?', in: Brosig, S. Hartmann, M. (Eds.): Analysis of Food Consumption in Central and Eastern Europe: Relevance and Empirical Methods. *Studies on the Agricultural and Food Sector in Central and Eastern Europe*, Vol. 13. (Kiel: Vauk, 2001 pp. 120-141).

Gale, F. and Huang, K. *Demand for Food Quantity and Quality in China*. Economic Research Report No. 32 (Washington, D.C.: USDA, 2007)

Goodwin, H.R., Holcomb, R.B. and Shiptsova, R. 'An Evaluation of East Russian Household Expenditures for Non-Dairy Animal Protein Sources', *Journal of Food Distribution Research*, Vol. 34, (2003) pp. 11-20.

Goskomstat. *Central statistical data base.* Available at http://cbsd.gks.ru/. (Accessed December 2013)

Green, R. and Alston, J. 'Elasticities in AIDS Models', *American Journal of Agricultural Economics*, Vol. 72, (1990) pp. 442-445.

Heien, D. and Wessels, C. 'Demand System Estimation with Microdata: A Censored Regression Approach', *Journal of Business and Economic Statistics*, Vol. 8, (1990), pp. 365-371.

Henning, C.H.C.A. and Michalek, J. 'Innovatives Konsumentenverhalten für Nahrungsmittel? Ableitung und Schätzung eines auf Nahrungsmittel fokussierten kompletten Nachfragesystems unter Berücksichtigung von zeitlichen Präferenzänderungen' (in German). *German Journal of Agricultural Economics (Agrarwirtschaft),* Vol. 42, (1992) pp. 330-342.

Hoch, S.J., Kim, B., Montgomery, A.L. and Rossi, P.E. 'Determinants of Store-Level Price Elasticity', *Journal of Marketing Research*, Vol. 32, (1995) pp. 17-29.

Honkanen, P. 'Food Preference Based Segments in Russia', *Food Quality and Preference*, Vol. 21, (2010) pp. 65-74.

Honkanen, P. and Frewer, L. 'Russian Consumers' Motives for Food Choice', *Appetite*, Vol. 52, (2009) pp. 363-371.

Hossain, F., Jensen, H.H. and Snuka, R. 'Food Demand Pattern in Latvia: Evidence from Household Budget Survey', in: Brosig, S. Hartmann, M. (Eds.): Analysis of Food Consumption in Central and Eastern Europe: Relevance and Empirical Methods. *Studies on the Agricultural and Food Sector in Central and Eastern Europe*, Vol. 13. (Kiel: Vauk, 2001 pp. 142-156).

Huang, K. and Lin, B. *Estimation of Food Demand and Nutrient Elasticities from Household Survey Data*. Technical Bulletin No. 1887 (Washington, D.C.: USDA, 2000).

Liefert, W., Liefert, O. and Shane, M. *Russia's Growing Agricultural Imports. Causes and Outlook*. WRS-09-04 (Washington, D.C.: USDA, 2009).

Mergenthaler, M., Weinberger, K. and Qaim, M. 'The Food System Transformation in Developing Countries: A Disaggregate Analysis for Fruits and Vegetables in Vietnam', *Food Policy*, Vol. 34, (2009) pp. 426-436.

Michalek, J. and Keyzer, M.A. ' Estimation of a Two-Stage LES-AIDS Consumer Demand System for Eight EC Countries', *European Review of Agricultural Economics*, Vol. 19, (1992) pp. 137-163.

Moro, D. and Sckokai, P. 'Heterogeneous Preferences in Household Food Consumption in Italy', *European Review of Agricultural Economics*, Vol. 27, (2000) pp. 305-323.

Notten, G. and de Crombrugghe, D. 'Consumption Smoothing in Russia', *Economics of Transition*, Vol. 20, (2012) pp. 481-519.

OECD. *Russia*. Agricultural Policies in Emerging Economies 2009: Monitoring and Evaluation. (OECD Publishing, 2009). Available at: http://dx.doi.org/10.1787/agr_emerging-2009-8-en.

Park, J., Holcomb, R., Raper, K., Capps, Jr., O. 'A Demand System Analysis of Food Commodities by U.S. Households Segmented by Income', *American Journal of Agricultural Economics*, Vol. 78, (1996) pp. 290-300.

Pollak, R.A. and Wales, T.J. 'Estimation of Complete Demand Systems from Household Budget Data: The Linear and Quadratic Expenditure Systems', *American Economic Review*, Vol. 68, (1978) pp. 348-59.

Pollak, R.A. and Wales, T.J. *Demand System Specification and Estimation*. (New York, Oxford: Oxford University Press, 1992).

Qaim, M., von Braun, J. and tho Seeth, H. *Food Consumption in Russia: Econometric Analyses with Household Data.* Discussion Papers Series Food Economy and Food Policy: The Russian Food Economy in Transition, No. 8. (Kiel: Christian-Albrechts-University, 1997).

Raper, K.C., Wanzala, M.G. and Nayga Jr., R.M. 'Food expenditures and household demographic composition in the US: a demand systems approach', *Applied Economics*, Vol. 34, (2002) pp. 981–992.

Rickertsen, K. 'The Demand for Food and Beverages in Norway', *Agricultural Economics*, Vol. 18, (1998) pp.89-100.

Schmid, S. *Der Russische Konsument. Lebensumwelt, Konsumentenverhalten und Markenwahrnehmung.* (Münster: OWC - Verlag für Außenwirtschaft, 2004).

Schröck, R. 'The Organic Milk Market in Germany is Maturing: A Demand System Analysis of Organic and Conventional Fresh Milk Segmented by Consumer Groups', *Agribusiness*, Vol. 28, (2012) pp. 274-292.

Sheng, M. *Consumption Analysis for Russia: A Linear Expenditure System*. Discussion Papers Series Food Economy and Food Policy: The Russian Food Economy in Transition, No. 12. (Kiel: Christian-Albrechts-University, 1997).

Shiptsova, R., Goodwin, H.R. and Holcomb, R.B. 'Household Expenditure Patterns for Carbohydrate Sources in Russia', *Journal of Agricultural and Resource Economics*, Vol. 29, (2004) pp. 296-307.

Shonkwiler, J.S. and Yen, S.T. 'Two-step Estimation of a Censored System of Equations', *American Journal of Agricultural Economics*, Vol. 81, (1999) pp. 972-982.

Smed, S., Jensen, J.D. and Denver, S. 'Socio-economic characteristics and the effect of taxation as a health policy instrument', *Food Policy*, Vol. 32, (2007) pp. 624-639.

Staudigel, M. 'How do Obese People Afford to be Obese? Consumption Strategies of Russian Households', *Agricultural Economics*, Vol. 43, (2012) pp. 701-714.

Stewart, H. 'Food Away From Home', in: Lusk, J.L, Roosen, J., Shogren, J.F. (Eds.): The Economics of Food Consumption and Policy. (New York: Oxford University Press, 2011 pp. 647-666).

Stillman, S. and Thomas, D. 'Nutritional Status during an Economic Crisis: Evidence from Russia', *The Economic Journal*, Vol. 118, (2008) pp. 1385-1417.

Turk, J. and Erjavec, E. 'Ascertaining Changes in Food Consumption Habits During Transition: The Case of Slovenia', in: Brosig, S. Hartmann, M. (Eds.): Analysis of Food Consumption in Central and Eastern Europe: Relevance and Empirical Methods. *Studies on the Agricultural and Food Sector in Central and Eastern Europe*, Vol. 13. (Kiel: Vauk, 2001 pp. 192-207).

USDA. *Russian Federation - Retail Foods. Russian Retail Market Continues Expansion*. GAIN Report Number: RSATO1110 (Washington, D.C.: USDA, 2011).

van Berkum, S., Roza, P. and Belt, J. *Long-term Perspectives for the Russian Agri-food Sector and Market Opportunities for the Dutch Agribusiness*. Report 5.07.03 (The Hague: LEI, 2007).

von Braun, J., Qaim, M. and tho Seeth, H. 'Poverty, Subsistence Production, and Consumption of Food in Russia: Policy Implications', in: Wehrheim, P., Serova, E., Frohberg, K., von Braun, J., (Eds.): Russia's Agro-food Sector: Towards Truly Functioning Markets. (Boston: Kluwer Academic Publishers, 2000 pp. 301-321).

White, H. 'A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity', Econometrica, Vol. 48, (1980) pp. 817-838.

Worldbank (a). *GINI index*. Available at http://data.worldbank.org/indicator/SI.POV.GINI. (Accessed July 2013).

Worldbank (b). *GDP growth (annual %)*. Available at http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG. (Accessed January 2013).

Zhang, X., Dagevos, H., He, Y., van der Lans, I. and Zhai, F. 'Consumption and Corpulence in China. A Consumer Segmentation Study Based on the Food Perspective', *Food Policy*, Vol. 33, (2008) pp. 37-47.

Appendix

Table A1: Allocation of single food items to food groups for the demand analysis.

Food Group	Included products	Unit
Bread	Bread, black & white	kg
Cereals	Groats, Flour, Pasta	kg
Potatoes	Potatoes	kg
Vegetables	Canned Vegetables, Cabbage, Cucumbers, Tomatoes, Beets/Carrots, Onions/Garlic, Squash, Other Vegetables	kg
Fruits	Melons, Canned Fruits, Berries, Fresh Fruits, Dried Fruits, Nuts	kg
Meat	Canned Meat, Beef, Lamb, Pork, Organ Meat, Poultry, Smoked Meat, Meat Products, Fish, Canned Fish	kg
Milk & Dairy products	Milk, Canned Milk, Kefir, Cream, Curd, Cheese, Ice cream, Eggs	l, kg
Fat & Oils	Vegetable Oil, Margarine, Butter, Lard	l, kg
Sugar & Confectionery	Sugar, Confectionery, Jam, Honey, Cakes	kg, l (Honey)
Tea & Coffee	Coffee, Tea	kg
Tobacco	Tobacco	Packages
Alcohol	Vodka, Liquor, Beer	l
Beverages	Beverages	l

Source: Own compilation.

Table A2: Rotated Matrix of Components with factor loadings of the five-factor-solution

	Component				
	Dairy products & Meat	*Alcohol, Tobacco & Sweets*	*Staple Foods*	*Vegetables & Fruits*	*Non-perishables*
Curd	**.580**	-.084	-.092	.123	.068
Cream	**.563**	.003	.010	.021	.115
Milk	**.516**	-.011	.101	-.040	-.146
Cheese	**.488**	.198	-.026	.086	.120
Kefir	**.481**	.161	-.168	.095	-.023
Fruit	.455	.260	-.088	.142	.255
Eggs	**.453**	.069	.199	.159	-.076
Poultry	**.373**	.166	.047	.152	-.023
Beef	.351	-.111	.229	.011	.186
Fish	**.295**	.141	.147	.082	.023
Pork	**.259**	.032	.170	-.056	.044
Organ Meat	.196	.048	.098	.150	-.177
Beverages	.139	**.538**	-.128	.034	.160
Beer	.028	**.510**	-.026	.023	-.134
Tobacco	-.022	**.480**	.243	-.017	-.229
Cake	.293	**.456**	.028	-.095	.033
Smoked Meat	.415	.436	.090	-.020	-.004
Meat Products	.144	.362	-.044	.111	-.222
Candy	.216	**.330**	.115	-.139	.282
Ice cream	.031	**.318**	.059	-.038	.213
Vodka	-.057	**.297**	.150	.013	.062
Liquor	.027	**.279**	-.052	.058	.228
Coffee	.147	**.260**	.080	.037	.122
Canned Fish	.005	.223	.131	.055	.101
Pasta	.054	.138	**.496**	.028	-.138
Vegetable Oil	.078	.026	**.483**	.124	.009
White Bread	.030	.151	**.422**	-.117	.027
Groats	.131	.017	**.419**	.083	-.050
Sugar	-.032	-.048	**.414**	.019	.144
Tea	.047	.208	**.392**	-.001	.085
Flour	-.024	-.153	**.333**	-.009	.240
Canned meat	.000	.156	.175	.097	.007
Tomatoes	.052	.124	-.038	**.546**	.032
Root vegetables	.090	-.053	.066	**.519**	.031
Potatoes	-.011	-.020	.077	**.472**	-.081
Cucumbers	.063	.168	-.114	**.418**	.163
Onion & Garlic	-.027	-.026	.177	**.378**	.056
Cabbage	.070	-.070	.106	**.374**	-.022
Other Vegetables	.037	.067	-.031	**.318**	.050
Squash	.025	-.042	-.004	**.255**	.072
Berries	.102	.066	-.062	.191	.039
Melons	.128	.037	.081	.186	-.147
Black Bread	.161	-.008	.225	.009	**-.316**
Canned Milk	.058	.059	.110	.046	**.304**
Canned Fruit	.004	.083	.000	.042	**.274**
Dried Fruit	.151	-.043	-.031	.025	**.272**
Jam	.000	.026	.024	.006	**.265**
Canned Vegetables	-.004	.100	-.018	.113	**.246**
Mutton	.011	-.047	.105	-.008	**.238**
Nuts	.118	.133	.035	.085	.197
Honey	.101	-.051	.096	.079	.109

Principal Component Analysis, Varimax rotation with Kaiser Normalization

Source: Own computations based on RLMS data, 1994-2010.

Table A3: Unconditional Expenditure Elasticities for Clusters over Time

	Urban Non-Growers *Cluster 1*			Aspiring Hedonists *Cluster 2*			Rural Home Producers *Cluster 3*			Restricted Majority *Cluster 4*			Quality Elite *Cluster 5*		
Time Period	**1995-98**	**2001-03**	**2008-10**	**1995-98**	**2001-03**	**2008-10**	**1995-98**	**2001-03**	**2008-10**	**1995-98**	**2001-03**	**2008-10**	**1995-98**	**2001-03**	**2008-10**
1st Stage															
Food	0.97 ***	0.78 ***	0.73 ***	0.83 ***	0.69 ***	0.66 ***	0.97 ***	0.78 ***	0.69 ***	0.96 ***	0.92 ***	0.89 ***	0.88 ***	0.71 ***	0.63 ***
FAFH	0.78 ***	1.43 ***	1.71 **	1.12 ***	1.38 ***	1.41 ***	0.90 ***	1.21 ***	1.37 ***	0.48 ***	0.80 ***	0.94 ***	0.72 ***	1.53 ***	1.69 ***
Clothing	1.27 ***	1.69 ***	1.57 **	1.37 ***	1.26 ***	1.21 ***	1.17 ***	1.56 ***	1.51 ***	1.19 ***	1.27 ***	1.23 ***	1.42 ***	1.53 ***	1.45 ***
Rent	0.98 ***	0.93 ***	0.69 **	1.17 ***	1.24 ***	1.05 ***	1.34 ***	1.26 ***	1.06 ***	1.33 ***	1.21 ***	1.05 ***	1.07 ***	0.95 ***	0.70 ***
Recreation	1.13 ***	1.38 ***	1.40 **	1.27 ***	1.41 ***	1.44 ***	1.09 ***	1.40 ***	1.42 ***	0.97 ***	1.07 ***	1.09 ***	1.21 ***	1.39 ***	1.46 ***
Other Services	1.03 ***	1.49 ***	1.67 **	1.36 ***	1.31 ***	1.41 ***	0.88 ***	1.45 ***	1.77 ***	1.06 ***	0.89 ***	1.08 ***	1.38 ***	1.37 ***	1.66 ***
2nd Stage															
Bread & Bak.	0.36 ***	0.19 ***	0.37 ***	0.22 ***	0.22 ***	0.22 ***	0.23 ***	0.02 ***	0.29 ***	0.29 ***	0.15 ***	0.05 ***	0.19 ***	0.21 ***	0.26 ***
Cereals	1.07 ***	0.61 ***	0.72 ***	0.79 ***	0.48 ***	0.49 ***	0.76 ***	0.56 ***	0.37 ***	1.15 ***	0.91 ***	0.82 ***	0.84 ***	0.58 ***	0.55 ***
Potatoes	1.03 ***	1.18 ***	0.89 ***	1.05	0.87 ***	0.74 ***	1.03 ***	1.08 *	0.77 ***	1.01 ***	0.93 ***	1.02 ***	1.10 ***	0.87 ***	0.76 ***
Vegetables	0.44 ***	0.36 ***	0.47 ***	1.11 ***	0.85 ***	0.92 ***	1.04 ***	0.60 ***	0.77 ***	0.94 ***	0.92 ***	0.93 ***	0.87 ***	0.77 ***	0.75 ***
Fruits	1.11 ***	0.85 ***	0.40 ***	0.89 ***	0.83 ***	0.76 ***	0.88 ***	0.87 ***	0.53 ***	1.08 ***	1.04 ***	0.95 ***	0.88 ***	0.74 ***	0.56 ***
Meat	1.29 ***	1.00 ***	0.84 ***	1.09 ***	0.96 ***	0.87 ***	1.27 ***	0.98 ***	0.98 ***	1.38 ***	1.31 ***	1.19 ***	1.19 ***	0.97 ***	0.75 ***
Milk & Dairy	1.05 ***	0.67 ***	0.62 ***	0.84 ***	0.71 ***	0.67 ***	0.87 ***	0.80 ***	0.63 ***	0.85 ***	0.83 ***	0.70 ***	0.39 ***	0.25 ***	0.31 ***
Fat & Oils	0.91 ***	0.59 ***	0.61 ***	1.13 ***	0.65 ***	0.77 ***	0.61 ***	0.51 ***	0.30 ***	1.26 ***	1.05 ***	0.94 ***	1.01 ***	0.68 ***	0.70 ***
Sugar & Conf.	1.47 ***	0.86 ***	0.96 ***	0.79 ***	0.71 ***	0.58 ***	1.27 ***	1.21 ***	0.73 ***	1.30 ***	1.07 ***	1.04 ***	1.08 ***	0.92 ***	0.84 ***
Tea & Coffee	1.55 ***	0.77 ***	0.98 ***	0.94 ***	0.66 ***	0.58 ***	0.70 ***	0.63 ***	0.46 ***	1.10 ***	1.05 ***	0.99 ***	1.05 ***	0.94 ***	0.87 ***
Tobacco	1.05 ***	0.80 ***	0.86 ***	0.39 ***	0.40 ***	0.42 ***	1.28 ***	1.27 **	0.70 ***	0.88 ***	0.99 ***	0.78 ***	1.19	0.80 ***	0.76 ***
Alcohol	1.17 ***	0.92 ***	0.95 ***	0.62 ***	0.53 ***	0.63 ***	1.33 ***	0.95 ***	0.18	1.20 ***	1.09 ***	1.11 ***	1.33 ***	1.11 ***	1.00 ***
Beverages	0.27 (*)	0.46	0.54 **	0.32	0.37 ***	0.33 (*)	0.45 **	-0.08	1.37	-0.27	0.37 ***	0.55 ***	0.04	0.19 ***	0.22 ***
No. of obs.	535	864	498	707	1849	2764	1058	611	539	5427	6143	7256	1629	1896	3546
% of obs. in each period	5.7	7.6	3.4	7.6	16.3	18.9	11.3	5.4	3.7	58.0	54.1	49.7	17.4	16.7	24.3

* Significant at the 5 % level; ** Significant at the 1 % level; *** Significant at the 0.1 % level.

Source: Own estimates based on RLMS data, 1995-2010.

Table A4: Unconditional Own-Price Elasticities for Clusters over Time

	Urban Non-Growers *Cluster 1*			Aspiring Hedonists *Cluster 2*			Rural Home Producers *Cluster 3*			Restricted Majority *Cluster 4*			Quality Elite *Cluster 5*		
Time Period	**1995-98**	**2001-03**	**2008-10**	**1995-98**	**2001-03**	**2008-10**	**1995-98**	**2001-03**	**2008-10**	**1995-98**	**2001-03**	**2008-10**	**1995-98**	**2001-03**	**2008-10**
1st Stage															
Food	-1.10 ***	-0.82 ***	-1.04 ***	-1.09 ***	-0.70 ***	-0.53 ***	-1.01 ***	-0.85 ***	-0.52 **	-1.03 ***	-0.96 ***	-0.79 ***	-1.06 ***	-0.77 ***	-0.63 ***
FAFH	-1.33 ***	-0.99 ***	-1.91 **	-1.55 ***	-0.73 ***	-0.33 (*)	-1.13 ***	-1.12 ***	-0.32	-1.06 ***	-1.02 ***	-0.77 ***	-1.30 ***	-0.96 ***	-0.75 **
Clothing	-1.51 ***	-0.87 ***	-1.69 **	-1.59 ***	-0.73 ***	-0.38 *	-1.10 ***	-0.98 ***	-0.18	-1.14 ***	-1.01 ***	-0.69 ***	-1.48 ***	-0.87 ***	-0.66 ***
Rent	-1.15 ***	-0.65 ***	-1.00 **	-1.38 ***	-0.57 ***	-0.36 *	-1.06 ***	-0.76 ***	-0.23	-1.11 ***	-0.95 ***	-0.72 ***	-1.14 ***	-0.65 ***	-0.53 ***
Recreation	-1.42 ***	-0.89 ***	-1.54 **	-1.56 ***	-0.79 ***	-0.46 **	-1.10 ***	-0.99 ***	-0.26	-1.09 ***	-0.99 ***	-0.73 ***	-1.37 ***	-0.91 ***	-0.76 ***
Other Services	-1.47 ***	-1.08 ***	-1.87 **	-1.78 ***	-0.88 ***	-0.53 **	-1.14 ***	-1.19 ***	-0.22	-1.14 ***	-1.05 ***	-0.76 ***	-1.61 ***	-1.08 ***	-0.91 ***
2nd Stage															
Bread & Bak.	-0.50 ***	-0.32 ***	-0.52 ***	-0.42 ***	-0.37 ***	-0.49 ***	-0.56 ***	-0.51 ***	-0.61 ***	-0.67 ***	-0.53 ***	-0.58 ***	-0.47 ***	-0.40 ***	-0.53 ***
Cereals	-1.72 ***	-1.05 ***	-0.79 ***	-0.69 ***	-0.81 ***	-0.79 ***	-1.74 ***	-1.64 ***	-1.36 ***	-0.97 ***	-0.82 ***	-0.86 ***	-0.99 ***	-0.96 ***	-0.88 ***
Potatoes	-0.99 ***	-1.06 ***	-1.12 ***	-0.34	-1.05 ***	-0.72 ***	-0.74 ***	-0.91 *	-1.20 ***	-0.39 ***	-0.88 ***	-0.67 ***	-0.98 ***	-0.72 ***	-0.80 ***
Vegetables	-0.96 ***	-0.98 ***	-0.94 ***	-0.75 ***	-0.87 ***	-0.76 ***	-1.13 ***	-1.26 ***	-0.98 ***	-0.96 ***	-1.02 ***	-0.97 ***	-1.03 ***	-1.08 ***	-0.88 ***
Fruits	-1.03 ***	-1.08 ***	-0.91 ***	-0.92 ***	-0.93 ***	-0.83 ***	-0.86 ***	-0.93 ***	-0.63 ***	-0.91 ***	-0.93 ***	-0.90 ***	-0.82 ***	-0.96 ***	-0.73 ***
Meat	-1.17 ***	-0.80 ***	-0.84 ***	-1.01 ***	-0.84 ***	-0.71 ***	-1.00 ***	-0.94 ***	-0.64 ***	-1.01 ***	-0.95 ***	-0.81 ***	-1.13 ***	-0.89 ***	-0.66 ***
Milk & Dairy	-0.87 ***	-0.86 ***	-0.87 ***	-0.96 ***	-0.92 ***	-0.88 ***	-0.92 ***	-0.87 ***	-0.87 ***	-1.04 ***	-1.01 ***	-0.92 ***	-0.84 ***	-0.79 ***	-0.72 ***
Fat & Oils	-1.00 ***	-0.90 ***	-0.93 ***	-0.80 ***	-0.85 ***	-0.96 ***	-0.99 ***	-0.96 ***	-0.99 ***	-1.01 ***	-1.05 ***	-1.01 ***	-0.87 ***	-0.90 ***	-0.94 ***
Sugar &Conf.	-1.08 ***	-0.87 ***	-0.69 ***	-0.97 ***	-0.83 ***	-0.79 ***	-1.09 ***	-1.11 ***	-0.72 ***	-1.14 ***	-1.04 ***	-0.82 ***	-1.07 ***	-0.69 ***	-0.72 ***
Tea & Coffee	-0.81 ***	-0.84 ***	-0.69 ***	-0.77 ***	-0.75 ***	-0.72 ***	-0.87 ***	-0.84 ***	-0.82 ***	-0.73 ***	-0.58 ***	-0.59 ***	-0.65 ***	-0.65 ***	-0.64 ***
Tobacco	-1.37 ***	-0.64 ***	-0.99 ***	-0.91 ***	-0.94 ***	-0.81 ***	-0.77 ***	-0.60 **	-0.92 ***	-0.79 ***	-0.67 ***	-1.19 ***	-0.54	-0.66 ***	-0.74 ***
Alcohol	-1.06 ***	-0.89 ***	-0.89 ***	-0.80 ***	-0.87 ***	-0.86 ***	-0.59 ***	-0.75 ***	-0.38	-0.85 ***	-0.80 ***	-0.75 ***	-0.70 ***	-0.82 ***	-0.78 ***
Beverages	-1.00 (*)	-0.34	-0.89 **	-0.14	-0.40 ***	-0.16 (*)	-0.47 **	-0.57	-0.25	-1.02 ***	-0.74 ***	-0.50 ***	-0.74	-0.94 ***	-0.38 ***
No. of obs.	535	864	498	707	1849	2764	1058	611	539	5427	6143	7256	1629	1896	3546
% of obs. in each period	5.7	7.6	3.4	7.6	16.3	18.9	11.3	5.4	3.7	58.0	54.1	49.7	17.4	16.7	24.3

* Significant at the 5 % level; ** Significant at the 1 % level; *** Significant at the 0.1 % level.

Source: Own estimates based on RLMS data, 1995-2010.

4 Contributions to the scientific and political debate over food consumption and undesired outcomes

4.1 On the application of household production theory to health and nutrition

by Matthias Staudigel

Contributed Paper presented at the 52nd Annual Conference of the German Society of Economic and Social Sciences in Agriculture (GEWISOLA), 26-28 September 2012, Hohenheim.

Published in: Bahrs, E., Becker, T., Birner, R. et al. (2013): Herausforderungen des globalen Wandels für Agrarentwicklung und Welternährung. Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e.V., Band 48. Münster: Landwirtschaftsverlag, 33-46.

On the application of household production theory to health and nutrition

Abstract

This paper reviews the application of household production theory to health and nutrition and their determinants in the economics literature. We examine 17 recent studies applying this approach and analyse how they model utility functions, elementary goods, and production processes. Notwithstanding the valuable insights provided by these economic analyses into the phenomenon of obesity and health behaviour, the framework's basic idea, the separation of utility generation and production technology, is not pursued consistently. The majority of the studies reviewed focus solely on health production, thereby neglecting important production processes for other elementary commodities and their related inputs and technologies. We advocate a broader application of the household production principle and discuss how such a view can guide theoretical and empirical analysis and may provide inspiration for data collection and policy design.

Keywords

Household production theory; health; nutrition; obesity; economic analysis.

1 Introduction

"Economics is a science which studies human behaviour as a relationship between ends and scarce means which have alternative uses" (ROBBINS, 1932). This definition of the subject of economic research does not only include the case of firms which deliberate on what to produce to maximise profits or consumers who consider what to buy with their limited budget. It also applies to any human action, even in non-market settings. Every day we have to make trade-offs regarding what to eat (hamburger and french fries vs. chicken salad) or what to do in our leisure time (watching TV or playing football outside), because we have a fixed time budget of 24 hours, as well as limited mental and physical capacity to satisfy every wish that we can think of.

It was BECKER (1965) who translated this perception into a concrete model. The well-known household production function approach refined economic consumer theory in two ways.

First, the notion that it is not the purchased market goods which provide utility but more elementary entities (which BECKER called commodities) demanded a more precise formulation of the "ends" that people strive for. Second, the idea that it is the households themselves that produce these commodities allowed assessment of the "means" that households have at their disposal in a more explicit and rigorous way. Among those means are the time available, the wage rate by which time can be converted to income, and abilities, knowledge, assets and environmental conditions (i.e. their "technology") that determine the production of the elementary commodities.

The literature contains much work that applies the household production approach to study the impact of economic variables and human capital (e.g. education) on non-market behaviour like diet and physical activity and resulting health outcomes. A first wave can be identified in the development literature of the 1980s and 1990s. At that time, researchers were predominantly concerned with the determinants of nutrient intake and health status in developing countries (see e.g. ROSENZWEIG and SCHULTZ, 1983; PITT and ROSENZWEIG, 1985; BEHRMAN and DEOLALIKAR, 1988; STRAUSS and THOMAS, 1998). From 2000 on, a second wave has met the challenge of analysing the problem of rising obesity rates and overnutrition in industrialised countries. Household production concepts have been utilised as frameworks not only to illustrate the economic view of obesity in general (e.g. CHOU et al., 2004; CAWLEY, 2004; MAZZOCCHI et al., 2009) but also to focus on special factors and determinants. Among those are knowledge of health (NAYGA, 2000), healthy diet (RÖDER, 1998), healthy food variety (DRESCHER et al., 2009), time for and cost of food preparation (HAMERMESH, 2007; DAVIS and YOU, 2010; RASCHKE, 2012), effects of maternal employment on obesity (FERTIG et al., 2009) and physical activity (MULLAHY and ROBERTS, 2010), price effects on obesity (POWELL, 2009; STAUDIGEL, 2011) and blood pressure (CHEN et al., 2002).

These and other economic studies emphasize that it is important to consider multiple goals and the restrictions on achieving them in the study of health and nutrition. PHILIPSON and POSNER (2008) point out the important contribution of economics: "Naturally, when obesity is regarded as a public health issue, government intervention to control it is recommended as soon as a substantial percentage of the population weighs more than is optimal for maximizing health. From an economic standpoint, the proper maximand is of course not health but utility, in which good health is only one argument" (p.977). This raises the question what other arguments apart from health should be considered and how these

multiple goals are related to each other. PHILIPSON and POSNER note that "rational persons constantly trade off health for competing goods, such as pleasure, income, time, and alternative consumption possibilities" (pp.978). However, it is not fully clear why trade-offs are necessarily at work here. Better health could just as well enable us to derive more pleasure from certain activities (like sports, etc.) and consumption possibilities. Healthier people have better chances of finding jobs and generating higher incomes and have – in the long run – more time at their disposal. A second example of trade-offs, concerning policy decisions, is given by MAZZOCCHI et al. (2009), who state that "although people support the goal of better human health, people would not choose to impose strict regulations if doing so would divert resources from other goals such as climate protection, education, and a decent standard of living" (pp.158). Again, pursuing these goals may also offer synergies instead of competition between each other.

In the light of the ambiguity concerning the goals related to health and dietary behaviour and their interrelations, it seems worthwhile to investigate more closely their nature and the processes that might lead to either synergies or trade-offs. Guided by the original ideas of household production theory, we provide a review of economic studies on nutrition and health and assess the framework's potential for future research. We draw the conclusion that a more explicit inclusion of other goals in household production approaches yields new insights into determinants of human behaviour, and possible interdependencies therein, can guide theoretical and empirical analysis and may be a source of inspiration for data collection and policy design.

We proceed as follows. In Section 2, we review the basic household production literature and discuss the advantages and disadvantages of the different specifications of utility functions and the respective commodities used in them. We turn to studies that apply household production functions to nutrition and health in Section 3 and discuss the state of the art in practice. In Section 4, we stress the importance of considering joint production as well as input substitution in household production. Section 5 addresses consequences for modelling, data collection and policy making that arise from the aspects discussed in the earlier sections, and it also draws a conclusion.

2 Household production theory revisited

2.1 Taste versus technology

We start our analysis from the basic advantage that the household production literature claims to possess over traditional demand theory. BECKER (1965) and MICHAEL and BECKER (1973) emphasize that a large part of what is usually subsumed under the diffuse term "preferences" can be explicitly expressed as restrictions. Pollak and Wachter (1975) concur with this view: "Traditional demand theory treats V(x) (the derived utility function) as the household's utility function and is thus guilty of confounding tastes and technology, rather than maintaining a separation between them. A consequence of this, as the household production function literature points out, is that changes in demand which are attributable to changes in technology must formally be described as changes in tastes" (p.260). The importance of separating production functions (i.e. the consumption technology) from utility assessments is stressed by SEEL (2006), who identifies an advance in modern economic thinking in two ways. The first is a more detailed and differentiated analysis of the restrictions imposed on human behaviour. The second is, as a consequence of the first, enabling utility theory to be free to concentrate on its core competence: the "finally decisive motives and values of human beings" (SEEL, 2006, p.115).

To prevent utility functions from being what MICHAEL and BECKER (1973) call a "hodge-podge of some arguments which yield satisfaction, some quantities of time and goods which are directly distasteful[1], and several arguments – e.g. age, education – which may have little direct utility associated with them", household production functions are introduced which "effectively separate objects of choice from the means used to produce them" (p.393). Therefore, MICHAEL and BECKER advocate the use of utility functions that exclusively contain Z-goods[2]. Hence, if the household production approach is to fully develop its potential, those who apply it will have to think carefully about what the objects of choice are and what the means are. However, "applying production theory to the household, the household production function literature has not attempted to draw the line indicating where production processes stop and utility begins" (POLLAK and WACHTER, 1975, p.274). Even more than four decades after BECKER's seminal paper, there is no consistent perception (let alone a

[1] In the sense of "utility-neutral".

[2] Commodities are written as "Z_i" in the household production framework, and therefore "Z-goods" is synonymous with commodities.

definition) of what constitutes a Z-good. However, this lack of clarity has severe impacts on theoretic formulation, collection of data and policy recommendations on the basis of household production theory. Therefore the next section tries to locate and sketch the hazy concept of a Z-good.

2.2 What exactly is a Z-good?

BECKER (1965) assumes households "combine time and market goods to produce *more basic commodities* that *directly enter their utility function*." He provides the examples of "seeing a play", which is produced with actors, script, theatre and the playgoer's time, and of "sleeping", which depends on the input of a bed, a house, pills, and time[3] (BECKER, 1965, p.495). In the course of time, the nature of the Z-goods mentioned in Becker's work became more fundamental, together with the claim to explain an ever wider spectrum of human behaviour (MICHAEL and BECKER, 1973; STIGLER and BECKER, 1977). MICHAEL and BECKER (1973) state that the household production approach "views as *the primary objects of consumer choice* various entities, called commodities, from which *utility is directly obtained"* (p.381). Note that the terms "entities" and "primary objects" refer more strongly to final goals compared with "more basic commodities" in BECKER (1965). The new formulation also invites us to think about what provides "direct utility" (1973) instead of what "enters the utility function (1965)." MICHAEL and BECKER focus much more on the identification of **means and ends**: "Many discussions of the notion that goods are desired not for their own sake but for some specific service which they perform can be found throughout the literature" (p.384).

MICHAEL and BECKER perceive Z-goods as very basic and finally argue "that they (the consumers) all derive that utility from the same "basic pleasures" or preference function, and differ only in their ability to produce these "pleasures""(MICHAEL and BECKER, 1973, p.392). Hence Z-goods should be regarded as elementary to human existence, which is reflected in the examples given by MICHAEL and BECKER. These are more basic than those from 1965 and include "good health", "children", "marriage", "intercity visits" and concepts like "envy", "prestige", "physical and psychological health", as well as "circumspectness". In line with this argument, STIGLER and BECKER (1977) maintain that preferences can be considered as constant and identical across individuals and over time and any differences in behaviour

[3] Other examples in this article include leisure, reading a book, having a haircut, commuting, eating dinner, frequenting a night-club, sending children to private summer camps, business lunch, good diet, relaxation, transportation, milk-consumption at home.

can be explained by prices and other restrictions. Although authors like HIRSCHMAN (1984) and COWEN (1989) provided good reasons to question this last conclusion, we could indeed think of elementary ends which every human being strives for (although these ends may be given different priorities). Moreover, most people would agree that people differ in terms of their abilities and strategies to reach these goals.

A suggestion of what such elementary goods might look like can be found in the work of ROKEACH (1973). In US-wide large-scale surveys, he examined the ultimate values of the population. He concluded that such "terminal values" can be expressed by a relatively small number of concepts. These are shared by everyone, but they are weighted differently across socio-economic status, occupation, gender, race, etc. ROKEACH's terminal values consist of: *True Friendship, Mature Love, Self-Respect, Happiness, Inner Harmony, Equality, Freedom, Pleasure, Social Recognition, Wisdom, Salvation, Family Security, National Security, A Sense of Accomplishment, A World of Beauty, A World at Peace, A Comfortable Life, An Exciting Life*. In the following, we utilize this list as a basis for discussion. It is surely not intended to be an exclusive or complete list of Z-goods but serves the purpose of being a reference point for argument.

A look at commercials and marketing strategies may support the notion that these items are quite close to elementary goods. Often, one certainly gets the impression that it is the concepts from the list that are sold rather than cars, beer or cigarettes. Also, studies that deal with food consumption have picked up the topic of more elementary, stable preferences or values. Recently, LUSK and BRIGGEMAN (2009) took up ROKEACH's idea of terminal values to identify "a set of food values or meta-attributes for which people may have more well-defined preferences" (p.194). In the social sciences, SCITOVSKY (1981) describes the case of excitement for which people have a basic need. Since technical progress and increasing wealth have relieved humans of the daily struggle for life, other activities now serve the production of excitement, e.g. crime, extreme sports or other risky behaviour.

POLLAK and WACHTER (1975) point to several problems that arise when Z-goods are regarded in a very abstract manner. When the household production approach "is applied to variables which may be interpreted as "utilities" (numbers representing preference orderings) rather than "commodities" (the outputs of production processes)…the production function approach loses its unique identity and cannot be distinguished from a variety of hypotheses

about the structure of the household's preferences" (p.256). Of course, when we lack direct measures of the produced commodities, it is not easy to identify what is still technology and what is already taste. The alternative offered by POLLAK and WACHTER is to study the allocation of time and goods among household activities. A precondition for such an analysis is the ability to divide the day into non-overlapping activities. Additionally, such a procedure no longer focuses on the production processes and would be closer to traditional demand theory (POLLAK and WACHTER, 1975, p.256).

3 Applications to health and nutrition in practice

3.1 Specification of Z-goods in studies on health and nutrition

So far, we have collected rather theoretical arguments both in favour of using commodities that mirror the essential goals in human life and against using those which are too abstract and immeasurable to allow the identification of actual production processes.

Examining recent applications from practice enables us to check the soundness of those arguments as well as the relative advantages of each view. Table 1 in the Appendix shows excerpts from 18 recent studies applying household production approaches to health and obesity and the utility functions that they take as a basis.

A first look at the studies shows that hardly any of them exclusively employ elementary commodities in the sense of MICHAEL and BECKER (1973). Naturally, most of them include *health*, but only three of them add arguments that seem close to those *elementary ends* discussed in Section 2.2. CHOU et al. (2004) include the "enjoyment of eating palatable food" and the "entertainment provided by dining with family and friends in restaurants and at home". RÖDER (1998) regards "basic needs", "pleasure from eating" and, optionally, "leisure" as utility-yielding commodities. MAZZOCCHI et al. (2009) argue that "appearance" is an entity that affects utility directly. Besides health, CAWLEY (2004) includes *weight* in his utility function.

A whole series of studies include variables of *food and drink consumption* as a direct source of utility (CAWLEY, 2004; DRESCHER et al., 2009; HAMERMESH, 2009; HUFFMAN et al., 2010; HUFFMAN, 2011; MAZZOCCHI et al., 2009; POWELL, 2009). Most of the studies specify the taste of the food as the major component generating utility. HUFFMAN (2011) additionally sees social

interaction during meals as a source of utility. The studies of CAWLEY (2004) and MAZZOCCHI et al. (2009) explicitly equate food and drink with energy intake (and thereby reduce the source of utility to the calories consumed).

Many utility functions also feature several *time inputs.* The most prominent item here is leisure, which can be found in eight studies. HUFFMAN (2011) divides leisure into "physically active leisure time" and "other leisure time". He assumes sedentary leisure (TV viewing, surfing the web) to be utility-increasing, whereas "time allocated to vigorous physically active leisure may directly reduce utility, i.e. adults find this activity unpleasant or uncomfortable" (p.51). CAWLEY (2004), in order to obtain the acronym '*SLOTH'* for his model, adds sleep, occupation, transport, and home production to leisure. HAMERMESH (2007), without explicitly specifying a utility function, directs his analysis to the "utility-maximizing production of the commodity eating".

Several authors introduce a residual that is defined either as a *composite of purchased goods* which do not affect health (CHEN et al., 2002; MAZZOCCHI et al., 2009), other purchased consumer goods (HUFFMAN et al., 2010; HUFFMAN, 2011), all non-food/non-drink items (HAMERMESH, 2009; DRESCHER et al., 2009), or as a "vector of other commodity-producing variable inputs that may also confer direct utility" (MULLAHY and ROBERTS, 2010).

The last group of variables included in utility functions are *individual and environmental characteristics*. HUFFMAN et al. (2010) state, that "a household's utility is determined by a vector of fixed observables, e.g. education of the adults and number of children" (p.12). HUFFMAN (2011) appends "gender, and race/ethnicity of adults" to this list. MULLAHY and ROBERTS (2010) introduce "a vector of exogenously given environmental (social, natural, etc.) measures that may influence the marginal utilities of the other utility determinants" (p.414). MAZZOCCHI et al. (2009) do not explicitly specify variables but note that the "exact relationship (between utility and its determining factors) would vary for every individual according to their preferences" (p.46).

Only a few studies provide a statement about the formal characteristics of their utility functions. CHEN et al. (2002) employ a "weakly separable, well-behaved" utility function, NAYGA (2000) states that the utility function is "subject to the usual properties", and RÖDER (1998) notes that her formulation of the utility function implies additive separability, because leisure represented a potential commodity but has not been included. HUFFMAN

(2011) and HUFFMAN et al. (2010) explicitly state that they employ "strictly concave" utility functions. CAWLEY (2004) argues that "the function of utility overweight is nonlinear for most people. Living at starvation weight causes disutility, achieving one's ideal weight provides positive utility, and morbid obesity causes disutility" (p.118).

The above assessment shows that most applications of household production theory do not strictly adhere to utility functions that exclusively contain Z-goods as claimed by MICHAEL and BECKER (1973). Apart from health, most authors include items we would assign to the categories of time and market inputs in the sense of BECKER. These are considered as a direct source of utility, but how and under what conditions their benefits accrue is not discussed explicitly. As we will show below, taking into account other production processes that are likely to be linked to health and nutrition yields a series of interesting and relevant insights and raises a lot of new questions for future research.

3.2 Production functions

Production of health

Remarkably, the examination of "technology" in the studies presented above is strictly restricted to the production of health, with most authors having similar perceptions about the health production processes taking place in households. The primary inputs, food or diet, enter in various forms. Besides very general specifications using "food intake" (CAWLEY, 2004), "food inputs" (HUFFMAN et al., 2010) or the "appropriate diet" (CHOU et al., 2004), more specific variables are used. These are often single *nutrients* people obtain from different foods (RÖDER, 1998; VARIYAM et al., 1999; CHEN et al., 2002) or measures of *diet quality* (MAZZOCCHI et al., 2009). Some authors introduce intermediate inputs like *weight* (CAWLEY, 2004; MAZZOCCHI et al., 2009), *meals* (CHOU et al., 2004), and *healthy food diversity* (DRESCHER et al., 2009) that are also "produced" in special production functions.

Additional inputs are often grouped as *non-food inputs* or *purchased health inputs* like "medical services and drugs" (HUFFMAN et al., 2010), "medical treatment or sports" (RÖDER, 1998), "medical care" (VARIYAM et al., 1999), "level of medication" (CHEN et al., 2002), and "medical services and exercises" (DRESCHER et al., 2009). A third group of variables consists of *time inputs* for several activities (CAWLEY, 2004; MULLAHY and ROBERTS, 2010), physically active and sedentary leisure (HUFFMAN, 2011) or the time a mother spends at home with her child (FERTIG et al., 2009).

In addition to those variable inputs, nearly all authors share the view that the production functions depend on exogenous observable or unobservable factors. *Education* plays a prominent role in the first set. VARIYAM et al. (1999) identify education as a key component, because "more educated individuals are more efficient producers of health because they are more informed about the true effects of inputs on health; they have higher allocative efficiency, i.e., ability to select a better input mix" (p.218). Some authors point out that measuring the influence of education (or of single educational aspects) on health unambiguously is very difficult. *Other characteristics* referred to in this context are variables of gender, race, attitude or knowledge (DRESCHER et al., 2009), society's organisation of the health care industry and public health practices, society's stock of medical and nutritional knowledge and technologies and urban congestion (HUFFMAN et al., 2010), human capital in general (RÖDER, 1998), dietary knowledge (NAYGA, 2000) and nutrition information (VARIYAM et al., 1999). Finally, the *unobservable characteristics* included are exogenous state of health, exogenous health endowments or genetic ability.

Other production processes

Only a few authors mention production processes for commodities other than health. CHOU et al. (2004) list entertainment and enjoyment but just as outcomes related to eating. MULLAHY and ROBERTS (2010) point out that "the other commodities, z, are produced using the same inputs as go into the production of health." According to them, health or wellbeing of other family members would be examples, but they do not specify further Z-goods. VARIYAM et al. (1999) just mention that "households combine various inputs to produce 'commodities'" but don't specify them further.

4 Health production in a more complex setting

The previous section has shown that most of the studies that apply the household production framework to health and nutrition strictly focus on health as an elementary commodity. Although some of them explicitly or implicitly acknowledge that there are other production processes associated with diet and the production of health, these pathways are not pursued further. This section explores what can be gained by allowing for a more complex set of elementary commodities and interdependent production processes. We take

the terminal values (ROKEACH, 1973) from Section 2 as a basis, and consider the role of health as well as joint production and input substitution.

4.1 The role of health

In household production frameworks, health almost exclusively has the status of a Z-good. However, when the underlying Z-goods are items like “Self-Respect”, “Happiness”, “Inner Harmony”, “Freedom”, or “Pleasure”, we might well regard health not as an end in itself but rather as a means to realise other goals (albeit as a very important, if not the most important one). As soon as we regard health as an input into other production processes, we may think of substitution effects that emerge from technological progress or the change in social norms. Pain, for example, may diminish the production of “pleasure”, where pills are an additional market input to stop this pain. In the context of obesity, the production of “social recognition” or “love” may be affected negatively. Another example is the production of “happiness”, “pleasure” or “excitement”, where former physically active production processes (sports, playing outside) may have been substituted by physically inactive alternatives like TV viewing or computer games.

4.2 Joint production

Although POLLAK and WACHTER had already pointed out in 1975 that “jointness is pervasive because time spent in many production activities is a direct source of utility as well as an input into a commodity” (p.256), the household production literature has largely avoided modelling the joint production of two or more commodities. SEEL (1991) shows that BECKER’s approach allows joint production to be modelled in principle, but she also admits that the variety of potential processes makes this “hardly operationalisable”. Disregarding the difficulties of implementing joint production in a rigorous manner, we want to emphasize the importance it has for the analysis of nutrition and health. In fact, many of the studies implicitly describe joint production but hide those processes in the utility function. Consequently, the “technology” is dropped and does not enter consideration of how to explain behaviour or how to create policies to reach certain goals.

Activities like eating or sports generally yield more outcomes than just health. This can be illustrated by countless examples. Some of the studies examined here explicitly refer to such joint production processes. RÖDER (1998) includes the production of a commodity called

"pleasure" with food as an input. CHOU et al. (2004) mention the "enjoyment" (of eating palatable food) and "entertainment" (provided by dining with family and friends in restaurants and at home). We could further think of "excitement" produced by eating exotic foods (an alternative version related to excitement would be that some people might prevent boredom by simply eating, no matter what), "social recognition" by consuming foods (or drinks) that are considered to be trendy in certain peer groups, or the production of feelings of "fairness or equity" by eating organic or fair trade products. Other authors are well aware of the multiple purposes food and eating can serve, but they regard those as a source of direct utility instead of assuming specific production processes. This is shown by the following example: "However, food intake also frequently yields utility directly because food texture and taste give satisfaction and eating and drinking together are a major part of satisfaction-yielding social interaction" (HUFFMAN, 2011, p.51).

Modelling the benefits of eating via differentiated production processes may direct our attention to the human capital necessary to generate pleasure. We definitely oppose the view that the utility gained from eating certain foods is just a matter of immutable preferences or tastes, and that, as CAWLEY (2004) argues, the attempt to alter them would probably be "futile" (in the case of ice cream and broccoli). Rather, the ability to derive pleasure from food (including broccoli, salads, vegetables, etc.) is in fact the result of a good upbringing and opportunities to collect impressions and experiences from as many different foods and flavours as possible. We are convinced that here lies a starting point for education measures. Many people may not lack the knowledge of how to produce health by consuming an adequate combination of "healthy" and "unhealthy" food products (which is the predominant view in the health production and public health literature) but rather of how to also produce pleasure (and other commodities) from healthy foods.

A second relevant sector where the analysis of joint production is worthwhile is sports or physical activity. In the frameworks presented above, physical activity generates utility indirectly through its positive effects on weight and health. Additionally, it is mostly connected to higher discomfort and regarded as directly affecting utility negatively (see e.g. HUFFMAN, 2011, p.51). In keeping with the view that we hold in this paper, the negative aspect of physical activity could be described as reducing the commodity "comfort". However, we could think of many commodities where physical activity is a quite positively operating input, and the millions of people doing sports in their leisure time (and having fun

with it) provide overwhelming evidence for this point. Hence, jointly produced commodities range from “excitement” and “freedom” (generated by skiing, (kite) surfing, etc.), to “inner harmony” (running, yoga) or even “mature love” (tango!). Further, team sports produce “friendship”, and good performance yields “social recognition”. Again, human capital is an important factor determining such production processes.

4.3 Input substitution

The issue of joint production is closely related to the question of input substitution within the production of several commodities. So far, substitution effects have only been considered in the production of health. Unhealthy food items (burgers, pizza, doughnuts and soft drinks) should be substituted by healthy products (fruit, vegetables, whole grain, and lean meat), and it is better to replace sedentary leisure (TV, video games, car driving) with physically more demanding activities (sports, cycling). The prevailing view of economists is that whether a substitution occurs depends on relative costs determined by prices of food, entertainment products, leisure activities and transportation, transport infrastructure and workplace, and education. Education is important, because in this view it represents the knowledge of how to produce health most efficiently. However, when the modelling neglects joint production processes as given in the examples of Section 4.2, a multiple of substitution possibilities is lost for analysis and policy design.

Considering joint production of health, pleasure and other commodities requires us to model restrictions more accurately. Once we accept that pleasure may be produced by eating but also by exercise, sex, music, art or literature, we should extend our analysis to the abilities and knowledge people possess, as well as to what inputs are available to them, to produce pleasure from higher quality food, from listening to music or exercise. An associated question is how strong those substitution effects are, whether we can expect them to occur marginally or whether a fundamental change in lifestyle is necessary. The separation of utility and production functions supports modelling and analysing such relationships, as it emphasizes that most of the “preferences” are not god-given and immutable factors but rather technologies and abilities that need to be cultivated. Some economists might argue at this point that “taste” for fast food, vegetables, alcohol or exercise is beyond the scope of economics. However, to understand the trade-offs that people make in their every-day decisions, what ends they strive for and what restrictions they face, economists should work

closely together with other disciplines to throw light on the production processes that are at work.

5 Discussion and conclusion

In the previous section we advocated applying household production theory more broadly to health and nutrition in a very intuitive but less rigorous manner. However, this implicit model of behaviour related to health and nutrition may serve as a valuable basis for (a) explicit models, (b) data collection and (c) policy design.

Modelling

It is a challenging task to model such complex interdependent processes as described above. In the light of joint production and reciprocal influences, SEEL (1991) points out that classical marginal instruments may soon reach their limits. She suggests using linear-optimisation models to allow for the "complexity of interdependencies by widely differentiating activities and restrictions as well as objectives and conditions" (ibid., p.181). Such a model would yield discontinuous reactions to changing prices under certain circumstances, which could be used e.g. to assess the effects of fat taxes. We could expect people to stick to unhealthy food even when their prices are increased via taxes because their technology restricts their production of "pleasure" solely to those unhealthy products. The changes would not occur marginally but all at once, when the financial pressure gets overwhelming.

HAMMOND (2009) points out that obesity exhibits the characteristics of a complex adaptive system. First, it involves a "great breadth in levels of scale" that are the object of different fields of science "from genetics to neuroscience to economics and political science". Second, the relevant actors ranging from consumers and politicians to firms, etc., are very diverse. They have "different goals, motivations, constraints, sources of information, modes of decision making and types of connections to other actors." Third, multiple mechanisms are at work that are not fully understood and often examined in the isolated setting of the respective field. As a result, "linkages and feedback between these mechanisms are not well understood" and "interventions may affect each differently". HAMMOND recommends agent-based computational modelling as a tool to explicitly model such complex phenomena. Modelling macro-patterns like changes in the BMI-distribution, eating patterns and health outcomes should take the complexity into account. Path dependence issues could be

analysed and policies could be simulated in computational laboratories. The broader, more complex household production framework presented in this paper could serve as a theoretical basis for approaching this task.

Data Collection

Critics of a broader view of the household production framework as presented here may object that there are no adequate data to examine the complex relationships described above. Defining and measuring those abstract commodities and those seemingly inscrutable production processes where multiple inputs serve multiple outputs appears to be an insoluble task. However, some trends from fields like happiness and experimental economics or neuroeconomics are a reason to be optimistic regarding future research.

POLLAK and WACHTER (1975) warned about the use of non-measurable "utilities" that just represent preference orderings. More than three decades later, psychologists as well as (happiness) economists are not that shy about measuring utility. Work in the field of happiness economics has shown that utility/satisfaction can be reliably and reasonably measured (see e.g. KAHNEMAN, DIENER and SCHWARZ, 1999). Of special interest is the use of area-related satisfaction that measures the contentment with work or leisure activities. Variables that represent commodities or are related to commodities have not yet been part of large household surveys. However, questions about satisfaction with life or satisfaction with certain areas of life like the "food situation" (e.g. in the Russia Longitudinal Monitoring Survey, RLMS) or "job satisfaction" (e.g. in the German Socio-Economic Panel, SOEP) are pioneering items that have entered these large-scale studies and may function as door openers. Likewise, education and abilities should be measured in more detail to cover as many aspects of household technology as possible.

Besides enhanced household surveys, the field of experimental economics is a promising source of information on commodities and their inputs used by different individuals. In their work on food values, LUSK and BRIGGEMAN (2009) state that "small-scale laboratory research can be used to determine the link consumers make between specific food attributes, such as use of biotechnology, fat content, meat tenderness, etc., and food values" (p.195). In principle, the same procedure could be applied to inputs and commodities in a more general setting. Further papers by NAYGA (2008) and ROOSEN and MARETTE (2011) give rise to optimism that new methods and data from neuroeconomics and experimental economics are

potentially at hand that allow the measuring of such ostensible entities as pleasure, happiness, self-respect, etc., (albeit with considerable effort).

Policy Design

Mazzocchi et al. (2009) group nutrition policy instruments into 1) information measures and 2) market intervention measures. Group 1) consists of information campaigns, advertising regulations, nutritional education programmes in schools, labelling rules, nutritional information on menus, regulating health and nutrition claims. In group 2), they list taxes on unhealthy nutrients, price subsidies for healthy nutrients, regulation of the liability of food companies, food standards, facilitating access to shopping areas for disadvantaged (consumer) categories, regulation of catering in schools, hospitals, etc., and funding epidemiological, behavioural and clinical research. The majority of those measures target the narrow area of health production, the knowledge of how to produce health and the restrictions that people face in producing health. A more comprehensive approach that includes other aspects of life as well could be helpful to identify other points of action. The theoretical considerations above have made it clear that production processes related to eating and sports pursue a wider set of goals than health, for example pleasure, excitement or recognition. The benefit derived by those processes is not determined by diffuse preferences hidden in the remotest corners of a utility function but can be represented by a production process whose inputs and technology allow scientific analysis. We are convinced that the economic principle is a powerful instrument to guide the analysis of the complexity inherent in nutrition and health. It is the more surprising that the household production literature, which, as such, accepts the application of economics to many parts of life, has not yet dared to go further. The success and substantial contribution of economics to uncovering some important factors responsible for rising obesity rates should be greatly appreciated. However, the instruments that might lead the way out of the crisis are likely to be found somewhere completely different. May the following statement of HIRSCHMAN (1984) be encouraging for future research: “Something is sometimes to be gained by making things more complicated. I have increasingly come to feel this way” (p.89).

References

BECKER, G.S. (1965): A Theory of the Allocation of Time. In: The Economic Journal 75, 493-517.

BEHRMAN, J.R. and A.B. DEOLALIKAR (1988): Health and Nutrition. In: CHENERY, H. and T.N. SRINIVASAN (Eds.): Handbook of Development Economics, Volume I, Amsterdam: North Holland, 631-711.

CAWLEY, J. (2004): An Economic Framework for Understanding Physical Activity and Eating Behaviors. In: American Journal of Preventive Medicine 27, 117-125.

CHEN, S.N., J.F. SHOGREN, P.F. ORAZEM and T.D. CROCKER (2002): Prices and Health: Identifying the Effects of Nutrition, Exercise, and Medication Choices on Blood Pressure. In: American Journal of Agricultural Economics 84(4), 990-1002.

CHOU, S., M. GROSSMAN and H. SAFFER (2004): An economic analysis of adult obesity: results from the behavioral risk factors surveillance system. In: Journal of Health Economics 23, 565–587.

COWEN, T. (1989): Are all tastes constant and identical? A critique of Stigler and Becker. In: Journal of Economic Behaviour and Organization 11, 127-135.

DAVIS, G.C. and W. YOU (2010): The time cost of food at home: general and food stamp participant profiles. In: Applied Economics 42, 2537-2552.

DRESCHER, L., S. THIELE, R. ROOSEN and G.B. MENSINK (2009): Consumer Demand for healthy eating considering diversity – an economic approach for German individuals. In: International Journal of Consumer Studies 33, 684-696.

FERTIG, A., G. GLOMM and R. TSCHERNIS (2009): The connection between maternal employment and childhood obesity: inspecting the mechanisms. In: Review of the Economics of the Household 7, 227-255.

HAMERMESH, D.S. (2007): Time to Eat: Household Production under Increasing Income Inequality. In: American Journal of Agricultural Economics 89, 852-863.

HAMERMESH, D.S. (2009): Grazing, Goods and Girth: Determinants and Effects. IZA Discussion Paper No. 4378. Institute for the Study of Labor, Bonn, Germany.

HAMMOND, R.A. (2009): Complex System Modeling for Obesity Research. In: Preventing Chronic Disease 6(3), 1-10.

HIRSCHMAN, A.O. (1984): Against Parsimony: Three Easy Ways of Complicating Some Categories of Economic Discourse. In: American Economic Review 74, 89-96.

HUFFMAN, W.E., S.K. HUFFMAN, K. RICKERTSEN and A. TEGENE (2010): Over-Nutrition and Changing Health Status in High Income Countries. In: Forum for Health Economics & Policy 13, Article 2.

HUFFMAN, W.E. (2011): Household Production Theory and Models. In: LUSK, J.L., J. ROOSEN and J.F. SHOGREN (eds.): The Oxford Handbook of Food Consumption and Policy. Oxford, 35-74.

KAHNEMAN, D., DIENER, E., SCHWARZ, N. (eds.) (1999): Well-being: The foundations of hedonic psychology. New York: Russell Sage Foundation.

LUSK, J.L. and B.C. BRIGGEMAN (2009): Food Values. In: American Journal of Agricultural Economics 91, 184-196.

MAZZOCCHI, M., W.B. TRAILL and J.F. SHOGREN (2009): Fat economics. Nutrition, health, and economic policy. New York: Oxford University Press.

MICHAEL, R.T. and G.S. BECKER (1973): On the New Theory of Consumer Behavior. In: Swedish Journal of Economics 75, 378-396.

MULLAHY, J. and S.A. ROBERTS (2010): No time to lose: time constraints and physical activity in the production of health. In: Review of the Economics of the Household 8, 409-432.

NAYGA, R.M.JR. (2000): Schooling, Health Knowledge, and obesity. In: Applied Economics 32, 815-822.

NAYGA, R.M.JR. (2008): Nutrition, obesity and health: policies and economic research challenges. In: European Review of Agricultural Economics 35, 281-302.

PHILIPSON, T.J. and R.A. POSNER (2008): Is the Obesity Epidemic a Public Health Problem? A Review of Zoltan J. Acs and Alan Lyles's Obesity Business and Public Policy. In: Journal of Economic Literature 46, 974-982.

PITT, M.M. and M.R. ROSENZWEIG (1985): Health and Nutrient Consumption across and within Farm Households. In: Review of Economics and Statistics 67(2), 212-23.

POLLAK, R.A. and M.L. WACHTER (1975): The Relevance of the Households Production Function and Its Implications for the Allocation of Time. In: Journal of Political Economy 83, 255-277.

POWELL, L.M. (2009): Fast food costs and adolescent body mass index: Evidence from panel data. In: Journal of health Economics 28, 963-970.

RASCHKE, C. (2012): Food stamps and the time cost of food preparation. In: Review of the Economics of the Household 10, 259-275.

ROBBINS, L. (1932): An Essay on the Nature and Significance of Economic Science. London: Macmillan & Co.

RÖDER, C. (1998): Determinanten der Nachfrage nach Nahrungsmitteln und Ernährungsqualität in Deutschland. Eine ökonometrische Analyse auf der Grundlage der Nationalen Verzehrsstudie. Agrarwirtschaft Sonderheft Nr. 161. Also: Dissertation, University of Giessen.

ROKEACH, M. (1973): The Nature of Human Values. New York: Free Press.

ROOSEN, J. and S. MARETTE (2011): Making the 'right' choice based on experiments: regulatory decisions for food and health. In: European Review of Agricultural Economics 38, p.361-381.

ROSENZWEIG, M.R. and T.P. SCHULTZ (1983): Estimating a Household Production Function: Heterogeneity, the Demand for Health Inputs, and Their Effects on Birth Weight. In: Journal of Political Economy 91(5), 723-746.

SCITOVSKY, T. (1981): The Desire for Excitement in modern Society. In: Kyklos 34(1), 3-13.

SEEL, B. (1991): Ökonomik des privaten Haushalts. Stuttgart: Ulmer.

SEEL, B. (2006): Haushaltsökonomik – Grenzgänge zwischen Wissenschaftsparadigmen. In: Hauswirtschaft und Wissenschaft 54 (3), 112-119.

STAUDIGEL, M. (2011): How (much) do food prices contribute to obesity in Russia? In: Economics and Human Biology 9(2), 133-147.

STIGLER, G.J. and G.S. BECKER (1977): De Gustibus Non Est Disputandum. In: American Economic Review 67, 76-90.

STRAUSS, J. and D. THOMAS (1998): Health, Nutrition, and Economic Development. In: Journal of Economic Literature, 36(2), 766-817.

VARIYAM, J.N., J. BLAYLOCK and D. SMALLWOOD (1999): Information, endogeneity, and consumer health behaviour: application to dietary intakes. In: Applied Economics 31, 217-226.

Appendix:

Table 1: Specification of utility functions in studies applying household production theory to health and nutrition

No.	Reference	Study Object	Utility Function	Notes of the author(s)
1	Cawley (2004)	physical activity and eating behaviour	U=u(S, L, O, T, HP, F, W(.), H(.), Y); S=sleep; L=leisure; O=occupation; T=transport; HP=home production; F=food (calories); W=weight; H=health; Y=composite of all goods other than food.	"...sometimes people are less willing to sacrifice health in exchange for other things they value."
2	Chen et al. (2002)	prices and health impacts	U=u(H, L, Z); "weakly separable, well-behaved"; H=health state; L=leisure; Z=composite of purchased goods which do not contribute to bodily health.	"The person values the purchased goods (e.g. food, exercise bicycles, medication) because they produce characteristics (e.g. nutrients) necessary for the production of health"
3	Chou et al. (2004)	economic factors and obesity	Since no one desires to be obese, it is useful to consider obesity as the byproduct of other goals in the context of Becker's household production function model. "Three such commodities are health [...], the enjoyment of eating palatable food, and the entertainment provided by dining with family and friends in restaurants and at home."	
4	Drescher et al. (2009)	healthy food diversity	"Households maximise a combined utility function to produce final goods such as own health…". "These final goods are called 'commodities' and these provide utility." U=u(Q, h, Z); Q=food consumption bundle; h= health status; Z=consumption of non-food items.	"…food consumption bundles enter directly into the utility function because they are valued in themselves, e.g. foods are consumed because of taste."; reference to Variyam et al. (1999)
5	Fertig et al. (2009)	maternal employment and childhood obesity	No remarks on utility, just focus on production function for health: "The overarching theoretical principle [...] is the concept of a health production function for children, where **child's health** is the output and mother's time at home with the child as the input."	
6	Hamermesh (2007)	time and goods inputs to "eating"	Production of the commodity "eating".	
7	Hamermesh (2009)	eating patterns, meals, grazing	Assume that the typical consumer seeks to maximize: U=u(Z, F) - WS(nP); Z= composite commodity consisting of all non-food/drink items; F=commodity food/drink; WS(nP) is an expression for set-up costs of meals.	

8	Huffman (2011)	health, obesity, with food as an input	U=u(H, X, C, LP, LO; He, Z); H=health; X=consumption of food and drink; C=other purchased goods; LP=physically active leisure; LO=other leisure time; He=early health status; Z=fixed observables (such as education, gender, race).	However, food intake also frequently yields utility directly because food texture and taste give satisfaction and eating and drinking together are a major part of satisfaction-yielding social interaction.
9	Huffman et al. (2010)	obesity, health, non-communic-able diseases	U=u(H, X, C, L, ;Z1); H=current health status; X=consumption of food and drink; C=other purchased goods; L=leisure time; Z1= vector of fixed observables, e.g. education, that determine utility.	
10	Mazzocchi et al. (2009)	obesity, health	U=u(K, S, L, H, A, Z); K=calorie intake (from food & drink); S=smoking; L=leisure; H=health; A=appearance; Z=consumption of goods which do not affect health.	
11	Mullahy and Roberts (2010)	physical activity	U=u(h, z, t, v; e); h=measure of health; z=vector of other commodities produced by combining goods and time; t is a vector of time use activities; v is a vector of other commodity producing variable inputs that may also confer direct utility; e is a vector of exogenously given environmental measures (which influence marginal utilities; e.g. ice cream and jogging are more enjoyable at 30°C than at 0°C.	
12	Nayga (2000)	schooling, health knowledge and obesity	U=u(Xi, H); U is "subject to the usual properties; H=health; X="X-goods" (in the sense of market goods).	
13	Powell (2009)	food prices and obesity	"economic framework where individuals engage in behaviors related to work, leisure, and home production; they produce and demand health and weight; they also consume food which directly and indirectly (through health and weight) impacts utility.”	reference to Cawley (2004)
14	Raschke (2012)	time cost, food preparation	U=u(Y, L); Y=total consumption; L=leisure.	
15	Röder (1998)	determinants of food demand	U=u(basic needs; pleasure; health); other possible arguments like "leisure".	implies additive separability of preferences; activity: eating; input substitution: concert visit produces pleasure too!
16	Variyam et al. (1999)	Information, health knowledge, dietary behaviour	"In this framework, households combine various inputs to produce 'commodities', including the health of family members, so as to maximize a joint utility function."	derive reduced form nutrient demand functions
17	Davis and You (2010)	time cost of food at home	U(X, L); X=consumption goods (or services); L=leisure (or consumption time).	

4.2 Fettsteuern zum Wohle der Umwelt?

von Matthias Staudigel

Erschienen in *Ökonomenstimme*, 19. Juli 2012 (www.oekonomenstimme.org).

Fettsteuern zum Wohle der Umwelt?

In seinem Umweltgutachten 2012 "Verantwortung in einer begrenzten Welt" [SRU 2012] weist der Sachverständigenrat für Umweltfragen (SRU) auf viele potenziell negative Umweltauswirkungen des Lebensmittel- und speziell des Fleischkonsums hin. Entlang der Wertschöpfungskette, aber vor allem durch die landwirtschaftliche Produktion, entstehen ein massiver Flächen- und Ressourcenverbrauch, negative Einflüsse auf die Biodiversität und das Klima, zunehmende Eutrophierung sowie Resistenzbildung durch Antibiotikaeinsatz.

Aus diesem Grund, so die Sachverständigen, sei der Konsum tierischer Produkte zu reduzieren, und sie schlagen unter anderem zu diesem Zweck fiskalische Maßnahmen vor. Zum einen solle der reduzierte Mehrwertsteuersatz auf Lebensmittel tierischer Herkunft abgeschafft werden. Zum anderen sei eine Steuer auf (vor allem in tierischen Produkten enthaltene) gesättigte Fettsäuren zu prüfen. Eine solche wurde Ende 2011 in Dänemark eingeführt, wenn auch mit dem Ziel schlankerer Dänen und einer dickeren Staatskasse. Für den Fall, dass hiervon auch positive Effekte auf die Umwelt ausgehen, solle eine solche Steuer auch mittelfristig in Deutschland erhoben werden.

Der Sachverständigenrat bewertet solche Instrumente angesichts der massiven Umwelteffekte als „politisch legitim“. Zur weiteren Rechtfertigung führt er ins Feld, dass die Preise, vor allem für tierische Lebensmittel, nicht die gesamten bei der Erzeugung auftretenden Kosten widerspiegeln, externe Effekte also nicht internalisiert sind. Zudem bringt das Gutachten zum Ausdruck, dass es die Konsumenten als nicht sehr rational einschätzt und ihre Präferenzen „häufig inkonsistent, kontextabhängig und vielfältig beeinflussbar“ zu sein scheinen.

Da vor allem tierische Produkte einen hohen Anteil an gesättigten Fettsäuren enthalten, so der SRU, könnte die Reduktion des Konsums dieser Produkte durch eine derartige Steuer auch positive Effekte für Treibhausgas- und Stickstoffemissionen sowie den Flächenverbrauch nach sich ziehen. Das Gutachten ist bezüglich der „Treffsicherheit“ und des Potenzials solcher Maßnahmen sehr optimistisch.

Damit die vorgeschlagenen Maßnahmen erfolgreich sind, müssen entlang der Wirkungskette von der Erhebung oder Erhöhung einer Steuer bis hin zur signifikanten Reduktion der negativen Umweltauswirkungen grundsätzlich folgende Bedingungen erfüllt sein:

1. Die Steuern müssen die Preise für die anvisierten Produkte signifikant beeinflussen.
2. Höhere Preise müssen den Konsum tierischer Lebensmittel im Inland signifikant senken.
3. Ein sinkender Konsum tierischer Lebensmittel im Inland muss signifikante Auswirkungen auf die genannten Umweltparameter haben.

Den sehr positiven Einschätzungen des Sachverständigenrates nach zu urteilen, nimmt dieser implizit an, dass alle drei Voraussetzungen zu großen Teilen erfüllt sind. Leider ist das Gutachten sehr kurz gehalten, was die ökonomischen Argumente angeht, die eine solche Sichtweise stützen oder abschwächen. Betrachten wir die einzelnen Annahmen also einmal genauer:

1. Die Steuern müssen die Preise für die gewünschten Produkte signifikant beeinflussen

Hier wurde die Rechnung offensichtlich ohne den Wirt gemacht, was in diesem Fall die Lebensmittelhersteller und der Lebensmitteleinzelhandel sind. Diese müssten die Steuer in vollem Maße weitergeben, damit deren Anreizwirkung auch bei den Konsumenten ankommt. Ob sich Händler und Hersteller auch tatsächlich so verhalten, darf bezweifelt werden.

Der Lebensmitteleinzelhandel verfügt über die Option, die Mehrbelastung tierischer Produkte im Rahmen einer Mischkalkulation auf viele andere Produkte umzuschlagen und damit den Effekt der Steuer zu verwässern. Durch den harten Wettbewerb im Einzelhandel könnten sich außerdem bestimmte Angebotsstrategien für Fleisch- und Milchprodukte entwickeln. Wenn Konsumenten diese Güter dann noch stärker im Sonderangebot kaufen, wären die tatsächlich gezahlten Preise auch nicht höher als vor der Maßnahme. Zudem wäre angesichts des nicht unerheblichen Grades an Marktmacht des Handels gegenüber den Herstellern zu erwarten, dass die Handelsunternehmen in Verhandlungen den Herstellern den entstehenden Preis- und Kostendruck teilweise weitergeben.

Auf Seiten der Hersteller wären verschiedene Reaktionen denkbar. Bezüglich der Steuer auf gesättigte Fettsäuren könnten diese die Rezepturen ihrer Produkte so verändern, dass der

Anteil gesättigter Fettsäuren geringer wird, z.B. entweder durch „low-fat“-Produkte oder durch Substitution mit pflanzlichen Fetten (z.B. Butter mit Rapsöl). Ein solches Ergebnis mag im ersten Moment positiv erscheinen, kann aber sehr schnell, je nachdem wie Lebensmittel dann chemisch und technologisch verändert werden, den Forderungen anderer Interessensgruppen nach möglichst unverfälschten Lebensmitteln zuwiderlaufen (z.B. Analogkäse). Zudem könnten sich Unternehmen veranlasst sehen, an anderer Stelle (bei Arbeit, Produktionsweise, Qualität der Produkte) Kosten einzusparen, um die Preise tierischer Produkte niedrig zu halten. Eine solche Reaktion würde viele unerwünschte Ergebnisse mit sich bringen.

2. Höhere Preise müssen den Konsum tierischer Lebensmittel im Inland signifikant senken

Selbst wenn bei den Konsumenten ein deutliches Preissignal ankommen sollte, hätten diese mehr als eine Möglichkeit, darauf zu reagieren. Der Sachverständigenrat verweist in seinem Gutachten schlicht auf eine „Preiselastizität im Bereich von 1“ (SRU, 2012, p.188) für Fleisch- und Milchprodukte und leitet daraus die Möglichkeit „erheblicher Steuerungseffekte“ (SRU, 2012, p.189) ab. Eine solche Darstellung gibt die erwartbare Reaktion der Konsumenten jedoch viel zu vereinfacht und zu undifferenziert wieder. Neben den Eigenpreiselastizitäten existieren zunächst auch Kreuzpreiselastizitäten, die mögliche Substitutionsreaktionen aufzeigen. Das Gutachten betont selbst an mehreren Stellen, dass es für die Effekte auf die Umwelt wichtig ist, welche tierischen Lebensmittel durch welche anderen (tierischen oder nicht-tierischen) Lebensmittel ersetzt werden. Wenn Fleisch teurer wird und Konsumenten vielleicht etwas weniger davon essen, kaufen sie dann andere Produkte stattdessen? Wenn ja, welche? Daher greift eine Argumentation, die sich nur auf Eigenpreiselastizitäten hoch aggregierter Produktgruppen bezieht, zu kurz.

Zudem mag sich mancher Leser in diesem Zusammenhang einigermaßen verwundert zeigen, wenn zunächst die „neoklassische Annahme stabiler und konsistenter Präferenzen“ verworfen wird, nur um ein paar Seiten später mit Steuereffekten auf Basis von Preiselastizitäten zu argumentieren, die genau durch diese Annahmen theoretisch begründet und nach diesen statistisch ermittelt werden.

Weiterhin lässt das Gutachten offen, wie Konsumenten hinsichtlich der Produktqualität auf eine Steuer reagieren. Werden Fleisch- und Milchprodukte höher besteuert, wäre neben einer Mengenreaktion (weniger tierische Produkte) auch eine Qualitätsreaktion (billigere

tierische Produkte) denkbar, um das Gesamtbudget gleich zu halten. Leicht überspitzt gesagt, würde statt Filet dann Hackfleisch oder Bauchfleisch gekauft, statt Bioeiern solche aus Bodenhaltung, statt Schinken Wurst aus Massenproduktion. Würde ein solches Szenario eintreten, wären die beabsichtigten Effekte der vorgeschlagenen Steuern in ihr Gegenteil verkehrt.

3. Ein sinkender Konsum tierischer Lebensmittel im Inland muss signifikante Auswirkungen auf die inländische Produktion und die genannten Umweltparameter haben

Die dritte Bedingung für die intendierte Wirkung einer erhöhten Steuer auf tierische Produkte, ist, dass ein Rückgang des Konsums im Inland einen signifikanten Einfluss auf Umweltparameter wie Landnutzung, Treibhausgasemissionen etc. hat. Das Gutachten schafft es nicht, den Mechanismus plausibel zu beschreiben, der diesen Zusammenhang herstellt. Im Gegenteil, die Sachverständigen zeigen sogar Argumente auf, die selbst bei Erfüllung der ersten beiden Bedingungen einen Rückgang der Landnutzung fraglich erscheinen lassen: An anderer Stelle nämlich favorisiert das Gutachten Steuern auf den Konsum im Vergleich zu produktionsseitigen Maßnahmen etwa durch das Ordnungsrecht (Einhaltung bestimmter Produktionsstandards) oder der Besteuerung bestimmter Produktionsfaktoren (z.B. Düngemittel). Allerdings hätten diese den Nachteil, dass die hierdurch geänderten Wettbewerbsrelationen bei unverändertem Konsum Umwelteffekte nur in andere Länder exportierten.

Maßnahmen, die direkt den Konsum bestimmter Produkte unabhängig von deren Herkunft beeinflussen, gäben hingegen keine Anreize zur Verlagerung der Produktion ins Ausland. Auch an dieser Stelle verwundert es, dass der Export überschüssiger Produkte aus Deutschland bei einem geringeren Konsum in Deutschland überhaupt nicht diskutiert wird. Angesichts der weltweit steigenden Bevölkerung und steigender Nachfrage nach Agrarprodukten (vor allem auch solchen tierischer Herkunft) sowie einer zunehmenden Liberalisierung des Weltagrarhandels erscheint es unplausibel, dass zukünftig die heimische Agrarproduktion allein durch die inländische Nachfrage bestimmt werden soll.

Mögliche unbeabsichtigte und unvorhergesehene Effekte

Neben den bereits dargelegten offenen Fragen könnten weitere, nicht beabsichtigte Effekte von einer Besteuerung tierischer Lebensmittel ausgehen. Gesetzt den Fall, dass die Steuer

greifen sollte und der Konsum spürbar zurück geht, wäre anzunehmen, dass vor allem kleinere und mittlere Unternehmen des Handwerks mangels Möglichkeiten, zu niedrigeren Preisen anzubieten und die Mehrbelastung auf viele andere Produkte umzuschichten, nicht mehr wirtschaftlich arbeiten können. Die Konsequenz wäre, dass sich die Zahl dieser Betriebe weiter verringert. Doch sind es gerade diese Firmen, die noch nicht im großen Stil herstellen und Vielfalt und Qualität bieten und die ihre Tiere meist von kleineren landwirtschaftlichen Betrieben aus der Umgebung beziehen. Ein solcher Rückgang wäre wohl nicht als Erfolg einer Steuer anzusehen, wie sie vom SRU vorgeschlagen wird.

Fazit

Es bleibt festzuhalten, dass der Vorschlag des Sachverständigenrates für Umweltfragen zur Einführung einer Steuer auf gesättigte Fettsäuren bzw. zur Abschaffung des reduzierten Mehrwertsteuersatzes auf Lebensmittel tierischer Herkunft mit vielen unbeantworteten Fragen zu den ökonomischen Konsequenzen behaftet ist. Die propagierte „Treffsicherheit“ solcher Maßnahmen ist in keiner Weise zwingend und zeitigt möglicherweise kontraproduktive Ergebnisse eines „gut gemeinten“ Eingriffs in Konsumentenentscheidungen.

Literatur

SRU (SACHVERSTÄNDIGENRAT FÜR UMWELTFRAGEN) (2012): Umweltgutachten 2012. Verantwortung in einer begrenzten Welt. Berlin: Erich Schmidt Verlag (erscheint im Herbst 2012). Online verfügbar unter: http://www.umweltrat.de/DE/Publikationen/Umweltgutachten/umweltgutachten_node.html. Abgerufen am 10.05.2013.

5 Lessons for future research, policy making, and society

This dissertation comprises economic analyses of human behaviour related to health and nutrition with a special focus on the increasingly prevalent problem of obesity. First, a comprehensive review of the economic literature dealing with obesity provided a basis for the core articles. In the following empirical analyses based on Russian household survey data, I examined food price effects on body weight and reactions of food consumption in terms of quantity and quality caused by income fluctuations across different weight groups. A demand system analysis in the third paper yielded insights on structural parameters of food demand for Russia in the course of time and for different consumer segments. In addition to the empirical work, two theoretical contributions discussed issues relevant for research and policies with respect to unintended consequences of nutrition and health behaviour. In the first paper, I assessed economic models of health and nutrition behaviour critically and highlighted some neglected issues that may enhance future research and policy design. The second paper discussed suggestions for taxes on saturated fatty acids to reduce environmental harms caused by animal production.

I want to complete this dissertation by a discussion of basic lessons that arise from the empirical and theoretical work in this thesis for the design of appropriate policies and for future research.

Why taxes will not work

First of all, the empirical results support a clear *rejection of fiscal measures like fat taxes* aimed at reducing obesity. In STAUDIGEL (2011), I could show that that the small impact of price variation on the Body Mass Index, found for the US and European countries, holds in the case of the Russian Federation, too. Price-weight elasticities assumed absolute values smaller than 0.01. Apart from the negligible size of most coefficients, some food prices revealed interesting coefficients that invalidate certain arguments in favour of targeted taxes or subsidies. One of these arguments is that lower prices for lean meat or vegetables triggers substitutions away from unhealthy foods. However, the price of chicken had a significantly negative effect on BMI. This result indicates that the own-price effect dominates the cross-price effects. Hence, lower prices for this lean type of meat would not lead people

to substitute chicken for more fatty meat items but just to buy more chicken with an increase in energy intake.

Possible refinements in analyses that estimate direct price-weight relationships may account for possibly asymmetric price effects on weight that have not been examined yet. Although there are good arguments for the theory of technological progress which lowers food prices and, in turn, induces people to eat more and increasing their weight. This development may not be reversed easily. Once people have reached a certain weight status, their body may have established some kind of fixed set point or they have built up strong eating habits. Such asymmetric reactions of weight to prices or other incentives are strong arguments to place more effort on prevention, especially targeted to children.

Future research should also take a closer look at the quality dimension of food consumption and its relation to obesity. In STAUDIGEL (2012), I introduced a new argument saying that consumers who are facing a fat tax or other fiscal measures, which are intended to divert consumption behaviour from "unhealthy" foods to "healthy" foods, have more alternatives at their disposal than a horizontal substitution across different food groups. In a world of high and increasing product differentiation, they may as well make evasive manoeuvres in a vertical direction and change the quality, i.e. the per-unit price, of their food.

The empirical analysis shows that even substantial economic fluctuations as experienced by Russians during transition have negligible effects on energy intake. Estimates indicate that the expenditure elasticity of energy is very low at around 0.07. People in Russia have managed to adjust to economic changes by switching between more expensive and cheaper food products. Thereby, obese people seem to be more flexible in terms of what they spent per unit of food item.

Apart from the issue whether fat taxes and price changes actually affect body weight, there are some more fundamental questions about the logic of such incentives. One rationale for fat taxes is that some people do not behave completely rationally and their decisions are vulnerable to biases, addiction, external cues or time inconsistencies. The idea to address irrational behaviour through an instrument like a fat tax that is expected to work in a setting of rational utility maximisation subject to given prices and a fixed budget seems remarkable.

Of particular interest is the question, what price elasticities we actually should expect for the part of the population in which these modes of behaviours and the level of obesity are

especially pronounced. Such knowledge is important for the discussion of possibly regressive effects of a fat tax. Some proponents of taxes on junk food argue that people of lower socio-economic status may face a larger tax burden because they consume more "unhealthy" food on the one hand. At the same time, these authors postulate that this part of the population reacts more strongly to the tax incentive because of their tighter total budgets. Overall, the welfare gains from larger weight losses are assumed to exceed the losses from more expensive food and optimal food consumption. These considerations have no profound empirical basis yet. Vulnerable groups might as well show asymmetric price reactions and react more inelastically. They may not alter their consumption patterns substantially in response to a tax on junk food. A possible result would be that they only pay higher prices and do not loose weight - just their money. Future research in this direction can shed more light on these issues.

A look at other attempts to fight undesired consumption behaviours by means of taxes and increasing prices reveals no compelling examples of success. One example is the tax that was levied in Germany some years ago on so-called "alcopops", pre-mixed beverages containing spirits and soft drinks or fruit juices that attracted especially adolescents because of their sweetness. Consumption of alcopops dropped drastically after the introduction of the tax, however the youths simply switched to substitutes like beer-based mixed drinks but also to spirits without substantially reducing their total alcohol intake (MÜLLER et al., 2010). Another example may be smoking, where a mixture of actions that also included enormous tax hikes on cigarettes was successful in decreasing smoking to some degree. However, the heavy smokers don't seem to be impressed by higher prices. A look at the balance sheet of Philipp Morris International Inc. shows that the company could even raise its profits despite declining consumption in Europe by raising prices together with the taxes and benefiting from its price-inelastic core customers (BRAND EINS, 2013). Finally, the introduction and abandonment of the Danish fat tax showed quite plainly the political and societal resistances to such measures.

More thorough examination of possible sources of market failure may yield alternatives

Economists request the existence of market failure that lead to suboptimal weight outcomes from a total welfare perspective as a precondition to government regulation. Therefore, researchers and policy makers may be well advised to have a closer look at the nature and

extent of potential causes of market failure. Although plausible arguments and studies support the occurrence of externalities, lack of rationality, and lack of information (see Chapter 2.4), the respective analyses and policy recommendations often turn out to be very general. As a consequence, most policies address only the symptoms and neglect the underlying causes of market failure that lead to outcomes like obesity. In the following, I want to sketch some avenues for future research and policies that take account of neglected points.

Costs and benefits of obesity and the question of externalities

The main arguments with respect to externalities refer to the cost burden that obesity places on public health systems. Although cost estimates indicate that extremely obese persons cause indeed substantially higher annual medical costs in national health care systems, the discussion often disregards important points.

First, some authors like BRUNELLO et al. (2009) argue that a life-time assessment of costs may yield a totally different picture because of the lower life expectancy of severely obese patients resulting in lower care and pension expenditures for them than for people who live longer. On the one hand, a dynamic perspective makes sense because different costs over time should be considered. On the other hand, this argumentation takes too narrow a view since it implicitly assumes that the value of life itself is zero. Researchers and politicians are well-advised to look more comprehensively at both costs *and* benefits. This is also at the heart of the next aspect.

Second, most of the contributions that emphasise the costs of obesity are largely silent about possible benefits of overeating, passive leisure, entertainment, and transportation or treatment of diseases associated with obesity. In this context, a study that estimates the profits for the food industry, entertainment companies, car manufacturers, nutritionists, hospitals, or the pharmaceutical industry arising from “undesired behaviours” would be really interesting. At the same time there are also additional costs that are not considered so far, for example the time and money that people spend to loose excess weight or to keep their ideal weight. Future research directed to these issues could draw a more comprehensive picture about the real costs and benefits of overweight and obesity.

Third, identifying obesity as the result of an externality requires more than just a redistribution of health costs, for instance. A behavioural response to a change in costs must

be present. Otherwise, the market equilibrium would not shift to a more efficient point (see BRUNELLO et al. 2009; BHATTACHARYA and SOOD, 2007; and the discussion in Chapter 2.4). In a recent literature survey on the effect of financial incentives on weight loss, PALOYO et al. (2013) arrive at the conclusion that "scientific literature on the subject has not yet satisfactorily settled whether such a mechanism is effective at eliciting the desired behavioral and health outcomes" (p.1). Although some studies point to a certain success of financial incentives, PALOYO et al. (2013) manifest "considerable doubts on the sustainability of any weight loss" (p.1).

Increasing people's awareness of irrational behaviour may outperform paternalistic measures in the long run

Considerable effort by economists and psychologists and from other sciences is necessary to shed more light on processes of perception and decision making. I want to pick up two aspects from the vast portfolio of theories how and why people make decisions that lead to an increasing body weight as outlined in Chapter 2.3.

One area is intertemporal behaviour and, in particular, the question of inconsistent time preferences or hyperbolic discounting. The potential existence of such behaviour and its connection to obesity emerged as one of the top justifications for interventions. An often-cited paper is that of O'DONOGHUE and RABIN (2006) where the authors show how a sin tax (e.g. on potato chips) can help people with self-control problems to behave in a way that maximises their long-term utility. The basic idea is that a tax raises the costs of immediate gratification because people substitute away from the sin good that is now more expensive. However, the "irrationality" in their model is only constituted by the formulation of the utility function. A present bias is introduced by an extra discount on the utility of future periods. A crucial point in this model is that consumption behaviour is still rational, i.e. people react to market prices. O'DONOGHUE and RABIN acknowledge themselves that "for over-consumption that is driven by visceral motivations, there may be reasons to believe that consumption is not very price-sensitive" (p.1839). They conclude that "if so, then sin taxes may not be optimal, because they might merely make addicts pay a higher price without changing their consumption" (pp.1839).

Hence, it is crucial in further research to examine determinants of intertemporal decision and whether price signals reach one's mind in situations of emotional decision processes. An

alternative to taxes would be to raise awareness about possible misperceptions of future situations and to provide strategies how to respond to such situations. Research and policies should focus more on all relevant alternatives and how to tackle the primary source of market failure by educative measures rather than fighting the symptoms with paternalistic interventions. Surely, this lies more in the competence of psychologists and educationists than in that of economists.

What kind of information should be provided?

A third source of market failure often referred to is lack of information. So far, most attention is directed to missing knowledge about the relationship of health and body weight, about what is a healthy weight, and which behaviours (diets, physical activities) lead to a healthy weight (see Chapter 2.4). In my discussion about models of health behaviour based on household production theory in STAUDIGEL (2013; Chapter 4.1) I illustrate that recent literature restricts the role of information, education and abilities merely to the production of health. These models do not sufficiently account for other goals and objectives humans strive for and how they are related to health. In doing so, they oversimplify interdependencies within human behaviour, particularly with respect to two particularly neglected issues. First, health is nearly always produced jointly with one or more other elementary goods during a single activity. Assuming that those activities are not primarily carried out because of their health effect, more attention must be paid to the other goals, their determinants and restrictions. Second, one and the same objective can be pursued by different activities. Pleasure, for example, can be generated by eating and drinking, literature, art, sports and many more leisure activities and this provides an enormous potential for substitutive relationships.

A central question for future research and policy making connected to this discussion is how to generate more knowledge on the basic goals that people pursue in life, their underlying preferences and the means they apply to reach them. In this respect, it is very interesting where and how two or more elementary commodities are jointly produced or whether and how inputs to the production of one commodity can be substituted by each other. In my view, dynamics and learning play a crucial rule. How do preferences for sweet and fatty food emerge? What are the preconditions for learning the production of pleasure from healthier foods like vegetables and fruit? Another point is the case of sports or alternative activities

like playing an instrument. Here, it seems that a dynamic process might look like an exogenous chemical reaction that needs a little bit of activation energy to run by itself afterwards. STIGLER and BECKER (1977) describe such a process where listening to music enhances "music capital" that, in turn, increases the utility from listening to music and so on. However, they say nothing about the initiation of such a process and the conditions that have to be met to start "good addictions". This may be a fruitful avenue for future research.

Education, information, and raised awareness of the complex interdependencies are essential to reduce the prevalence of obesity in the long run. This is no new or revolutionary statement but nevertheless true. However, a different accent on education measures may be appropriate, comparable to what I discussed in Chapter 4.1. Of course, people need knowledge on what constitutes a healthy diet, a rough idea about nutritional recommendations, and awareness of the health benefits of an active lifestyle. Providing this knowledge is however only half of the solution (at best). They still face the (sometimes insoluble) task to get the objective of a good health in accordance with their various other goals such as experiencing pleasure, having fun, getting excited and many more.

It seems that especially those parts of the population that are vulnerable to obesity are stuck in a situation where eating and drinking "tasty" calorie-rich food and a "comfortable" inactive lifestyle emerge as the basic inputs to "produce" many elementary commodities all at once. Just telling (or "nudging" or forcing) them to give up on these behaviours without providing strategies how to get their elementary needs satisfied by other activities or inputs would reduce their overall utility. Behavioural changes are not very likely to occur under these circumstances.

Interdisciplinary research for a complex problem

Methodologically, future research on questions as pointed out above should be tackled from many different perspectives. Experiments are necessary to test innovative hypotheses on human behaviour in a closed setting. More comprehensive large-scale and longitudinal data would provide the basis to assess some of the issues as raised in the present chapter. Although the RLMS proved to be very helpful with the mixture of economic, health and socio-demographic data, future surveys with a higher frequency and variables that contain more and explicit information on the production technology of households and individuals could enable very interesting analyses of consumer behaviour.

Last but not least, qualitative research could contribute more direct insights into actual lifestyles of households and individuals that have to cope with obesity. Although being not representative, researchers' attention may be directed to circumstances and determinants of health behaviour that cannot or can only hardly be derived in a deductive way from theory or rigid questionnaires in household panel surveys. Examples for existing qualitative research in this direction are PETER (2011) and LEONHÄUSER et al. (2009) that provide valuable insights into the social processes and structures within families which determine nutrition behaviour and body weight of family members.

Research on the role of enterprises and the supply side

Recently, some authors pointed to a considerable research gap on the supply side of markets relevant for health and nutrition. DUVALEIX-TRÉGUER et al. (2012) note that the "vast majority of economic research related to nutritional policies focuses on the demand side and deals with consumer behaviour" (p.843). However, "firms' reactions in terms of price and product quality can amplify or reduce the expected impacts of nutritional policies" (ibid., p.844). HAWKES et al. (2012) call for increasing research efforts concerning the incentives faced the actors that buy, process, and market farm commodities. The authors emphasise the power of these "food consuming industries" in providing a differentiated portfolio of food products appealing to consumers. Insights into incentives or restrictions for these companies to shift supply towards more healthy options could yield new starting points for policies or ideas for entrepreneurial strategies. Especially the field of industrial economics could examine sourcing strategies and cost structures that favour the use of cheap ingredients high in energy. Also the concept of household production raises interesting research questions about the ability of processed food products to contribute to the production of elementary commodities such as health or pleasure. The discussion in Chapter 2.4.4 already mentioned that firms should have strong incentives to provide consumers with food products that help them lead a healthy life and keep a healthy weight. These products, however, seem to promise too much with respect to their influence on weight.

References

BHATTACHARYA, J. and N. SOOD (2007): Health insurance and the obesity externality. In: Bolin, K. and J. Cawley (eds.): The Economics of Obesity. Advances in Health Economics and Health Services Research. Amsterdam: Elsevier, Volume 17, 279-318.

BRAND EINS (2013): Blick in die Bilanz: Nicht totzukriegen. *brand eins* **12/2012**, 24-25.

BRUNELLO, G., P.-C. MICHAUD and A. SANZ-DE-GALDEANO (2009): The Rise of Obesity in Europe: An Economic Perspective. *Economic Policy* **24**, 551-596.

DUVALEIX-TRÉGUER, S., A. HAMMOUDI, L. ROUACHED and L.G. SOLER (2012): Firms' responses to nutritional policies. *European Review of Agricultural Economics* **39**, 843-877.

HAWKES, C., S. FRIEL, T. LOBSTEIN and T. LANG (2012): Linking agricultural policies with obesity and noncommunicable diseases: A new perspective for a globalising world. *Food Policy* **37**, 343-353.

LEONHÄUSER, I.-U., U. MEIER-GRÄWE, A. MÖSER, U. ZANDER and J. KÖHLER (2009): Essalltag in Familien. Ernährungsversorgung zwischen privatem und öffentlichem Raum. Wiesbaden: Verlag für Sozialwissenschaften.

MÜLLER, S., D. PIONTEK, A. PABST, S. E. BAUMEISTER and L. KRAUS (2010): Changes in alcohol consumption and beverage preference among adolescents after the introduction of the alcopops tax in Germany. *Addiction* **105**, 1205–1213.

O'DONOGHUE, T. and M. RABIN (2006): Optimal sin taxes. *Journal of Public Economics* **90**, 1825-1849.

PALOYO, A.R., A.R. REICHERT, H. REINERMANN and H. TAUCHMANN (2013): The Causal Link Between Financial Incentives and Weight Loss: An Evidence-Based Survey of the Literature. *Journal of Economic Surveys.* Early View-Online Version: DOI: 10.1111/joes.12010.

PETER, C. (2011): Essen ohne Maß? Zu Formen der Essensorganisation in Familien mit dicken Kindern. In: Zwick, M., J. Deuschle und O. Renn (eds.): Übergewicht und Adipositas bei Kindern und Jugendlichen. Wiesbaden: Verlag für Sozialwissenschaften, 137-160.

STAUDIGEL, M. (2011): How (much) do food prices contribute to obesity in Russia? *Economics and Human Biology* **9**, 133-147.

STAUDIGEL, M. (2012): How do obese people afford to be obese? Consumption strategies of Russian households. *Agricultural Economics* **43**, 701-714.

STAUDIGEL, M. (2013): On the application of household production theory to health and nutrition. In: Bahrs, E., Becker, T., Birner, R. et al. (eds.): Herausforderungen des globalen Wandels für Agrarentwicklung und Welternährung. Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e.V., Band 48. Münster: Landwirtschaftsverlag, 33-46.

STIGLER, G.J. and G.S. BECKER (1977): De Gustibus Non Est Disputandum. *American Economic Review* **67**, 76-90.

Declaration

I declare that the dissertation here submitted is entirely my own work, written without any illegitimate help by any third party and solely with materials as indicated in the dissertation. I have indicated in the text where I have used texts from already published sources, either word for word or in substance, and where I have made statements based on oral information given to me.

At all times during the investigations carried out by me and described in the dissertation, I have followed the principles of good scientific practice as defined in the “Statutes of the Justus Liebig University Gießen for the Safeguarding of Good Scientific Practice”.

Giessen, October 2013

Matthias Staudigel