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THE DYNAMICS OF FOOD DEPRIVATION AND OVERALL HEALTH: EVIDENCE FROM THE CANADIAN NATIONAL POPULATION HEALTH SURVEY

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The Dynamics of Food Deprivation and Overall Health: Evidence from the Canadian National Population Health Survey

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Abstract

The paper explores whether the responses to food deprivation questions on the longitudinal Canadian National Population Health Survey help explain the links between socio-economic status and health. Transitions in food deprivation status are correlated with changes in health status. While health transitions are correlated with changes in food deprivation status, there is little evidence that change in food deprivation status leads changes in health status but some evidence that change in health status leads change in food deprivation status.

Keywords: Food insecurity, Granger causality
JEL classification: I12, I32

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1. INTRODUCTION

Within every economy that has been studied, measures of individual socioeconomic status and measures of health tend to be positively correlated [1]. A simple possible explanation for part of this correlation might be that even in wealthy countries, some of the less affluent do not always obtain the necessities of life, perhaps because of a sheer lack of resources or perhaps because of a greater vulnerability to adverse events of various kinds. This paper attempts to investigate this empirically using the responses to questions regarding food deprivation in the Canadian National Population Health Survey (NPHS).

There are other related reasons to study the connections between food deprivation and overall health. Eliminating hunger and improving health are important policy goals. (See [2-3] and the many references therein.) It would be valuable to know if there were interactions so that progress toward one goal would spill over into gains on the other. In addition, the NPHS has no consumption or wealth questions so that a main indicator of socio-economic status is current income. But current income can be a poor indicator of economic capacity because the same amount of current income may have different implications for those with different wealth or different prospects, who live in different regions or who may receive different amounts of "in-kind" benefits. Hence our second motivation is to use food deprivation status as one measure of poverty and to examine the relationship between transitions in poverty status and changes in overall health.

Che and Chen [3] provide a thorough empirical analysis of responses to food insecurity questions in the third (1998-99) cycle of the National Population Health Survey (NPHS), concluding in part that food insecurity was correlated with health problems. However, their analysis was purely cross sectional. Our analysis takes advantage of a comparable food deprivation question posed to the same individuals in the second (1996-97) cycle of the NPHS (but not asked in the first or fourth cycles). This is the only opportunity with Canadian national survey data to investigate jointly the *transitions* in food deprivation status and health status.

We note from the beginning that as food deprivation is concentrated at lower socio-economic status [3], studying food deprivation is not likely relevant for the entire range of health (and mortality) differences [1, 4-9] that "run right across society with every level in the social hierarchy having worse health than the one above it" [10]. There may be many reasons for these differences and some may be operative at some socio-economic levels and not at others. We are focusing on that part of the correlation involving those with low socio-economic status and below-average health.

Section 2 discusses the data, Section 3 the results and Section 4 concludes.

2. DATA

2.1 THE SURVEY

The NPHS is administered by Statistics Canada and collects both cross-sectional and longitudinal data on the physical and mental health of Canadians, their use of health

care services, and other relevant socio-demographic information. The NPHS is comprised of three elements: the Household Survey, the Health Care Institution Survey and the Northwest Territories Survey. The Household Survey is used in this paper.

The NPHS Household Survey is administered to households in all provinces. Therefore homeless individuals are excluded, meaning that the extent of food deprivation is likely underestimated. See [11-12] for analyses of specialized surveys that include the homeless. Individuals who live on Indian reserves, Canadian forces bases, and in some remote areas of Quebec and Ontario are excluded from the household component. Each cycle of the NPHS collects general health information from all members of a household. Within each household a specific person participates in a more in-depth interview. A random sample of respondents is chosen to participate in the longitudinal response. These individuals must have reported in cycle 1 (1993-94) and continue to report in subsequent cycles. The attrition between cycles is minimal; close to 95% of those who responded in cycle 2 in 1996-97 also responded in cycle 3 in 1998-99 [13].

2.2 VARIABLES

In 1996-97, there was a food deprivation question: "*Thinking about the past 12 months, did your household ever run out of money to buy food?*" In 1998-99, the question was slightly different: "*In the past 12 months, did you or anyone else in your household not have enough to eat because of a lack of money?*" These questions are slightly different but much of our analysis compares the relative changes experienced by different

groups and hence does not require perfect comparability. In both cases answers are coded as zero for no and one for yes.

The NPHS reports two measures of health status. The first is an ordinal measure of self-reported health (SRH). Questions regarding SRH have respondents answer the question "*How would you evaluate your health status?*" by stating either: excellent, very good, good, fair or poor which are coded as 1, 2, 3, 4 and 5 respectively. There is some evidence that overall reporting patterns in SRH are consistent over time with equal percentages reporting health improvement and deterioration [14].

However, while it makes no difference to our conclusions, we emphasize a second measure, the Health Utility Index (HUI), a generic health status index developed at McMaster University's Centre for Health Economics and Policy Analysis (CHEPA) and based on the Comprehensive Health Status Measurement System (CHSMS). The CHSMS is a method to describe an individual's overall functional health based on eight self-reported health attributes. These attributes are: vision, hearing, speech, mobility, dexterity, cognition, emotion, and pain and discomfort. The HUI synthesizes these attributes into a single numerical measure of health. Its weights were constructed from interviews on a sample assembled by the developers of the index and intended to elicit societal views of different conditions. A value of 1.000 indicates perfect health; a value of 0.000 indicates death, and negative values indicate health states considered worse than death. Increments are 0.001 [15, Appendix F, p. 21].

Other variables we use in the analysis include age and a labour force status dummy (EMPLOY equals one if the person is currently employed, 0 otherwise). The latter variable is included in part because there is some evidence that unemployed individuals may systematically overreport certain chronic conditions on the NPHS [16]. Income is included as a set of categorical variables indicating whether the individual reports household income between $0 and $5,000, $5,000 and $10,000 etc. Because income is a categorical variable, it is not possible to correct for inflation. However inflation was low during this period at a cumulative 3.4% from 1996 to 1998. Some summary statistics on the data are given in the Appendix.

2.3 SAMPLE RESTRICTIONS

Not every observation record in the NPHS is complete. The overall sample size for individuals present in both cycles 2 and 3 is 14,619. Because we want to use the same sample throughout our analysis and because we want to use income as a variable, we exclude households that did not report their household income for 1996 and 1998, reducing the sample size by 1,209 and a further 959 observations respectively. Households that did not answer the food deprivation question for 1996 and 1998 were also removed from the sample, resulting in an additional 17 and 49 observations lost respectively. Another variable that will be prominent in our subsequent analysis is labour force status: households that do not report labour force status are excluded from the sample, reducing the sample size by an additional 2,444 observations for 1996 and 216 observations for 1998. Finally, respondents who do not have a HUI derived for 1996 and

1998 are also excluded, resulting in an additional 41 and 46 lost observations respectively. With these exclusions, the sample size is reduced by 4,981 observations to 9,638. While this loss of observations is not ideal, recall our focus is not on measurement in any one year but on transitions, and it is important to our method that records be complete enough to examine alternative dimensions of the transition.

3. RESULTS

The basic data on food deprivation and health are reported in Table 3.1.

TABLE 3.1

FOOD DEPRIVATION AND HEALTH STATUS IN 1996 AND 1998

1998 FOOD DEPRIVATION		1996 FOOD DEPRIVATION: NO	1996 FOOD DEPRIVATION: YES
		8753 (90.8%)	479 (5.0%)
NO	HUI96	0.913 [0.154]	0.835 [0.225]
	HUI98	0.900 [0.173]	0.853 [0.212]
		216 (2.2%)	190 (2.0%)
YES	HUI96	0.815 [0.247]	0.712 [0.309]
	HUI98	0.772 [0.282]	0.700 [0.312]

THE TOP NUMBER REPORTED IS THE NUMBER OF OBSERVATIONS THAT ARE IN THE CATEGORY. THE NUMBER IN PARENTHESES IS THE CORRESPONDING PERCENTAGE. HUI IS THE AVERAGE VALUE FOR THE HEALTH UTILITY INDEX. THE NUMBER IN SQUARE BRACKETS IS THE STANDARD DEVIATION.

It can be seen that just over 90% of the sample who do not suffer food deprivation either year have better health status than the 2% who experience it both years, with the health status of those who experience it only one of the two years in between. Switching from food deprivation in 1996 to no food deprivation in 1998 is associated with an increase in health status from 0.835 to 0.853 and moving into food deprivation between the two years is associated with a decline in health status from 0.815 to 0.772. See the Appendix

Table A3.1 for the very similar results that use the larger unrestricted sample (where the only incomplete records removed are the small number that do not report health status or food deprivation status). That table also shows that very similar results are obtained when self-reported health status is used as the overall health measure.

The apparent relationship between the changes in Table 3.1 may be confounded by other variables. Suppose we consider a model such as:

$$HUI_t = \alpha_i + \beta F_{it} + \gamma Z_{it} + \varepsilon_{it} \qquad (1)$$

where α_i is a fixed effect for the ith individual which we allow also to be a function of age (in 1996), F_{it} are dummy variables representing the food deprivation status for that individual at time t, Z_{it} represents the labour force status variable and the income dummy variables which also change over time and ε_{it} is a random error. Because of the fixed effect approach, we do not control for education (which changes little over time), although an alternative would have been to allow the fixed effect to vary with education. Table 3.2 presents standard fixed effects regression OLS estimates of (1). From the age coefficient we can see there is evidence that health tends to improve for the young from 1996 to 1998 but the coefficient on age-squared shows that this effect reverses and accelerates over time (at an estimated age 25, as can be shown). We have used three different food status dummies representing (a) food status deterioration between 1996 and 1998 (b) food status improvement between 1996 and 1998 and (c) continued food deprivation both years. (The omitted category is no food deprivation either year.) Food status worsening has a coefficient of –0.0341 and food status improvement has a

coefficient of 0.0255, where the signs are as expected. The two coefficients are also statistically significant (at the 5 per cent level we will use throughout), are about the same magnitude and are not very far

TABLE 3.2

FIXED EFFECT REGRESSION WITH HEALTH UTILITIES INDEX AS DEPENDENT VARIABLE, 1996 AND 1998

n: 9638
R^2: 0.0457

	COEFFICIENT	STANDARD ERROR	T – STATISTIC	P – VALUE
AGE	0.0082	0.0025	3.23	0.001
AGE-SQUARED	- 0.0002	0.0000	- 6.04	0.000
FOOD_WORSEN	- 0.0341	0.0111	- 3.08	0.002
FOOD_IMPROVE	0.0255	0.0076	3.35	0.001
FOOD_NO_IMPROVE	-0.0029	0.0118	-0.25	0.806
EMPLOY	0.0082	0.0042	1.98	0.048
INC_0	0.0236	0.0230	1.03	0.304
INC_0_5	- 0.0159	0.0150	- 1.06	0.290
INC_5_10	0.0076	0.0099	0.76	0.445
INC_10_15	- 0.0080	0.0084	- 0.96	0.337
INC_15_20	0.0018	0.0080	0.23	0.819
INC_20_30	0.0045	0.0069	-0.66	0.509
INC_30_40	0.0044	0.0065	0.68	0.496
INC_40_50	0.0001	0.0062	0.01	0.991
INC_50_60	0.0029	0.0060	0.49	0.625
INC_60_80	0.0014	0.0054	0.26	0.796
CONSTANT	0.9151	0.0612	14.97	0.000

FOOD_WORSEN IS A DUMMY FOR SHIFTING INTO FOOD DEPRIVATION; FOOD_IMPROVE IS A DUMMY FOR SHIFTING OUT OF FOOD DEPRIVATION; FOOD_NO_IMPROVE IS A DUMMY FOR REMAINING IN FOOD DEPRIVATION. INC_0 IS A DUMMY FOR ZERO OR NEGATIVE INCOME. INC_0_5 IS A DUMMY FOR INCOME BETWEEN $0 AND $5000 PER YEAR. OTHER DUMMIES ARE DEFINED SIMILARLY WITH OVER $80,000 THE OMITTED CATEGORY.

from the corresponding values that were suggested by Table 3.1. The coefficient on the third food status dummy suggests there is no statistically significant *deterioration* in

health by those who remain food deprived in both years, although Table 3.1 indicates that these individuals have a lower level of overall health. The employment status dummy coefficient is positive and significant. An *F*-test cannot reject the null hypothesis that the income dummy coefficients are all zero and the other coefficients and their *t*-statistics are almost identical if the income dummies are omitted. Moreover, the results where self-reported health is used instead of HUI (see Appendix for Table A3.2) have exactly the same implications.

While models such as (1) are often interpreted in a causal framework, we view our estimates in Table 3.2 as just a convenient and accessible way to illustrate that the basic message of Table 3.1 is not altered when allowance is made for other variables that may influence health and/or food deprivation. In either Table 3.1 or 3.2, the apparent relationship between transitions in food deprivation and transitions in health status does not imply causality. Some authors [17-19] use quasi-experimental methods based on unexpected payments or regional variation in unemployment to infer causality from income to health but similar approaches are not available here. Instead we use a Granger causality approach ([20], p. 714). That is, we try to determine whether 1996 food deprivation status helps predict 1998 health status, conditional upon 1996 health status and other variables, and whether 1996 health status helps predict 1998 food deprivation status, conditional upon 1996 food deprivation status and other variables. The intuitive notion is that if, say, food deprivation does have a causal effect on health status, there should be some perhaps small fraction of cases in 1996 where a household is food deprived, has not yet experienced reduced health status but that the causal effect of the

food deprivation will reduce health status by 1998. One limitation of the approach is that the observation period is so short.

TABLE 3.3

CENSORED REGRESSION OF HUI98 ON VARIOUS LAGGED VARIABLES

n: 9638
PSEUDO-R^2: 0.9653

	COEFFICIENT	STANDARD ERROR	T – STATISTIC	P – VALUE
HUI96	0.6768	0.0119	56.80	0.000
AGE96	-0.0035	0.0008	-4.38	0.000
AGE96-SQUARED	0.0000	0.0000	- 1.05	0.293
FOOD96	- 0.0142	0.0083	- 1.70	0.090
EMPLOY96	0.0257	0.0051	5.05	0.000
INC96_0	-0.0608	0.0336	-1.81	0.070
INC96_0_5	- 0.0221	0.0280	- 0.79	0.429
INC96_5_10	-0.0497	0.0120	-4.14	0.000
INC96_10_15	- 0.0368	0.0098	- 3.74	0.000
INC96_15_20	-0.0218	0.0097	-2.26	0.024
INC96_20_30	-0.0212	0.0084	-2.52	0.012
INC96_30_40	-0.0112	0.0081	-1.38	0.169
INC96_40_50	-0.0019	0.0084	-0.22	0.825
INC96_50_60	0.0068	0.0086	0.79	0.432
INC96_60_80	0.0000	0.0088	0.00	0.998
CONSTANT	0.4475	0.0209	21.44	0.000

FOOD96=1 IF FOOD DEPRIVATION IN 1996, 0 OTHERWISE. SEE TABLE 3.2 FOR DEFINITIONS OF INCOME VARIABLE.

Table 3.3 examines whether food deprivation Granger-causes health status. We use the same auxiliary variables as used in Table 3.2 (and obtain similar results in a variety of other specifications, including those with the income variables omitted). The results here are from a censored regression because HUI has an upper limit of one. The key result is that the food deprivation coefficient has the expected sign but has a small

magnitude and it is not statistically significant at the 5 per cent level. It can be seen that the lagged employment status coefficient is positive and statistically significant. The income variable coefficients are now statistically significant; as the omitted category is income in excess of $80,000, the pattern of coefficients (mostly negative and declining in magnitude at higher income levels) is consistent with the standard income-health gradient. The results in Appendix Table A3.3 use self-reported health as a measure (and ordinal probit estimation) and are entirely consistent with the results discussed here.

Table 3.4 examines the predictive power of 1996 variables for 1998 food deprivation using a probit regression (where the presented results are the marginal effects). 1996 health status does have a statistically significant and fairly large coefficient with a magnitude about half that of the coefficient of 1996 food deprivation, many times greater than the employment status coefficient (which is not statistically significant) and about the same as the coefficient that corresponds to being in the $20,000 to $30,000 income range as opposed to being in the omitted over $80,000 income category. Note also that the income coefficients are statistically significant and are mostly positive with declining magnitudes, as might be expected. Again similar results are achieved with specifications in which the income variables and other variables are removed and in Appendix Table A3.4, where self-reported health status is used instead of HUI.

TABLE 3.4

PROBIT REGRESSION OF FOOD 98 ON VARIOUS LAGGED VARIABLES

n: 9638
PSEUDO-R^2: 0.2534

	MARGINAL EFFECT	STANDARD ERROR	T – STATISTIC	P – VALUE
FOOD96	0.0904	0.0123	13.30	0.000
AGE96	0.0021	0.0005	4.15	0.000
AGE96-SQUARED	-0.0000	0.0000	-5.33	0.000
HUI96	- 0.0462	0.0060	- 8.28	0.000
EMPLOY96	-0.0028	0.0030	-0.94	0.346
INC96_0	0.1185	0.0819	2.62	0.009
INC96_0_5	0.1667	0.0677	4.61	0.000
INC96_5_10	0.1310	0.0362	6.44	0.000
INC96_10_15	0.1085	0.0292	6.34	0.000
INC96_15_20	0.0872	0.0259	5.54	0.000
INC96_20_30	0.0416	0.0157	3.72	0.000
INC96_30_40	0.0247	0.0123	2.56	0.011
INC96_40_50	0.0120	0.0106	1.31	0.190
INC96_50_60	0.0008	0.0086	0.09	0.927
INC96_60_80	-0.0069	0.0072	-0.83	0.407

THESE ARE MARGINAL EFFECTS FOR A ONE UNIT CHANGE IN THE RIGHT HAND SIDE VARIABLE (OR A CHANGE FROM ZERO TO ONE, IN THE CASE OF A DUMMY VARIABLE). NOTES TO PREVIOUS TABLES APPLY. A CONSTANT IS USED IN THE ESTIMATION BUT HAS NO MARGINAL EFFECT.

4. CONCLUSION

This paper has examined the relationship between health status transitions and food deprivation transitions within a household. The data set derives from two similar food deprivation questions on the 1996 and 1998 Canadian National Population Health Survey. There is evidence that changes in health status are correlated with changes in food deprivation, even when allowance is made for potential correlations with other

variables. However, an approach based on Granger causality finds that there is no statistically significant effect of 1996 food deprivation status on 1998 health status, *conditional upon 1996 health status (and other1996 variables).* Part of this may be lack of power (although note the result does not change if the 1996 income variables are omitted) given that there are only two points of time in the analysis. But it is striking that the effect of 1996 health status on 1998 food deprivation status, conditional upon 1996 food deprivation status, appears to be large and statistically significant. Hence there is stronger evidence that causality runs from health status to food deprivation status as opposed to vice versa.

While food deprivation may only be relevant to the lower range of the socio-economic status/health gradient, our results do suggest the potential importance of causality from health to socio-economic status in that range. They also hint at the advantages of health policies that target less affluent households and thereby reduce the risk of subsequent food deprivation.

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APPENDIX

TABLE A2.1

DEFINITION OF ANALYSIS VARIABLES

VARIABLE	DEFINITION
AGE	The age of the household representative interviewed.
FOOD	= 1 if not enough money to buy food/not have enough to eat due to a lack of money
EMPLOY	= 1 if the respondent is currently employed
HUI	Health Utilities Index for respondent, maximum 1, 0=death, negative values possible
SELF_HEALTH	Respondent's general health (as viewed by the respondent). Ranked on a scale from 1 (excellent) to 5 (poor).
EX_HEL	= 1 if respondent reports EXCELLENT health.
VG_HEL	= 1 if respondent reports VERY GOOD health.
GOOD_HEL	= 1 if respondent reports GOOD health.
FAIR_HEL	= 1 if respondent reports FAIR health.
POOR_HEL	= 1 if respondent reports POOR health.
INC_0	= 1 if household income is $0 or less.
INC_0_5	= 1 if household income is less than $5,000.
INC_5_10	= 1 if household income is between $5,000 and $9,999.
INC_10_15	= 1 if household income is between $10,000 and $14,999.
INC_15_20	= 1 if household income is between $15,000 and $19,999.
INC_20_30	= 1 if household income is between $20,000 and $29,999.
INC_30_40	= 1 if household income is between $30,000 and $39,999.
INC_40_50	= 1 if household income is between $40,000 and $49,999.
INC_50_60	= 1 if household income is between $50,000 and $59,999.
INC_60_80	= 1 if household income is between $60,000 and $79,999.
INC_80	= 1 if household income is greater than $80,000.

TABLE A2.2

DESCRIPTIVE STATISTICS

VARIABLE	YEAR	MEAN	STANDARD DEVIATION
AGE	1996	41.7926	15.2496
	1998	43.7610	15.2470
FOOD	1996	0.0694	0.2542
	1998	0.0421	0.2009
HUI	1996	0.9029	0.1691
	1998	0.8912	0.1855
EMPLOY	1996	0.6420	0.4794
	1998	0.6539	0.4758
HHINC	1996	7.3320	2.3012
	1998	7.7144	2.3940
SELF_HEALTH	1996	2.2233	0.9452
	1998	2.2464	0.9579
EX_HEL	1996	0.2359	0.4246
	1998	0.2302	0.4210
VG_HEL	1996	0.4111	0.4921
	1998	0.4092	0.4917
GOOD_HEL	1996	0.2645	0.4411
	1998	0.2640	0.4408
FAIR_HEL	1996	0.0708	0.2564
	1998	0.0771	0.2667
POOR_HEL	1996	0.0177	0.1320
	1998	0.0195	0.1383

Table 2.1 provides some variable definitions and Table 2.2 has some basic summary statistics.

The basic data on food deprivation and health are reported in Table A3.1.

TABLE A3.1

FOOD DEPRIVATION AND SELF-REPORTED HEALTH STATUS IN 1996 AND 1998: NO DATA RESTRICTIONS

1998 FOOD DEPRIVATION		1996 FOOD DEPRIVATION: NO			1996 FOOD DEPRIVATION: YES		
		#	MEAN	SD	#	MEAN	SD
NO	HUI 96	12418	0.907	0.165	631	0.849	0.221
	HUI 98	12626	0.893	0.186	637	0.860	0.214
	SRH 96	12173	2.153	0.942	672	2.402	1.057
	SRH 98	12172	2.181	0.963	672	2.311	1.013
YES	HUI 96	278	0.832	0.242	245	0.741	0.298
	HUI 98	287	0.792	0.282	251	0.741	0.305
	SRH 96	289	2.505	2.505	255	2.839	1.237
	SRH 98	289	2.623	2.623	255	2.776	1.220

THE TOP NUMBER REPORTED IS THE NUMBER OF OBSERVATIONS IN THE CATEGORY. THESE VARY BECAUSE THE NUMBER OF MISSING VALUES VARIES BY CATEGORY, UNLIKE TABLE 3.1, WHERE THE SAME RESRICTED SAMPLE IS USED. HUI IS MEASURED ON A SCALE WHERE 0 IS DEATH, 1 IS PERFECT HEALTH AND NEGATIVE VALUES ARE POSSIBLE. THIS TABLE ALSO REPORTS SRH, THE AVERAGE VALUE OF SELF-REPORTED HEALTH ON A SCALE WHERE 1 IS EXCELLENT AND 5 IS POOR.

It can be seen that the HUI results are very similar to those in Table 3.1, even though here we have used the maximum number of observations available for each cell. The principal difference is that in cases where there is food deprivation, the HUI values in this table are somewhat higher, although the changes with transitions are identical. The SRH results have the same implications as the HUI results, namely that average food deprivation worsening is associated with average health worsening and vice versa.

The results in Table A3.2 again use the same restricted sample as used for Table 3.2, and are very similar to the results of that table. Recall that since self-reported health is on a scale where 1 is excellent and 5 is poor, it is consistent that FOOD_WORSEN has a positive coefficient as a shift into food deprivation is associated with a relative worsening

TABLE A3.2

FIXED EFFECT REGRESSION WITH SELF REPORTED HEALTH AS DEPENDENT VARIABLE, 1996 AND 1998

n: 9638
R^2: 0.0654

	COEFFICIENT	STANDARD ERROR	T – STATISTIC	P – VALUE
AGE	0.0086	0.0138	0.62	0.532
AGE-SQUARED	-0.0000	0.0001	0.53	0.597
FOOD_WORSEN	0.1092	0.0603	1.81	0.070
FOOD_IMPROVE	-0.1007	0.0414	-2.43	0.015
FOOD_NO_IMPROVE	-0.1041	0.0641	-1.62	0.104
EMPLOY	-0.0483	0.0226	-2.14	0.033
INC_0	-0.0116	0.1251	-0.09	0.926
INC_0_5	0.1418	0.0817	1.74	0.083
INC_5_10	0.0324	0.0538	0.60	0.548
INC_10_15	0.0308	0.0455	0.68	0.498
INC_15_20	-0.0007	0.0436	-0.02	0.988
INC_20_30	-0.0135	0.0374	-0.36	0.719
INC_30_40	0.0049	0.0351	-0.14	0.889
INC_40_50	-0.0186	0.0338	-0.55	0.583
INC_50_60	-0.0196	0.0326	-0.60	0.547
INC_60_80	-0.0666	0.0291	-2.29	0.022
CONSTANT	1.7486	0.3266	5.35	0.000

FOOD_WORSEN IS A DUMMY FOR SHIFTING INTO FOOD DEPRIVATION; FOOD_IMPROVE IS A DUMMY FOR SHIFTING OUT OF FOOD DEPRIVATION; FOOD_NO_IMPROVE IS A DUMMY FOR REMAINING IN FOOD DEPRIVATION. INC_0 IS A DUMMY FOR ZERO OR NEGATIVE INCOME. INC_0_5 IS A DUMMY FOR INCOME BETWEEN $0 AND $5000 PER YEAR. OTHER DUMMIES ARE DEFINED SIMILARLY WITH OVER $80,000 THE OMITTED CATEGORY.

of health. Similarly FOOD_IMPROVE has a negative coefficient which has almost the same magnitude as the FOOD_WORSEN coefficient, similar to the HUI case. However, unlike the case with HUI as the dependent variable, the dummy associated with remaining in food

deprivation has a negative coefficient, although that coefficient is not statistically significant at the 5 per cent level used in this paper.

Unlike the HUI case, the age coefficients are not statistically significant but like the HUI case, there is evidence of a statistically significant positive association between health and employment status. Also like the HUI case, an *F*-test cannot reject the null hypothesis that the income dummy coefficients are zero. Again it turns out that if we omit the income dummies, it makes almost no difference to the remaining results.

TABLE A3.3

ORDERED PROBIT REGRESSION OF SRH98 ON VARIOUS LAGGED VARIABLES

N: 9638

PSEUDO-R^2: 0.1382

	COEFFICIENT	STANDARD ERROR	T – STATISTIC	P – VALUE
SRH96	0.7375	0.0139	53.15	0.000
AGE96	0.0209	0.0045	4.69	0.000
AGE96-SQUARED	-0.0002	0.0001	- 2.96	0.003
FOOD96	0.0555	0.0468	1.18	0.236
EMPLOY96	-0.1611	0.0285	-5.65	0.000
INC96_0	0.1577	0.1921	0.82	0.412
INC96_0_5	0.1938	0.1569	1.23	0.217
INC96_5_10	0.3872	0.0683	5.67	0.000
INC96_10_15	0.3515	0.560	6.28	0.000
INC96_15_20	0.3224	0.0551	5.86	0.000
INC96_20_30	0.2918	0.0479	6.10	0.000
INC96_30_40	0.1901	0.0462	4.11	0.000
INC96_40_50	0.1541	0.0478	3.22	0.001
INC96_50_60	0.1502	0.0487	3.08	0.002
INC96_60_80	0.1720	0.0495	3.47	0.001

FOOD96=1 IF FOOD DEPRIVATION IN 1996, 0 OTHERWISE. SEE TABLE 3.2 FOR DEFINITIONS OF INCOME VARIABLE. ORDERED PROBIT ESTIMATION DOES NOT PROVIDE AN ESTIMATE OF A SINGLE CONSTANT BUT RATHER CUTPOINTS WHICH ARE HERE: 1.3754, 2.7391, 4.0010 AND 5.0796, ALL WITH STANDARD ERRORS CLOSE TO 0.10.

Because self-reported health is an ordinal categorical variable, when it is used as a dependent variable ordinal probit estimation is a better technique than censored regression. Table A3.3 presents ordinal probit results using self-reported health in a situation otherwise similar to Table 3.3. The results in the two tables are similar.

Moreover we obtain similar results (not reported) if censored regression is used with self-reported health as a dependent variable.

TableA3.4 is analogous to Table 3.4 in the text except that self-reported health is used instead of the HUI as a health measurement. The results in the two tables are almost the same.

TABLE A3.4

PROBIT REGRESSION OF FOOD 98 ON VARIOUS LAGGED VARIABLES

n: 9638
PSEUDO-R^2: 0.2534

	MARGINAL EFFECT	STANDARD ERROR	T – STATISTIC	P – VALUE
FOOD96	0.0939	0.0125	13.68	0.000
AGE96	0.0022	0.0005	4.30	0.000
AGE96-SQUARED	-0.0000	0.0000	-5.48	0.000
SRH96	0.0089	0.0013	6.90	0.000
EMPLOY96	-0.0032	0.0031	-1.07	0.286
INC96_0	0.1035	0.0759	2.43	0.015
INC96_0_5	0.1623	0.0663	4.57	0.000
INC96_5_10	0.1230	0.0347	6.25	0.000
INC96_10_15	0.1045	0.0284	6.25	0.000
INC96_15_20	0.0826	0.0250	5.40	0.000
INC96_20_30	0.0393	0.0152	3.60	0.000
INC96_30_40	0.0228	0.0118	2.41	0.016
INC96_40_50	0.0105	0.0102	1.18	0.237
INC96_50_60	0.0001	0.0084	0.01	0.991
INC96_60_80	-0.0070	0.0071	-0.86	0.392

THESE ARE MARGINAL EFFECTS FOR A ONE UNIT CHANGE IN THE RIGHT HAND SIDE VARIABLE (OR A CHANGE FROM ZERO TO ONE, IN THE CASE OF A DUMMY VARIABLE). FOOD96=1 IF FOOD DEPRIVATION IN 1996, 0 OTHERWISE. SEE TABLE 3.2 FOR DEFINITIONS OF INCOME VARIABLE.

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