A CASUAL ANALYSIS OF THE HEALTH-INCOME NEXUS

HAK-JU KIM*

The purpose of this paper is to shed some light in this casual relationship of health- income nexus in Korea, where the social safety net is not well devised, compared to Scandinavian countries. This paper utilizes five waves of data drawn from the KLIPS to analyze the relationship between income and health status. The difficulty in approaching this task is that both income and health may be endogenous; it is just as likely that health affects income as vice versa. Using the instrumental approach, this paper performed two-stage random effects panel model, which is a straightforward strategy to deal with reverse causality bias. Using instrument approach, this paper examine the casual effects of health and income after controlling for covariates, such as age, sex, education and employment status. The results found that there is a reciprocal relationship between health and income and particularly the causal link running from income to health may be a little bit stronger than vice versa. However, health status became emerged as very strong predictor of level of household income and employment, more importantly than level of education. These findings suggest that the recent programs to prompt employment of the economically active population by the central and local governments may not be effectively removing employment barriers for unhealthy workers and that stronger public awareness and/or enforcement may be required.

I. INTRODUCTION

Previous studies have documented that there is a strong link between health and economic resources (Ettner, 1996; Meer, Miller, Rosen, 2003; Smith 1999). The inverse relationship between poor health and income has long concerned social scientists: The lower one's economic resources is, the higher the prevalence of health problems. But we have relatively little empirical knowledge about

the causal effects of health-economic resources. The nature of this relationship is central to economists' understanding of life cycle wealth accumulation, and to the interpretation of cohort based age-wealth profiles. Further, it is directly relevant to the public policy debate over health care. In particular, it is widely assumed that there is a causal link running from economic wealth to health, and that, as a consequence, the key to improving health status is to transfer income to the poor.

However, there is ongoing debate about the direction and size of effects of causation of the health-economic resources and the possibility of a reciprocal relationship of them theoretically and empirically. First, changes in economic resources directly affect one's health. Individuals with more income or assets can afford better medical care services and upgrade environments (Ettner, 1996; Smith, 1999). However, Health can also influence one's economic wellbeing and resources (reverse causality hypothesis). Healthier individuals may be able to work more than those who are ill, enabling them to earn higher income and accumulate more assets (McClellan, 1998; Levy, 2000; Wu, 2003). Empirically, there are relatively many evidences that economic wellbeing affect health status (Kitigawa and Hauser, 1973).

The standard analysis on economic resources and health, which is based on the cross-sectional data, is limiting its predictive ability in drawing causal inferences. As noted above, the direction of the association between economic wellbeing and health that could be potentially bi-directional. Furthermore, it is likely that there is a substantial time delay in the real world necessary for individuals' health to be affected by changes in their economic status. Recent econometric literatures on the panel data analysis direct an attention to addressing this question. In order to shed some lights on the above controversy, investigation into the potential endogeneity bias and lag structure of the effects of income on health is called for. For this purpose, Granger causality test can be the good starting point of empirical analyses. According to Granger (1969), the causal relationship between two variables can be determined by examining the way they move with respect to each other over time. In the Granger sense, the first variable causes the second variable if the forecast for the second variable improves when lagged values of the first variable are taken into account. However, empirical work designed to test causality has so far been limited in specific sectors and not been able to provide conclusive results. One of the basic problems inherent in the literature is that a sufficiently long time series necessary for using Granger causality test is not likely to be available for social science. On the other had, recent theoretical developments in Granger causality methods have made tests using relatively short time series possible through the use of panel data. The techniques called

dynamic panel data estimation are widely used in causality analyses. We also conducted a random effect panel regression analysis to examine factors that affect the likelihood of receiving accommodations after controlling for other covariates, such as age, education, sex, and employment status.

II. LITERATURE REVIEW

Most studies on the causal link between health and income has been done in the United States and rich OECD countries, where the social safety net is relatively well equipped and relatively little research has been carried out in Asia countries. Regarding the measure of economic wellbeing, a number of studies have used income, and virtually all indicates that health improves with income (See, for example, Ettner, 1996; McDonough, *et al.,* 1997; Meara, 2001). Relatively few studies have explored the role of wealth. Jianakoplos, Menchik, and Irvine (1989), using the National Longitudinal Survey (NLS) of older men, show that elderly individuals in the bottom two deciles of the wealth distribution exhibit mortality rates three times as large as those of individuals in the top docile. More recently, Menchik (1993) uses the NLS of Older Men to estimate mortality over a 15 – year panel and finds an inverse relationship between mortality and wealth which persists in the presence of controls for health, permanent income, and background variables. The negative relationship between economic resources or status and health is also found whether social inequality is measured at an individual level or at the level of neighborhood, community, or even society (Kawachi, 1999; Kennedy et al. 1998).

On the other hand, researchers in this area are well aware of the possibility that economic resources and health status may be simultaneously determined. However, not much has been done to deal with this causal problem econometrically. One careful attempt, by Ettner (1996), examines the relationship between health and income in an ordered probit instrumental variables framework. Among the instruments she uses for an individual's income are the state unemployment rate, work experience, parental education, and spousal characteristics. She finds that the effect of income on health remains significant and even increases after controlling for instrument variables. Of course, the instrumental variables results are dependent on the assumption that the instruments can be excluded from the main regression, and as Ettner notes, there may be some problems in this regard.

Hurd, McFadden, and Merrill (1997) also analyze the causal relationship between health and wealth. They use data from the Asset and Health Dynamics among the Oldest-Old (AHEAD) study, and focus on Granger-causality between measures of socioeconomic status and health.1 They find that self-reported health status (SRHS) in 1993 is correlated with changes in wealth between 1993 and 1995, but that changes in health conditions, conditional on SRHS, are not correlated with changes in wealth. They also find that measures of socioeconomic status in 1993 are correlated with mortality rates between 1993 and 1995.

III. METHODOLOGY

A two-stage panel regression is used to control for the potential reverse causality of health and income as well as other economic and demographic characteristics in this study as well as controlling for unobserved heterogeneity. For example, in order to analyze the effect of health on income, the first-stage health regression predicts the health stock of the economically active population as a function of behavioral risk factors and other explanatory variables from the second-stage income equation. The reverse causality can be tested likewise. This instrumental variables approach handles exogenously the unbalanced panel data

In the first stage, the health equation is,

$$x_{it} = \mathrm{Z}_{it}\gamma + \mathrm{M}_{it}\delta + \mu_{it}$$

$$\left(i = 1,\ldots\ldots\ldots, N; t = 1,\ldots\ldots\ldots, T\right)$$

where Z_{it} is a vector of demographic and economic variables, which are exogenous, included as covariates and M_{it} is a vector of indicator variables, The income equation is specified as,

$$y_{it} = \mathrm{Z}_{it}\alpha + \hat{x}_{it}\beta + \nu_i + \varepsilon_{it} \qquad (1)$$

where y_{it} is the dependent variable as a proxy of economic resources at time t for the individual observations i respectively. $\hat{x}_{it}$ is the predicted variable of the each individual's health stock at t from the first-stage regression, α and β are the coefficients of the linear projection of y_{it}, ν_i and

ε_{it} are residual terms: ν_i is the unit-specific residual and assumed to be random, independent and identically distributed over the panels, by calculating means,

$$\overline{y}_i = \overline{Z}_i\alpha + \overline{x}_i\beta + \nu_i + \overline{\varepsilon}_i \quad (2)$$

differencing equation (2) from (1) to remove the random effects and then estimate the model, we can get the following equation

$$(y_{it} - \overline{y_i}) = (Z_{it} - \overline{Z}_i)\alpha + (x_{it} - \overline{x}_i)\beta + (\varepsilon_{it} - \overline{\varepsilon}_i) \quad (3)$$

IV. DATA

The estimation framework in this study models the short-term change in health status of an individual as a function of the change in household income and other covariates. For this purpose, the data are drawn from the Korean Labor and Income Panel Study (KLIPS). The KLIPS is a longitudinal survey of a representative sample of the South Korean population. The samples are randomly drawn with equal probability from 7 metropolitan cities and the burden areas in 8 provinces in Korea. In 2004, 11,661 individuals aged 15 years old and over are selected from 4,762 households, excluding Jeju Island (Korean labor institute, 2005). Data exist for individuals as well as for the family units in which they reside. For this study, only five waves from the total seven waves of panel data, which include self-rated health status, are used: the 1999, 2000, 2001, 2003, and 2004 waves, except for the 1st (1998) and the 5th (2002) waves. I also excluded people who were not age eligible in 2004 and only contained the economically active population aged 15 and 64. The final sample was 9,771 individuals.

V. VARIABLES

The key variables included are aggregate household equalized income, self-rated health, and socio-demographic covariates for each individual. To determine household equalized income as a proxy for economic resources, the OECD Equivalence Scale, which equals $(N)^{0.5}$, where N = the number of

household members. In recent years the OECD measure has been used for international comparisons of income studies (Atkinson, Rainwater, & Smeeding, 1995).

Meanwhile, a variety of health measures have been utilized in previous studies. These include subjective health status, objective reports on chronic and acute health conditions, weeks of illness and level of medical care utilization. However a ongoing debate continues on how best to measure health status in the context of measuring socioeconomic wellbeing (Bazzoli, 1985; Sammartino, 1987). The health measures most frequently used in previous research are based on self-reported health status (Gordon & Blinder, 1980; Hanoch and Honig, 1985, Burkhauser & Quinn, etc). The use of self-assessed health measures has gained increased acceptance due to the belief that an individual may have relevant information as compared to that gained through objective medical evaluation (Menefee, 1980), Gustman and Steinnmeier (1994) utilized a health variable in their study that equals one if an individual reports that he is healthy and zero otherwise.

For this study, the measure of the individual's health status is based on the self-rated answer to the following question: "Would you say your health in general is very good, good, fair, poor, and very poor?" The answer to this question is coded on a 1 to 5 scale, from 1 being excellent to 5 as very poor. A prior study has shown that poor subjective health status is strongly correlated with mortality (Idler and Benjamin, 1997). This is true across many populations, and after controlling for a variety of socio-demographic variables, the presence of health conditions, and even medical doctors' objective health assessments. Additional evidence along these lines is provided by Hurd *et al.* (1997), who find correlations in the AHEAD data between the self-reported health and both mortality and the onset of several serious health conditions, again controlling for socio-demographic conditions. While the consensus thus appears to be that subjective health is a meaningful indicator of health, another dependent/endogenous variable is income. This study converted the household income variable to thousands of 2004 Korean won using the adjusted by the household equivalence scale. In addition, several demographic covariates that are included in the model are sex, age, and marital status. Employment status and behavioral risk factors are chosen as instruments.

VI. RESULT

Table 1. Descriptive Statistics: Yr 2004

(Unit: %, Mean)

			Self-rated health				
	%	(N)	Very Healthy	Healthy	Fair	Poor	Very Poor
All	100		1.21	9.76	31.35	52.69	4.99
Sex							
Male	49.62	(5051)	1.39	7.64	28.13	56.76	6.08
Female	50.38	(5129)	1.03	11.85	34.51	48.68	3.92
Education							
Elementary	9.81	(999)	4.8	34.13	35.04	25.33	0.70
Middle	13.17	(1341)	2.09	17.82	35.50	41.83	2.76
High	39.94	(4066)	0.89	7.11	31.48	55.48	5.04
College and above	37.07	(3774)	0.29	3.31	28.75	60.78	6.86
Marital Status							
Married	63.52	(6466)	1.19	11.46	35.15	48.93	3.26
Single	30.71	(3126)	0.61	3.29	22.20	64.78	9.12
Separated/Divorced	2.8	(285)	5.96	22.11	36.49	32.98	2.46
Windowed	2.98	(303)	3.3	28.71	39.60	26.73	1.65
Employment (binary)							
Employed	58.71	(5977)	0.35	7.58	33.11	54.76	4.2
Unemployed	41.29	(4203)	2.43	12.87	28.84	49.75	6.11
Employment Status							
Regular	32.02	(3252)	0.15	4.21	30.38	60.21	5.04
Temporary	4.23	(430)	0.70	7.67	34.88	50.93	5.81
Daily	4.6	4(67)	0.64	15.42	38.33	43.68	1.93
Employer	4.9	(498)	0.20	5.62	32.53	58.03	3.61
Self-employed	8.74	(888)	0.68	12.95	37.16	47.07	2.14
Family business	4.11	(417)	0.72	15.83	38.85	41.25	3.36
Unemployed	41.39	(4203)	2.43	12.87	28.84	49.75	6.11
Smoking							
Yes	30.96	(2876)	1.80	9.11	30.54	54.21	4.34
No	69.04	(6413)	1.26	12.46	32.7	49.58	4.00
Drinking							
Regularly	13.3	(1235)	1.31	9.26	32.33	53.47	3.63
Occasionally	38.58	(3584)	1.06	8.12	31.7	54.43	4.68
Never	48.12	(4470)	1.76	14.7	32.2	47.56	3.78
Exercise							
Regularly	11.99	(1114)	1.57	9.74	31.80	52.63	4.26
Occasionally	11.17	(1038)	0.62	9.36	30.34	55.93	3.75
Rarely/None	76.83	(7137)	1.52	11.97	32.3	50.07	4.13
			MEAN(S.E)				
Age	38.00	13.17	29.42	34.96	40.47	49.28	50.46
Asset	1711.56	5923.30	1660.33	1629.53	1991.56	1406.34	703.02

*Note: All numbers in cells are weighted. Some cases may not be summed into 100.00% due to rounding.

Table 1 illustrates the distribution of 15-64 aged respondents' characteristics in terms of age, sex, education, martial status, employment status, asset, and behavioral risk factors (smoking, drinking, and exercise). As expected, most respondents are at least the highs school graduate or college and above (39.94 and 37.07%, respectively). Most of them are either regularly employed (32.02%) or unemployed (41.39%). Regarding health-relevant behavioral risk factors, more than two thirds (69.04%) are non-smokers and about half (48.12%) report not to drink. However, the majority of subjects (76.83%) do rarely exercise and only 12% of the sample report they enjoy the regular exercise. The most interesting point in Table 1 would be the fact that self-rated health status is disproportionately distributed. Approximately 58% reported their health status is either 'poor' or 'very poor.' A higher percentage of women reported healthy, while a higher percentage of men had poorer health status. Men belonged in 'very poor' category (6.08) is almost double of the case of women. Education and age also appears to be strongly correlated into poorer health status. For example, only 25.33% of subjects with elementary education had poorer health, while 60.78% of college graduates reported poor health. In addition, those who are regularly smoking and drinking are likely to being in poor health.

Table 2. Annual household equalized income statistics according to health status*

(Unit: 10,000 won, %)

	Total		Very Healthy		Healthy		Fair		Poor		Very poor		Ratio
Year	%	EI (M)	%	EI (M)	%	EI (M)	%	EI (M)	%	EI (M)	%	EI (M)	of DI
1999	100	1093.39	28.33	1215.37	47.02	1112.39	15.73	955.72	7.13	859.95	1.79	812.53	0.50
2000	100	1164.28	23.24	1220.99	52.40	1231.28	16.1	1062.07	6.86	781.35	1.4	709.19	0.72
2001	100	1209.84	5.53	1320.19	56.70	1286.17	22.83	1167.70	12.83	979.68	2.11	698.23	0.89
2003	100	1658.78	5.51	1777.20	53.23	1757.08	28.52	1648.82	10.97	1222.74	1.77	1112.83	0.60
2004	100	1790.36	4.99	1836.29	52.69	1865.79	31.35	1822.45	9.76	1351.78	1.21	992.15	0.85
PC(%)	-	Δ0.64	▽0.82	Δ0.51	Δ0.12	Δ0.68	Δ0.99	Δ0.91	Δ0.37	Δ0.57	▽0.32	Δ0.22	Δ0.70

*Note: EI=Average annual household equalized income, PC=Percentage changes of individuals and household equalized income from 1999 to 2004, and DI=Differences in household equalized income between Very healthy and Very poor, respectively..

Table 2 indicates average annual household equalized income according different health status. It is noteworthy that though reported annual average of household equalized income increased for the poor and healthy between 1999 and 2004, the ratio of difference in income between the healthy and poor has been increased by 70% during the same period. Although it is a small scale of variation is traced by year, mean income per person in 'very healthy' earns approximately 1.5 times of those in

'very poor' health category. Considerably the majority of subjects have been declined from 28.33 percent in 1999 to 4.99 percent in 2004.

Table 3. Spearman correlation scores between health and income: 1999, 2000, 2001, 2003, & 2004

	1	2	3	4	5	6	7	8	9	10
1. Health (1999)	_	.513	.428	.386	.350	-.150	-.109	-.182	-.175	-.126
2. Health (2000)	.327	_	.488	.417	.394	-.121	-.132	-.185	-.178	-.126
3. Health (2001)	.194	.255	_	.525	.500	-.148	-.139	-.173	-.153	-.135
4. Health (2003)	.156	.177	.314	_	.589	-.143	-.118	-.179	-.170	-.131
5. Health (2004)	.121	.148	.281	.409	_	-.147	-.113	-.176	-.163	-.125
6. Income (1999)	-.105	-.061	-.102	-.096	-.100	_	.334	.379	.354	.277
7. Income (2000)	-.073	-.097	-.105	-.083	-.080	.399	_	.360	.302	.239
8. Income(2001)	-.095	-.091	-.095	-.097	-.099	.368	.420	_	.488	.374
9. Income(2003)	-.103	-.105	-.082	-.118	-.107	.346	.349	.471	-	.414
10. Income (2004)	-.061	-.056	-.078	-.074	-.073	.286	.290	.375	.435	-

* All spearman coefficients are significant at p <.01 in two-tailed and boxed statistics are standardized by demographic variables (age, sex, education and marital status).

The above Table 3 shows the spearman's correlation matrix for the model dependent variables. The result indicates all lagged terms of dependent variables are inversely associated with each other (poor health and income) and all correlation coefficients are significant at $p < .01$. After adjusting for age, sex, and employment status, the correlation scores (in boxes) are a little decreased but still statistically significant.

Table 4. Household Equalized Income Regression

Dependent Variable:	OLS reg			Ranndom-effects panel reg			2SLS Random-effects panel reg		
Equalized income	Coef.	95% CI		Coef.	95% CI		Coef.	95% CI	
Health	0.043 **	0.020	0.066	0.058 ***	0.048	0.068	1.148 ***	0.680	1.615
Sex (male=1)	-0.057 **	-0.093	-0.022	-0.007	-0.028	0.015	-0.132 ***	-0.202	-0.062
Age	-0.004	-0.014	0.006	0.014 ***	0.009	0.019	0.036 ***	0.025	0.048
Age^2	0.000	0.000	0.000	0.000 ***	0.000	0.000	0.000 *	0.000	0.000
Education									
Middle	0.117 **	0.043	0.190	-0.088 ***	-0.120	-0.055	-0.104 **	-0.165	-0.043
High	0.173 ***	0.105	0.242	-0.056 ***	-0.079	-0.032	-0.149 ***	-0.210	-0.088
College and above	0.311 ***	0.239	0.384	0.030 *	0.001	0.058	-0.015	-0.072	0.042
(ref: elementary)									
Marital Status									
Single	-0.005	-0.060	0.051	0.010	-0.016	0.037	0.073 *	0.016	0.130
Separated/Divorced	-0.186 **	-0.294	-0.077	-0.202 ***	-0.271	-0.133	0.088	-0.079	0.254
Windowed	-0.191 **	-0.294	-0.087	-0.133 ***	-0.190	-0.076	-0.034	-0.137	0.069
(ref: married)									
Employment Status									
Regular	0.192 ***	0.151	0.233	0.141 ***	0.120	0.163	-0.064	-0.156	0.029
Temporary	0.034	-0.051	0.118	-0.022	-0.061	0.017	-0.225 ***	-0.335	-0.114
Daily	-0.013	-0.103	0.076	-0.093 ***	-0.137	-0.049	-0.265 ***	-0.375	-0.156
Employer	0.358 ***	0.278	0.437	0.137 ***	0.104	0.170	-0.099	-0.207	0.010
Self-employed	0.105 **	0.040	0.170	0.126 ***	0.093	0.160	-0.078	-0.179	0.023
Family business	0.087 *	0.002	0.172	0.052 *	0.006	0.097	-0.075	-0.168	0.019
(ref: Unemployed)									
Asset(log)	0.182 ***	0.171	0.193	0.090 ***	0.087	0.093	0.058 ***	0.046	0.070
Yr 2000				0.134 ***	0.114	0.155	0.171 ***	0.135	0.208
Yr 2001				0.059 ***	0.035	0.082	0.543 ***	0.338	0.748
Yr 2003				0.413 ***	0.391	0.435	0.892 ***	0.691	1.093
Yr 2004				0.494 ***	0.471	0.518	0.991 ***	0.780	1.201
(ref: Yr 1999)									
_cons				5.838 ***	5.732	5.943	0.938	-1.135	3.010
# of obs	6157			31874			33913		
R-square	0.221			0.360			0.182		
Wald statistics	χ^2=3094 p<.0001			χ^2=9239 p<.0001			χ^2=2795 p<.0001		

*p<.05 ** p<.01 ***p<.001*

Table 4 shows coefficients and 95% confidence intervals for three types of regression models for comparison. The dependent variable is the natural logged household equalized income. In the first column (1) of Table 4, the simple regression estimate of the health effect on household equalized

income is only 0.043. This estimate implies that the poorer health status reduces the probability of having a higher level of income only by 4.3%. The income also increases with their age and their educations, but the signs of the coefficients are not significant. The income equation estimation seen in column (2) of Table 4, shows a random effects panel regression model without considering reverse causality bias from income to health. The estimate of the effect of the self-rated health on income is 0.058 and is significant at the 0.1 % level. Although all the coefficients of covariates have the expected signs, the coefficients on the unmarried and temporary workers are not significant, while all time dummy variables are significant. Finally, column (3) of Table 4 finally presents the two-stage panel estimates of the income equation for 15-65 economically active population. Using the behavioral risk factors as IV, the two-stage IV panel estimate controls an endogenous health variable. The result clearly shows that poorer health has a large negative effect on their income, with a value of 1.148. This estimate implies that an additional unit of an increase of health status can increase the level of income by 114.8%.

Table 5. Employment Regression Model (employed=1)

Dependent Variable:	Probit reg			Ranndom-effects probit panel reg			2SLS Random-effects probit panel reg		
Employed or not	Coef.	95% CI		Coef.	95% CI		Coef.	95% CI	
Health	-0.226 ***	-0.277	-0.176	0.040 ***	0.035	0.046	0.346 *	0.082	0.610
Sex (male=1)	-0.829 ***	-0.903	-0.756	0.254 ***	0.240	0.268	0.209 ***	0.155	0.263
Age	-0.302 ***	-0.324	-0.279	0.081 ***	0.078	0.084	0.077 ***	0.072	0.083
Age^2	0.003 ***	0.003	0.004	-0.001 ***	-0.001	-0.001	-0.001 ***	-0.001	-0.001
Education									
Middle	0.259 **	0.098	0.419	0.001	-0.021	0.022	0.011	-0.023	0.046
High	0.262 **	0.113	0.411	-0.015 *	-0.030	-0.001	-0.030	-0.059	0.000
College and above	0.135	-0.022	0.293	0.029 **	0.012	0.045	0.022	-0.001	0.045
(ref: elementary)									
Marital Status									
Single	-0.336 ***	-0.460	-0.213	0.030 ***	0.016	0.045	0.057 ***	0.035	0.079
Separated/Divorced	-0.011	-0.241	0.219	0.019	-0.019	0.056	0.064	-0.004	0.132
Windowed	-0.214	-0.430	0.002	0.020	-0.012	0.051	0.018	-0.023	0.058
(ref: married)									
Asset (log)	0.061 ***	0.036	0.085	-0.001	-0.003	0.001	-0.004	-0.008	0.000
Yr 2000				0.010	-0.001	0.020	0.018 **	0.005	0.031
Yr 2001				0.037 ***	0.025	0.049	0.168 **	0.057	0.280
Yr 2003				0.028 ***	0.017	0.040	0.167 **	0.059	0.276
Yr 2004				0.022 **	0.009	0.034	0.164 **	0.052	0.277
(ref: Yr 1999)									
_cons				-1.295 ***	-1.357	-1.233	-2.516 ***	-3.688	-1.344
# of obs	6228			32505			27715		
R-square	0.245			0.317			0.220		
Wald statistics	χ^2=1182 p<.0001			χ^2=5381 p<.0001			χ^2=1591 p<.0001		

** p<.05 ** p<.01 ***p<.001*

Table 5 shows multivariate regression coefficient results on employment status (employed=1). As expected, IV estimate of the positive effect of health on the income is much larger than that of the cross-sectional probit estimate or panel probit estimates. Inconsistent with prior income regression model, categorical education variables which are significantly related to employment in the first column (1) are not statistically significant in third two-stage panel model except for being in a single in martial status and time effect variables. Respondents who report that they have never married are more likely to be employed, in comparison to the married respondents and it is statistically significant at 5% level. Results suggests that after controlling for endogeneity bias and subject-specific unobserved heterogeneity, one's health status as well as demographic variables, age and sex, are the key predictor of being employed among respondents.

Table 6. Health Regression Models

Dependent Variable:	OLS reg			Ranndom-effects panel reg			2SLS Random-effects panel reg		
Health	Coef.	95% CI		Coef.	95% CI		Coef.	95% CI	
HH equalized income (log)	0.072 ***	0.039	0.106	0.085 ***	0.071	0.982	1.408 ***	1.172	1.643
Sex (Male=1)	0.103 **	0.043	0.163	0.116	0.081	0.151	0.044 *	0.001	0.087
Age	-0.002	-0.017	0.014	-0.006 ***	-0.012	0.000	-0.041 ***	-0.051	-0.031
Age^2	0.000	0.000	0.000	0.000 ***	0.000	0.000	0.000 ***	0.000	0.000
Education									
Middle	0.260 ***	0.171	0.350	0.027	-0.012	0.066	0.172 ***	0.119	0.225
High	0.345 ***	0.261	0.429	0.097 ***	0.068	0.126	0.188 ***	0.150	0.226
College and above	0.382 ***	0.291	0.473	0.058 **	0.021	0.095	0.007	-0.046	0.061
(ref: elementary)									
Marital Status									
Single	-0.046	-0.124	0.031	-0.059 **	-0.094	-0.025	-0.071 *	-0.126	-0.015
Separated/Divorced	-0.297 ***	-0.441	-0.154	-0.231 ***	-0.321	-0.141	0.169 *	0.013	0.324
Windowed	0.080	-0.045	0.205	-0.060	-0.130	0.009	0.221 ***	0.104	0.339
(ref: married)									
Asset (log)	0.022 **	0.006	0.038	0.016 ***	0.012	0.021	-0.123 ***	-0.150	-0.095
Smoking	0.002	-0.063	0.066	0.020	-0.019	0.059	0.109 ***	0.062	0.156
Drinking	0.027	-0.008	0.063	0.055 ***	0.034	0.077	0.022	-0.003	0.047
Exercise	-0.002	-0.032	0.028	0.022 *	0.004	0.041	-0.089 ***	-0.117	-0.061
Yr 2000				-0.037 **	-0.061	-0.012	-0.227 ***	-0.281	-0.172
Yr 2001				-0.439 ***	-0.466	-0.412	-0.478 ***	-0.525	-0.431
Yr 2003				-0.447 ***	-0.474	-0.419	-0.972 ***	-1.077	-0.867
Yr 2004				-0.481 ***	-0.511	-0.451	-1.104 ***	-1.224	-0.984
(ref:: Yr 1999)									
_cons				3.625 ***	3.478	3.771	-3.846 ***	-5.183	-2.509
# of obs	4390			27203			27203		
R-sq	0.149			0.279			0.124		
Wald statistics	χ^2 =2535 p<.0001			χ^2 =5908 p<.0001			χ^2 =3055 p<.0001		

** p<.05 ** p<.01 ***p<.001*

In the first OLS regression model, naturally logged household equalized income variable is a significant predictor of health status, next to education dummy variables. However, the coefficient results of income variable from IV approach appear to be most significant explanatory variable (1.408). In addition, all the other coefficients of covariates still have the expected signs and statistically significant. Those who have bad behavioral habits, such as regularly smoking, are at greater risk of being in poorer health (0.109). Sex and age are also significant predictors of having poor health status.

VII. CONCLUSION

This study examined the causal effects of health and income using two-stage panel approach. Using the IV method, the findings here confirmed the result from earlier studies abroad that income as a proxy for one's economic resources has a statistically strong reciprocal relationship with health. Even after adjusting for age, sex, and employment status, it is revealed that health status significantly affects income status. These findings suggest that the recent programs to prompt employment of the economically active population by the central and local governments may not be effectively removing employment barriers for unhealthy workers and that stronger public awareness and/or enforcement may be required. Health status became emerged as very strong predictor of level of household income and employment. However, we have to admit here that the above results are tentative due to data constraints. Since the lagged information on health status is omitted in the first and fifth waves, it was not possible to employ the dynamic panel data approach and thus distinguish the short-term and long-term effects of the predictor variable.

REFERENCES

Anderson, T. W. and Cheng H. 1982. Formulation and estimation of Dynamic Models Using Panel Data, Journal of econometrics, 18.

Atkinson, A. B., Rainwater, L., Smeeding T. 1995. Income distribution in OECD countries: evidence from the Luxembourg income study. Social Policy Studies No. 18. Paris: OECD.

Ettner, S., 1996. New evidence on the relationship between income and health. Journal of Health Economics 15, 67–85.

Granger, C. W. J., 1969, Investigating Casual Relations by Econometric Models and Cross-Spectral Methods. Econometrica 56, 424-438.

Holtz-Eakin, D., Newey. W. and Rosen, H. S. 1988, Estimating Vector Autoregressions with Panel Data. Econometrica 56. 1371-1395

Hurd, M. .D., McFadden, D., Merrill, A., 1998. Healthy, Wealthy, and Wise? Socioeconomic Status,

Cheng, H. 1986. Anaysis of Panel Data. Cambridge University Press, Cambridge, England.

Jianakoplos, N. A., Menchik, P. L. and Irvine, F. O. 1989. Using panel data to assess the bias in cross-sectional inferences ogf life-cycle changes in the level and compositionof household wealth, in R. Lispey and H. S. tice, eds, The Measurement of Saving, Investiment and Wealth', The University of Chicago Press, Chicago, 553-644

Kennedy, B. P., Kawachi, I., Glass, R. and Deborah Prothrow-Stith. 1998. Income

Distribution, Socioeconomic Status, and Self Rated Health in the Unoted States: Multilevel Analasis. British Medical Jounal 317. 917-921

Kawachi, I. 1999. Social Capital and Community Effects on Population and Indivisual Health. Annals of the New York Academy of Sciences 986,120-130

Kitigawa, Evelyn M. and Houser, Philip M. 1973 Differential Mortality in the United Statres: A Study in socioeconomic Epidemiology. Cambridge, MA:Harvard Universituy Press.

Kiviet Jan F. 1995. On bias, inconsistency, and efficiency of various estimators in dynamic panel data model. Journals of Econometrics 68.

Meer, J. Miller, D.L. and Rosen, H.S. 2003. Exploring the health-wealth nexus. Journal of Health Economics 22. 713-730.

Menchik, P.L. 1993. Economic Status as a Determinant of Mortality Among Black and White Older

Men:Does Poverty Kill?. Populration Studies 47, 427-436

Morbidity, and Mortality among the Elderly (Manuscript). University of Chicago, Berkeley.

Nickell, Stephen b1981. Biases in Dynamic Models with Fixed Effects. Econometrica 49,6.

Idler, E., Benyamini, Y., 1997. Self-related health and mortality: a review of twenty-seven community studies. Journal of Health and Social Behavior 38, 21–37.

Lefkowitz, B., 2000. Dollars Count More Than Doctors (http://www.inequality.org/healthdc2.html).

Levy, H., 2000. The Financial Impact of Health Insurance (Manuscript). Harris Graduate School of Public Policy Studies. University of Chicago, Berkeley.

Meara, E., 2001. Why is Health Related to Socioeconomic Status? The Case of Pregnancy and Low BirthWeight. NBER Working Paper No. 8231.

McClellan, M., 1998. Health events, health insurance, and labor supply: evidence from the health and retirement survey. In: Wise, D.A. (Ed.), Frontiers in the Economics of Aging. University of Chicago Press, Chicago, pp. 301–346.

McDonough, P., Duncan, G.J., Williams, D., and House, J., 1997. Income dynamics and adult mortality in the United States, 1972 through 1989. American Journal of Public Health 87 (9), 1476–1483.

Wu, S., 2003. The effects of health events on the economic status of married couples. Journal of Human Resources 38(1), 219–230.