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MICRO-LEVEL ANALYSIS OF CAUSALITY FROM HEALTH TO INDIVIDUAL INCOMES IN UKRAINE

We investigated the effect of health and aspects of health on income and implemented empirical analysis on micro- level. Ukrainian Longitudinal Monitoring Survey individual-level database is used for micro-level analysis of causality from differentials in health to differentials in monthly income. Significant impact of health to income in Ukraine has been proven.

Keywords: Income, health, Ukrainian Longitudinal Monitoring Survey.

Introduction

The key motivation of our research is based on the fact that health factor influence on income and inequality, especially in former USSR countries is heavily underestimated. For the last twenty years of transition most achievements of Soviet healthcare system were lost. In Ukraine for the period of transition were initiated 17 legislative draft bills, but none of them was adopted. Health care remains the only sector in Ukraine which wasn't reformed since time of independence. All this made considerable contribution towards deterioration of accessibility and quality of medical care in Ukraine.

The research questions that we plan to cover is how much income can be explained by different aspects of health on micro-level? Some issues of this aspect were partially covered by authors in one of the GDN Working Papers with Podvysotskiy Y. and Osinkina O.[8]. The aim of this paper is to investigate the issue with higher time horizon.

Literature Review

Well-known theoretical framework explaining relation between health and income was introduced by Grossman [3]. His model of demand for health explains two-way causality: from income to health via decreasing substitution effect as well as from health to income through increased productivity.

Causality from income to health so far is more studied and more commonly recognized. For example, as Marmot [5] stated 'even in most affluent countries, people who are less well-off have substantially shorter life expectancies and more illness than the rich.' Quite a number of empirical papers obtained empirical evidence of causality from income to health.

Some papers concentrated on exogenous shocks to income, for example, Lindahl [4] studied effect of lottery winnings on health, Frijters [2] studied the effect upon health of income increase of East Germans after reunion of Germany. These and many other researchers found rather significant effect of income on health; for example Lindahl found that a 10-percent income increase improves health by a twentieth of its standard deviation. Recent researches argue for prevailing importance for health of social, rather than pure economical, factors such as poverty, social support and inclusion, unemployment, working conditions and some other, see Marmot [5].

Previous evidence on poverty in Ukraine based on micro level largely comes from two studies by the World Bank [7], [8]. These use different survey instruments and are therefore not strictly comparable. The former provides a static picture based on 1995 data while the latter titled "Determinants of Poverty during Transition covers the period from 1999 to 2003" but is not very informative about the developments in the 1990s, the period of the most intense transition.

Gustafsson and Nivorozhkina (2004) provide quiet a good analysis of on the evolution of poverty and its determinants, also considering for health determinants, but they focus on one city only, which significantly restricts possibility for policy implications on the country level.

Bruck, Danzer and Murayev [1] studied the incidence severity and determinants of household poverty in Ukraine over time using multiple measures of household welfare. They analyzed how and how much long – term transition process affects household welfare, particular attention in their research was paid to adjustments of the labor market. Despite they tried to investigate different determinants of poverty, health aspect was not covered at all. To fill this gap we investigate causality from health to income in Ukraine.

Data and Construction of Variables

Here we introduce the ULMS individual-level database which was used for the micro-level empirical analysis in our paper. The ULMS panel data

set is similar to Russian Longitudinal Monitoring Survey, and is conceived as a statistically representative sample of the population aged 15 to 72 years in Ukraine, which comprises approximately 8,500 individuals. We used two rounds of ULMS, namely for years 2006 and 2010 (similar number of observations in both). The ULMS data set covers a number of aspects relating to health aspects of individuals – mainly life styles, morbidity, chronic diseases, and self-assessment of their health by individuals.

Because 'health' is individual-specific parameter, we used *individual-level database* for our empirical investigation.

As dependant variable we used actual income for the last month, which was constructed as total of the following incomes:

– official and unofficial *salaries earned* in the workplace during the last month;
– market value of the *in-kind benefits* received in the workplace during the last month;
– *additional salary* (or salaries) for the last month (if person worked at more than one place);
– income from *household production* (agricultural and non-agricultural).

Table 1. **Description of variables used in regressions**

Variable	Definition
Log of Income (for last 30 days)	Log of total: salary from all sources, household production at market prices
Drink (alcohol consumption)	*0* – "Less than once / month", …, *6* – "Every day"
Smoke	Number of cigarettes smoked per days
Sport (physical exercises out of work)	*0* – "No exercises", …, *4* – "Daily exercises >30 min"
Height	In centimeters
Age	In full years
Male	*1* – male, *0* – female
Nowork (did not have a paid work during the last week)	*1* – did not have a paid work, *0* – had a paid work.
Arrears (wage arrears incidence)	*1* – arrears took place, *0* – otherwise
Education	*1* – vocational training, *2* – professional college, *3* – university and above; 0
Settlement (type of settlement dummy)	*1* – village, *2* – town, *3* – large city
Health (self-assessed)	*1* – bad, *2* – average, *3* – good
Morbidity (health aspect,)	Constructed via PCA from a set of morbidity variables (more detailed info presented below)
Chronic morbidity (health aspect)	Constructed via PCA from a set of chronic morbidity variables (more detailed info below)
Life style (health aspect)	Constructed via PCA from a set of life style variables (more detailed info presented below)

Source: ULMS – Ukrainian Longitudinal Monitoring Survey.

We did not include pensions, stipends and unemployment benefits, as these types of income do not seem to reflect available human capital of an individual.

For empirical analysis a limited sample was selected – including only strictly positive monthly income not exceeding 5500 UAH. Selection of the limited sample was performed based on analysis of income distribution within the total sample. We observed the following two features of the total sample:

– high proportion (53 %) of persons with zero income (relates to non-working aged people receiving pension, students and other dependants, and unemployed);
– few persons (only three observations) with incomes above 5500 UAH.

Therefore, limiting our sample in the way described above, we concentrate on income of persons using their human capital, and also avoid obtaining biased results due to few outliers.

It is usual to look at sub-samples within a total sample to identify some specific relationships. Usually, within selected sample 'poor' and 'rich' categories are identified. In our analysis only 'poor' category is identified. We do not identify 'rich' category, as thinness of the upper tail of income distribution problem, which is inherent to all questionnaire-based datasets (only three observations of income above USD 1000).

As an identifier for the 'poor' category we used official subsistence level, published by government of Ukraine. Official subsistence level includes minimum needs of food, clothes and social goods; official subsistence level is calculated by Ukrainian health-care authority, based on WHO norms of food and nutrition needs.

Empirical methodology

In order to estimate hypothesis about influence of different aspects of health on income inequality, we estimated the inequality equation with each of the following health aspects:

- **Health** – as self-defined.
- **Chronic morbidity** – diseases of heart, lungs, liver, kidneys, digestive tract, back problems, and other chronic diseases. Estimated by principal-component analysis method of data-reduction.
- **Morbidity** – incidences of diabetes, myocardial infarction, high blood pressure, insult, anemia, tuberculosis. Estimated by principal-component analysis method of data-reduction.
- **Style of life** – smoking, drinking and doing exercises. Estimated by principal-component analysis method of data-reduction.

For each of the two separate data sets – ULMS 2006 and ULMS 2010 databases – we estimated the following model:

$$\ln(Income_i) = \alpha + \beta_1 \cdot Male_i + \beta_2 \cdot Nowork_i + \\ + \beta_3 \cdot Arrears_i + \beta_4 \cdot Pensioner_i + \\ + \beta_5 \cdot Educ_i + \sum_{j=2}^{3} \delta_j Settl_j + \gamma \cdot Health_i + \varepsilon_i \quad (1)$$

Here, *Health* – is proxy for health and aspects of health of i^{th} individual. All other variables are as described in the previous paragraph.

We make use of the Principal Component Analysis (PCA) methodology in order to overcome possible multicollinearity problem, achieve data-reductions and facilitate intuitive interpretation of the results.

Morbidity was constructed based on data on incidence of serious diseases like diabetes, myocardial infarction, high blood pressure, stroke, anemia and tuberculosis.

Practically all diseases have positive signs within the aspect of 'Morbidity' (but for anemia and tuberculosis which have very low absolute values), therefore 'Morbidity' is *negatively correlated* with health (or decreasing in health, in other words).

Chronic morbidity was constructed based on data on availability of chronic diseases like heart disease, illness of the lungs, liver disease, kidney disease, gastrointestinal disease, spinal problems.

All chronic diseases have positive signs within the aspect of 'Chronic morbidity', therefore 'Chronic morbidity' is *negatively correlated* with health.

Life style was constructed based on data on smoking intensity, alcohol drinking intensity and frequency of doing out-of-work exercises.

Negative variables 'smoking' and 'drinking' enter aspect of 'Life Style' with positive signs, while positive variable 'sports' enters with a negative sign, therefore obtained 'Life style' is *negatively correlated* with health.

New variables (the first components), obtained from application of PCA method, are usually not measured in some economically sensible units. Therefore, we implemented normalization of these variables, mapping them into 0-100 scale, to achieve better interpretation and comparability. Besides, in order that each aspect of health to be positively correlated with health, we applied two different normalization approaches, depending whether a health aspect is positively (equation 2) or negatively (equation 3) correlated with health:

$$x_i^{NORM} = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}} \cdot 100 \quad (2)$$

normalization of health aspects positively correlated with health,

$$x_i^{NORM} = \frac{x_{\max} - x_i}{x_{\max} - x_{\min}} \cdot 100 \quad (3)$$

normalization of health aspects negatively correlated with health.

After application of the normalization method all three aspects of health became increasing in health (that is positively 'correlated' with health) and scaled on 0–100 scale.

The data set under analysis is a cross-section, which is exposed to the heterogeneity problem. In order to overcome the heterogeneity problem, we apply the OLS with generalized residuals.

Results

Based on the methodology described above, we estimated equation (1) for the datasets of years 2006 and 2010.

Several specifications were estimated for each year:

- OLS model including health as self-defined (model 1a);
- IV model including health as self-assessed, health instrumented by height and mother education (model 1b);
- Model including health as self-defined, including dummy 'poor' and its interaction terms (model 1c);
- Model including 'Morbidity' aspect of health (model 2);
- Model including 'Chronic morbidity' aspect of health (model 3);
- Model including 'Life style' aspect of health (model 4a);
- Model including components of 'Life style' explicitly – drinking, smoking and doing exercises (model 4b).

We have obtained such actual estimation results.

The parameters of the effect of 'health' and its aspects on personal income for most models are positive and significant, which aligns with expected outcome. Here we detail estimation results regarding each aspect of health.

Aspect of *self-assessed* health is significant under each specification. The model with instrumental variables for health was estimated to verify robustness of estimated parameters of the other models, as there could be inverse relation from income to health. Estimated parameters of the IV model are comparable to that of the OLS model, therefore we do not instrument health in other models.

According to estimates of Model 1a, an increase in *health* by 1 standard deviation leads to an increase in income by 6,7 % (2006: by 3,3 %); by multiplying coefficients by mean of *health* we obtain elasticity coefficient, showing percentage change in income in relation to percentage change in health – 0,24 (2006: 0,12).

Coefficients of health aspects of *Morbidity* and *Chronic morbidity* mainly do not show statistical

significance, although signs of the coefficients match expectations. We suggest that these factors do in fact determine income differential, but their effect should be analyzed in dynamics. According to estimates of Model 2 (year 2006), an increase in *Morbidity* aspect by 1 standard deviation leads to as increase in income by 4,1 %; coefficient of elasticity equals 0,65.

Health aspect of *Life-style* is statistically significant for year 2010. According to outcomes of estimation of Model 4a, an increase in Life-style by 1 standard deviation leads to 3,2 % increase in income, coefficient of elasticity equals 0,29.

Besides, the effect of individual components of Life-style was estimated (Model 4b). The effect of *Sports* on income has positive, while *Smoking* has negative signs in either year.

Estimated coefficients of the other variables of equation (1) provide interesting observations upon income differentials and income inequality.

On average, men have by 26–32 % higher income than women, which is consistent over all model specifications and periods.

Persons not currently employed in a paid workplace (*'Nowork'* = 1), naturally, earn less. Positive income of such persons relate to their household production of agricultural and non-agricultural goods.

Another proxy of human capital, *Education*, also significantly explains differentials in income. Each additional level of education (secondary, technical school, university, graduate school) seem to add, on average, 6–7 % (2006: 5 %) to personal income. Significance of both '*Health'* and '*Education'* provides evidence for the need for stimulating both health and education infrastructure as a means of income inequality reduction.

Coefficients of dummies for type of *Settlement* are significant. Estimation outcomes evidence that persons living in towns earn, on average, by 5–15 % more, while persons living in cities earn by 15–50 % more than persons from countryside.

Inclusion of dummy for people below subsistence level ('Poor') adds significant explanatory power to the model, although, it does not seem to provide valuable inferences. Probably, a dynamical analysis might lead to interesting conclusions about sub-category of poor people.

Conclusions

The focus of present analysis was to explore how different aspects of health influence income level of Ukrainian households. In order to address this research question, we implemented empirical analysis on micro- level. The research evidenced significant influence of health factor on micro-level, proxied by self-assessed level of health, and by life-styles aspect of health. Besides, other important variables explaining income differentials such as level of education, gender and size of settlement were tested. The research findings add value to policy implications in a way of equal importance of improvements in health-care and education for households' income improvement.

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АНАЛІЗ ЗАЛЕЖНОСТІ МІЖ ФАКТОРОМ ЗДОРОВ'Я ТА ДОХОДАМИ НАСЕЛЕННЯ В УКРАЇНІ НА МІКРО-РІВНІ

Проведено аналіз впливу здоров'я і різних його складових на доходи населення України і здійснено емпірічний аналіз на мікрорівні. Для проведення дослідження використовувалась база даних «Ukrainian Longitudinal Monitoring Survey». Доведено значний вплив фактору здоров'я на доходи населення в Україні.

Ключові слова: дохід, фактор здоров'я, база даних «Ukrainian Longitudinal Monitoring Survey».

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ПРІОРИТЕТИ СОЦІАЛЬНО-ЕКОНОМІЧНОГО РОЗВИТКУ УКРАЇНИ

У статті проаналізовано та обґрунтовано інноваційні пріоритети соціально-економічного розвитку України. Дано комплексну оцінку процесів модернізації національної економіки на шляху подолання фінансово-економічної кризи.

Ключові слова: інноваційні пріоритети, модернізація, фінансово-економічна криза.

За теорією зміни техніко-економічної парадигми (ТЕП), створеною Крисом Фрименом, Карлотою Перес і Дж. Досі у 70–80-х рр. XX ст. [8], і теорією технологічних укладів (ТУ), розробленою Сергієм Глазьєвим [1] в СРСР наприкінці його існування, після «технологічного пату» Герхарда Менша [9] кластер базисних інновацій формує новий цикл економічного розвитку за Йозефом Шумпетером [10]. Ще за першою «емпіричною правильністю» «довгих хвилях» Кондратьєва [3] він вже формується в сучасній кризовій економіці, для якої необхідно визначити пріоритети її розвитку. Визначаючи пріоритети соціально-економічного розвитку, дуже важливо обґрунтувати ієрархію галузей господарства та промисловості за певними ознаками їхньої значущості. Відповідно до міжнародної класифікації усі галузі економіки можна поділити на чотири групи за мірою їх інноваційності [2]. До першої, високотехнологічної групи належать галузі з високою мірою інтенсивності науково-дослідних та досвідно-конструкторських робіт (НДДКР), де співвідношення витрат на дослідження і розробки до об'ємів продажів перевищує 5 %: фармацевтика і біотехнологічна промисловість, виробництво медичної техніки і надання медичних послуг, комп'ютерне і телекомунікаційне устаткування, а також комп'ютерні послуги, що сприяють розвитку економіки знань.

До другої групи середньо-високотехнологічних галузей належать: електронна промисловість, автомобільна індустрія, аерокосмічна промисловість, загальне машинобудування, хімічна промисловість, виробництво товарів тривалого користування для домашніх господарств. Тут співвідношення витрат на НДДКР до обсягів продажу коливається вже у межах від 2 до 5 %.

Група середньо- та низькотехнологічних галузей – харчова промисловість, виробництво нафтогазового устаткування, електроенергетика, галузі туризму і фіксованого зв'язку, співвідношення витрат на НДДКР до обсягів продажу у яких становить 1–2 %.

Нарешті, остання група низькотехнологічних галузей зі співвідношенням витрат на НДДКР до