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Variatio Delectat Consumer Demand for Food Diversity

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Variatio Delectat:
Consumer Demand for Food Diversity

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Abstract:

Whereas a large number of empirical studies have been devoted to analysing consumer demand for specific products, much less attention has been paid to the household's demand for product variety (the number of different products consumed in a specific time period). This paper analyses consumer demand for food variety in Germany. The econometric analysis of 4.632 household in 1995 suggests, that variety increases with income and the number of children aged between 6 and 18 years and is significantly higher if the family lives in larger cities in East-Germany, and the housekeeping person is not additionally working full-time. A single male household consumes a significantly smaller number of different food products. The significant (and positive) impact of household income on food variety is in line with the hypothesis that consumption evolves along a hierarchical order as income increases.

JEL: D12, Q11

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Variatio Delectat:

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1. Introduction

Individuals differ in their consumption behaviour in various respects. The quantity consumed of a specific product for example has been found to be systematically related to different characteristics of the household (such as age and income of household members as well as the size and composition of the household, …) in a large number of empirical studies. By far less attention has been devoted to other dimensions of the consumption behaviour, such as the number of different products a household is consuming in a specific time period (product variety or product diversity).

Understanding variety in food consumption is important in several areas. First, food variety can be important for nutrition (Krebs-Smith et al., 1987). Secondly, studying variety in food consumption may also reveal consumption patterns useful for marketing (Trijp and Steenkamp, 1992). Knowledge of consumer preferences on variety may serve as a criterion for market segmentation and assist firms in adapting marketing strategies more effectively to consumers' needs.[1] Lancaster (1990) draws attention to the growing literature on the

[1] However, van Trijp and Steenkamp (1992) stress that a clear distinction between variation in overt behaviour and consumers' underlying motivations for this behaviour (variety seeking behaviour) is of great importance for marketing decisions. "Extending the product line in order to offer a portfolio of products within which consumers find the desired level of variety may be a viable strategy when consumers' variety seeking tendency is the major underlying consumer motivation for variation in overt behaviour. This strategy may be inappropriate, however, when other consumer motivations underlie variation in behaviour" (p. 182). These other motives for variation in overt behaviour have nothing to do with a preference for change in and of itself. They could result from the fact that the brand usually

relationship between international trade and product variety. And finally, from a macroeconomic point of view, the expanding variety of consumption plays an important role in the process of long-run growth and development. This literature takes up the idea that in the process of growth, consumption is expanded along the hierarchy of wants.

On the basis of observations for 4,632 households in Germany in 1995, we aim at empirically analysing the determinants of variety in food consumption. Following a short review of the theoretical and empirical literature in section 2, the data and the empirical results are reported in section 3. Section 4 summarizes and addresses areas for future research.

2. Theoretical Background

The traditional model of consumer choice, based on strictly quasi-concave preferences (smooth indifference curves convex to the origin), implies an inherent preference for variety. The individual will always consume all available products and the number of products consumed thus is independent of individual preferences and incomes. This can be seen in Figure 1(a) for the specific case of homothetic preferences.

Homothetic preference imply linear Engle curves (e_1, e_2, … e_i) for the n homogenous products ($i = 1 \ldots n$), all of them starting from the origin. For any given income $y > 0$, the individual consumes all products available. An increase in income simply raises expenditures for the various products (e_i) in fixed proportions without influencing the number of products consumed nor the composition of the commodity bundle. Similarly, individual-specific preferences imply different consumption patterns for different individuals, but still, the number of products consumed will be identical to the number of products available in the market for every individual.

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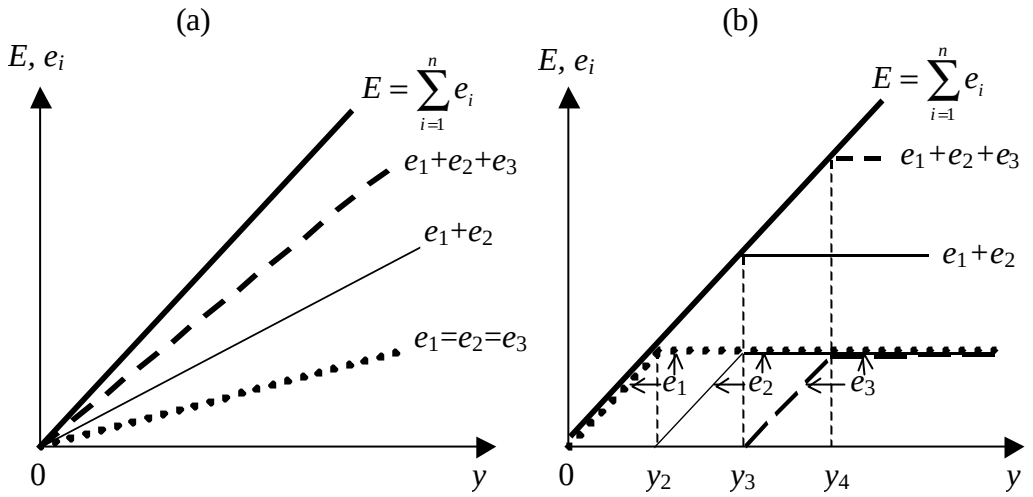
purchased is out of stock, that a competing brand currently is on sale, or that different household members prefer different products.

Figure 1: (Linear) Engel curves with strictly quasi-concave preferences (a) and hierarchical demand (b)



Remarks: See Falkinger and Zweimüller (1996)

Although homothetic preferences have been widely used in a large number of theoretical models as well as empirical demand studies[2], it is evident that this model is inadequate for analysing the demand for product variety.

A more appropriate framework for modelling demand for variety has been suggested by Jackson (1984). Jackson characterises a class - called hierarchic demand systems - for which only a subset of commodities are in the purchased set. This hierarchical structure of demand is illustrated in a stylised way in Figure 1(b). At low levels of income, only a small fraction of all goods available is actually consumed.[3] At certain levels of incomes (y_2, y_3 and y_4), non-necessities sequentially enter the consumption bundle. This implies a non-linear Engle curve and a systematic relationship between the income of a consumer and the variety of consumed

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[2] The popularity of this assumption is due mainly to attractive aggregation properties.

[3] Analytically, a hierarchy of purchases is modelled by specifically focusing on the non-negativity constraints in a demand system. Also note, that distinguishing between the traditional and the hierarchic model of consumer demand is impossible from the aggregate Engel curve.

products. For example, the number of products consumed is 1 for $0 < y < y_2$, 2 for $y_2 < y < y_3$ and 3 for $y_3 < y < y_4$.

Much of the existing empirical literature on the demand for variety focuses on the relationship between income and diversity. In a cross-section of 30 countries, Theil and Finke (1983) report an increasing diversity (measured inversely by the Herfindahl-index as well as the entropy-index) with countries' per capital real income. Similarly, estimation of cross-country Engel curves indicates that the number of goods consumed increases, and the concentration of expenditure decreases with income per head (Falkinger and Zweimüller, 1996). Jackson (1984) is among the first to study the demand for variety in a cross-section of households. Examining published data for 304 expenditure categories from the Consumer Expenditure Survey conducted in 1972-1973 in the USA, Jackson finds a significant and positive relationship between the number of commodities purchased and household income. This result is confirmed by the study of Shonkwiler, Lee, and Taylor (1987) on the basis of the 1977-1978 Survey of Household Food Consumption in the USA. The authors find that the number of individual food products consumed significantly increases with household expenditures on all foods. However, the authors explicitly point to the fact that their analysis is restricted to childless households which have one male and one female member each between 23 and 51 years of age. Since this group will not be representative of the average household, further analysis of the impact of additional variables (such as characteristics of the household) is required. Following this suggestion, Lee and Brown (1989) analyse data for 1,061 (urban) households from the 1981 consumer expenditure survey in the north-eastern region of the United States. In addition to a significant and positive impact of total food expenditure on the entropy measure and the Berry-Index, they also find that the demand for a diverse diet is positively related to the number of household members in different age-sex groups. Demand increases at a decreasing rate as household size increases.

In contrast to these studies, which are based on household survey data, the most recent study by Jekanowski and Binkley (2000) examines the factors that affect the variety of food purchases as reflected in aggregate sales shares across U.S. markets. Using data for 484 products in 54 market areas in 1990, the authors show that the diversity of expenditures decreases as the proportion of low-income consumers in the market increases. In addition, they also find significant effects of racial diversity as well as the average store size.

3. Data and Empirical Results

The present study utilizes Germany "Consumer Panel Research Data" provided by the GFK ("Gesellschaft für Konsumforschung"). This data base aims at recording the consumption behaviour of individuals for certain product groups e.g. food, beverages, products for washing and cleaning etc. as well as regional and socio-demographic characteristics such as income, size and composition of the household, age of household members. The present paper utilizes a subsample of the 1995 panel wave for 4.632 German private households which contains 149 food product groups. Not included are fresh food products like vegetables, fruits, meat, fish etc. These food products are included in another panel wave, which is not available for this study.

Research on variety in food consumption has used different measures. The number of food items actually consumed has been used in Jackson (1984), Shonkwiler et al. (1987) as well as Lee (1987). This index, although easy to apply and interpret, has the disadvantage, that it does not consider information on the distribution of individual food quantities consumed. A more appropriate alternative is the Berry-index (Berry, 1971), which is defined as $BI_i = 1 - H_i = 1 - \sum_{j=1}^{n} s_{i,j}^2$, where H_i is the well known Herfindahl-index for household i and $s_{i,j}$

is the share of product j in the total expenditures for food.[4] The present study distinguishes between 149 food products (n = 149). Another frequently used measure of diversity is the entropy index, which places greater weight on smaller shares and thus is especially sensitive to differences in the number of minor commodities in the market basket. It is defined as $EI_i = \sum_{j=1}^{n} s_j \log(1/s_j)$. The Entropy-index[5] as well as the Berry-index are bounded between 0 and 1, EI_i = 0 (BI_i = 0) indicates that this household only consumes one food product in the period under consideration and EI_i = 1 (BI_i = 1) refers to a situation where the household consumes equal shares of all 149 products considered. Since $0 \le EI_i \le 1$ and $0 \le BI_i \le 1$, one may be suspicious of the assumption of normality. Further, one may wish an estimator which ensures that predicted values for EI_i and BI_i are in the interval (0, 1). A popular transformation to alleviate these problems is the logit transformation (Greene, 1997, p.227f) where the dependent variables become $TEI_i = \ln[EI_i/(1-EI_i)]$ and $TBI_i = \ln[BI_i/(1-BI_i)]$. The definition and summary statistics of all variables used is reported in the following Table 1 and the results of the estimation model are shown in Table 2.

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4 This index is also known as Simpson-Index (Patil and Taillie, 1982).

5 The maximum for the entropy index is log(1/n). In what follows, we use the "relative Entropy Index" which is EI/log(1/n) = EI/5.

Table 1: Definition and descriptive statistics of variables used

Dependent Variable	Symbol	Mean (Std.Dev.)	Minimum Maximum
Berry Index: $= 1 - \sum_{j=1}^{n} s_j^2$ where s_j is the share of product j	*BI*	0.901	0.018
in total food expenditures and n is the number of products.		(0.073)	0.977
Transformed Berry Index is defined as: $TBI = \ln[BI/(1-BI)]$	*TBI*	2.367 (0.628)	-3.991 3.7697
Entropy Index: $= \sum_{j=1}^{n} s_j \log(1/s_j) / 5.0039$ where s_j is the share	*EI*	0.599	0.010
of product j in total food expenditures and n is the number of products.		(0.098)	0.806
Transformed Entropy Index is defined as: $TEI = \ln[EI/(1-EI)]$	*TEI*	xxxxx (0.578)	-3.991 9.210
Household income is the net monthly income in 1000 DM, reported in 13 income- intervals. The mean of each interval was chosen as the income for the respective household.	*INCOME*	3.248 (1.359)	0.250 5.750
The age of the household keeping person in years is reported in 12intervals. The mean of each interval was chosen as the relevant age for the household head.	*AGE*	51.151 (14.775)	10.000 72.000
The number of inhabitants (in 1000) of the village or city is reported in 12 intervals. The mean of each interval was chosen as the relevant city size for the respective household.	*CITY-SIZE*	293.786 (562.195)	1.000 2000.000
Dummy variable for East-Germany is set equal to 1 if the household is living in East-Germany and zero otherwise	*EAST*	0.200 (0.400)	0 1
Dummy variable for pursuing a full-time job. Is set equal to 1 if the household keeping person is pursuing a full-time job and is zero otherwise.	*FULL-JOB*	0.219 (0.414)	0 1
Dummy variable for pursuing a half-time job. Is set equal to 1 if the household keeping person is pursuing a half-time job and is zero otherwise.	*HALF-JOB*	0.094 (0.292)	0 1
Dummy variable for lowest education level. Is set equal to 1 if the principal wage earner has finished 9-year elementary school but does not have additional professional training (“Hauptschule ohne Berufsausbildung”) and is zero otherwise.	EDU_1	0.139 (0.346)	0 1

Dummy variable for education level. Is set equal to 1 if the principal wage earner has finished 9-year elementary school and has additional professional training (“Hauptschule mit Berufsausbildung”) and is zero otherwise.	EDU_2	0.276 (0.447)	0 1
Dummy variable for education level. Is set equal to 1 if the principal wage earner has an intermediate high school certificate but does not have additional professional training (“Mittlere Reife ohne Berufsausbildung”) and is zero otherwise.	EDU_3	0.067 (0.251)	0 1
Dummy variable for education level. Is set equal to 1 if the principal wage earner has an intermediate high school certificate and has additional professional training (“Mittlere Reife mit Berufsausbildung”) and is zero otherwise.	EDU_4	0.141 (0.348)	0 1
Dummy variable for education level. Is set equal to 1 if the principal wage earner has finished Highschool but does not have additional professional training (“Abitur ohne Berufsausbildung”) and is zero otherwise.	EDU_5	0.021 (0.142)	0 1
Dummy variable for education level. Is set equal to 1 if the principal wage earner has finished Highschool and has additional professional training (“Abitur mit Berufs-ausbildung”) and is zero otherwise.	EDU_6	0.021 (0.142)	0 1
Dummy variable for education level. Is set equal to 1 if the principal wage earner has a degree from a technical college (“Fachschule”) and is zero otherwise.	EDU_7	0.162 (0.369)	0 1
Dummy variable for highest education level. Is set equal to 1 if the principal wage earner has university degree (“Fachhochschule/Staatsexamen”) and is zero otherwise.	EDU_8	0.171 (0.377)	0 1
Number of children aged below 6 years.	$\#FAM_{<6}$	0.137 0.429	0 4
Number of children aged between 6 and 14 years.	$\#FAM_{6\text{-}14}$	0.235 0.568	0 4
Number of children aged between 15 and 18 years.	$\#FAM_{15\text{-}18}$	0.123 0.366	0 3
Number of family members living in the household aged 18 and above.	$\#FAM_{>18}$	0.937 0.759	0 6
Dummy variable which is set equal to one if the household comprises of a single female person and is zero otherwise.	*SINGLE-F*	0.214 0.410	0 1
Dummy variable which is set equal to one if the household comprises of a single male person and is zero otherwise.	*SINGLE-M*	0.037 0.188	0 1
Dummy variable for the occupation of the principal wage earner. Is set equal to one if the principal wage earner is a farmer and is zero otherwise.	*FARMER*	0.003 0.055	0 1
Dummy variable for the occupation of the principal wage earner. Is set equal to one if the principal wage earner is a carrying on a trade and is zero otherwise.	*TRADE*	0.015 0.124	0 1

Dummy variable for the occupation of the principal wage earner. Is set equal to one if the principal wage earner is a self employed and is zero otherwise.	*SELF*	0.013 0.111	0 1
Dummy variable for the occupation of the principal wage earner. Is set equal to one if the principal wage earner is a civil servant and is zero otherwise.	*CIV-SERV*	0.089 0.286	0 1
Dummy variable for the occupation of the principal wage earner. Is set equal to one if the principal wage earner is a white-collar worker and is zero otherwise.	*WHITE-COLL*	0.283 0.451	0 1
Dummy variable for the occupation of the principal wage earner. Is set equal to one if the principal wage earner is a blue-collar worker and is zero otherwise.	*BLUE-COLL*	0.177 0.382	0 1
Dummy variable for the occupation of the principal wage earner. Is set equal to one if the principal wage earner is a not employed (is retired, unemployed, etc) and is zero otherwise.	*NOT-EMP*	0.419 0.493	0 1

Table 2 reports the results of econometric models estimated on the transformed Berry- and Entropy Index, respectively. The results of the two models are very similar. The following discussion refers to the parameter estimates reported in column [1].

Table 2 clearly indicates that food diversity increases with household income. A 10% increase in household income raises the transformed Berry-Index (*TBI*) by 0.41%. The significant and positive impact of household income supports the notion of a hierarchical structure of product demand as suggested by Jackson (1984). A non-linear impact of income on *TBI* is not supported by the data, the parameter estimate of $INCOME^2$ did not contribute significantly to the explanatory power of the model and is thus not shown here. In addition to household income, characteristics of the family and in particular the housekeeping person, as well as regional characteristics significantly influence consumption decisions.

With respect to the occupation of the principal wage earner, we find that farmers (*FARMER*) significantly consume less different products in a given time interval than do blue-collar workers (the reference group). The dummy variables for the occupational status of other groups do not significantly influence the endogenous variables.

Table 2: Results of estimation model explaining differences in the transformed Berry- and Entropy Index (*TBI* and *TEI*) between households

Dependent Variable *Independent Variables*	Symbol	*TBI* Parameter (t-ratio)	*TEI* Parameter (t-ratio)
Constant	*CONST*	2.761 (20.33)	0.613 (6.86)
Household income	*INCOME*	0.030 (3.34)	0.020 (3.44)
Occupational status – farmer	*FARMER*	-0.483 (-3.50)	-0.309 (-3.58)
Occupational status – trade	*TRADE*	0.103 (1.31)	-0.055 (-1.06)
Occupational status – self employed	*SELF*	0.081 (0.91)	0.011 (0.19)
Occupational status – civil servant	*CIV-SERV*	0.080 (2.06)	0.031 (1.22)
Occupational status – white-collar w.	*WHITE-COLL*	0.035 (1.18)	0.003 (0.14)
Occupational status – not employed	*NOT-EMP*	-0.003 (-0.08)	-0.009 (-0.38)
Age of person keeping the household	*AGE*	-0.025 (-4.36)	-0.013 (-3.50)
(Age of person keeping the h.h.)^2/100	$AGE^2/100$	0.027 (4.65)	0.014 (3.64)
Dummy for full-time work	*FULL-WORK*	-0.103 (-3.59)	-0.078 (-4.11)
Dummy for half-time work	*HALF-WORK*	0.021 (0.65)	0.013 (0.63)
Dummy for level of education 1	EDU_1	-0.117 (-3.23)	-0.075 (-3.11)
Dummy for level of education 2	EDU_2	-0.003 (-0.10)	0.008 (0.40)
Dummy for level of education 3	EDU_3	-0.098 (-2.38)	-0.068 (-2.42)
Dummy for level of education 4	EDU_4	-0.014 (-0.45)	0.005 (0.22)

Table 2 to be continued

Dependent Variable *Independent Variables*	Symbol	*TBI* Parameter (t-ratio)	*TEI* Parameter (t-ratio)
Dummy for level of education 5	EDU_5	0.004 (0.06)	0.016 (0.40)
Dummy for level of education 6	EDU_6	0.006 (0.10)	0.014 (0.39)
Dummy for level of education 7	EDU_7	-0.031 (-0.98)	-0.009 (-0.43)
Number of children age 6 and below	$\#FAM_{<6}$	0.047 (1.87)	0.039 (2.29)
Number of children aged between 7 and 14	$\#FAM_{6\text{-}14}$	0.081 (4.84)	0.065 (5.92)
Number of children aged between 15 and 18	$\#FAM_{15\text{-}18}$	0.099 (3.96)	0.082 (4.91)
Number of family members aged > 18	$\#FAM_{>18}$	-0.008 (-0.44)	0.004 (0.31)
Dummy variable for single female h.h.	*SINGLE-F*	-0.010 (-0.30)	-0.048 (-2.17)
Dummy variable for single male h.h.	*SINGLE-M*	-0.392 (-6.15)	-0.325 (-7.66)
Size of the village (city)/1000	*CITY-SIZE*/1000	0.049 (3.31)	0.040 (4.07)
Dummy for East- and West-Germany	*EAST*	-0.059 (-2.49)	-0.063 (-3.95)
	R^2(adj.)	0.049	0.074
	F(4,605)	10.18	15.20
	LLF($\boldsymbol{b}$=0)	-4,416.8	-2,623.7
	LLF	-4,287.3	-2,432.9

Remarks: R^2(adj.) refers to the R^2 adjusted for the degrees of freedom, F is the F-statistics and LLF (and LLF($\boldsymbol{b}$=0)) is the log of the (restricted) likelihood function. The t-ratios are based on heteroscedasticity consistent estimates of the covariance matrix (White, 1980).

The diversity of food consumption is significantly related to the age of the housekeeping person (*AGE*). The Berry index (as well as the Entropy index) first decreases with age, reaches its minimum at the age of 46 years and then increases moderately again. This result

corresponds to Lee and Brown (1989) who also report a similar non-linear impact of the age of additional family members.

The variable *FULL-JOB*, which measures whether the housekeeping person has a full-time job, has a significant impact on food diversity in both equations. Pursuing a full-time job (*FULL-JOB* = 1) leaves less time for preparation of a broad range of different meals and significantly reduces the variety of food products consumed in this household. The relationship between the labour market activity of the housekeeping person and consumption behaviour is less pronounced part-time work (*HALF-JOB* = 1) is considered. Here, the parameter estimate is not significantly different from zero.

The relationship between schooling and consumption behaviour, which is found to be important in Lee (1987) for example, does not seem to be very strong here. Most of the seven dummy variables (EDU_1 to EDU_7) included in Table 2 are found to have a parameter estimate which is not significantly different from zero at the 5% level. Only in the case of low and very low levels of schooling (EDU_3, and EDU_1)[6] the (negative) parameter estimate is significantly different from zero.

With respect to household composition, two variables have significant explanatory power. The larger the number of children living in the household aged between 6 and 18 ($\#FAM_{6\text{-}14}$, and $\#FAM_{15\text{-}18}$), the larger is the degree of food diversity. The number of children below the age of 6 ($\#FAM_{<6}$) only is significant at the 1%-level in column [2], the number of additional family members aged 18 and above ($\#FAM_{>18}$) does not significantly influence food variety. The degree of food variety of single females (*SINGLE-F*) and a two person household (the reference group) is found to be very similar in column [1], the parameter estimate of *SINGLE-F* is not statistically significant. What really differs substantially is the consumption behaviour of a single male household (*SINGLE-M*). The parameter estimate for *SINGLE-M* and

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[6] The highest level of schooling (EDU_8) has been chosen as the reference situation here.

SINGLE-F indicates that the degree of food diversity of a single male household is 16.13% lower than that of an otherwise identical single and female person.

The two regional characteristics included in Table 2 both influence consumption behaviour significantly. Households living in larger cities consume significantly more different products than do households living in the country-side, diversity increases with the size of the village or town (*CITY-SIZE*). Further, we find significant differences between East and West Germany (*EAST*). Ceteris paribus, the degree of diversity is 2.53% higher in East-Germany *EAST* = 1). A more detailed analysis of regional differences reveals significant parameter estimates for many country dummy variables within East- and West-Germany, the results however do not influence the parameter estimates of the other explanatory variables described above.

4. Conclusions

This paper analysis one dimension of consumer demand for food products, which has not been investigated extensively so far, the demand for food variety. The econometric analysis of 4.632 household in 1995 for Germany suggests, that diversity in food consumption is significantly related to characteristics of the family and in particular the housekeeping person. Variety increases with income and the number of children aged between 6 and 18 years, declines (increases) with the age of the housekeeping person below (above) a threshold age of 46 years and is significantly higher if the family lives in larger cities in East-Germany, and the housekeeping person is not additionally working full-time. A single male household consumes a significantly smaller number of different food products. The significant (and positive) impact of household income on food variety is in line with the hypothesis that consumption evolves along a hierarchical order as income increases.

Following Jekanowski and Binkley (2000), analysing diversity within more narrowly defined product categories - as opposed the rather broad definition (all food products) used in the present study - seems to be a promising area of future research. Further, analysing individual

behaviour over time with panel data would allow us to eliminate unobservable time-invariant individual effects as well as address the issue of inertia in consumption behaviour.

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