**Endogenous, spurious or just mysterious?**

*Income inequality and individual health across countries*

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**Abstract**

This paper examines the association between economic inequality and individual health across low, middle and high income countries. We use a unique dataset containing information on the health status of individuals in 21 countries and territories throughout the world with very different characteristics. The survey covers respondents between the ages of 40 and 79. Our dependent variable is self-assessed health (SAH), a categorical variable which ranges from 'very poor' to 'very good'. As a robustness check, we also consider activities of daily living (ADL).

We estimate the relationship between economic inequalities and health – with particular focus on the potential endogeneity related to incomes as well as income inequalities. Using an MLE approach with appropriate instruments and exclusion restrictions, we find mixed evidence. It seems quite clear that there is an endogeneity problem associated with individual incomes; however, the estimated impact of income inequalities seems to be much less affected by this than the estimated income effect. When taking endogeneity into account we still find robust evidence of an income inequality effect amongst OECD countries.

## 1 Introduction

There is an unresolved scientific debate as to whether economic inequalities in themselves contribute to ill-health. This issue engages researchers in several disciplines. The starting point for the controversy was the existence of a striking negative correlation between the average health status in a population and various measures of inequality (such as, for example, the Gini coefficient). However, the observed relationship could be a statistical artifact reflecting diminishing returns to income in the production of health at the individual level (Gravelle, 1998).

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At the same time, there are several mechanisms through which economic inequalities could have a direct impact on health status. For example, it might be the case that sharp differences lead to increased levels of stress or reduce people's overall well-being in other ways (Wilkinson, 1996). Also, it has been suggested that social rank and social networks are important determinants of health (Cutler and Lleras-Muney, 2006). Consequently, if the degree of positive social interaction between people is related to the level of economic inequality in societies, this might be important in the analysis of health outcomes. Moreover, if economic inequality affects health directly or indirectly, social and economic policies that influence income distributions may have important consequences which so far have been largely ignored by economists and policy makers (Wilkinson 1992, Deaton, 2003). In *Figure 1*, we plot the propensity to report 'very good' health in our dataset against the national Gini coefficient from the same year, and a crude image of a negative relationship emerges.

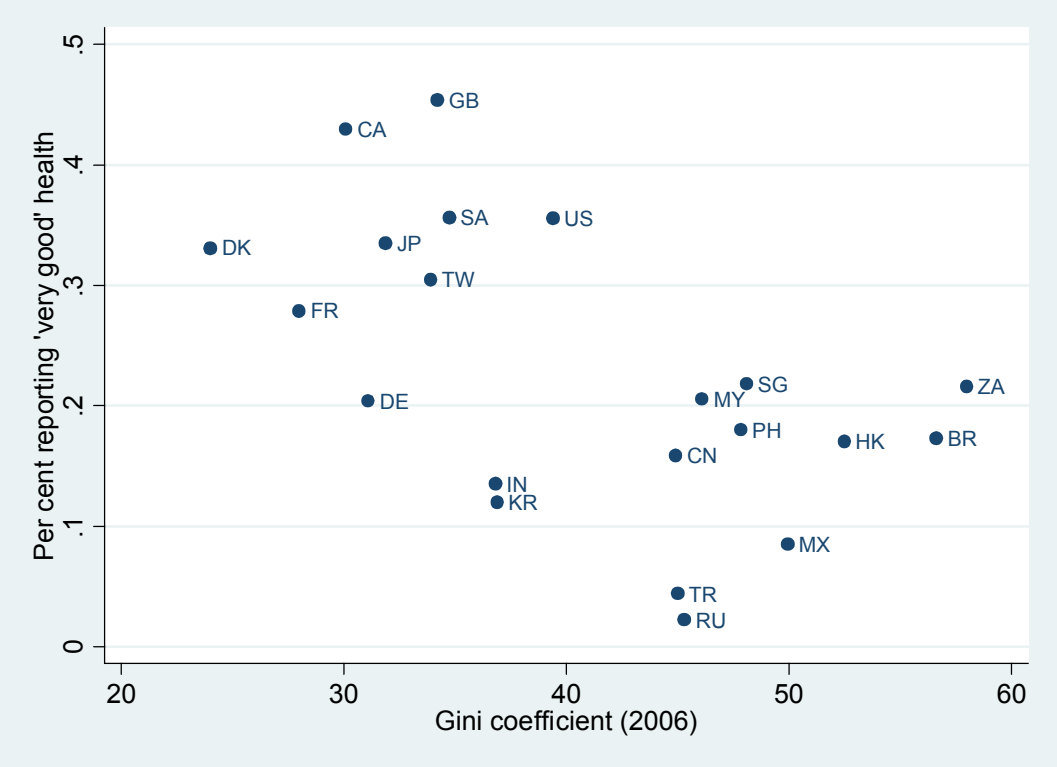


**Figure 1.** *Self-assessed health and national income inequality*

To exclude the possibility of observing a spurious relationship due to a non-linear relation between income and health, the empirical examination of inequality and health should be based on information at the individual level. Datasets on individuals is often available for separate countries and several studies on the particular association in different developed economies have been carried out during the past decade. The empirical evidence from this research is largely contradictory. This ambiguity might be due to the differences between the countries which have been studied, but there are also important differences in terms of methods used, the dependent variables considered, the

choice of inequality measure and in the interpretation of additional covariates as confounders or mediators.

Moreover, it has been argued that findings of an association between inequality and health could be attributable to reverse causality – since policies which improve health amongst the poor are likely to improve their incomes and thereby reduce income inequalities – or unobserved heterogeneity.

The objective of this paper is to examine the association between inequality and individual health across low, middle and high income contexts making use of a new dataset, *The Future of retirement*, which includes information on the health status of individuals in 21 countries across the world. More specifically, we intend to take a closer look at one of the hypotheses which has been proposed in the literature: the income inequality hypothesis. It has already been shown (Karlsson et al, 2008) that there is a strong negative correlation between national Gini coefficients and individual health in this setting. However, it remains to verify the robustness of this result also when taking endogeneity into account.

The contribution of this paper is twofold. First of all we examine the relation between inequality and individual health in a cross national setting by introducing a new and useful dataset which has previously not been available. It includes information at the individual level on a wide range of important variables which have been collected in a consistent way. Furthermore, information from both developing as well as developed economies is available. This is of great importance, not the least as this allows for sufficient variation in the contextual exposure to economic inequalities. As discussed by Gerdtham and Johannesson (2004), a low variation of inequality across observations may decrease the chances of detecting an effect on health. Secondly, we take some steps towards addressing endogeneity - an issue that often has been overlooked in this literature. For this exercise we make use of maximum likelihood techniques and instrumental variables which seem to be appropriate for our purposes.

The paper is organized as follows. In the next section, we give a brief overview of the theories and evaluate the empirical evidence to date. In Section 3, we outline the methodological considerations underlying our econometric approach, and Section 4 gives an overview of the dataset and imported variables. Section 5 presents results from the various specifications we have considered. Section 6 concludes and identifies open issues for future research.

## 2 Theoretical Considerations and Empirical Evidence

The negative relationship between inequality and population health is consistent with no less than five different hypotheses at the individual level. For this examination two out of these are of particular interest.[1] It should be noted that there has been some confusion concerning terminology in the literature, partly because several disciplines are involved. We will follow the definitions employed in Wagstaff and van Doorslaer (2000).

Amongst the hypotheses discussed, the **absolute income hypothesis** (AIH) is the simplest one, since it suggests that individual health is affected by own income but not

the distribution of incomes in a reference group or in the general population. According to this explanation, health is moreover a concave function of income so that the positive effects of an increase in income diminish at higher incomes. The **AIH** has strong empirical support (Li and Zhu, 2006; van Ourti et al., 2006; Lorgelly and Lindley, 2008). The assumed relationship between income and health seems to hold regardless whether studied at the population, community or individual level; and also across demographic groups and in different economic contexts. The finding that increases in income improve health at a diminishing rate seems highly intuitive. However, it has been argued that it can only account for around 2/3 of the observed correlation between inequality and ill-health (Blakely et al., 2002).

According to the **income inequality hypothesis** (IIH) economic inequalities in a society affect everyone's health. At least three underlying mechanisms have been suggested in the literature. Firstly, societies with sharper inequalities may also be suffering from a lower level of social capital and mutual trust (Kawachi et al. 1997) – which in turn might be detrimental to health. The negative health effect is in this case related to a lower degree of social interaction among people living in unequal circumstances. Evidence suggests that socially integrated individuals have higher immunological resistance to certain diseases and are happier compared to their more socially isolated counterparts. Moreover, social networks are believed to promote better health education (Baum, 1999). Secondly, due to the lack of social cohesion, individuals in these societies might also be exposed to higher crime or accident rates, which have a direct impact on health. Thirdly, the relationship between inequality and health might also be attributable to political effects: unequal societies tend to be more polarized and might as a result provide fewer common resources such as public health care services (Arujo et al., 2008; Krugman, 1996; Kawachi et al., 1997; Zhao, 2006).

The **IIH**, has traditionally been tested by including the Gini coefficient – or some other measure of income inequality – as an independent variable. Many studies using aggregate data identify an inequality effect (cf. Asafu-Adjaye, 2004, Blakely et al., 2002; Cantarero et al. 2005); however, this does not suffice as evidence in favor of the IIH.

For individual level data, the evidence is mixed. Some studies analyzing US data report evidence of a negative effect of income inequality on a variety of health indicators. Fiscella and Franks (2000) report that community inequality is negatively related to self-assessed health, but not to mortality. They further conclude that this negative effect seems to be mediated by psychological distress, but not biomedical morbidity. The IIH is also supported in the work on US states by Kennedy et al. (1998) and Subramanian and Kawachi (2004) In contrast, the majority of articles testing the IIH in a non-US high-income context reject the hypothesis. Using self-rated health as a dependent variable, Jones et al. (2004) conclude that income inequality does not seem to have a detrimental effect on mortality among UK residents. This result is also supported in a later UK study by Lorgelly and Lindley (2008). Moreover, using a Swedish dataset, Gerdtham and Johanesson (2004) analyzed the effect of municipality-level inequalities on mortality while Shibuya et al. (2002) examined the relation in a Japanese context. In neither of these cases there seems to be evidence in favor of the IIH.

Three studies on individual data examine the relationship between income inequality and health in a middle income context. Subramanian et al. (2003) study the association in Chile and conclude that community inequality has an independent effect on self-rated health. Also the work by Larrea and Kawachi (2005) on child health in Ecuador supports the IIH. Finally, using a Chinese dataset, self-assessed health as the dependent variable and allowing the income inequality effect to be a non-linear function of inequality, Li and Zhu (2006) find that the effect of income inequality on health only appears in communities with a relatively high degree of inequality.

Turning to available evidence from cross-national studies, the evidence is still mixed. Using cross-sectional data from a group of relatively homogenous post-communist countries, Bobak et al. (2000) find no effect of inequality on health. On the other hand, Hildebrand and van Kerm (2005) report weak, albeit significant evidence for the IIH, examining the effect of inequality on self-assessed health using a panel consisting of ten European Union countries. Karlsson et al (2008) find a strong inequality effect when regressing SAH on Gini coefficients and other individual covariates in an international dataset. This result is also robust when replacing SAH by ADLs.

To some degree, the ambiguity of previous results seems to depend not only on differences between countries and the choice of dependent variable but also on the methodological approach chosen. Mellor and Milyo (2002, 2003) show that otherwise significant coefficient estimates tend to vanish once certain personal characteristics and fixed effects at different administrative levels are included in the analysis – suggesting that the estimated relationship is due to unobserved heterogeneity and not reflecting a causal effect. However, their approach has been challenged. Blakely et al. (2002) argue that the inclusion of fixed effects is too restrictive and, more importantly, that Mellor and Milyo confuse confounders and mediators.

There is still not much empirical evidence concerning the hypothesized pathways from income inequality to individual health. This is partly due to authors not differentiating between exogenous control variables and potential mediators. In our terminology, a confounder is an exogenous factor that affects health but is not in itself influenced by inequalities in income. A mediator, on the other hand, is a factor that is influenced by income inequalities and in its turn affects health; hence (some of) the effect of inequalities on health may take the form of affecting this mediating factor. In the latter case, it is not obvious that the mediator should be included as a regressor, as that would reduce the estimated effect of inequalities in income on health. Alternatively, including a mediating factor can be seen as a way of investigating the mechanisms through which income inequality affects health.

Analysing the effect of economic inequality on health is further complicated by the fact that in reality we are often dealing with simultaneous relationships (endogeneity) and unobserved heterogeneity. These problems could be addressed in a panel data setting – but very few international panel datasets with individual level data and sufficient variation in inequalities exist to date.

## 3 Econometric Considerations

Considering the plethora of different econometric approaches that have been used in the analysis of these issues, it is important to pin down some of the most important methodological choices and to develop strategies for how the relationships of interest can be estimated in a rigorous manner. In this section we highlight some modeling choices and discuss the tradeoffs involved. The advantages of using an individual-level dataset should be obvious already, and hence we here focus on other methodological choices.

### 3.1 General Considerations

The main dependent variable used in this study is categorical (answers to the question "how is your health?"). In the literature which uses an indicator of self-assessed health (SAH), it is common to dichotomize this categorical ordered variable into a binary one and to use probit or logit models. However, Lorgelly and Lindley (2008) argue that this kind of transformation can come at the expense of less variability in the data and that findings may be very sensitive to the choice of cut-off point. Moreover, in a study on French data, Etilé and Milcent (2006) note that for those in the middle of the SAH distribution a rise in income seems to affect SAH mainly via reporting. Thus, we use an ordered probit model in our regressions.

While self-assessed health measures are relatively unproblematic to use when evaluating health outcomes within groups, this kind of indicator might be less useful for comparisons between groups or across countries as different groups might systematically evaluate their health differently (c.f. Etilé and Milcent, 2006; Sadana et al., 2000). Although empirical work suggests that there does not seem to exist any reporting heterogeneity in measures of self-assessed health with respect to education and income levels (Lindeboom and van Doorslaer, 2004), it is likely that the interpretation of health-related questions will depend on cultural and linguistic factors. Also, the reference points for what constitutes good or poor health can be expected to depend on the general population health in the country where the respondent lives. One common strategy to overcome this problem is to use vignettes, where the individuals' reporting of their own health is anchored against some hypothetical cases. This option is not available to us, but we decided to anchor national reporting patterns against national health statistics. As a further robustness check, we ran separate regressions with the number of activities of daily living (ADLs) that respondents complete without difficulty as dependent variable. The questions related to ADLs are much more specific and are hence more likely to be internationally comparable. Overall, considering the concentration of ADL impairments immediately before death, we would however argue that SAH is more likely to capture effects related to the IIH (cf. also section 4.2).

In the specifications with SAH as a dependent variable, we include two variables to control for national reporting biases. These were derived in the following way: for each country and gender, we used reporting patterns as a dependent variable in an auxiliary regression, where national health statistics were used as independent variables. In this part, we relied on the sex-specific data on healthy life expectancy (HLE) and total life expectancy (LE) (WHO, 2008; Taiwanese Statistics Office, 2007).[2] Since the WHO database has been set up with the explicit aim to further comparability of health statistics,

these data should be particularly good determinants of the "objective" part of differences in reporting behavior between countries. Hence, we estimated a system of equations of the form

$$\ln\left(\frac{p_{ijk}}{1-p_{ijk}}\right) = \alpha_{ijk} + \beta_{ijk} HLE_{ij} + \delta_{ijk} LE_{ij} + \varepsilon_{ijk}$$

where $p_{ijk}$ is the proportion of respondents from country $i$ of gender $j$ who report SAH category $k$.[3] We used Zellner's SUR approach (Zellner, 1962) to account for the correlation across equations, and then used the residuals from the regression to derive the two new variables, *Res12b* and *Res45b*, containing the information whether an individual can be expected to over-report poor or good health respectively, based on their country of residence and gender.

Just as expected, HLE tended to have a positive impact on the propensity to report good health and LE tended to have a negative impact. For a given HLE statistic, an increase LE is connected with more people surviving in bad health, and hence we should expect a higher proportion of our respondents reporting poor health – and vice versa. Despite the small sample (21 observations) the estimates came out significant in most of the equations. According to our estimates, Canadians are the most optimistic concerning their own health, whereas Russians are by far the most pessimistic; and this seems to be the case for women as well as for men.

### 3.2 Addressing endogeneity

It has been suggested (Deaton, 2003) that the observed relationship between income inequalities and health can be attributed either to reverse causality running from health to incomes or to third factors affecting both. Furthermore, any attempt to wash out a spurious "inequality effect" on health, related to the above described non-linearities, by including individual incomes is challenging as this variable obviously suffers from the same endogeneity problems.

Our approach to these issues is to estimate log incomes and health jointly. It is common in the applied literature is to use a simple two-stage method; either two-stage predictor inclusion or two-stage residual inclusion (Terza et al, 2008). Although the latter delivers consistent estimates, it is generally not useful for inference (Wooldridge, 2002). Instead we decided to use a full information maximum likelihood approach, where a joint normality assumption and exclusion restrictions are used to achieve identification.

The exclusion restriction we use is the marginal tax rate which an average worker faces in the different countries. The OECD provides a very useful dataset of typical marginal tax rates for their member countries (OECD, 2007), and we have extended this dataset to incorporate also the non-OECD countries in the dataset (PriceWaterHouseCoopers, 2005; World Bank, 2007; IMF, 2007). There are several reasons why marginal tax rates can be expected to be good predictors of gross (adjusted) household income:

- Labour supply is likely to be affected: the marginal tax rate changes the relative price of leisure and will ceteris paribus affect total earnings.

- Unless the demand for labour is perfectly inelastic, the marginal tax rate will also have an impact on gross wages, since workers will pass the tax burden on to their employers.

It should be noted that these hypothesised effects tend to work in opposite directions: the substitution effect suggests a negative relationship between marginal taxes and gross incomes, whereas the income effect and the adjustment of equlibrium wages imply a positive relationship. Hence, we do not hypothesise the sign of the coefficient, but conclude that any of these explanations will suffice to qualify the marginal tax rate as an instrument.

Basing identification on a national-level variable of course invites the criticism that it might pick up cross-country heterogeneity in unobserved characteristics. Thus, it does seem desirable to include further national characteristics in the regression equation for individual health. However, in this regard, the lack of a consistent theory underlying the IIH becomes problematic, since any national characteristic could be a mediator between inequalities and health. Instead, we rely on careful robustness checks, using different sets of variables, different definitions of health, and comparing different country sub-groups.

## 4 Data and variables

In this section, we give an overview of the primary dataset as well as information on the variables which have been imported from other sources.

### 4.1 The Future of Retirement Survey

The study utilizes data from the 2006 third wave of the *Future of Retirement Global Ageing Survey* which covers 21 countries and territories. The survey is funded by the bank HSBC and designed and carried out by the Oxford Institute of Ageing. The principal aim of *The Future of Retirement* is to investigate people's attitudes and expectations with regard to ageing and old age and to gain insight into people's perceptions of their current life situation. A total of 21,233 respondents aged between 40 and 79 years were successfully interviewed from all five major regions of the world (Asia, Europe, North America, Latin America and Middle East/Africa) in China, Hong Kong, India, South Korea, Japan, Malaysia, Singapore, Philippines, Taiwan, United Kingdom, Germany, Russia, France, Denmark, Canada, USA, Brazil, Mexico, Saudi Arabia, Turkey and South Africa.[4] Interviews were conducted primarily by telephone (random digit dialing including mobile numbers) but in some countries they were face-to face (random selection of address-based sampling points in geographical strata). If more than one valid respondent is present in a household, the one with the next birthday is interviewed. Interviews lasted for 20-30 minutes depending on language.

Respondents were drawn from various social classes with proportional representation of age and sex within each of the four cohorts aged 40-49, 50-59, 69-69 and 70-79 years, with approximately 250 completely completed interviews in each cohort in each country/territory. Samples are thus generationally representative, albeit with the caveat of an overrepresentation of urban sampling in the transitional economies.

The survey questionnaire contained a wide range of questions about respondents' socioeconomic and demographic status, expectations and attitudes to ageing and old age, as well as validated structured questions about quality of life.

## 4.2 Variables

Our main dependent variable is self-assessed general health, a categorical variable ranging from 1 to 5, where 1 corresponds to very poor and 5 to very good health. This kind of self-assessed health measure has been shown to be highly correlated with more objective indicators of health, such as mortality (Benyamini and Idler, 1999; Maddox and Douglas, 1973). As mentioned above, we also use the number of ADLs (the maximum is five) that a respondent is able to perform to check the robustness of our findings.

In *Table 1*, we provide summary statistic of the health variables by country, and compare them to the national WHO data on two objective health indicators; healthy life expectancy (HLE) and total life expectancy (LE). The distribution of the SAH variable seems to be largely as expected: high-income countries tend to have a distribution skewed towards the right compared with the overall average, whereas less developed countries tend to have a distribution skewed to the left. Pairwise rank-order tests confirmed that the rankings of countries according to LE, HLE, SAH and ADLs are highly consistent. However, there also seem to be national idiosyncrasies. For example, German respondents are much less likely to report 'very good' health than their American counterparts, despite the German HLE being higher than the American one. The ADL variable is heavily concentrated in the "full functionality" category in most countries, and yet the differences between the countries are very consistent with the differences in other health indicators.

**Table 1.** *Self-assessed health, ADLs and healthy life expectancy. Summary statistics.*

| | N | *SAH1* | *SAH2* | *SAH3* | *SAH4* | *SAH5* | *ADL* | *se(ADL)* | *HLE* | *LE* |
|---|---|---|---|---|---|---|---|---|---|---|
| Canada | 902 | 0.011 | 0.018 | 0.121 | 0.415 | 0.436 | 4.766 | 0.647 | 72 | 81 |
| China | 893 | 0.026 | 0.086 | 0.559 | 0.174 | 0.156 | 4.190 | 1.279 | 64 | 73 |
| Denmark | 920 | 0.016 | 0.069 | 0.162 | 0.405 | 0.348 | 4.815 | 0.607 | 70 | 79 |
| France | 722 | 0.008 | 0.037 | 0.170 | 0.500 | 0.284 | 4.896 | 0.461 | 72 | 81 |
| Germany | 889 | 0.006 | 0.069 | 0.233 | 0.483 | 0.210 | 4.800 | 0.690 | 72 | 80 |
| Hong Kong | 918 | 0.025 | 0.086 | 0.330 | 0.391 | 0.168 | 4.740 | 0.690 | 73 | 83 |
| India | 995 | 0.034 | 0.118 | 0.319 | 0.393 | 0.137 | 3.946 | 1.554 | 53 | 63 |
| Japan | 669 | 0.002 | 0.060 | 0.286 | 0.286 | 0.368 | 4.621 | 1.012 | 75 | 83 |
| Malaysia | 932 | 0.004 | 0.035 | 0.358 | 0.400 | 0.202 | 4.519 | 1.070 | 63 | 72 |
| The Philippines | 654 | 0.002 | 0.043 | 0.288 | 0.465 | 0.203 | 4.483 | 1.099 | 59 | 68 |
| Russia | 1,014 | 0.054 | 0.189 | 0.583 | 0.152 | 0.022 | 4.134 | 1.345 | 58 | 66 |
| Saudi Arabia | 954 | 0.004 | 0.059 | 0.243 | 0.330 | 0.364 | 4.357 | 1.202 | 61 | 70 |
| Singapore | 622 | 0.008 | 0.045 | 0.211 | 0.495 | 0.241 | 4.817 | 0.613 | 70 | 80 |
| South Africa | 870 | 0.058 | 0.181 | 0.236 | 0.324 | 0.202 | 4.320 | 1.265 | 44 | 51 |
| South Korea | 784 | 0.042 | 0.149 | 0.309 | 0.383 | 0.117 | 4.365 | 1.132 | 68 | 79 |
| Taiwan | 674 | 0.006 | 0.071 | 0.367 | 0.236 | 0.321 | 4.763 | 0.844 | 70 | 77 |
| Turkey | 876 | 0.064 | 0.150 | 0.438 | 0.300 | 0.048 | 3.212 | 1.669 | 62 | 73 |
| UK | 819 | 0.010 | 0.033 | 0.123 | 0.365 | 0.469 | 4.784 | 0.759 | 71 | 79 |
| USA | 898 | 0.013 | 0.051 | 0.134 | 0.447 | 0.355 | 4.714 | 0.788 | 69 | 78 |
| Total | 16,005 | 0.022 | 0.084 | 0.292 | 0.362 | 0.240 | 4.467 | 1.133 | 65 | 74 |

The income variable in the dataset is categorical, with the number of brackets and their cutoff points differing from country to country. Since it is crucial to be able to convert it

into a continuous variable in a common currency, we assumed the national income distributions follow a log-normal distribution and used it to impute means for the various brackets. These were then converted into US dollars using purchasing power parities (PPP) for 2006. Finally, we corrected income for household size, using a square root equivalence scale. In all specifications we include the natural logarithm of income.

For tests of the IIH, income inequality is measured by the standard deviation of log income, a conventional summary proxy for economic inequality which is widely used in empirical studies. A notable property of this metric is that it attaches a greater weight to changes at the lower end of the income distribution. An attractive feature of this inequality measure is further that it is scale-independent and that it can be consistently estimated from the dataset.

Some additional individual-level variables which are useful for our analysis can be obtained from the dataset. The additional individual variables which we use in at least some specifications are gender, age, educational attainment (primary, secondary or tertiary), occupation, marital status, number of parents alive, and living in an urban or a rural environment. Some descriptive statistics for these variables and individual ADLs are provided in *Table 2.*

**Table 2.** *Variable definitions and descriptive statistics.*

| *Variable* | *Obs* | *Mean* | *Std. Dev.* | *Min* | *Max* | *Definition* |
|---|---|---|---|---|---|---|
| incomppp | 16,005 | 21,204 | 23,774 | 0 | 379,501 | *Adjusted household income in 2006 PPP dollars* |
| gender | 16,005 | 0.526 | 0.499 | 0 | 1 | *Respondent is female* |
| npeople | 16,005 | 3.465 | 2.052 | 1 | 20 | *Number of people in household* |
| parents | 16,005 | 0.537 | 0.750 | 0 | 2 | *Number of parents alive* |
| nchildren | 15,957 | 2.359 | 1.662 | 0 | 20 | *Number of children* |
| age | 16,005 | 57.652 | 11.249 | 39 | 78 | *Age in 2006* |
| urban | 15,826 | 0.818 | 0.386 | 0 | 1 | *Respondent lives in area with more than 20,000 inhabitants* |
| EduSec | 14,454 | 0.398 | 0.490 | 0 | 1 | *Respondent has completed secondary education* |
| EduTer | 14,454 | 0.311 | 0.463 | 0 | 1 | *Respondent has completed tertiary (further) education* |
| married | 16,005 | 0.700 | 0.458 | 0 | 1 | *Respondent is married* |
| cohab | 16,005 | 0.021 | 0.143 | 0 | 1 | *Respondent is cohabiting* |
| widow | 16,005 | 0.159 | 0.366 | 0 | 1 | *Respondent is widow* |
| single | 16,005 | 0.117 | 0.322 | 0 | 1 | *Respondent is single* |
| Pensioner | 15,845 | 0.103 | 0.304 | 0 | 1 | *State pensioner with no other earnings* |
| Manual | 15,845 | 0.055 | 0.227 | 0 | 1 | *Manual or service worker with minimal formal education or training* |
| Semi-skilled | 15,845 | 0.085 | 0.279 | 0 | 1 | *Semi-skilled manual or service worker* |
| Skilled | 15,845 | 0.111 | 0.314 | 0 | 1 | *Skilled manual worker* |
| Clerical | 15,845 | 0.119 | 0.324 | 0 | 1 | *Clerical worker* |
| Junior | 15,845 | 0.049 | 0.215 | 0 | 1 | *Junior managerial, administrative, or professional position* |
| Supervisor | 15,845 | 0.052 | 0.221 | 0 | 1 | *Supervisor in managerial, administrative, or professional position* |
| Intermediate | 15,845 | 0.060 | 0.237 | 0 | 1 | *Intermediate managerial, administrative, or professional position* |
| Upper | 15,845 | 0.052 | 0.221 | 0 | 1 | *Upper level managerial, administrative, or professional position* |
| Other | 15,845 | 0.170 | 0.376 | 0 | 1 | *Other position* |
| None | 15,845 | 0.141 | 0.348 | 0 | 1 | *None* |
| Pensioner2 | 15,845 | 0.004 | 0.065 | 0 | 1 | *State pensioner with other earnings* |
| Walking | 15,862 | 0.832 | 0.374 | 0 | 1 | *No difficulty to walk 100 metres* |
| Dressing | 16,005 | 0.932 | 0.251 | 0 | 1 | *No difficulty to get dressed* |
| Bathing | 16,005 | 0.927 | 0.261 | 0 | 1 | *No difficulty to bath* |
| Eating | 16,005 | 0.906 | 0.292 | 0 | 1 | *No difficulty to eat* |
| Bed | 16,005 | 0.877 | 0.328 | 0 | 1 | *No difficulty to get into or out of bed* |

In *Table 3*, we provide a national breakdown of some important country characterstics. In the first two columns, we report two measures of inequality: the Gini coefficient and the standard deviation of logs. After that follow GDP per capita, expressed in purchasing power terms, and the national average of our calculated (adjusted) household income, together with the response rate for that variable.[5] We then present the proportion of people in the national samples who have secondary and tertiary education. Finally, we present the marginal tax rates which have been used as instruments.

**Table 3.** *National statistics and national averages of some independent variables*

| | *Gini* | *SD(y)* | *GDPpc* | *incomppp* | *resprate* | *EduSec* | *EduUni* | *Margtax* |
|---|---|---|---|---|---|---|---|---|
| Canada | 30.1 | 0.742 | 36,713 | 36,723 | 0.84 | 0.254 | 0.581 | 0.350 |
| China | 44.9 | 1.395 | 4,644 | 5,916 | 0.89 | 0.207 | 0.090 | 0.250 |
| Denmark | 24.0 | 0.675 | 35,692 | 34,728 | 0.90 | 0.397 | 0.141 | 0.492 |
| France | 28.0 | 0.715 | 31,992 | 22,965 | 0.72 | 0.524 | 0.476 | 0.368 |
| Germany | 31.1 | 0.836 | 32,322 | 27,412 | 0.87 | 0.227 | 0.497 | 0.590 |
| Hong Kong | 52.5 | 0.835 | 39,062 | 24,735 | 0.92 | 0.487 | 0.151 | 0.020 |
| India | 36.8 | 0.690 | 2,469 | 3,464 | 0.98 | 0.547 | 0.188 | 0.000 |
| Japan | 31.9 | 0.673 | 31,947 | 17,878 | 0.69 | 0.272 | 0.382 | 0.244 |
| Malaysia | 46.1 | 0.953 | 12,536 | 32,777 | 0.93 | 0.708 | 0.054 | 0.280 |
| The Philippines | 47.9 | 1.218 | 3,153 | 13,014 | 0.65 | 0.379 | 0.439 | 0.100 |
| Russia | 45.3 | 1.764 | 13,116 | 6,318 | 0.98 | 0.464 | 0.453 | 0.130 |
| Saudi Arabia | 34.7 | 0.716 | 22,296 | 16,725 | 0.95 | 0.617 | 0.153 | 0.000 |
| Singapore | 48.1 | 0.916 | 44,708 | 21,904 | 0.62 | 0.310 | 0.405 | 0.035 |
| South Africa | 58.0 | 2.430 | 9,087 | 9,820 | 0.86 | 0.315 | 0.195 | 0.180 |
| South Korea | 36.9 | 0.882 | 22,988 | 20,561 | 0.78 | 0.332 | 0.309 | 0.232 |
| Taiwan | 33.9 | 0.729 | 28,011 | 18,717 | 0.68 | 0.381 | 0.352 | 0.130 |
| Turkey | 45.0 | 0.813 | 8,417 | 6,112 | 0.86 | 0.104 | 0.272 | 0.326 |
| UK | 34.2 | 0.718 | 33,087 | 40,911 | 0.80 | 0.353 | 0.439 | 0.330 |
| USA | 39.4 | 0.818 | 43,968 | 43,171 | 0.89 | 0.535 | 0.413 | 0.289 |

Overall, our income measure is roughly consistent with GDP per capita. However, the oversampling of urban individuals is apparent in some cases – such as the Philippines or Malaysia. Thus, it is crucial to control for regional characteristics (e.g. urban/rural) whenever possible.

The OECD dataset contains information on the marginal tax rates applying to several different types of income earners – differentiated by marital status, relative earnings and number of children. Thus, in theory, we could have used the marginal tax rates actually applying to the individuals in different circumstances. However, such individual tax rates would clearly suffer from the same endogeneity problems as the income variable (most importantly since earnings are affected by health). Thus, we used the marginal tax rate applying to an individual who earns 100 per cent of average earnings in their country and who are further single with no children. The instrument turned out to have high explanatory power in our regressions.

For non-OECD countries, we needed to rely on alternative sources. Fairly detailed information on income tax systems from 2006 or adjacent years has been provided by various international organizations. We then picked the marginal tax rates which applied

to average income earners (according to our own dataset) in these countries. Obviously, there is no guarantee that the tax rates derived in this way are comparable to the OECD figures, and hence, we ran separate estimates for OECD and non-OECD countries to check the robustness of our findings. In general, the marginal tax rates had very high explanatory power in the income regressions.

## 5 Results

For the health dimension, we use ordered probit models throughout, but change the independent variables included and whether correcting for reporting heterogeneity or not.

First we report results from a univariate specification, where we temporarily ignore the endogeneity problems related to the income and income inequality variables. After that we provide results for a bivariate model, where the parameters determining the income variable are estimated together with the health variable of interest. In all specifications below, we report estimated coefficients and not marginal effects. Although this reduces the possibilities to draw inference, comparisons of different specifications can still be informative.

### 5.1 Univariate specifications

The results from univariate specifications are provided in *Table 4*. We report parameter estimates and the associated *p* values. The left panel presents results from specifications with SAH as the dependent variable, and the right panel presents results from specifications with the number of ADLs as dependent variable. For each of these dependent variables, we run six separate regressions, where the number of countries included and the set of further covariates vary.

As expected, our estimates suggest that gender and age are important determinants of health, at least when we restrict the set of covariates. Also, we find that individual income is of immense importance to good health throughout, but the impact seems to be much stronger in OECD countries than in non-OECD countries. For income inequality, on the other hand, our results are mixed. Apparently, the coefficient for the standard deviation of log income (denoted **SD(y))** for the entire sample is not always between the estimates for the two subsamples, which suggests that the two groups of countries are systematically different from each other. What seems rather clear, however, is that income inequalities are significantly and negatively related to health in the subsample of individuals living in OECD countries.

Concerning the additional covariates which are added in some specifications, we find that education is strongly significant and of the expected sign. Also the number of parents alive has a strong impact, whereas marital status and the number of children seem to be of less importance.

**Table 4.** *Estimates from univariate specifications.*[6]

| | SAH | | | | | | ADL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *all* | *OECD* | *NOECD* | *all* | *OECD* | *NOECD* | *all* | *OECD* | *NOECD* | *all* | *OECD* | *NOECD* |
| a1 | -2.850 | -1.826 | -3.615 | -2.120 | -1.877 | -3.080 | -1.688 | -0.634 | -3.244 | -1.479 | -0.682 | -3.004 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | 0.230 | 0.000 | 0.001 | 0.338 | 0.000 |
| a2 | -1.988 | -1.002 | -2.713 | -1.259 | -1.052 | -2.173 | -1.177 | 0.026 | -2.791 | -1.217 | -0.330 | -2.777 |
| | 0.000 | 0.016 | 0.000 | 0.000 | 0.052 | 0.001 | 0.000 | 0.961 | 0.000 | 0.006 | 0.643 | 0.000 |
| a3 | -0.836 | -0.029 | -1.416 | -0.049 | -0.058 | -0.791 | -1.417 | -0.255 | -3.022 | -0.983 | -0.048 | -2.558 |
| | 0.001 | 0.944 | 0.000 | 0.885 | 0.915 | 0.238 | 0.000 | 0.629 | 0.000 | 0.026 | 0.946 | 0.000 |
| a4 | 0.273 | 1.171 | -0.361 | 1.090 | 1.187 | 0.287 | -0.847 | 0.374 | -2.447 | -0.041 | 0.967 | -1.595 |
| | 0.283 | 0.005 | 0.296 | 0.001 | 0.028 | 0.668 | 0.008 | 0.479 | 0.000 | 0.926 | 0.174 | 0.028 |
| a5 | | | | | | | -0.265 | 0.972 | -1.831 | -0.641 | 0.315 | -2.203 |
| | | | | | | | 0.405 | 0.065 | 0.000 | 0.148 | 0.658 | 0.002 |
| gender | -0.093 | -0.039 | -0.107 | -0.034 | 0.002 | -0.032 | -0.191 | -0.192 | -0.168 | -0.094 | -0.060 | -0.148 |
| | 0.000 | 0.137 | 0.000 | 0.087 | 0.960 | 0.237 | 0.000 | 0.000 | 0.000 | 0.000 | 0.139 | 0.000 |
| age | -3.576 | -4.126 | -3.571 | -2.123 | -2.771 | -1.630 | -3.412 | -3.436 | -4.868 | -1.969 | -3.024 | -2.630 |
| | 0.000 | 0.001 | 0.003 | 0.026 | 0.058 | 0.207 | 0.002 | 0.041 | 0.001 | 0.106 | 0.117 | 0.109 |
| age2 | 0.904 | 2.238 | 0.232 | 0.263 | 1.547 | -0.679 | 0.727 | 1.714 | 1.316 | -0.015 | 1.621 | -0.037 |
| | 0.221 | 0.042 | 0.819 | 0.746 | 0.210 | 0.538 | 0.431 | 0.229 | 0.289 | 0.988 | 0.319 | 0.978 |
| Res12b | -0.213 | -0.349 | -0.132 | -0.166 | -0.164 | -0.047 | | | | | | |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.003 | 0.158 | | | | | | |
| Res45b | 0.271 | 0.055 | 0.264 | 0.317 | 0.145 | 0.363 | | | | | | |
| | 0.000 | 0.236 | 0.000 | 0.000 | 0.009 | 0.000 | | | | | | |
| Inc | 0.141 | 0.292 | 0.101 | 0.100 | 0.244 | 0.074 | 0.238 | 0.527 | 0.136 | 0.182 | 0.405 | 0.110 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| SD(y) | -0.035 | -0.922 | -0.092 | 0.062 | -1.837 | 0.037 | 0.035 | -2.360 | -0.014 | 0.030 | -1.676 | -0.009 |
| | 0.086 | 0.000 | 0.000 | 0.011 | 0.000 | 0.164 | 0.154 | 0.000 | 0.608 | 0.324 | 0.000 | 0.791 |
| urban | | | | -0.028 | -0.024 | -0.161 | | | | -0.061 | -0.055 | 0.045 |
| | | | | 0.260 | 0.422 | 0.005 | | | | 0.070 | 0.180 | 0.524 |
| npeople | | | | 0.001 | 0.018 | 0.001 | | | | -0.026 | -0.002 | -0.040 |
| | | | | 0.821 | 0.153 | 0.889 | | | | 0.000 | 0.906 | 0.000 |
| nchildren | | | | 0.005 | 0.003 | 0.026 | | | | -0.003 | -0.048 | 0.044 |
| | | | | 0.411 | 0.750 | 0.004 | | | | 0.712 | 0.000 | 0.000 |
| married | | | | 0.209 | 0.379 | -0.283 | | | | -0.012 | 0.326 | -0.577 |
| | | | | 0.227 | 0.060 | 0.599 | | | | 0.959 | 0.254 | 0.263 |
| cohab | | | | 0.046 | 0.174 | -0.370 | | | | -0.266 | 0.007 | -0.939 |
| | | | | 0.802 | 0.420 | 0.498 | | | | 0.286 | 0.983 | 0.075 |
| widow | | | | 0.071 | 0.287 | -0.419 | | | | -0.123 | 0.209 | -0.679 |
| | | | | 0.687 | 0.163 | 0.438 | | | | 0.606 | 0.472 | 0.189 |
| single | | | | 0.159 | 0.303 | -0.266 | | | | -0.025 | 0.181 | -0.540 |
| | | | | 0.361 | 0.136 | 0.623 | | | | 0.918 | 0.531 | 0.297 |
| parents | | | | 0.104 | 0.068 | 0.136 | | | | 0.072 | 0.032 | 0.107 |
| | | | | 0.000 | 0.004 | 0.000 | | | | 0.000 | 0.327 | 0.000 |
| EduSec | | | | 0.160 | 0.104 | 0.198 | | | | 0.209 | 0.214 | 0.117 |
| | | | | 0.000 | 0.006 | 0.000 | | | | 0.000 | 0.000 | 0.001 |
| EduUni | | | | 0.275 | 0.227 | 0.298 | | | | 0.327 | 0.261 | 0.273 |
| | | | | 0.000 | 0.000 | 0.000 | | | | 0.000 | 0.000 | 0.000 |
| FEocc | N | N | N | Y | Y | Y | N | N | N | Y | Y | Y |
| N | 16,005 | 7,479 | 8,526 | 14,100 | 6,445 | 7,655 | 16,005 | 7,479 | 8,526 | 14,100 | 6,445 | 7,655 |
| Logl | -1.243 | -1.209 | -1.246 | -1.208 | -1.177 | -1.204 | -0.859 | -0.719 | -0.938 | -0.795 | -0.659 | -0.874 |

## 5.2 Bivariate specifications

Next, we present a number of regressions where we have used a bivariate specification for health and individual income. We regress log income using the same explanatory variables as in the health equation, but include also the marginal tax rates applying to an average worker in each country to achieve identification.[7] We also allow the income

variable to be heteroskedastic – with the variance estimated individually for each country – and we estimate the correlation coefficient between health and income to capture the endogeneity of income. Due to space limitations, we only report parameter estimates from the health equation. Results are presented in *Table 5*.

**Table 5.** *Estimates from bivariate specifications. Health equation.*

| | SAH | | | | | | ADL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *all* | *OECD* | *NOECD* | *all* | *OECD* | *NOECD* | *all* | *OECD* | *NOECD* | *all* | *OECD* | *NOECD* |
| a1 | -3.562 | -1.960 | -4.021 | -3.117 | -2.452 | -3.484 | -1.725 | 3.183 | -3.977 | -2.373 | 4.097 | -3.955 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| a2 | -2.705 | -1.137 | -3.122 | -2.264 | -1.628 | -2.580 | -1.454 | 3.527 | -3.757 | -2.112 | 4.414 | -3.729 |
| | 0.000 | 0.035 | 0.000 | 0.000 | 0.061 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| a3 | -1.560 | -0.164 | -1.828 | -1.065 | -0.635 | -1.202 | -1.214 | 3.786 | -3.528 | -1.879 | 4.668 | -3.511 |
| | 0.000 | 0.761 | 0.000 | 0.003 | 0.465 | 0.085 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| a4 | -0.456 | 1.036 | -0.774 | 0.065 | 0.608 | -0.127 | -0.884 | 4.105 | -3.186 | -1.539 | 4.998 | -3.157 |
| | 0.100 | 0.054 | 0.045 | 0.860 | 0.487 | 0.856 | 0.011 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 |
| a5 | | | | | | | -0.302 | 4.649 | -2.574 | -0.942 | 5.587 | -2.548 |
| | | | | | | | 0.387 | 0.000 | 0.000 | 0.051 | 0.000 | 0.001 |
| gender | -0.105 | -0.044 | -0.114 | -0.038 | -0.002 | -0.037 | -0.192 | -0.070 | -0.178 | -0.096 | -0.042 | -0.167 |
| | 0.000 | 0.114 | 0.000 | 0.056 | 0.947 | 0.184 | 0.000 | 0.031 | 0.000 | 0.000 | 0.272 | 0.000 |
| age | -3.335 | -3.828 | -3.534 | -1.873 | -2.538 | -1.431 | -3.334 | -6.306 | -5.002 | -2.195 | -4.758 | -3.444 |
| | 0.000 | 0.003 | 0.003 | 0.050 | 0.089 | 0.270 | 0.002 | 0.000 | 0.001 | 0.072 | 0.010 | 0.033 |
| age2 | 0.617 | 1.955 | 0.161 | -0.011 | 1.273 | -0.850 | 0.654 | 4.828 | 1.368 | 0.117 | 3.770 | 0.284 |
| | 0.406 | 0.082 | 0.875 | 0.989 | 0.320 | 0.443 | 0.481 | 0.000 | 0.271 | 0.910 | 0.015 | 0.836 |
| Res12b | -0.210 | -0.351 | -0.135 | -0.164 | -0.167 | -0.054 | | | | | | |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.002 | 0.102 | | | | | | |
| Res45b | 0.273 | 0.058 | 0.261 | 0.316 | 0.149 | 0.359 | | | | | | |
| | 0.000 | 0.219 | 0.000 | 0.000 | 0.008 | 0.000 | | | | | | |
| Inc | 0.066 | 0.270 | 0.058 | -0.008 | 0.179 | 0.020 | 0.233 | 0.881 | 0.064 | 0.103 | 0.879 | 0.039 |
| | 0.000 | 0.000 | 0.001 | 0.602 | 0.022 | 0.340 | 0.000 | 0.000 | 0.008 | 0.000 | 0.000 | 0.229 |
| SD(y) | -0.071 | -0.917 | -0.100 | 0.024 | -1.818 | 0.033 | 0.032 | -1.638 | -0.033 | -0.004 | -1.416 | 0.092 |
| | 0.001 | 0.000 | 0.000 | 0.325 | 0.000 | 0.212 | 0.220 | 0.000 | 0.239 | 0.905 | 0.000 | 0.027 |
| urban | | | | -0.042 | -0.021 | -0.157 | | | | -0.071 | -0.064 | 0.664 |
| | | | | 0.093 | 0.495 | 0.006 | | | | 0.034 | 0.096 | 0.000 |
| npeople | | | | -0.013 | 0.007 | -0.002 | | | | -0.037 | 0.093 | 0.019 |
| | | | | 0.027 | 0.713 | 0.739 | | | | 0.000 | 0.000 | 0.788 |
| nchildren | | | | 0.007 | 0.001 | 0.026 | | | | -0.002 | -0.023 | -0.038 |
| | | | | 0.304 | 0.955 | 0.004 | | | | 0.837 | 0.055 | 0.000 |
| married | | | | 0.203 | 0.394 | -0.268 | | | | -0.042 | 0.185 | 0.045 |
| | | | | 0.243 | 0.056 | 0.624 | | | | 0.858 | 0.527 | 0.000 |
| cohab | | | | 0.042 | 0.188 | -0.386 | | | | -0.294 | -0.122 | -0.583 |
| | | | | 0.819 | 0.392 | 0.485 | | | | 0.240 | 0.699 | 0.258 |
| widow | | | | 0.056 | 0.286 | -0.401 | | | | -0.160 | 0.215 | -0.959 |
| | | | | 0.751 | 0.173 | 0.464 | | | | 0.502 | 0.469 | 0.069 |
| single | | | | 0.142 | 0.300 | -0.258 | | | | -0.064 | 0.181 | -0.676 |
| | | | | 0.418 | 0.147 | 0.638 | | | | 0.788 | 0.540 | 0.190 |
| parents | | | | 0.116 | 0.073 | 0.143 | | | | 0.080 | -0.014 | -0.568 |
| | | | | 0.000 | 0.003 | 0.000 | | | | 0.000 | 0.657 | 0.272 |
| EduSec | | | | 0.189 | 0.120 | 0.218 | | | | 0.229 | 0.038 | -0.380 |
| | | | | 0.000 | 0.004 | 0.000 | | | | 0.000 | 0.446 | 0.046 |
| EduUni | | | | 0.326 | 0.254 | 0.323 | | | | 0.363 | 0.004 | 0.149 |
| | | | | 0.000 | 0.000 | 0.000 | | | | 0.000 | 0.938 | 0.000 |
| σhy | 0.115 | 0.021 | 0.071 | 0.146 | 0.053 | 0.084 | 0.009 | -0.532 | 0.123 | 0.114 | -0.494 | 0.119 |
| | 0.000 | 0.549 | 0.011 | 0.000 | 0.367 | 0.005 | 0.698 | 0.000 | 0.001 | 0.000 | 0.000 | 0.011 |
| FEocc | N | N | N | Y | Y | Y | N | N | N | Y | Y | Y |
| N | 16,005 | 7,479 | 8,526 | 14,100 | 6,445 | 7,655 | 16,005 | 7,479 | 8,526 | 14,100 | 6,445 | 7,655 |
| Logl | -2.746 | -1.209 | -1.246 | -1.208 | -1.177 | -1.204 | -0.859 | -0.719 | -0.938 | -0.795 | -0.659 | -0.874 |

In the first three columns, we present results from a specification with SAH as the dependent variable, with the further covariates restricted to gender, age, income, inequality and proxies of heterogeneity in reporting behaaviour. As expected, the estimated impact of individual income is now slightly smaller in magnitude (although not in statistical significance), which is largely attributable to the positive correlation between the residuals of health and income, as captured by the correlation coefficient **σhy**.[8] Thus, our results deliver fairly strong evidence for endogeneity of individual income (and thereby also endogeneity of inequalities).

Concerning the parameter estimated for the standard deviation of log income, we find somewhat stronger evidence for an inequality effect in this minimalistic specification, particularly when the entire sample is considered. For the two subsamples, estimates are very similar to the previous specification. In conclusion, the endogeneity problem seems to have biased the estimated income effects more than the inequality effects.

When we add further explanatory variables, the estimated impact of income is weakened even more. It is only for the OECD subsample that the estimated effect is significant. Interestingly, the correlation coefficient σhy is insignificant in that specification. Concerning the estimated income inequality effect, we fail to reject that the effect is equal to zero in the full sample as well as in the subsample of non-OECD countries. On the other hand, in the subsample of OECD countries we find a robust inequality effect which is comparable to the previous estimates.

If we turn to the specifications with ADLs as dependent variable, we get the surprising result that there is negative correlation between income and health in the OECD subsample, whereas the correlation is positive in non-OECD countries. As a consequence, the previous specification seems to have underestimated the income effect in this subsample. It is unclear how this result should be interpreted. In any case, we also find that the estimated inequality effect is negative and strongly significant in the OECD subsample, whereas it is insignificant in the other specifications.

## 6 Conclusions

The aim of this study has been to analyze the impact of economic inequalities on individual health, while also addressing the potential problem of endogeneity. It has long been observed that economic inequalities and population health are strongly and negatively correlated, and this relationship seems to hold at country-level as well as at the regional level. However, there is still widespread disagreement as to whether this correlation is actually caused by inequalities, or whether it simply reflects a non-linear relationship between individual income and health. Furthermore, there is disagreement concerning the pathways through which economic inequalities may influence individual health. Existing empirical evidence is inconclusive and seems to be sensitive to the inclusion of some control variables and to the statistical approach chosen.

We have endeavoured to shed some light on these issues, using a unique dataset, *The Future of Retirement*. In this survey, a large number of subjects from 21 different countries have been asked the same questions concerning their economic situation, social networks and general health. The dataset is particularly useful for studying the

relationship between economic inequalities and health, since it covers a wide range of countries with very different economic circumstances.

Our main findings can be summarized as follows: We find strong evidence of the AIH as individual income is positively related to health in a non-linear fashion. However, estimates based on the assumption that income is exogenous tend to overestimate the impact of income – which probably is due to a reverse causality going from health to income. In fact, some specifications suggested that income is irrelevant to health and that the observed correlation has more to do with differences in other individual attributes.

Concerning the IIH, we find very mixed evidence. Taking the endogeneity of income (and thus inequalities) into account tends to increase the estimated (negative) impact of inequalities in some cases. However, only for the subsample of OECD countries do we find consistent evidence of a substantial inequality effect on individual health. Hence, this finding seems to lend support to the common view that inequalities start to make a difference only after a certain level of development has been reached.

Obviously, several caveats apply; the most important one being that our identification strategy might be weak. This problem is in turn related to the lack of a clear theory of how economic inequality matters to health. As soon as such a theory emerges, we could add credibility to our approach by controlling for further national characteristics. Thus, empirical studies on the importance of various mechanisms seem to be a high priority for future research within this field.

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[1] The three suggested hypotheses not discussed in detail in this paper are the relative position hyposis, the relative deprivation hypothesis and the relative income hypothesis. The latter theory states that it is the individual income *in comparison with average incomes* in a reference group which matters. In other words, health depends on the deviation of the individual income from the mean. Our intention is to also address this hyposesis in future work when assuming income is not exogenous.

[2] The WHO measure of HLE is based on life expectancy at birth, but includes an adjustment for time spent in bad health. The methods used by the WHO to calculate HLE have been developed to maximize international comparability. To overcome the problem of comparability of self-reported variables, the WHO survey instrument uses performance tests and vignettes to calibrate self-reported health in each of seven core domains. The calibrated responses are used to estimate the prevalence of different states of health by age and sex. More information on the survey method can be found in Salomon et al. (2003). As the WHO does not provide information on HLE or LE for Taiwan, we complement with information from the national statistics office in Taiwan.

[3] The SAH variable was collapsed into three values, 1-2 and 4-5 with the value 3 as reference category.

[4] Due to incomplete information on certain variables of interest, data from Brazil and Mexico were excluded.

[5] In fact, it is the joint response rate for the variables income, family size (necessary to derive adjusted household income), age and region; thus, the figure gives an indication on how many cases are lost in each country in our baseline specifications.

[6] Fixed effects for occupation were included in some specification (denoted FEocc).

[7] The variables capturing national reporting heterogeneity – Res12b and Res45b – have been excluded from the income equation.

[8] In fact, we report Fisher's Z transformation of the correlation coefficient, which is a good approximation of the correlation coefficient for the values reported in the table.