Individual good, public bad, or societal syndrome?

A cross-country study of income, inequality and health

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Abstract

This paper examines the association between inequality and individual health across low, middle and high income countries making use of 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 and the relationship between reference group incomes and health – with particular focus on how the estimated effects depend on the reference group considered. We find strong evidence that average incomes within the own age group has a negative effect on health, thus giving support to the relative income hypothesis. This reference group seems to be more important than those based on geographic proximity. However, there seem to be important differences between high- and low-income countries in this and other respects. Finally, there is strong evidence of a general income inequality effect.

1 Introduction

In economics, as well as epidemiology, there is an ongoing discussion as to whether economic inequalities contribute to ill-health. Initially, the empirical support brought forward for this claim 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, it has also been argued that the observed relationship could be a statistical artifact reflecting a non-linear relationship between income and health at the individual level (Gravelle, 1998). When there are diminishing returns to income in the production of health, the observed relationship between societal inequalities and population health will to some extent be spurious and not causal.

On the other hand, there are reasons to believe that 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 health determinants (Cutler and Lleras-Muney, 2006). Consequently, if the degree of social interaction between people is related to the level of economic inequality in societies, this might be important in the analysis of health outcomes. 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.

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).

However, there are several possible relationships between income, inequality and health at the individual level that could help explain the observed correlation between inequality and population health. Wagstaff and van Doorslaer (2000) identify no less than five competing explanations for the relationship between income inequalities and health. Evidently, it is necessary to distinguish between these hypotheses as they have different policy implications. A minimum requirement to make this possible is to use data on health status and incomes of individuals.

Information on individuals is often available for separate countries and several studies on the association between inequality and individual health 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 (self-assessed health or mortality), the choice of inequality measure and in the interpretation of additional covariates as confounders or mediators.

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 test three of the five hypotheses which have been suggested in the literature: the absolute income hypothesis, stating that individual income, but not the income distribution, matters to individual health status; the relative income hypothesis, according to which an

individual's health is affected by the average income in a reference group; and the income inequality hypothesis, according to which economic inequalities in a society influence everyone's health.[1]

The contribution of this paper is threefold. First of all we introduce a new and useful dataset which has previously not been available. It includes information at the individual level. Moreover, it includes 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, the wide range of countries included allows for a comparative analysis of whether effects are different at different levels of economic development. To our knowledge this has not been done before with individual level data. Finally, we investigate a new reference group; assuming that people compare themselves with individuals of their own age rather than with people in a particular part of the country. This seems reasonable from an economic point of view and transpires to have a very strong explanatory power, especially in a high-income context.

The paper is organized as follows. In the next section, we give a brief overview of the hypotheses which have been discussed in the literature 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

In the literature, there has been some confusion concerning terminology, partly because several disciplines are involved. We will follow the definitions employed in Wagstaff and van Doorslaer (2000). Moreover, it seems important to spell out that, although there are reasons to distinguish between the different hypotheses in the empirical analysis, they are not necessarily mutually exclusive. Clearly, each of them could be a partial explanation to the observed correlation between inequality and public health.

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 **relative income hypothesis** (RIH), 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. This hypothesis requires the average income in the reference group to be included in the regression of individual health. The main mechanism through which relative income is assumed to matter to health is the stress which might be induced by belonging to the relatively deprived in a particular society. This explanation suggests that, controlling for individual income, the coefficient of reference-group average income should be negative. However, it has also been suggested that reference group income could matter through other channels, such as the local provision of public goods or other services (e.g. clean environment, publicly provided health care), and thus be a positive influence in some cases.

Concerning these two versions of the RIH the evidence is weak, with several studies finding virtually no such effects (Lorgelly and Lindley, 2008; Li and Zhu, 2006). Among the few articles with significant coefficients of average incomes, both the negative and the positive RIH have found some empirical support. Using an American dataset, Luttmer (2005) finds evidence of a **negative RIH** when individual happiness is used as dependent variable. Regarding the **positive RIH** both Gerdtham and Johanesson (2004) and Miller and Paxson (2006) find evidence of such an effect on mortality, suggesting that neighborhood effects work through a better supply of social services or public goods.

One important issue which has often been overlooked is which reference group to consider. It has been suggested (Miller and Paxson, 2006) that the RIH should be tested

with reference to average income within the subgroup of the population to which the individual belongs – where subgroups are defined according to geographical context, birth cohort or ethnic groups.

Our approach to these issues is, in addition to the more common strategy of using regional averages, to assume that individuals compare their economic situation to people of their own age. In other words, our scenario is one where individuals are not always concerned with keeping up with their neighbors, but with people who belong to the same generation. This seems reasonable since people of the same age are more likely to be at a similar stage of the life cycle. Moreover, this aspect has often been overlooked in the literature – with the exception of Miller and Paxson (2006) – and is clearly worth investigating.

Finally, an **income inequality hypothesis** (IIH) has been proposed, according to which 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 normally 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.

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.

The situation 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 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.

One issue to consider is the timing of effects. Arguably, some risk factors require a very long exposure to have an observable effect on health, and hence inequalities might affect health with a substantial time lag. Besides, individual health might be more sensitive to inequalities in childhood than inequalities at adult ages. These considerations suggest that lagged inequalities play a more important role than current inequality. Indeed, Mellor and Milyo (2003) report that the Gini coefficient lagged 15 to 19 years has the strongest effect on health. Moreover, controlling for past levels of economic inequality will remedy estimation bias following from potential reverse causality between inequality and health. For these reasons, we will import data on inequalities at current as well as previous points in time.

A related issue is the difficulty to model the relationship between individual income and health when income is likely to be affected by health status (Grossman, 1972). Moreover, there might be a simultaneity problem, implying that the estimated relationship does not reflect a causal effect. These problems will not be addressed in this analysis but should be considered in future research.

Furthermore, it has already been mentioned that results seem to be heavily influenced by the specification – and in particular the inclusion of fixed effects and some personal characteristics. For the current study, the possibilities to include fixed effects are limited, mainly due to the cross-sectional character of the dataset. However, in order to wash out some of the unobserved heterogeneity, we apply fixed effects at the levels for which

inequality effects are not included – e.g. at the national level in regressions where regional-level inequalities are analyzed, and so forth. In addition, we will try to capture unobserved heterogeneity by including the one exogenous health-related variable which is actually present in the dataset – the question whether the respondent's parents are still alive or not.

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 RIH and IIH (cf. also section 4.2).

For SAH, we derived two variables for national reporting biases 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 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.

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 from the dataset

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 already mentioned, 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.

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. To test the AIH we include this variable and its square in the estimations.

To test the RIH, we also derive an average income measure from the data set with respect to country and age group. Consequently, individuals born in the same time period and living in the same country all get the same value for this variable. Since the dataset is stratified over 10-year age groups (i.e. 40-50, 50-60 etc) it was natural to choose these groups as reference points for the age-related RIH. With this approach, we can investigate if people primarily compare their economic situation to that of others in the same age group. Furthermore, for each national sample, we have complete information on the region in which individuals live. This regional variable typically refers to the main administrative level below the national level – such as member states in the US or *Bundesländer* in Germany. This variable was used as a reference to calculate regional averages for the income variable.

Some further 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.*

4.3 Imported Variables

For tests of the IIH, income inequality is measured by the Gini coefficient; one of the most commonly used proxies for economic inequality. Our data on national inequality is taken from the World Income Inequality Data base (WIID2b, 2007).[5] There are several problems related to the measurement of inequality across economies (Deaton, 2003). In order to overcome some possible pitfalls, we adopt a conservative approach for selecting inequality indicators. First, we only use observations which earned a quality rating of 1 or 2 in the WIID2b. In brief this implies that the underlying income concept and/or the survey methodology are judged appropriate. We restrict our sample to inequality indicators based on a unified income concept which are derived from nationally representative income distributions.

The Future of Retirement was collected in 2006. Accordingly, we choose to include Gini coefficients from that year. However, in line with the discussion above, we also test the relation between inequality and individual health using lagged values of the distribution of incomes. Based on the results in Mellor and Milyo (2003), we include national Gini coefficients from 1990. When inequality data is not available for these exact time points, we use data from years close to 2006 and 1990.

For the RIH we use three different variables for average income. First, we include PPP adjusted GDP per capita. This data is imported from the World Development Indicators (World Bank, 2007).[6] Second, as mentioned above, we derive average income measures

from the data set with respect to region as well as within-country age groups, assuming that people compare their income to people in their surroundings and to compatriots of the same age, respectively.

In *Table 3*, we provide a national breakdown of some of the variables used. In the first two columns, we report the Gini coefficient in 2006 and 1990. 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.[7] Finally, we present the proportion of people in the national samples who have secondary and tertiary education.

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.

5 Results

We use ordered probit models throughout, but change the independent variables included and whether correcting for reporting heterogeneity or not. Due to the limited dispersion of the ADL variable, we were not able to use it in specifications with regional fixed effects.

First, we report results from a 'minimalist' specification, where we have only included variables directly related to the hypotheses we want to test, as well as the most obvious exogenous variables. Next, we include a wide range of covariates, as a test of whether our

results are robust. Finally, we split the sample into two groups – one consisting of high-income countries and the other one of less developed countries.

5.1 Baseline specifications

In a first set of regressions, we include age and its square, gender, and the variables related to the hypotheses. We also control for unobserved heterogeneity at the national and regional level by clustering observations and using fixed effects whenever possible. We present our estimates as elasticities[8] of the probability of reporting very good health (SAH=5) with respect to the independent variables. In *Table 4*, we present results for the national-level variables, estimated with fixed region effects. Our estimates to the left (**National-Ia** and **IIa**) include GDP per capita and the national Gini coefficient at different points in time, whereas the two following columns also address reporting heterogeneity by including the gender-country-specific residuals in reporting frequencies (*Res12b* and *Res45b*).

As expected, absolute income improves health at a decreasing rate, hence giving support to the AIH. We also find that health deteriorates with age, but at a decreasing rate, and being female is associated with a significantly lower propensity to report 'very good' health. Moreover, our baseline results suggest that inequalities have a strong impact on individual health – irrespective of whether we consider the level of inequality in the current year or at a previous point in time.[9] There is also evidence of a national-level RIH. Finally, our results suggest that the relationships between national-level variables and health seem to be partly masked behind differences in reporting behaviour.

Next, we turn to variables related to age group and region. In *Table 5*, we first report results for a specification where we included regional and age group means of incomes as independent variables (**Regional-a**). In the middle column, we also control for differences in reporting behavior. In the rightmost column, we replicate the first regression, but with the number of ADLs as the dependent variable, and report elasticities[10] of the probability of reporting full functionality (ADL=5) with respect to the independent variables.

The estimated relationship between absolute income and health is very similar to that reported in *Table 4*. The same is true for gender and (roughly) age. Concerning the variables related to the RIH we find that the within-country age group average (*agemean*) has a negative and significant effect on health whereas the regional average (*regmean)* comes out insignificant. Hence, we have found support for a negative RIH with reference to one's own age group. These findings are supported by the regression using ADLs as dependent variable.

5.2 Including further covariates

The dataset contains a wide range of other variables which have previously been shown to be important determinants of health, such as educational attainment and marital status. In a further set of specifications, we included these variables in order to find out whether our previous results are robust. One criticism of previous works on the IIH has been that they fail to account for confounding factors. Since we lack a unifying theory concerning the mechanisms underlying the relationships it is not obvious what role these additional covariates can be assumed to play, whether as confounders or mediators, as argued

above.

If they are mediators, including them becomes a way to investigate the mechanisms through which inequality affects health. For example, if the provision of health services is affected by the income distribution, the same is likely to be true of the provision of education, which means that educational attainment can be seen as a mediator. Furthermore, the efficiency of the matching mechanism in the marriage market is likely to be affected by the income distribution, and the same is true for the individual's prospects of finding suitable employment. In conclusion, our analysis delivers a robustness check, but also a test of whether the estimated impact of economic inequalities on health can be attributed to factors related to these additional variables.

Our results are presented in *Table 6*. The first column – **National-Ic** – represents a specification where we have added additional covariates to specification **National-Ib** in *Table 4* above. The next column extends the specification **National-IIb** above (with lagged values of the Gini) in a similar way. The third column, **Regional-c**, adds further covariates to the specification **Regional-b** reported in *Table 5*. Finally, the column **ADL-c** extends the specification **ADL-a** above. Since the variable Res12b did not add any explanatory power in this setting, we decided to capture reporting heterogeneity by *Res45b* only.

In specifications **National-Ic** and **National-IIc**, we see that including further covariates does not change the general finding of a non-linear relationship between absolute income and health, or between age and health. However, the previously observed gender difference now vanishes, suggesting that the gender effect on health is attributable to

these further covariates. Otherwise, results are largely as expected: marital status and education both have expected effects on the propensity to report good health. Interestingly, the effect associated with parents being alive is strong and of similar magnitude in all specifications.

The Gini coefficient referring to the current level of inequality now comes out strongly significant and with a negative sign, and the result is even stronger for lagged Gini. Hence, we find strong support for the IIH also in this case. Again, the estimates suggest that GDP per capita is negatively associated with health, but the evidence is not robust as we do not find significance throughout.

Concerning specification **Regional-c**, we get very similar results with respect to the additional covariates. We also find that both the regional and the age group average income have a significantly negative effect on health. The age group average seems to have a particularly negative effect, which is similar in magnitude to what we found above in *Table 5*. Using ADLs as the dependent variable, results are comparable, although the regional variable seems to be stronger in this specification.

5.3 Comparing low- and high-income countries

It has been suggested (Deaton, 2003) that the relative importance of an individual's absolute and relative income to health might depend on the level of development. According to this theory, the RIH should increase in importance above a certain threshold in GDP per capita. In order to investigate this hypothesis, we take advantage of the broad coverage of the dataset and split the sample into two parts, depending on whether the

country is classified as a high income country according to World Development Indicators (World Bank, 2007). In our sample, 7,780 individuals lived in high-income countries, whereas 6,276 lived in low- or middle-income countries.[11]

We present estimated elasticities in *Table 7*. It is noteworthy that the two groups of countries exhibit many important differences: the shape of the relationship between absolute income and health is different; and family structures (children and family size) have different implications in the two groups of countries. Also, whereas the effect of a university degree is roughly the same in the two settings, secondary education seems to be of much greater importance in the poorer countries. A Likelihood ratio test of the difference between the split sample and the joint specification delivered a test statistic of 195.9, which at 37 degrees of freedom is strongly significant. Hence, this result suggests that the parameters are significantly different in the two groups.

Concerning the RIH, the age group remains important within the high-income group (**Regional-H)**, whereas only the regional average comes out significant amongst the poor countries (**Regional–L**). This finding seems to suggest that reference groups are different in rich and in poor countries. The results for ADLs are generally consistent with those for SAH; although, marital status seems to be of greater importance in high-income countries when ADLs are considered.

6 Conclusions

The aim of this study has been to analyze the impact of economic inequalities on individual health. 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. Concerning the RIH, the evidence is less conclusive at the national level. Although the coefficient is negative throughout, it is not significant in all specifications. In the same vein, the evidence for a regional RIH is comparatively weak. In contrast, we find relatively strong evidence in favor of the RIH when the average income of the respondent's age group is used as reference point. This differs from Miller and Paxon (2006) who do not find such an effect. Our confidence in this result is strengthened by the fact that it was unaffected when additional covariates were added, suggesting that the observed effect is not working

its way through an individual's observable attributes. From the separate estimations for high- and low-income countries, it is noteworthy that the effect on health from average incomes in one's own age group is strong in high-income countries, but not significant in the low-income group. This seems to suggest that the ambiguity in the literature concerning the relative income hypothesis might be due to, firstly, previous studies not having considered the appropriate reference groups, and secondly, the effect being different in different economic contexts. The fact that the RIH gains the strongest support when the respondent's own age group is used as the reference casts an interesting light on the discussion of the actual direction of the RIH. When the age group is used as a reference group, it could be argued that we have isolated some of the negative effects associated with the RIH (e.g. stress and personal well-being) whereas the positive effects (e.g. provision of local services) are less likely to appear at this level.

Finally, on the IIH, we find that the Gini coefficient has a statistically significant and negative association with health status. While existing cross-national studies on individuals residing in settings of relatively homogenous countries find weak or no effects of inequalities (Bobak et al. 2000, Hildbrand and van Kerm 2005), our results suggest a robust relationship, also controlling for individuals' characteristics. However, we are unable to determine whether contemporary or past inequalities are of greater importance.

Though we believe we have come an important part of the way, it is still too early to draw definite conclusions as to whether income is just a private benefit or if income inequalities represent a threat to public health. We would suggest that future work should

explore the reference-group issues further, looking, for example, at educational *cum* income groups and at smaller geographical areas. Moreover, the role of covariates as confounders or mediators also suggests itself for further investigations.

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

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	907	0.025	0.087	0.326	0.393	0.169	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	650	0.002	0.059	0.286	0.289	0.365	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	584	0.009	0.043	0.207	0.498	0.243	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	668	0.006	0.072	0.368	0.234	0.320	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	814	0.010	0.033	0.123	0.366	0.468	4.784	0.759	71	79
USA	895	0.013	0.051	0.134	0.447	0.354	4.714	0.788	69	78
Total	15,923	0.022	0.084	0.292	0.362	0.240	4.465	1.133	65	74

Table 2. *Variable definitions and descriptive statistics*

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*	*Definition*
incomppp	15,923	35,628	38,704	0	379,501	*Adjusted household income in 2006 PPP dollars*
gender	15,923	0.526	0.499	0	1	*Respondent is female*
npeople	15,923	3.466	2.054	1	20	*Number of people in household*
parents	15,923	0.536	0.749	0	2	*Number of parents alive*
nchildren	15,875	2.360	1.663	0	20	*Number of children*
age	15,923	57.664	11.246	39	78	*Age in 2006*
urban	15,754	0.818	0.386	0	1	*Respondent lives in area with more than 20,000 inhabitants*
EduSec	14,376	0.399	0.490	0	1	*Respondent has completed secondary education*
EduTer	14,376	0.311	0.463	0	1	*Respondent has completed tertiary (further) education*
married	15,923	0.699	0.459	0	1	*Respondent is married*
cohab	15,923	0.021	0.144	0	1	*Respondent is cohabiting*
widow	15,923	0.160	0.366	0	1	*Respondent is widow*
single	15,923	0.120	0.325	0	1	*Respondent is single*
Pensioner	15,763	0.103	0.304	0	1	*State pensioner with no other earnings*
Manual	15,763	0.054	0.227	0	1	*Manual or service worker with minimal formal education or training*
Semi-skilled	15,763	0.085	0.279	0	1	*Semi-skilled manual or service worker*
Skilled	15,763	0.111	0.314	0	1	*Skilled manual worker*
Clerical	15,763	0.119	0.324	0	1	*Clerical worker*
Junior	15,763	0.049	0.215	0	1	*Junior managerial, administrative, or professional position*
Supervisor	15,763	0.052	0.221	0	1	*Supervisor in managerial, administrative, or professional position*
Intermediate	15,763	0.060	0.237	0	1	*Intermediate managerial, administrative, or professional position*
Upper	15,763	0.052	0.221	0	1	*Upper level managerial, administrative, or professional position*
Other	15,763	0.171	0.376	0	1	*Other position*
None	15,763	0.141	0.348	0	1	*None*
Pensioner2	15,763	0.004	0.065	0	1	*State pensioner with other earnings*
Walking	15,862	0.857	0.350	0	1	*No difficulty to walk 100 metres*
Dressing	15,923	0.932	0.252	0	1	*No difficulty to get dressed*
Bathing	15,923	0.926	0.261	0	1	*No difficulty to bath*
Eating	15,923	0.906	0.292	0	1	*No difficulty to eat*
Bed	15,923	0.877	0.329	0	1	*No difficulty to get into or out of bed*

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

	Gini06	*Gini90*	*GDPpc*	*incomppp*	*resprate*	*EduSec*	*EduUni*
Canada	30.1	28.1	36,713	36,723	0.84	0.254	0.581
China	44.9	38.2	4,644	5,916	0.89	0.207	0.090
Denmark	24.0	25.0	35,692	34,728	0.90	0.397	0.141
France	28.0	32.7	31,992	22,965	0.72	0.524	0.476
Germany	31.1	30.8	32,322	27,412	0.87	0.227	0.497
Hong Kong	52.5	42.2	39,062	24,857	0.91	0.488	0.151
India	36.8	29.6	2,469	3,464	0.98	0.547	0.188
Japan	31.9	31.2	31,947	17,908	0.67	0.266	0.387
Malaysia	46.1	48.0	12,536	32,777	0.93	0.708	0.054
The Philippines	47.9	50.9	3,153	13,014	0.65	0.379	0.439
Russia	45.3	43.6	13,116	6,318	0.98	0.464	0.453
Saudi Arabia	34.7		22,296	16,725	0.95	0.617	0.153
Singapore	48.1	43.6	44,708	22,354	0.58	0.312	0.409
South Africa	58.0	63.0	9,087	9,820	0.86	0.315	0.195
South Korea	36.9	34.7	22,988	20,561	0.78	0.332	0.309
Taiwan	33.9	30.9	28,011	18,641	0.67	0.385	0.350
Turkey	45.0	46.5	8,417	6,112	0.86	0.104	0.272
UK	34.2	33.5	33,087	40,988	0.80	0.351	0.441
USA	39.4	37.4	43,968	43,070	0.89	0.536	0.411

Table 4. *Results for national-level variables* [a]

	National-Ia		**National-IIa**		**National-Ib**		**National-IIb**	
Variable	*ε*	*s.e.*	*ε*	*s.e.*	*ε*	*s.e.*	*ε*	*s.e.*
incomppp	0.4129	0.060 ***	0.4369	0.064 ***	0.4148	0.060 ***	0.4394	0.065 ***
incomppp2	-0.0703	0.014 ***	-0.0758	0.015 ***	-0.0700	0.014 ***	-0.0757	0.015 ***
gini_06	-3.8355	0.166 ***			-4.9631	0.338 ***		
gini_90			-1.7980	0.157 ***			-3.8093	0.310 ***
GDP_pc	-0.5895	0.098 ***	-0.1942	0.118 *	-1.2385	0.201 ***	-1.4012	0.206 ***
age	-3.0731	0.921 ***	-2.8767	0.959 ***	-3.0839	0.923 ***	-2.8791	0.962 ***
age2	0.5249	0.519	0.5192	0.553	0.5310	0.518	0.5218	0.553
gender	-0.0614	0.030 **	-0.0549	0.031 *	-0.0629	0.021 ***	-0.0591	0.024 **
Res12b					-0.0054	0.009	-0.0049	0.023
Res45b					-0.0264	0.008 ***	-0.0411	0.015 ***
Cluster	Country		Country		Country		Country	
FE	Region		Region		Region		Region	
N	15,923		14,969		15,923		14,969	
LogL	-19,414		-18,322		-19,395		-18,303	
Pseudo R2	0.1046		0.1029		0.1055		0.1039	

[a] * denotes statistical significance at the 10 per cent level, ** significance at the five per

cent level and *** significance at the one per cent level.

Table 5. *Results for regional and age group variables***.**

Variable	Regional-a		Regional-b		ADL-a	
	ε	*s.e.*	*ε*	*s.e.*	*ε*	*s.e.*
incomppp	0.4513	0.040 ***	0.4534	0.040 ***	0.1195	0.021 ***
incomppp2	-0.0774	0.013 ***	-0.0773	0.013 ***	-0.0202	0.004 ***
regmean	-0.1635	0.113	-0.1603	0.114	-0.0594	0.041
agemean	-0.7212	0.155 ***	-0.7232	0.154 ***	-0.1362	0.053 **
age	-2.0300	0.732 ***	-2.0391	0.739 ***	-0.5530	0.253 **
age2	-0.2371	0.421	-0.2330	0.423	-0.0754	0.143
gender	-0.0625	0.019 ***	-0.0641	0.018 ***	-0.0482	0.007 ***
Res12b			-0.0046	0.011		
Res45b			-0.0257	0.010 **		
Cluster	Region		Region		Region	
FE	Country		Country		Country	
N	15,923		15,923		15,923	
LogL	-19,623		-19,605		-12,975	
Pseudo R2	0.095		0.0958		0.117	

Table 6. *Results with additional covariates added.*

	National-Ic		National-IIc		Regional-c		ADL-c	
Variable	*ε*	*s.e.*	*ε*	*s.e.*	*ε*	*s.e.*	*ε*	*s.e.*
incomppp	0.3235	0.062 ***	0.3483	0.066 ***	0.3482	0.039 ***	0.0756	0.022 ***
incomppp2	-0.0585	0.011 ***	-0.0647	0.012 ***	-0.0622	0.011 ***	-0.0137	0.004 ***
regmean					-0.2842	0.093 ***	-0.0902	0.037 **
agemean					-0.6477	0.140 ***	-0.0838	0.047 *
gini_06	-0.5442	0.173 ***						
gini_90			-2.7098	0.180 ***				
GDP_pc	-0.1156	0.099	-1.1977	0.143 ***				
age	-1.9566	0.986 **	-1.7931	1.029 *	-0.9705	0.742	-0.3350	0.255
age2	0.2274	0.543	0.2053	0.573	-0.4476	0.401	-0.0859	0.137
gender	-0.0117	0.013	-0.0160	0.013	-0.0116	0.016	-0.0290	0.005 ***
married	0.0469	0.042	0.0672	0.039 *	0.0428	0.037	0.0372	0.012 ***
cohab	-0.0043	0.002 *	-0.0039	0.003	-0.0038	0.002	-0.0016	0.001 ***
widow	-0.0171	0.008 **	-0.0166	0.008 **	-0.0175	0.009 **	0.0012	0.003
parents	0.0630	0.017 ***	0.0566	0.016 ***	0.0704	0.015 ***	0.0087	0.005 *
npeople	-0.0106	0.046	-0.0169	0.049	-0.0137	0.044	-0.0098	0.014
nchildren	0.0685	0.041 *	0.0267	0.017	0.0554	0.026 **	-0.0047	0.008
urban	-0.0360	0.046	-0.0353	0.046	-0.0326	0.038	0.0227	0.013 *
EduSec	0.1084	0.024 ***	0.1073	0.026 ***	0.1095	0.016 ***	0.0221	0.004 ***
EduUni	0.1423	0.019 ***	0.1423	0.020 ***	0.1410	0.015 ***	0.0322	0.005 ***
Res45b	-0.0231	0.005 ***	-0.0355	0.008 ***	-0.0224	0.005 ***		
Cluster	Country		Country		Region		Region	
FE	Region Occupation		Region Occupation		Country Occupation		Country Occupation	
N	14,015		13,273		14,015		14,015	
LogL	-16,559		-15,787		-16,733		-10,626	
Pseudo R2	0.1141		0.1104		0.1048		0.1196	

Table 7. *Results for high- and low-income countries.*

	Regional-H		Regional-L		ADL-H		ADL-L	
Variable	*ε*	*s.e.*	*ε*	*s.e.*	*ε*	*s.e.*	*ε*	*s.e.*
incomppp	0.4581	0.039 ***	0.1632	0.061 ***	0.1057	0.013 ***	0.0070	0.034
incomppp2	-0.0844	0.013 ***	-0.0261	0.013 **	-0.0184	0.003 ***	-0.0027	0.006
regmean	-0.1872	0.090 **	-0.2839	0.118 **	-0.0115	0.027	-0.1584	0.044 ***
agemean	-0.5904	0.136 ***	0.2190	0.447	-0.1013	0.049 **	0.1593	0.137
age	-0.4946	0.817	-2.4067	1.425 *	-0.3567	0.226	-0.4965	0.589
age2	-0.3734	0.433	0.0660	0.786	0.0223	0.122	-0.1381	0.320
gender	-0.0186	0.019	-0.0074	0.034	-0.0097	0.005 **	-0.0625	0.011 ***
married	0.0424	0.035	-0.0308	0.079	0.0272	0.010 ***	0.0100	0.027
cohab	-0.0057	0.003 *	-0.0012	0.003	-0.0014	0.000 ***	-0.0022	0.001
widow	-0.0066	0.007	-0.0438	0.025 *	0.0013	0.002	-0.0064	0.008
parents	0.0574	0.018 ***	0.0891	0.026 ***	-0.0018	0.004	0.0219	0.009 **
npeople	0.0904	0.035 ***	-0.1288	0.091	0.0224	0.012 *	-0.0549	0.032 *
nchildren	0.0172	0.023	0.1128	0.051 **	-0.0024	0.007	-0.0061	0.020
urban	-0.0258	0.026	-0.0357	0.148	0.0034	0.007	0.0938	0.045 **
EduSec	0.0767	0.017 ***	0.1637	0.031 ***	0.0119	0.004 ***	0.0399	0.010 ***
EduUni	0.1272	0.020 ***	0.1406	0.018 ***	0.0193	0.005 ***	0.0406	0.007 ***
Res12b	0.1035	0.034 ***	-0.2026	0.064 ***				
Cluster	Region		Region		Region		Region	
FE	Country Occupation		Country Occupation		Country Occupation		Country Occupation	
N	7,755		6,276		7,755		6,276	
LogL	-9,183		-7,452		-3,926		-6,632	
Pseudo R2	0.0727		0.1172		0.1042		0.0778	

[1] Two additional hypotheses presented in Wagstaff and van Doorslaer (2000) are the deprivation hypothesis and the relative position hypothesis.

[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] As noted by others (e.g. Sala-i-Martin and Mohapatra, 2002) there are no comparable inequality estimates available for Saudi Arabia. Therefore we use the *Future of Retirement* to calculate a Gini coefficient. We are confident with this procedure as a similar exercise for the other countries generates inequality measures that agree well with

imported ones. Results proved not to be sensitive to the inclusion of Saudi Arabian observations.

[6] The GDP figure for Taiwan comes from the IMF's (2008) World Economic Outlook.

[7] 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.

[8] For variables with a quadratic specification, the average effect of an increase by one unit is the linear coefficient plus two times the squared term.

[9] The discrepancy in the number of observations is due to the missing 1990 Gini coefficient for Saudi Arabia.

[10] For variables with a quadratic specification, the average effect of an increase by one unit is the linear coefficient plus two times the squared term.

[11] The high-income countries used in our analysis are Canada, Denmark, France, Germany, Hong Kong, Japan, Singapore, South Korea, Taiwan, the UK and the US. Middle-income countries are China, Malaysia, the Philippines, Russia, Saudi Arabia, South Africa and Turkey. Only India was classified as a low-income country, and was hence merged with the group of middle-income countries.