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LIFE SATISFACTION AND DIET IN TRANSITION: EVIDENCE FROM THE RUSSIAN LONGITUDINAL MONITORING SURVEY

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Life satisfaction and diet in transition:

Evidence from the Russian Longitudinal Monitoring Survey

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Abstract

This paper develops a theoretical framework and provides empirical evidence on the impacts of diet and lifestyles on life satisfaction in Russia using 1995-2005 data from the Russian Longitudinal Monitoring Survey. Our results suggest that diet measured as calories, fat, protein, and diversity of food consumption has a statistically significant effect on life satisfaction levels of the Russian population. In addition, living in a region with higher per capita income increases population's life satisfaction. While living in a rural area, having health problems, and having young children affect individual life satisfaction in Russia in a negative and statistically significantly way. Life satisfaction is also positively correlated with education and income, and negatively with unemployment. Better understanding of the drivers of life satisfaction and more generally of subjective wellbeing in Russia can assist in the government decision-making processes, including the allocation of scarce resources and the design of public health policies.

Key words: diet, life satisfaction, transition, Russian Longitudinal Monitoring Survey

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1 Introduction

Life satisfaction is closely related to the concepts of happiness and subjective well-being as the three are often used interchangeably in the economics literature while psychologists consider them distinct (Dolan and Metcalfe, 2012; Graham, 2012). Subjective well-being (SWB) is a term that encompasses all of the ways in which people qualify their quality of life, from open-ended happiness, to satisfaction with specific domains of life such as work, health, and education, among others (Dolan et al., 2008; Graham, 2012). Adler et al. (2017) characterize happiness, which is the most loosely defined of the three concepts, as the affective side of individual preferences. Life satisfaction is somewhat more explicitly defined than happiness and correlates more closely with measurable goals and outcomes (Veenhoven, 1996). Adler et al. (2017) characterize life satisfaction as the evaluative aspect of SWB.[1] Life satisfaction is also an important indicator of quality of life when considering the broader concept of human development beyond narrower economic growth indicators (Ranis et al., 2000, Suri et al., 2011).

Clearly understanding the antecedents of life satisfaction is a way to identify drivers of people's quality of life, and more generally, the progress of society (Blume and Voigt, 2007; Hayo, 2007; Suri et al., 2011).[2] Considering that satisfaction is a state of mind—an evaluative appraisal of something (goals and outcomes)—our point of departure in studying the link between food consumption and life satisfaction is the Maslow's hierarchy of needs theory,

[1] A third eudaimonic component of SWB is a sense of purpose (Adler at al., 2017).
[2] Studies find that higher life satisfaction and SWB are associated with higher incomes and better health in Russia (Graham et al., 2004). Erdogan et al. (2012) review studies linking life satisfaction with job satisfaction and performance and identify a positive relationship, in general.

which is commonly illustrated by a pyramid, with the largest and most fundamental levels of needs at the bottom, and the need for self-actualization at the top (Maslow, 1943, 1968).[3] The physiological needs are the most fundamental set of needs and include food consumption and diet. Arguably, sufficient quantity of food and good quality diet are an important (but not the only) pre-condition for satisfaction from life.[4] Therefore, in this paper we focus on the link between life satisfaction and food consumption and diet composition while controlling for other important socio-economic factors. Thus, our study contributes to the interdisciplinary and growing literature on life satisfaction and diet by emphasizing the importance of adequately framing the effects and taking into account the socio-economic context within which consumption behaviors are studied.

The majority of existing studies on the link between food consumption and life satisfaction (or mental health) are on populations from developed market economies and do not consider explicitly the socio-economic context. A study by Blanchflower et al. (2013) provides evidence of a link between the consumption of fruit and vegetables and improvement in mental health indicators for a British sample but it uses only cross sectional survey data. Mujcic and Oswald (2016) use a short three-period panel of Australian adults and demonstrate that healthy diet, rich in fruit and vegetables, improves happiness, life satisfaction, and well-

[3] The most fundamental and basic four layers of the pyramid contain what Maslow called "deficiency needs" or "d-needs": esteem, friendship and love, security, and physiological needs. If these deficiency needs are not met, even though the body may give no physical indication, the individual would feel anxious and unsatisfied. Maslow's theory suggests that the most basic level of needs must be met before the individual will strongly desire (or focus motivation upon) the secondary or higher level needs. Maslow also coined the term meta-motivation to describe the motivation of people who go beyond the scope of the basic needs and strive for constant betterment. Meta-motivated people are driven by "b-needs" (being needs), instead of deficiency needs (d-needs).

[4] The concept of food as a fundamental human need is closely related to the more recent concept of food security comprising supply and demand factors and having four main aspects: availability (adequate food supplies), access (people's ability to access the available food supplies), utilization (calorie and micronutrient intake and absorption) and stability (environmental, economic, and political stability in access to food).

being. Conner et al. (2017) using young adults Australia New Zealand clinical trials also find evidence that fruit and vegetables can have psychological benefits over short periods of time.

However, a strand of (economic) psychology literature has shown that people acting under conditions of stress and scarcity face cognitive limitations (aka tunneling) and (sub)optimally make unhealthy choices (Mullainathan and Shafir, 2013; Shiv and Fedorikhin, 1999). For example, Shiv and Fedorikhin (1999) find that consumers, when put under conditions limiting their cognitive resources, spontaneously evoke affective reactions rather than cognitions, which has a greater impact on their choice. As a result, the consumers are more likely to (optimally) choose diets that are superior on the affective dimension but inferior on the cognitive dimension (e.g., sugar and fat-rich foods).[5] In contrast, when the availability of cognitive resources is high, cognitions related to the consequences of choosing the diet tend to have a bigger impact on choice. As a result, the consumers are more likely to choose the alternative that is inferior on the affective dimension but superior on the cognitive dimension (e.g., fruit and vegetables).

There is no study on life satisfaction and diet in transition countries. The transition country context offers a good identification set up that could be seen as a natural experiment considering that the radical shift from central planning to free market abruptly brought about significant stress in people's life. Russia, the largest transition country, is the ideal case at hand. During the decade of early transition, life satisfaction went through a decline until after the financial crisis of 1998, and then it recovered to and above pre-transition levels. This trend was accompanied by a similar trend in economic and political conditions associated, first, with the turbulent second term of the Boris Yeltsin's presidency, followed by the rise in power by

[5] Over time, economic development (and arguably transition) is associated with changes in diets, which bring along certain cognitive demands on food choices (Masters et al., 2016). In addition, the increasing production diversity leads to considerable increase in dietary diversity, which again is associated with cognitive demands on food choices (Hirvonen and Hoddinott, 2017).

Vladimir Putin in 2000 and the associated stabilization during his first term (Kuchins, 2006). Therefore, it is interesting to study to what extent diet could have contributed to life satisfaction on the backdrop of the dynamic socio-economic conditions in transition Russia.

What sort of diet makes people happy in transition Russia? This study contributes to the existing literature on life satisfaction by providing empirical evidence on the impact of diet while correcting for reverse causality by using 1994-2005 panel data from the Russian Longitudinal Monitoring Survey (RLMS). The paper is structured as follows: the next section discusses the status of life satisfaction and the implications of economic and nutritional transition in Russia in the context of relevant literature. Then, we present the theoretical framework, RLMS data, and our empirical methodology. These are followed by discussion of the estimation results. Finally, we draw conclusions.

2 Transition and life satisfaction in Russia

To further motivate our study of the link between life satisfaction and food consumption we selectively review the available literature on Russia's transition process and its implications for people's lives, including implications for life satisfaction and food consumption. There is a large body of literature on the broader topic of the antecedents of life satisfaction and happiness. Research finds general patterns in the relationship between socio-economic variables and life satisfaction across countries and across time (Helliwell et al., 2013).[6] The Russian transition period, and specifically the decade from the mid-1990s to the mid-2000s offers an ideal background to study life satisfaction in general, and the link between food diet and life

[6] Easterlin et al. (2010) examine happiness and life satisfaction in east Europe from 1989 to 1998 and find that life satisfaction followed the U-shaped pattern of GDP for those same years, but failed to recover commensurately; unhappiest respondents were the least educated and those over 30 years of age.

satisfaction in particular, considering the radical economic and societal shift from socialist to market-based system and the associated changes in the population's diet and lifestyle.

The early transition in Russia signified the real GDP falling to 55% of its 1989 level by 1998, the lowest point over the last two decades, followed by a subsequent recovery to 88% by 2005 (World Bank, 2007). High inflation, which was over 300% in 1994, emerging open unemployment, sharp decline in production, and quite common wage arrears eroded the income- generating basis for many households. As a result, social indicators point to a fall in living standards, a deterioration in health conditions, and increased mortality. Psychological stress and unhealthy lifestyles, which include heavy alcohol (vodka) and cigarette consumption, a high-fat and energy-intensive diet, and a lack of recreational exercise, have been identified as the main and often intertwined determinants of poor health in Russia (Zohoori et al., 1998).[7] Staudigel (2012) investigates the differences in households' food consumption when their economic resources change during the transition period and finds evidence of deterioration in diet quality.

Using data from the RLMS, Herzfeld et al. (2014) investigate how the changes in socio-demographic and economic indicators affect consumption behaviors, such as food diet, drinking and smoking, and ultimately the population's overall lifestyle. Unhealthy lifestyles include behaviors that are found to increase the probability of getting a disease and having a negative influence on health. These may have some positive immediate effect on happiness but are likely to negatively affect people's life satisfaction in the long run. During the transition, there are shifts in consumption behavior as a response to fluctuations in income, prices, and employment status. However, there might also be strong (and persistent) habits in consumption that mitigate the effects of the economic turmoil on the diet. Therefore, considering the impact

[7] The changes in Russia have also impacted importantly on population's goals and expectations, as well as on social norms in the labor market and more broadly in the society (Croucher and Rizov, 2011).

of (predetermined) consumption habits and the increasing cognitive demands on diet choices in the context of economic transition in Russia is relevant for understanding the link between food diet and people's life satisfaction.

Generally, studies on life satisfaction in Russia and other transition countries account for a wide variety of factors.[8] Graham et al. (2004) using data from the RLMS for only 1995 and 2000, analyze the individual characteristics' effects on life satisfaction and well-being in Russia. They find that retired people are much less happy than average, while men are happier than women (in contrast to the USA, where women are happier than men). Minorities are happier than ethnic Russians; and single people are happier than married. Eggers et al. (2006) find that regional unemployment rates do not negatively impact on a population's SWB in post-Soviet Russia. Overall, Sanfey and Teksoz (2007) find higher life satisfaction in households for which transition has "worked" for them relative to other (reference) households. Thus, the authors find that there are winners and losers from the transition process manifested in heterogeneous life satisfaction.

Helliwell et al. (2013) and various other studies point out that there is a dynamic relationship between happiness or life satisfaction and other important (objective) aspects of life with effects running in both directions. Life satisfaction and well-being also affect outcomes of interest such as health, income, and social behavior. Generally, life satisfaction may lead to better life outcomes. There is evidence about the processes that mediate between happiness and life satisfaction, and their beneficial outcomes. For example, positive feelings

[8] Hayo and Seifert (2003) find positive influences of education and relative income on happiness and long-term life satisfaction, negative effect of unemployment, and U-shaped age effect in several east European countries. Also, in transition context, Sanfey and Teksoz (2007) find association of higher levels of happiness with self-employment, and that men are happier than women. Cross (transition) country differences in aggregate happiness can be explained well by variations in the unemployment rates, the degree of political freedom, and the human development index (Hayo, 2007).

bolster the immune system and lead to fewer cardiovascular problems, while anxiety and depression are linked to poorer health outcomes. For example, Graham et al. (2004) analyze the effects of life satisfaction and happiness on incomes in Russia, and find that the unexplained happiness has a positive effect on future income as well as on health. Not only does good health make people happy, but happiness may also have a positive effect on health. The authors explore whether happiness has causal properties on future income and other variables. Happier people earned more income and were healthier. These results are suggestive and do not establish a clear direction of causality. Therefore, in our study on the link between life satisfaction and diet it is important to account for reverse causality.

3 Theoretical model

Starting from Becker and Rayo (2008) and Huffman and Rizov (2010), we develop a theoretical model of life satisfaction production accounting for the complexities of people's circumstances and choices they make in the face of prevailing constraints. We postulate that life satisfaction is a component of the individual utility function similar to health and other (non-tradable) goods; thus, life satisfaction and utility are not identical.[9] Such a formulation of the utility function makes it possible to address Adler et al.'s (2017) assertion that individuals trade off SWB and non-SWB aspects in their lives. The individual chooses to maximize utility, which is a composite of physiological (objective) and psychological (subjective) components.[10] Thus, the individual's utility function is specified as:

[9] Just and Gabrielyan (2016) argue against the simple formulation of the utility function, treated as identical to wellbeing in the standard neoclassical model because such formulation allows for a very limited policy insight in analyzing consumer diet choices. The authors suggest that behavioral models based on scientific evidence and allowing for a richer set up of consumer choices would be more appropriate.

[10] This formulation is consistent with Adler et al.'s (2017) description of utility where they follow Kahneman et al. (1997) and distinguish between *decision* utility and *experience* utility. The decision utility approximates preferences while experience utility is a measure of the quality of experiences. The formulation in equation (1)

$$U = U(S, D, C; O), \quad (1)$$

where *S* is life satisfaction, which plays an important moderating role in the utility function, *D* is food diet (including a lifestyle component such as tobacco smoking and alcohol consumption), *C* is the vector of other (market) goods and services consumed, and *O* is a vector of (quasi)fixed individual characteristics, such as age, gender, education, and socioeconomic background. For simplicity, we also include here individual health status. We expect *S* and *C* to have positive marginal utilities as well as the food consumption and good quality diet, *D*.

The individual cannot buy life satisfaction in the marketplace. Therefore, we assume that *S* is not directly purchased but has to be produced by each individual according to production function, using market goods, time, and other individual-specific inputs (e.g., health). Thus, the individual has the following life satisfaction production function:

$$S = S(D, C, L; O, \varepsilon), \quad (2)$$

where *L* is leisure and ε represents the unobservable individual characteristics that affect the individual's life satisfaction, *S*. While the role of food in satisfying basic energy and nutrition needs for functioning of the human body is well recognized and studied, the effect of food consumption on mental health, happiness, and life satisfaction is less well understood.[11] In our model we recognize the dual role of food diet in the individual's consumption choice and emphasize the link between food and life satisfaction. Furthermore, by relying on insights from the theory of cognition under scarcity (tunneling) we are also able to explain possible unhealthy

also reflects notions of the Maslow's hierarchy of needs theory as ranking of the d- and b-needs could be implemented by adding an explicit constraint in the optimisation model.

[11] There is growing literature that explores the psychological effects of macro, and especially micro nutrients consumed through the everyday diet (e.g., Rooney et al., 2013; Blanchflower et al., 2013; Mujcic and Oswald, 2016; Conner et al., 2017). In our study the focus is somewhat different but nevertheless we recognize that the biochemical effect of food on psychological health and life satisfaction could be an important channel. Another channel that has been suggested to link food and life satisfaction is consumers' perceptions of healthy food, which lead to positive emotions and higher life satisfaction when such foods are consumed (Lattimore et al., 2010).

diet choices observed during strained socio-economic conditions such as the transition period in Russia (Mullainathan and Shafir, 2013; Shiv and Fedorikhin, 1999). Under such conditions it is likely that higher life satisfaction is achieved by maximizing the affective dimension of the diet, characterized by high calorie, fat, sugar, and protein content rather than the cognitive (evaluative) dimension of the diet, characterized by healthier, and more diverse composition.

Finally, we formulate the individual's combined time and cash income constraint:[12]

$$P_D D + P_C C = W(T - L) + N, \tag{3}$$

where P_D and P_C denote the market prices of food (D), and other goods and services (C), respectively; W is the wage rate per unit of time, T is the fixed time endowment ($T - L$=work), and N is the non-labor income.

To obtain the full income budget constraint F, we define π_S to be the average shadow prices of life satisfaction S:

$$\pi_S S = W(T - L) + N - P_D D - P_C C = F. \tag{4}$$

The shadow price π_S depends on the prices of the market inputs (P_D and P_C), the wage rate (W), and the productivity of individual life satisfaction production function, which, in turn, depends on the various individual characteristics, O. Thus, the production of life satisfaction is affected by individual (objective and subjective) and market (environmental) characteristics.

We assume that the individual maximizes his/her utility subject to the life satisfaction production function and budget constraint. As in productive household models (Gronau, 1977), we proceed by substituting equation (2) in equation (1). Then, we maximize the utility function, and derive the optimal demand functions for D, L and C below:

[12] Equations (1) and (2) are not necessarily linear, while equation (3) is linear.

$$D^* = f(P_D, P_C, W, N, O), \quad (5)$$

$$C^* = f(P_D, P_C, W, N, O), \quad (6)$$

$$L^* = f(P_D, P_C, W, N, O). \quad (7)$$

After substituting the optimal demand functions D^*, C^*, L^* into the life satisfaction production function (2), we obtain the individual life satisfaction supply function:

$$S^* = S(D^*, C^*, L^*, O; \varepsilon). \quad (8)$$

Within the household production literature, the function in equation (8) is equivalent to a supply function.[13] The function represents the link between food diet and nutrition and life satisfaction which is in the focus of our empirical analysis that follows. The implicit assumption in our empirical implementation of equation (8) is that we observe in the data, given constraints, the optimal (desired) choices of diet, consumption of other market goods and services, and time allocation.[14]

4 Data and variables

To investigate the relationship between life satisfaction and diet we employ panel data from the Russian Longitudinal Monitoring Survey (RLMS) over the period 1994-2005. The RLMS is a nationally representative household survey and it samples annually the population of dwelling units as repeated cross-sections. The RLMS is coordinated by the Carolina Population

[13] Technically, equation (8) is indeed a supply function, however, in the context of the life satisfaction analysis, referring to *S** as demand for life satisfaction, could also be appropriate considering that it is achieved through a self-production process. Nevertheless, to keep the terminology in line with standard modelling conventions we refer to *S* as a supply relationship.

[14] The theoretical model discussed could also be empirically implemented through a structural two-stage approach as outlined in Huffman and Rizov (2010) and Braha et al. (2017) which, however, is more data and computationally demanding.

Center at the University of North Carolina (http://www.cpc.unc.edu/projects/rlms). The annual samples collect data for more than 4000 households and their members equaling more than 10000 individuals surveyed each year. The collected data include a wide range of information concerning household characteristics, such as demographic composition, incomes, and expenditure. The RLMS has rich data on individuals as well that include employment, anthropometric measures, health status, nutrition, alcohol and cigarette consumption, and medical problems. Also, 24-hour recall dietary data are available where nutrient intake levels are reported. However, actual detailed dietary data are not available (Kozyreva et al., 2016).

The dependent variable in our model is life satisfaction, which is measured by *IMSATISL* variable in the RLMS.[15] This is a single item measure where each respondent is asked: How satisfied or unsatisfied are you with your life at present? The answer choices are: 1- Absolutely satisfied; 2- Mostly satisfied; 3- Yes and no; 4- Not very satisfied; 5- Absolutely not satisfied. In our study, we transform the original RLMS variable such that 1 is dissatisfied and 5 is satisfied for ease of interpretation. Some happiness studies have used such ordinal-scaled variables as if they were cardinal measures, where 0 is dissatisfied, and 10 is satisfied (Katsaiti, 2012, Kropfhauber and Sunder, 2013). Lachmann et al. (2018) compare two popular approaches to life satisfaction measurement, specifically single item measures and short questionnaires generating various scales, and conclude that both types of measurement are very similar.

Based on our theoretical model and relevant studies discussed in previous sections, we identify in our data the sets of food diet, personality traits, and socio-economic environment variables available. These are diet characteristics (calories, fat, protein; and diet diversity), lifestyle (alcohol and cigarette consumption, and physical exercise), socio-demographic

[15] This is the code of the variable that measures the life satisfaction in the RLMS data.

characteristics (age, education, gender, marital status, household size, kids), income, health status, area of residence and its socio-economic characteristics. Brief definitions, means, and standard deviation for all variables used in our analysis are presented in Table 1.

Daily calorie intake is a quantity measure of the diet and is collected by a 24-hour recall, while the shares of protein and fat are major components (macronutrients) of the diet. Going forward we will refer to the shares of daily calories from fat and protein as shares of fat and protein in the diet respectively. Diet diversity represents the quality of the diet and is commonly measured by a Berry index, $BI = 1 - \sum s_j^2$, where s_j is the share of expenditures on food group j in total consumption expenditure (e.g., Herzfeld et al., 2014, Thiele and Weiss, 2003). Another diet diversity measure just counts the number of food items. The advantage of the Berry index (*BI*) is that it contains additional information on the concentration of items. Higher values indicate a more diverse diet where diet component foods are consumed in similar shares.[16] Nutritionists assert that a more varied diet is a core element of healthy nutrition behavior (e.g., Drewnowski et al., 1996). Alcohol consumption and smoking are defined as dummy variables equal to 1 if the individual consumed alcohol and smoked cigarettes during the last 30 days prior to the survey. Exercise is a categorical variable equal to 1 if the individual does not exercise at all, equal to 2 if the individual's exercise is light, and equal to 3 if the individual's exercise is medium to high.

Figure 1 presents the distribution of life satisfaction levels within the Russian population for the period 1994-2005. The share of the people who were absolutely unsatisfied and not very satisfied increased from 1994 to 1998, while the shares of the people who are satisfied decreased over that period. Since 2000, the shares of the mostly satisfied, absolutely

[16] Because *BI* takes values in the interval [0, 1] which might inhibit normality assumption, we use in the empirical analysis the transformed *BI*, or *TBI* =ln [*BI*/(1-*BI*)].

satisfied, and “yes and no” satisfied started increasing. The average life satisfaction levels generally follow the J-shaped pattern over the period 1994-2005 in Russia. Average life satisfaction levels tend to fall during the early years of transition (from 1994 to 1998, the year of the financial crisis in Russia), but returned to the pre-transition levels by 2000, and in 2005 were higher than in 1994.

Married individuals report higher levels of life satisfaction compared to non-married. Life satisfaction levels are higher for men than women. In addition, employed people have higher levels of life satisfaction compared to the unemployed. Life satisfaction of individuals living in urban areas is higher than those who live in rural areas. Life satisfaction shows a U-shaped pattern when graphed against age in Russia as the decline continues into the 40s and 50s cohorts, and it recovers thereafter as evident from Figure 2. This finding is consistent with the U-shaped pattern found in other countries.

The data also indicate that the highest values for life satisfaction are for individuals with university or higher education, while the lowest values are for people with the least education (below grade 8). Individuals who do not exercise have the lowest values of life satisfaction. People who consume alcohol report slightly higher level of life satisfaction, while there is no difference between the satisfaction of smokers and nonsmokers in Russia, with the exception of the last few years when the smokers report slightly higher level of life satisfaction than the nonsmokers.

Figures 3-5 present the relationship between life satisfaction and protein, fat, and diet diversity by quintiles of the respective distributions in Russia. The relationships generally follow the pattern of a U-shaped curve, showing the decline in life satisfaction during early years of the transition to a market economy, and steady increase afterwards up until 2002, after which the trend levels up. Importantly, there are no significant differences across quantiles.

Nevertheless, individuals in the last quintile of the consumption distributions (or those with the highest consumption) report the highest values of life satisfaction, while the individuals in the 1st quintile (with the least consumption) report the lowest values of life satisfaction in Russia. By 2005, the life satisfaction score has very similar values for all quintiles. This descriptive analysis suggests that there is no obvious non-linearity in the link between food consumption and life satisfaction in Russia.[17]

5 Empirical model

Based on the theoretically derived function of life satisfaction, equation (8) and the related discussion we estimate the following empirical model:

$$S = \alpha_0 + \alpha_1 D + \alpha_2 G + \alpha_3 A + \alpha_4 E + \alpha_5 O + \nu + \eta, \quad (9)$$

where S is an indicator of individual life satisfaction and D is a vector of food diet characteristics. Life style is approximated by G – a cigarette smoking indicator, A – an alcohol consumption indicator, and E – an exercise indicator. O is an extensive vector of control variables, including age, age squared, gender, education (the three categories, which include primary, high school and university education), household size and income, marital status, children 7 (age<8), children 17 (8<=age<=17), health problems (an indicator of self-assessed health status), work (employment status), rural location, regional GRP per capita, aggregate regions and time dummies. The panel data random effects ν are independently and identically distributed $N(0, \alpha_\nu^2)$; η is the disturbance term. We are allowing for fixed price differentials across regions, and the year dummy variables, included in the empirical model, allow for

[17] To further check for non-linearity in the links between life satisfaction and the diet characteristic variables, in our regression analysis we experimented by adding to the estimated specifications square terms which were found not to be statistically significant.

common price effects as well as capture general country level economic and political events related to the transition process.

The choice between estimators, for the two possible versions of our empirical model—with continuous dependent variable and with discrete, categorical dependent variable—rests on whether the categories of the life satisfaction indicator are considered cardinal or ordinal. Generally, economists consider the life satisfaction or SWB scores as ordinal and have mainly opted for Ordered Probit/Logit analysis. Psychologists and sociologists typically interpret life satisfaction or SWB as cardinal and therefore often use OLS. Ferrer-i-Carbonel and Frijters (2004) survey and test both empirical literatures to conclude that assuming ordinality or cardinality in life satisfaction surveys makes little difference in studies where the dependent variable is measured once per period. Nevertheless, to estimate the empirical model of life satisfaction in equation (9), we employ the two approaches. First, we consider the categories of life satisfaction ordinal and to account for the panel nature of our data, we estimate Random Effects Ordered Logit (REOL) model. Second, we consider the categories of life satisfaction cardinal, and account for possible endogeneity resulting from reverse causality between the dependent (life satisfaction) and independent variables (diet and lifestyle) by employing the panel data System Generalized Methods of Moments (SGMM) estimator of Blundell and Bond (1998).

Thus, we estimate our model by first using the *xtologit* command in STATA that fits random-effects ordered logistic regressions. Ordered logistic regressions are used to estimate relationships between an ordinal dependent variable and a set of independent variables. The actual values taken on by the dependent variable are irrelevant, although larger values are assumed to correspond to "higher" or "more preferred" outcomes. The conditional distribution

of the dependent variable given the random effects is assumed to be multinomial with success probability determined by the logistic cumulative distribution function.

Not many studies have addressed the issue of endogeneity that could result from reverse causality between the dependent and independent variables or measurement error in the context analyzed. Therefore, we adopt Blundell and Bond's (1998) system GMM estimator, which is an improvement on the first-difference GMM estimator of Arellano and Bond (1991). It uses both the first-difference and level information and allows the variables in levels to be instrumented with suitable lags of their own first differences.[18] We use the *xtabond2* (with two-step option) command in STATA to implement the system GMM estimator. In our estimations we treat the four diet characteristics and lifestyle choices (smoking, drinking, and exercise) either as endogenous or predetermined, while income, health status, education, employment status, marital status, and household size are treated only as predetermined. Thus, all these variables we consider potentially affected by the individual's level of life satisfaction. Age, gender, regional economic characteristics, and time dummies are used as exogenous instruments. Modifying the assumptions about individual variables in terms of being endogenous or predetermined does not significantly affect the results reported.

6 Results

[18] In the differences equation, for endogenous variables, lags 2 and earlier are valid instruments. For predetermined variables (not strictly exogenous), lag 1 is also valid. For the lagged dependent variable, which is predetermined, realizations of lags 2 and earlier are valid instruments. For the levels equation, for endogenous variables, lags 1 and earlier of the first differences of the same variables are valid instruments, while for predetermined variables the contemporaneous first differences of the same variables are also valid. The Roodman's (2009) collapse procedure creates one instrument for each variable and lag distance, rather than one for each time period, variable, and lag distance. However, in large samples such as ours, collapsing the instrument matrix reduces statistical efficiency.

Table 2 reports the results from the estimated empirical models. The dependent variable is life satisfaction and the first column of the table lists the independent variables in the model. The second column of Table 2 presents the estimated coefficients from the REOL regression. The coefficients of the diet and nutrition variables, which we call direct measures (in log) are of main interest in our study. Calories, fat, and protein consumption are all positive and statistically significant, indicating that these factors positively affect life satisfaction levels. Consuming a diverse diet also has a marginally signifficant positive effect on life satisfaction but only at the 10% level. The main message from these results is that diet does indeed affect life satisfaction. However, it is important to consider the diet component effects in the context of healthy diet and from a nutrition quality viewpoint. It seems that during transition individuals consume energy and fat (and protein) rich diets to achieve higher life satisfaction. These consumption patterns are also consistent with the traditional Russian diet (e.g., Herzfeld et al., 2014) and suggest that there is a certain degree of persistence and tradition in food consumption. The contribution of the healthier, more diverse diet to life satisfaction is less signifficant. Overall, our findings seem to support Maslow's theory of hierarchy of needs and suggest that, in transition Russia, having first basic physiological needs satisfied leads to a higher life satisfaction irrespective of the transition turmoil in the socio-economic and political environment. Our findings are also consistent with the proposition of the cognitive theory of tunneling where diet's affective dimension is the most important contributor to life satisfaction (Shiv and Fedorikhin, 1999).

In terms of economic importance, the magnitudes of the effects of main interest are relatively small. Life satisfaction will increase *ceteris paribus* by 0.15, 0.10, and 0.13 due to 1% increase in calorie intake, fat, and protein consumption respectively. These increases represent between 5% and 10% of the life satisfaction mean but signify important patterns of food consumption in Russia associated with preferences for affective (and unhealthy) diets.

Starting with the lifestyle controls, the coefficient on smoking is negative and statistically significant, indicating a negative correlation with life satisfaction, while consuming alcohol has a positive and statistically significant effect on life satisfaction. These results confirm the previous findings of Graham et al. (2004). Krekhovets and Leonova (2013) also find a positive correlation between alcohol consumption and life satisfaction in Russia.

The estimated coefficients of age and its squared term point to a convex or U-shaped relationship between life satisfaction and age. The economic literature (Blanchflower and Oswald, 2004, Easterlin 2006, Sanfey and Teksoz, 2007) finds the same U-shaped pattern of life satisfaction across the life span, with the lowest point being at age 50 years, which is the same age as found in our analysis. Having university or higher education and having higher income make people more satisfied with life in Russia. A large number of empirical studies arround the world find that life satisfaction is positively correlated with education (e.g., Blanchflower and Oswald, 2004, Frey and Studzer, 2002). The estimated coefficient of household size suggests that individuals living in larger households have higher levels of life satisfaction, while having young children, age 7 and under, decreases individual life satisfaction (Dolan et al., 2008). Frijters et al. (2006) also find that younger children are more likely to suppress the life satisfaction of their parents.

Contrary to the findings for Western males (Blanchflower and Oswald, 2004, Frey and Stutzer, 2002, Hayo, 2007), we find that Russian males are more satisfied with their lives. Being married for both genders increases life satisfaction levels in Russia, which is consistent with the findings of Blanchflower and Oswald (2004), Frey and Studzer (2002), Graham et al. (2004), and Studzer and Frey (2006).

Health is an important factor that affects life satisfaction. Being in poor health and living in rural areas decrease an individual's life satisfaction. Graham et al. (2004) find that

good health is positively and significantly correlated with life satisfaction; in their survey Dolan et al. (2008) summarize several studies with similar findings. Having a job and living in a richer region, with high GRP per capita increase the individual's life satisfaction. Not surprising, given the persistently found negative effects of unemployment on well being across space and time, those who have jobs are more satisfied. Having higher income increases life staisfaction, which is consistent with our theoretical model and studies by Blanchflower and Oswald (2004) and Frey and Studzer (2002) who find that wealthier individuals are on average happier than the poor.

The third column of Table 2 presents the estimated coefficients from the SGMM regression. The coefficients confirm the reported effects obtained from the REOL regression, with the exception of diet diversity and a few control variables (age, education, smoking) which are no longer statistically significant even though they preserve their signs. These results suggest the presence of some potential reverse causality issues where life satisfaction might affect diet diversity choices, smoking and education attainment. Of special importance is the insignificant coefficent of diet diversity which we have argued might be due to a cognitive tunneling effect during the turmoil of the Russian transition. There is also some empirical evidence from studies by Kennedy (2004) and Rizov et al. (2014) that under stress or uncertainty respectively individuals end up consuming less diverse diets. The difference in results might also indicate that treating the life satisfaction measure as ordinal or cardinal is of some significance.

The estimated coefficients on the East and West Siberia regional dummies point to negative and statistically significant effect only in the SGMM regression, suggesting that the people living in these regions have lower life satisfaction levels relative to the people living in Moscow-St.Peterbug areas. This finding could also be interpreted as reflecting negative price

effects, or could be driven by less favourable living conditions due to more severe climate, for example. All of the coefficients of the year dummies in both REOL and SGMM regressions are statistically significant, negative for the first three periods (1995, 1996, 1998) and positive from 2000 to 2005, which suggest U-shape of life satisfaction levels over the years.

As a robustness check in Table 3 we report results from the same two regression analyses as in Table 2 but with relative diet measures where the original (direct) diet measures are transformed by deducting the log median for each variable.[19] This way we take into account the prevailing common diet composition as a reference state, and the new results can be interpreted as with respect to the prevailing popular diet in Russia. The most important finding is that the estimated coefficients are quite similar in the two sets of regressions, which implies that our main conclusions are confirmed.

7 Conclusions

This paper is one of the first to analyze the relationship between life satisfaction and diet in transition country context, and the first such dedicated study for Russia. It provides empirical evidence on the impacts of diet and lifestyle on life satisfaction in Russia using 1995-2005 data from the Russian Longitudinal Monitoring Survey (RLMS). Our results suggest that diet measured as calories, fat, protein, and diversity of food consumption has an important, statistically significant effect on life satisfaction levels of the Russian population. In addition, we confirm several socio-economic antecedents of life satisfaction found in other studies. Living in a region with higher per capita income increases a population's life satisfaction.

[19] We use median rather than mean to transform the diet variables to minimize the impact of outliers; we have also experimented with means rather than medians and the results were not qualitatively different. We also experimented with three sets of medians calculated at country level, by time period, and by region respectively and found that the estimated coefficients in all versions were qualitatively similar. In the paper we report results with medians calculated by region and time period.

While living in a rural area, having health problems, and having young children affect individual life satisfaction in Russia in a negative and statistically significant way. It is generally found that life satisfaction is positively correlated with education and income, and negatively with unemployment. These findings were confirmed in the data for Russia.

Better understanding of the drivers of life satisfaction and SWB in Russia will assist in government decision-making processes, including the allocation of scarce resources and the design of public health policies. We generate important policy implications in terms of the food diet, which is in the focus of our analysis. In a turbulent transition situation, or any other similar circumstances, securing the basic physiological needs of the population should be a priority that should not be compromised. When aiming at improving a population's life satisfaction, special attention should be paid to vulnerable groups, such as those with low-income, less education, families with young children, and rural residents

Further in this context, policy makers should be aware that (short-term) life satisfaction could be achieved by the consumption of less healthy but sensory diet, rich in energy and fats. Therefore, Russian policy makers could consider supporting the provision of diverse food stuffs in order to achieve more diverse diets in Russia during periods of economic downturn beyond transition. Furthermore, considering the relatively high impact of proteins on life satisfaction, and bearing in mind that particular protein-rich foods are a desirable component of a healthy diet, supporting such types of food should also be considered. Complementing all of the above, well targeted and effective nutrition advice on healthy diet and lifestyle could play an important role in achieving sustainable long-term life satisfaction of the population. Higher life satisfaction as discussed in the introduction will result in higher quality of life and ultimately in a more advanced society.

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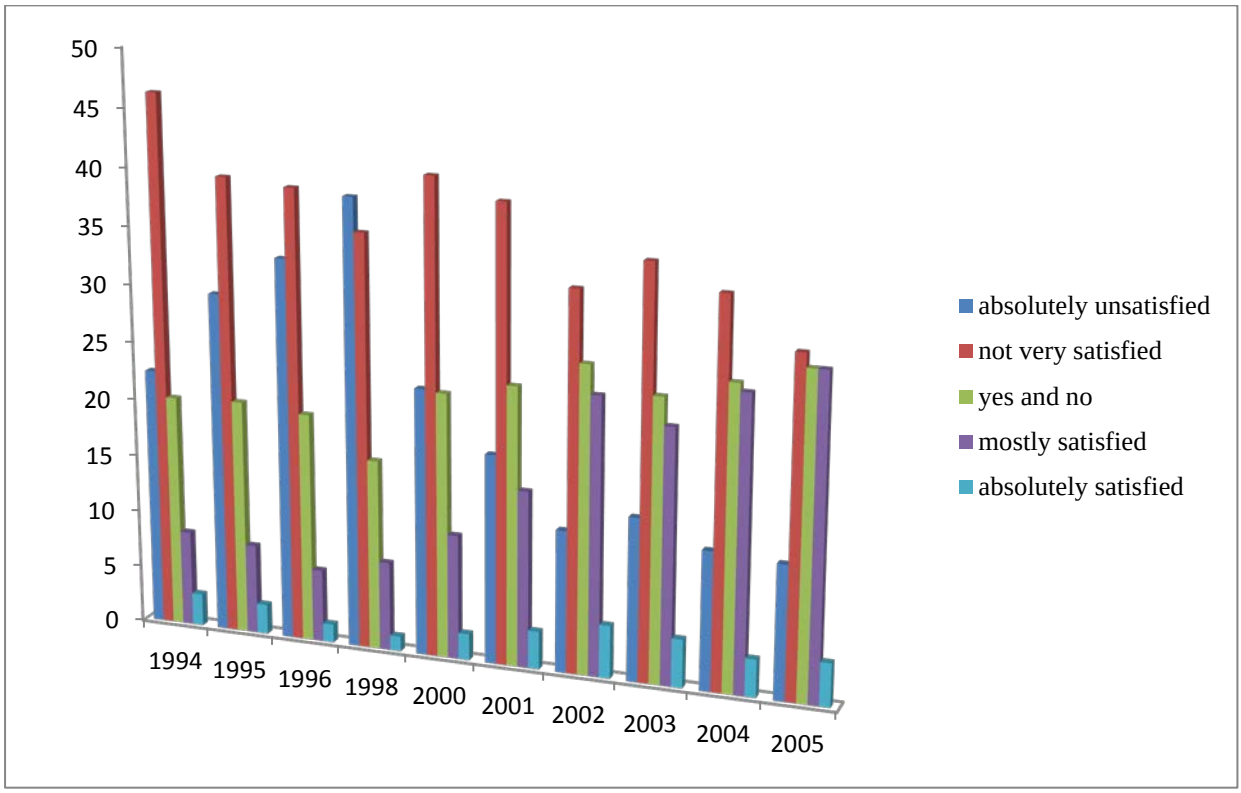
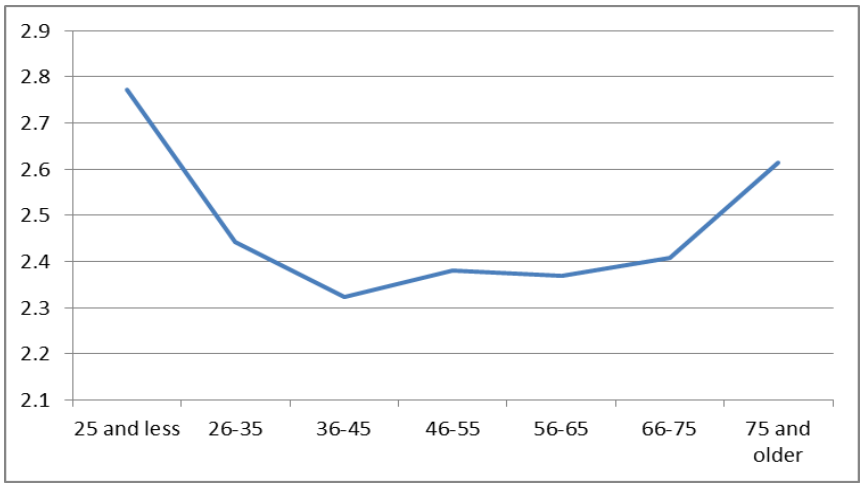


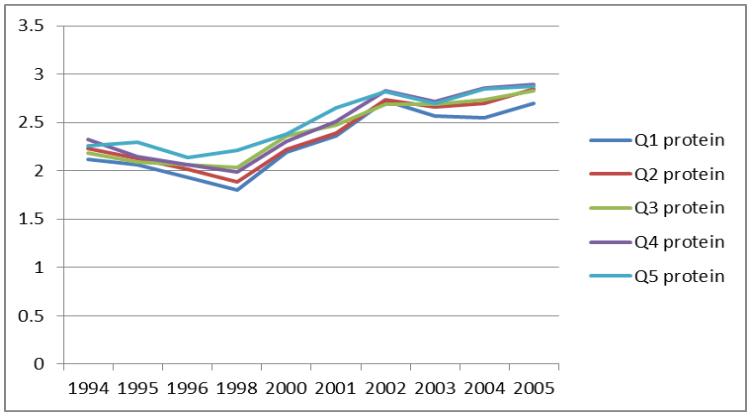
Source: RLMS, 1994-2005

Fig. 1. Distribution of life satisfaction levels among Russian people from 1994 to 2005, (%).



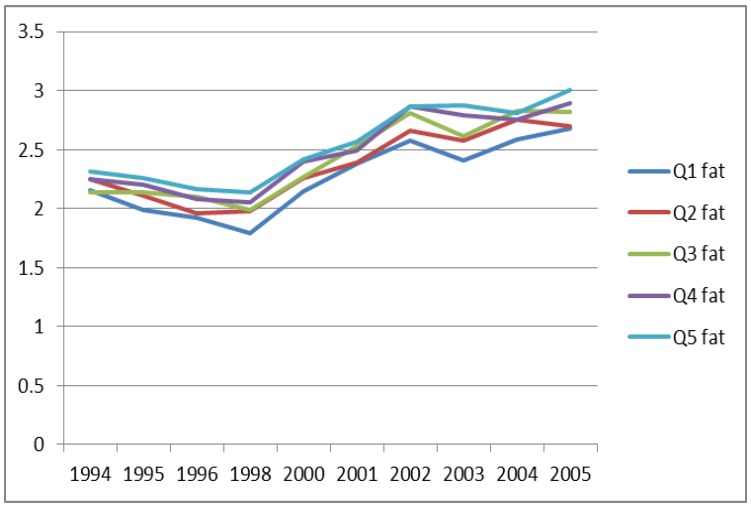
Source: RLMS, 1994-2005

Fig. 2. Life satisfaction and age in Russia.



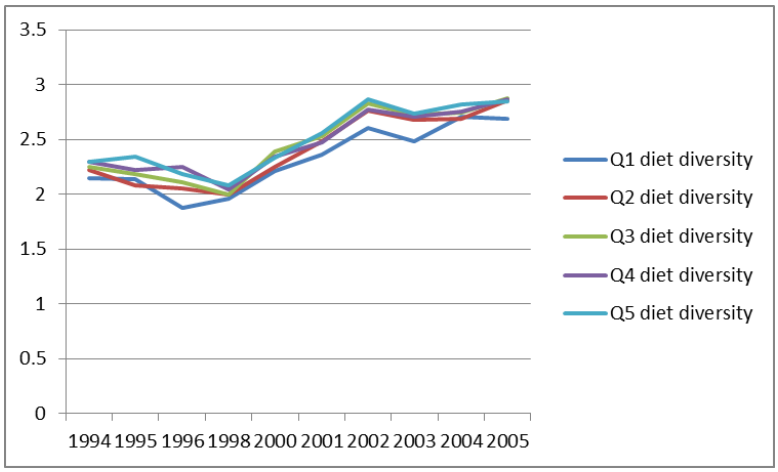
Source: RLMS, 1994-2005

Fig. 3. Life satisfaction and protein consumption in Russia.



Source: RLMS, 1994-2005

Fig. 4. Life satisfaction and fat consumption in Russia.



Source: RLMS, 1994-2005

Fig. 5. Life satisfaction and diet diversity in Russia.

Table 1.

Descriptive statistics for the variables used in the analysis

Variable	Full sample	
Dependent variable	Mean	Std.Dev
Life satisfaction	2.43	1.08
Explanatory variables-Log numbers		
Calories (total calories consumed per day) in logarithm	7.54	0.49
Fat (share in % of daily calories from fat) in logarithm	3.44	0.34
Protein (% of daily calories from protein) in logarithm	2.59	0.25
Diet diversity (TBI =ln[BI/(1-BI)]) in logarithm	0.79	1.45
HH_size (# household members) in logarithm	1.40	0.36
HH_income (monthly income in Rubles) in logarithm	7.21	4.46
GRP per capita (real regional GDP) in logarithm	10.37	0.39
Explanatory variables-Continuous/Categorical		
Age (# year)	46.79	15.88
Exercise (scale 1-3, 1=not at all, 2=light, 3=medium to high)	1.22	0.57
Explanatory variables-Dummies		
Primary school (has primary education)	0.35	0.48
High school (has high school education)	0.50	0.50
University (has university education)	0.15	0.36
Kids_age7 (presence of kids up to 7 years old)	0.19	0.39
Kids_age17 (presence of kids age 8 to 17 years old)	0.40	0.49
Work (individual is employed=1)	0.61	0.49

Gender (individual is male=1)	0.36	0.48
Married (individual is married=1)	0.69	0.46
Smoker (individual smokes=1)	0.26	0.44
Drinker (individual consumes alcohol=1)	0.52	0.50
Health problems (individual having health problems last month=1)	0.42	0.49
Moscow-St.Petersburg (individual resides in Moscow-St.Petersburg region=1)	0.01	0.09
North and Northwest (individual resides in North and Northwest region=1)	0.06	0.23
Central (individual resides in Central region=1)	0.20	0.40
Volga region (individual resides in Volga region=1)	0.24	0.43
North Caucasus (individual resides in North Caucasus region=1)	0.15	0.36
Ural region (individual resides in Ural region=1)	0.17	0.38
West Siberia (individual resides in West Siberia region=1)	0.09	0.28
East Siberia (individual resides in East Siberia region=1)	0.08	0.27

Source: Own computations based on RLMS, 1994-2005.

Table 2.

Coefficient Estimates (dependent variable-Life satisfaction), direct diet measures

Variable	REOL Coefficient (S.E.)	SGMM Coefficient (S.E.)
Diet		
Calories	0.0901 (0.0424)**	0.1510 (0.0578)***
Fat	0.2193 (0.0469)***	0.0967 (0.0307)***
Protein	0.2238 (0.0584)***	0.1320 (0.0493)***
Diet diversity	0.0199 (0.0108)*	0.0056 (0.0058)
Controls		
Smoker	-0.1734 (0.0589)***	-0.0142 (0.0075)*
Drinker	0.0733 (0.0341)**	0.0464 (0.0246)*
Exercise	0.1064 (0.0263)***	0.0269 (0.0161)*
Age	-0.1105 (0.0091)***	-0.0159 (0.0144)
Age_squared x 10^{-2}	0.1123 (0.0134)***	0.0108 (0.0122)
High school	0.0634 (0.0504)	0.0990 (0.2017)
University	0.1388 (0.0758)*	0.2420 (0.3692)
HH_size	0.1972 (0.0829)**	0.5710 (0.2704)**
Kidsage7	-0.1870 (0.0537)***	-0.5372 (0.1536)***
Kidsage17	-0.0730 (0.0439)*	-0.2050 (0.1369)
HH_income	0.0398 (0.0041)***	0.0102 (0.0026)***
Gender	0.3128 (0.0639)***	0.1821 (0.0626)***
Married	0.3538 (0.0560)***	0.2492 (0.1139)**
Work	0.2237 (0.0456)***	0.1095 (0.0460)**
Health problems	-0.2268 (0.0332)***	-0.0133 (0.0220)
Rural	-0.1387 (0.0617)**	-0.1130 (0.0488)**
Real GRP	0.2812 (0.0898)***	0.1020 (0.0630)*
North and Northwest	0.2301 (0.2979)	-0.1103 (0.1414)
Central	0.1859 (0.2819)	-0.1897 (0.1410)
Volga region	0.1915 (0.2812)	-0.2036 (0.1477)
North Caucasus	0.3464 (0.2913)	-0.1607 (0.1753)
Ural region	0.1495 (0.2813)	-0.2017 (0.1406)
West Siberia	-0.1882 (0.2935)	-0.3488 (0.1549)**
East Siberia	-0.1257 (0.2860)	-0.2593 (0.1378)*
Year 1995	-0.2541 (0.0691)***	-0.0732 (0.0350)**
Year 1996	-0.4718 (0.0735)***	-0.2590 (0.0415)***
Year 1998	-0.3296 (0.0708)***	-0.1684 (0.0362)***
Year 2000	0.3853 (0.0664)***	0.1306 (0.0367)***
Year 2001	0.7283 (0.0703)***	0.2965 (0.0400)***
Year 2002	1.3463 (0.0714)***	0.5985 (0.0426)***
Year 2003	1.0934 (0.0738)***	0.5045 (0.0449)***
Year 2004	1.2098 (0.0795)***	0.5770 (0.0517)***
Year 2005	1.3439 (0.0817)***	0.6540 (0.0553)***
Constants		-1.536 (1.062)
/Cut 1	2.2927 (1.0733)**	

/Cut 2	4.5609 (1.0730)***	
/Cut 3	6.0791 (1.0725)***	
/Cut 4	8.4723 (1.0755)***	
No observations	22,625	22,625
Number of instruments		284
Wald, chi2 (37)/LR, chi2 (37)	2824.97	14594.45
AR (2)		0.44 (0.658)
Hansen J, chi2 (247)		214.14 (0.231)

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

Source: Authors' computations based on RLMS, 1994-2005.

Table 3.

Coefficient Estimates (dependent variable-Life satisfaction), relative diet measures

Variable	REOL Coefficient (S.E.)	SGMM Coefficient (S.E.)
Diet		
Calories	0.0891 (0.0429)**	0.1114 (0.0269)***
Fat	0.2276 (0.0471)***	0.1094 (0.0285)***
Protein	0.1762 (0.0591)***	0.1356 (0.0356)***
Diet diversity	0.0166 (0.0100)*	0.0065 (0.0058)
Controls		
Smoker	-0.1751 (0.0589)***	-0.0268 (0.0077)***
Drinker	0.0735 (0.0341)**	0.0566 (0.0256)**
Exercise	0.1060 (0.0263)***	0.0308 (0.0137)**
Age	-0.1107 (0.0092)***	-0.0258 (0.0159)
Age_squared x 10^{-2}	0.1076 (0.0099)***	0.0216 (0.0159)
High school	0.0633 (0.0504)	0.0227 (0.2060)
University	0.1430 (0.0758)*	0.1465 (0.3881)
HH_size	0.1993 (0.0829)**	0.3549 (0.2091)*
Kidsage7	-0.1857 (0.0537)***	-0.4931 (0.1526)***
Kidsage17	-0.0729 (0.0440)*	-0.1868 (0.1454)
HH_income	0.0399 (0.0041)***	0.0121 (0.0027)***
Gender	0.3161 (0.0638)***	0.1678 (0.0606)***
Married	0.3546 (0.0561)***	0.3518 (0.1148)**
Work	0.2254 (0.0455)***	0.0991 (0.0469)**
Health problems	-0.2273 (0.0332)***	-0.0130 (0.0220)
Rural	-0.1502 (0.0616)**	-0.0966 (0.0415)**
Real GRP	0.2992 (0.0899)***	0.1150 (0.0552)**
North and Northwest	0.1796 (0.2978)	-0.1386 (0.1465)
Central	0.1620 (0.2816)	-0.1527 (0.1405)
Volga region	0.1520 (0.2810)	-0.1646 (0.1500)
North Caucasus	0.3297 (0.2911)	-0.1454 (0.1788)
Ural region	0.0995 (0.2799)	-0.1814 (0.1443)
West Siberia	-0.1298 (0.2931)	-0.1939 (0.1475)
East Siberia	-0.1867 (0.2856)	-0.1792 (0.1402)
Year 1995	-0.2726 (0.0691)***	-0.1132 (0.0328)***
Year 1996	-0.4364 (0.0670)***	-0.1890 (0.0319)***
Year 1998	-0.3679 (0.0708)***	-0.1844 (0.0368)***
Year 2000	0.3537 (0.0663)***	0.1102 (0.0357)***
Year 2001	0.7038 (0.0701)***	0.2696 (0.0415)***
Year 2002	1.3308 (0.0714)***	0.5738 (0.0444)***
Year 2003	1.0880 (0.0738)***	0.4778 (0.0470)***
Year 2004	1.2002 (0.0795)***	0.5315 (0.0535)***
Year 2005	1.3419 (0.0817)***	0.6089 (0.0574)***
Constants		-1.577 (1.105)
/Cut 1	2.3862 (1.0196)**	

/Cut 2	3.6542 (1.0196)***	
/Cut 3	4.1723 (1.0190)***	
/Cut 4	6.5659 (1.0223)***	
No observations	22,625	22,625
Number of instruments		284
Wald, chi2 (37)/LR, chi2 (37)	2236.32	15688.85
AR (2)		0.71 (0.476)
Hansen J, chi2 (247)		435.92 (0.347)

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

Source: Authors' computations based on RLMS, 1994-2005.