

# Income-Related Health Inequality in Russia: Unpleasing Equality

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Income-Related Health Inequality in Russia: Unpleasing Equality

*The development of Income-Related Health Inequality in Russia from 1994–2012.*

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## Foreword

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This report is written as part of the requirements for completion of the master's degree in Health Economics at Erasmus University Rotterdam. The master's program focuses on the application of concepts and tools of economic analysis in health and health care. The subject of this thesis, the development of income-related health inequalities in Russia from 1994 – 2012, falls within the scope of this master's program because the calculation, tracking and description of the development of a nation's levels of inequalities is vital in understanding the impact and consequences of uncontrollable events and policy reforms.

The subject was selected in co-operation with my supervisor, T. Van Ourti, professor of Applied Economics at the Erasmus School of Economics. The execution of this research was made possible by the data provided by the National Research University Higher School of Economics and ZAO "Demoscope" together with Carolina Population Center, University of North Carolina at Chapel Hill and the Institute of Sociology RAS. With the help of their Russia Longitudinal Monitoring Survey, I had access to the quality data necessary for conducting all the analyses.

I began conducting the research for this topic in 2014 and the process has been characterized by many ups and downs, but with the help of my supervisor I have kept up my enthusiasm for this research and maintained faith in a quality result. My learning goal for this thesis was to improve my statistical knowledge and skills and to experience what it is like to conduct an abstract scientific research project.

The process of writing my thesis was instructive and interesting, and really broadened my horizons in terms of conducting research. Prior to this project, I had never conducted a scientific research project of this magnitude, let alone written a scientific report. I feel like I have grown a lot in my statistical knowledge and skills, and my view on how to approach and conduct research in the future has improved as well. Trial and error and valuable, supportive feedback led to this thesis, a research project with which I am very satisfied.

Gijs Boom

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## Table of contents

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Abstract .....	5
1. Introduction.....	6
2. Decomposing income-related health inequalities .....	9
Measurement of income-related health inequalities .....	9
Changes in income distribution and IRHI: a decomposition approach .....	9
3. Data and empirical implementation.....	12
Estimating the relation between health, income and non-income variables.....	12
Selection of our sample, attrition and descriptive .....	13
Panel analysis .....	13
4. Results .....	15
Evolution of IRHI and changes in the income distribution in Russia.....	15
The relation between health, income, and non-income variables in Russia .....	15
Decomposition of evolution of IRHI in Russia .....	16
Further explanation income mobility.....	17
5. Conclusions.....	19
6. Acknowledgments .....	20
7. References.....	21
8. Appendix.....	24
Panel cohorts.....	36

## Abstract

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Since the collapse of the Soviet Union in 1992, Russia has undergone multiple political reforms, economic hardship and, on average, increasing inequality. This paper makes use of the decomposition method proposed by Baeten, et al., 2013 and the Russia Longitudinal Monitoring Survey to examine the extent to which changes in level and distribution of incomes and changes in income mobility are related to health disparities between the poor and rich during the period 1994–2012.

The main finding of this report is that Russia, on average, experienced an increasing income-related health inequality, but a decreasing inequality in times of economic hardship. The income mobility of elderly females proved to be the main driver behind the evolution of income-related health inequality, displaying the largest relation. The declining trends of inequality can be related to the elderly profiting from the social pension scheme in times of crisis.

## 1. Introduction

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The relation between income and health in Russia, and the resulting inequality has been researched and documented in various settings. What separates Russia from other countries are the drastic changes it has undergone in the 20-25 years since the collapse of the Soviet Union. A domestic economic crisis (Chiodo & M.T., 2002), an international economic crisis (Lane, 2012), a health care reform and a domestic health care improvement plan (Popovich, et al., 2011) have led to varying trends with respect to income and health.

GDP development showed an average annual decrease combined with an increasing Gini coefficient during the period of 1989-1998. This trend was reversed during the period of 1998-2008, when an average annual growth in GDP was combined with an average annual decrease in the Gini coefficient (Aristei & Perugini, 2012).

Poverty development illustrates a concave trend: between 1988 and 2009, the poverty headcount ratio (\$2 poverty line at 2005 international prices) decreased from 3.94% to 0.26%, but peaked during the period of 1996-1999 at 9.01-9.82%. During the period of 1999-2013, the poverty headcount ratio (measured at national poverty lines) decreased from 24.6% to 11% (World Bank, 2015).

During the period of 1992-1999, wages made a comeback, after declining most years, to about 50% of real wages in 1992. In 2004, real wages returned to 1992 levels and in 2012 the average wage level was twice the level of 1992 (OECD, 2014).

### *Life expectancy*

The World Bank categorizes Russia as a high income country, while life expectancy is on the level of a middle income country and life expectancy of males is around that of a low income country. In 2011, life expectancy returned to 1989 levels—at 69.2 years (69.7 in 2011) (The World Bank, 2015).

Various studies have described a relation between low life expectancy and excessive alcohol use in Russia (Neufeld & Rehm, 2013) (Bhattacharya, et al., 2013) (Jargin, 2013). The link between alcohol use and lower life expectancy is supported by the effect of Gorbachov's anti-alcohol campaign from 1985-1988, when life expectancy increased during and decreased after the campaign. After 1989, the year after the Gorbachev Anti-Alcohol Campaign ended, crude death rates had decreased and life expectancy increased. Following the collapse of the Soviet Union, there was a steep increase in the crude death rate and a decrease in life expectancy (Bhattacharya, et al., 2013). The decrease in life expectancy lasted until 1994, when life expectancy again increased until 1998. The increase in 1994 could be related to the introduction of mandatory medical insurance in 1993 and the decrease after 1998 could be related to the first ruble crisis of 1998, however no evidence was found to support these relationships. From 2006 onward, life expectancy showed a yearly increase (The World Bank, 2015) which could be related to the National Priority Plan Health (NPPH) that was introduced in 2006, however no evidence supporting this statement was found. In 2008, there was a 20 year difference in life expectancy between men in some West-European countries and Russia (Zatonski & Bhala, 2012).

### *Health care reforms*

As part of the decentralization of Russia, several health care reforms were adopted to improve quality and efficiency of health care. The first reform Russia adopted was mandatory medical insurance. The first law instituting mandatory medical insurance was adopted in 1991 and was aimed at promoting efficiency and patient choice. This law was constitutionalized in article 41 of the 1993 constitution, stating that everyone has the right to health care and medical assistance, free of charge (Tompson, 2007). With the new law, the financing of medical care shifted from the federal Ministry of Health to a hybrid, public-private mixture of

sources, mostly at the oblast<sup>1</sup> level. The system of mandatory health insurance was financed through tax revenues from employed individuals at the regional level and was supplemented by local government and, to a minor extent, federal funds (Burger, et al., 1998). The decentralized system was revised in 2011 with a law that all mandatory medical insurance funds be added to a federal fund.

The 1993 law for mandatory medical insurance underscores the goal of universal access for an unstated level of basic medical care. The law stated that medical care is care which guarantees certain value and conditions of medical care and pharmaceutical support (Article 1). The law also guaranteed the patient's freedom of choice regarding physician, hospital and source of insurance. Health insurance companies are not seen as part of the medical care system in Russia, as there has to be a clear separation between institutions providing financing of medical care and practitioners of care. Medical institutions are therefore also forbidden to set up health insurance companies. Government bodies supervise this system. The intended goal of contracting providers through insurers—efficiency and high quality care—was not achieved, however. The health care system significantly favors inpatient care at the expense of primary care. The favoring of inpatient care and high hospitalization rate testify to the low efficiency of primary care (Popovich, et al., 2011).

In 2006, the Russian government began the National Priority Plan Health (NPPH), with the goal of improving the population's health by improving material, technological and human resources provisions in the health sector (Popovich, et al., 2011). The NPPH was financed mainly from the national budget. The three main priorities included: improving primary care and disease prevention, improving the accessibility of tertiary care and improving maternal and child health services. The priorities were expanded after two years to tackle the burden of preventable mortality. The first expansion was the introduction of cover measures aimed to prevent cardiovascular disease<sup>2</sup> mortality (2008), Tuberculosis morbidity (2009) and cancer mortality (2009). In 2010, an anti-tobacco law was added (Popovich, et al., 2011).

Although life expectancy in Russia showed a positive trend from 2005 onwards, no evidence was found to support that reforms and the NPPH have had a direct positive influence on improvement of Russian health/life expectancy. It can only be said that life expectancy increased after the introduction of the NPPH. The question that arises is how the NPPH scores in terms of equality. Are the improvements in the health care sector financed by federal insurance or by private insurance/out-of-pocket payments? Data from the World Bank shows an increase in the share of out-of-pocket expenditures in relation to total health expenditures (from 16.9% in 1995 to 48% in 2013). The increase in out-of-pocket payments coincides with a decrease in the share of public health expenditure in the same period (from 73.9% in 1995 to 48.1% in 2013). What is striking is the steep increase in out-of-pocket payments (from 29.7% to 40%) and the decrease of public health expenditure (from 64.2% to 55.4%) in 2007-2008. The replacement of public health expenditure by out-of-pocket payments reflects a trend towards a less equitable distribution of health care resources and creates conditions for the growing inequality in financial access to medical services for various groups within the population (Popovich, et al., 2011).

#### *Ruble crisis*

August 1998 marks the starting point of the first Russian Ruble crisis, one of the most impressive currency crises in transition economies. In a matter of days, the Russian Ruble lost 60% of its value (Popov, 2001; Popov, 2000). During the period from 1992-1995 the Ruble was heavily overappreciated; the real exchange rate rose more than 600% and remained stable from 1995 until the crisis in 1998. (Popov, 2000). The exchange policy was built on a weak foundation. Decreasing exports due to a decrease in oil prices from

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<sup>1</sup> Oblast is a Russian province.

<sup>2</sup> The first expansion also included road traffic accidents.

\$23 to \$11 per barrel from mid-1997 to mid-1998 (Desai, 2000) contributed to a negative account and whiped out the trade surplus. This trend launched Russia into a negative spiral resulting in the first Ruble crisis.

Questions can be raised about whether health care reform and the health care improvement plan led to an improvement in mean domestic health and/or to more equality in domestic health. Did the health of the poor improve under the new health care system and if so, against what costs?

Next to the domestic health care sector, a domestic and international economic crisis can also affect income-related heath inequality. Do times of crisis influence an individual's health, independent of income. Who are the victim of an economic crisis? Will decreasing wages and employment rate (OECD, 2014) relate to positive or negative trends in income-related health inequality and what drives these trends?

The aim of this research project is to determine what drives income related-health inequalities in Russia. To determine the inequality trends, the Erreygers Index approach is used, comparable to the method used by Baeten, et al., 2013, over 16 rounds from the Russia Longitudinal Monitoring Survey and spanning a period of 18 years (1994-2012, excluding 1997 and 1999). In this paper, a 2-wave cohort comparison is used to determine the year-to-year changes in IRHI. The health variable has been simplified from Baeten, et al., 2013 to a bounded binomial variable: whether an individual reported good health or not. The extension considers the impact of income mobility on IRHI by summarizing differences in income re-ranking between groups defined by non-income characteristics.

The main exploration of the research will be whether health care reform, the national health improvement plan (NPPH) and the two economic crises contributed to increasing or decreasing the inequalities in Russia. In section 2, the decomposition framework proposed by Baeten, et al., 2013 is discussed and applied to the Russian data in section 3. Results and potential implications will be discussed in section 4.

## 2. Decomposing income-related health inequalities

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Income-related health inequalities are measured by the variation of health across the income dimension (Erreygers, 2009; Wagstaff & van Doorslaer, 2000) I will analyze the evolution of IRHI using a decomposition methodology (Wagstaff, et al., 2003). Since this paper focuses on income development in Russia since the fall of the Soviet Union, the role of changes in average incomes are isolated from other changes in the income distribution.

The decomposition is extended to the decomposition method proposed by Van Ourti, et al., 2009, such that it accounts for the bounded nature of reported health (Erreygers & Van Ourti, 2011b). The decomposition is expanded to include the role of income mobility or re-ranking (Baeten, et al., 2013).

### Measurement of income-related health inequalities

To determine income-related health inequality, the concentration index is used. The concentration index resembles a Gini index of health, but rank of health is replaced by rank of income so as to measure the variation of health across the income dimension (Wagstaff, et al., 1991).

Since the used health variable is bounded, the conditions that health and ill-health inequalities rank a set of health distributions similarly and relative health changes leave the inequality ranking unchanged cannot be satisfied at the same time. Therefore, more emphasis is placed on the condition that when health has a finite upper and lower bound, an impossibility result arises<sup>3</sup>. This means that the concentration index is no longer an option, but the Erreygers Index (2009) is used, it indicates that IRHI remains unchanged under equal health additions.

$$C_E(h|y) = \frac{8}{n^2(h^{\max} - h^{\min})} \sum_{i=1}^n z_i h_i = \frac{8}{n^2} \sum_{i=1}^n z_i h_i$$

Since a 0-1 health outcome is used, the upper ( $h^{\max}$ ) and lower ( $h^{\min}$ ) health outcome will detract to 1 and drop out the equation.

In the calculation,  $h_i$  equals the level of health of an individual  $i$ ,  $y_i$  equals income and  $n$  represents the number of observations.  $z_i$  equals the deviation of individual  $i$ 's income rank from the mean income rank ( $z_i = \frac{n+1}{2} - \lambda_i$ )<sup>4</sup> (Erreygers, 2009).  $z_i$  increases linearly between  $(1 - n)/2$  and  $(n - 1)/2$  and takes zero for individual  $i$  with the mean income rank. The sum of all  $z_i$  equals zero across the entire population. The  $z_i$ 's are positive for the richest half of the population and negative for the poorest half. This means that the Erreygers index will be negative if the poor, on average, report better health than the rich (pro-poor IRHI). Positive value of the Erreygers index means that the rich, on average, report better health than the poor (pro-rich IRHI).

### Changes in income distribution and IRHI: a decomposition approach

Decomposition, as proposed by Baeten, et al. (2013), is characterized as a cohort-decomposition, and reveals how IRHI evolves over time for a given cohort such that it can be abstract from changes that are driven by compositional changes within the underlying population.

We start by describing the association between health ( $h_i$ ) and income ( $y_i$ ) conditions and other variables ( $x_i$ ) (age, gender, work status, and settlement type) at time subscript  $t$ .

$$h_{it} = \alpha + \Phi(y_{it}) + x'_{it}\beta$$

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<sup>3</sup> The impossibility result states that starting from the same initial health distribution, the same equi-proportionate health change might rank inequalities in health and ill-health differently.

<sup>4</sup> Income rank  $\lambda_i$  takes value 1 for the richest individual and  $n$  for the poorest individual.

Health function  $h_i$  measures the health of an individual  $i$ . To measure the effect of income on health inequality, the function of an individual's health ( $h_i$ ) is determined by a (non-)linear function ( $\Phi(\cdot)$ ) of income ( $y_i$ ) and non-income variables ( $x'_i\beta$ ). An individual's health function is rewritten from  $h_i$  to  $h_{it}$  to indicate an individual's health at time  $t$ , where  $t$  represents the wave in which individuals participated.

The evolution of IRHI is expressed as the difference between the Erreygers index in period  $t$  and period 1. The equation for the evolution of IRHI is substituted with:

$$C_E(h_t|y_t) - C_E(h_1|y_1) = \frac{8}{n^2} \left\{ [z_{it}\Phi(y_{it}) - z_{i1}\Phi(y_{i1})] + \sum_{k=1}^K \beta^k [z_{it}x_{it}^k - z_{i1}x_{i1}^k] \right\}$$

Assuming that everyone's income grows with the same rate as average income growth or that income does not grow but other variables do leads to the following health functions (Van Ourti, et al., 2009):  $h_{it}^{pg} = \alpha + \Phi(y_{it}^{pg}) + x'_it\beta$  for when assuming proportional income growth with  $y_{it}^{pg} = y_{i1}(Y_t/Y_1)^5$  and  $h_{it}^{ng} = \alpha + \Phi(y_{i1}) + x'_it\beta$  for when assuming no income growth.

With these functions, the extended decomposition can be derived:

$$C_E(h_t|y_t) - C_E(h_1|y_1) = [C_E(h_t|y_t) - C_E(h_t^{pg}|y_1)] + [C_E(h_t^{pg}|y_1) - C_E(h_t^{ng}|y_1)] + [C_E(h_t^{ng}|y_1) - C_E(h_1|y_1)]$$

$$\begin{aligned} C_E(h_t|y_t) - C_E(h_1|y_1) &= \frac{8}{n^2} \left\{ \sum_{i=1}^n z_{i1} [\Phi(y_{it}^{pg}) - \Phi(y_{i1})] + \sum_{i=1}^n [z_{i1}\Phi(y_{it}) - z_{i1}\Phi(y_{it}^{pg})] + \sum_{i=1}^n (z_{it} - z_{i1}) \left( \sum_{k=1}^K \beta^k x_{it}^k \right) \right. \\ &\quad \left. + \sum_{i=1}^n z_{i1} \left[ \sum_{k=1}^K \beta^k (x_{it}^k - x_{i1}^k) \right] \right\} \end{aligned}$$

The functions exploit that  $C_E(h_t^{pg}|y_t^{pg}) \equiv C_E(h_t^{pg}|y_{i1})$  and  $y_t^{ng} \equiv y_{i1}$ .

The decomposition illustrates four effects of the evolution of income-related health inequality.

### 1. Term related to overall income growth

$$\sum_{i=1}^n z_{i1} [\Phi(y_{it}^{pg}) - \Phi(y_{i1})]$$

The first term represents the association between the evolution of IRHI and average income growth. The difference in IRHI in the hypothetical health state in which all individuals would have their incomes changed proportionately and IRHI in the state in which incomes would have remained at the level of the first period. Since all  $z_{it}$ 's sums to zero and increase linearly when moving from poorest to richest individual, inequality will increase when individuals with a higher initial income gain more health than individuals with a lower initial income. Inequality will decrease when individuals with higher initial income lose health compared to individuals with a lower initial income. IRHI will increase/decrease when an equal proportional income change has a larger/smaller effect on health for individuals with a higher initial income. The relationship between health and proportional income changes will depend on the shape of  $\Phi(\cdot)$ .

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<sup>5</sup>  $y_{it}^{pg}$  presents the hypothetical health level that individual  $i$  would have had in period  $t$  if her income growth had been equal to the actual mean growth.

## 2. Term related to other mean-preserving changes in the income distribution

$$\sum_{i=1}^n [z_{i1} \Phi(y_{it}) - z_{i1} \Phi(y_{it}^{pg})]$$

IRHI is associated with changes in income distribution, unrelated to proportional income growth. Each individual's contribution can be re-written as:  $(z_{it} - z_{i1}) \Phi(y_{it}) + [\Phi(y_{it}) - \Phi(y_{it}^{pg})]z_{i1}$ , changes in income rank (from  $z_{i1}$  to  $z_{it}$ ) are combined with mean-preserving changes in income levels (from  $y_{it}^{pg}$  to  $y_{it}$ ). Income changes will, on average, always cancel out (gains:  $y_{it} > y_{it}^{pg}$ , losses:  $y_{it} < y_{it}^{pg}$ ). When the income ranks do not change over time ( $z_{it} \equiv z_{i1}$ ), the impact on IRHI will depend on the form of  $\Phi(\cdot)$  and the distribution of the mean preserving changes ( $y_{it} - y_{it}^{pg}$ ) across initial income ranks ( $z_{i1}$ ).

When initially richer individuals experience income gains and initially poorer individuals income losses relative to  $y_{it}^{pg}$  and there are health returns to additional income ( $\Phi'(\cdot) > 0$ ), IRHI will rise because  $[\Phi(y_{it}) - \Phi(y_{it}^{pg})]z_{i1} > 0$  for all individuals. This increase of IRHI will be further reinforced by income re-ranking since the value of re-ranking ( $z_{it} - z_{i1}$ ) will be more heavily weighted for richer individuals because ( $\Phi'(\cdot) > 0$ ).

## 3. Term related to differences in income mobility

$$\sum_{i=1}^n (z_{it} - z_{i1}) \left( \sum_{k=1}^K \beta^k x_{it}^k \right)$$

Evolution of IRHI is also driven by the association between non-income variables and changes in income ranks. The health effect of non-income variables is illustrated in  $\beta^k$ ; with a positive effect, an increase in IRHI is dependent on that those who experience better health because of the non-income variable move up in the income distribution ( $\beta^k > 0$  &  $z_{it} > z_{i1}$ ). The opposite result holds when the effect is negative ( $\beta^k < 0$  &  $z_{it} < z_{i1}$ ). The term identifies the contribution of differences in income mobility across the non-income variables to IRHI.

## 4. Term related to association between changes in the other variables and $z_i$ in the first period.

$$\sum_{i=1}^n z_{i1} \left[ \sum_{k=1}^K \beta^k (x_{it}^k - x_{i1}^k) \right]$$

This term shows the evolution of IRHI, determined by the way in which changes in other non-income variables ( $\beta^k (x_{it}^k - x_{i1}^k)$ ) are related to the income rank in the first period ( $z_{i1}$ ). In the analysis, including gender-age in  $x_{it}^k$  will indicate whether the health effect of getting older ( $\beta^{\text{gender-age}} (x_{it}^{\text{gender-age}} - x_{i1}^{\text{gender-age}})$ ) for a male/female is related to the initial income rank ( $z_{i1}$ ). The aging of each gender in the cohort is isolated from the evolution of IRHI.

### 3. Data and empirical implementation

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The Russian Longitudinal Monitoring Survey (RLMS) was used to analyze the evolution of IRHI in the Russian Federation and the extent to which it is associated with changes in income distributions. The RLMS is an ongoing panel data set of nationally representative surveys. It is designed to monitor the effects of Russian reforms on the health and economic welfare of individuals and households within the Russian Federation. For details, I refer to the project website (Carolina Population Center, 2012).

#### Estimating the relation between health, income and non-income variables

##### *Health*

To measure an individual's health the individual respondents had to assess their own health on a 5 point scale. The posed question was 'Tell me, please, how would you evaluate your health? It is:' with the answer options: '1. Very good, 2. Good, 3. Average, not good, but not bad, 4. Bad, 5. Very bad'. The ordered outcome will not be suitable for measuring inequalities with a rank-dependent inequality index, such as the Erreygers index. The Erreygers index imposes that differences between subsequent SAH categories represent equal health changes (Erreygers & Van Ourti, 2011b).

To use the SAH variable in a different form, two options were taken into consideration. The first option was to use an interval regression estimator proposed by van Doorslaer and Jones (2003). This measure could not be used because of a lack of threshold data and/or literature to link the self-assessed health score to a VAS score that is Russia specific.

The second examined option was to scale an individual's self-assessed health as being good (health was rated as being 'Very good', 'Good' or 'Average, not good, but not bad') or bad (health was rated as being 'Bad' or 'Very bad') (Bobaka, et al., 2000). By scaling the health outcome variable in a 0-1 choice scale, a linear probability model could be estimated by estimating the probability of an individual assessing his/her health as good or not good. This predicted probability was used for calculating the Erreygers index.

##### *Income variable*

The RLMS collects information on individual and household income. The income is split according to various posts, such as wages, business revenue, pension, and agriculture. Household income weighs heavier on self-reported health than an individual's income (Dubikaytis, et al., 2010). Household income is expressed in rubles and for the analysis I made use of the real household income. Real household income is adjusted to 1992 rubles. To allow for differences in household size equivalence scaling is used by dividing household income by the square root of the household size (OECD, 2011).

##### *Non-income variable*

To determine the relation of non-income variables to health, four variables have been added to determine health. An individual's age, gender, settlement type, and work status.

Age is added to correct health for the aging effect; older people tend to report lower health than younger people in middle to low income countries (Deaton, 2008). Age is split up into four categories: 15-29 years, 30-44 years, 45-59 years, and 60 years and older. To examine the effect of male and female aging, age is combined with gender. Research by Perlman & Bobak (2008) found that Russian males report better health than females. Females aged 15-29 years are used as the base category.

Males reporting better health than females despite having a lower life expectancy could be related to the number one cause of death: cardiovascular disease. Russia was ranked among the highest worldwide in deaths due to cardiovascular disease (Finegold, et al., 2013; Kelly, B.B.; Instutie of Medicine; Fuster, V., 2010). The mean age of death from cardiovascular disease for males is much lower than for females (65-70 for males and 75-80 for females) (Kelly, B.B.; Instutie of Medicine; Fuster, V., 2010).

Health inequality can be related to the type of residence in which individuals live. Also, urban communities report having better health than rural communities (Popovich, et al., 2011). To create an extra distinction, PGT is added to represent a semi-urban settlement. Urban settlement is used as the base category. Beside the variables used by Baeten, et al. (2013), the work status of the respondents is taken into account. The work status of individuals is broken down into six categories: individuals who have worked less than 140 hours in the last 30 days, 140-169 hours, 170-199 hours, more than 200 hours, and individuals who are on (paid) leave or unemployed. Unemployed individuals are used as the base category. On average, people in Russia work 1,982 hours a year, which translates to 162.8 hours in a 30-day period (OECD, 2014).

### Selection of our sample, attrition and descriptive

We use all the waves of the RLMS that were available at the time of the analysis (1994, 1995, 1996, 1998 and 2000 up to 2012). The waves collected prior to 1994 are not included because of poor quality data; the results cannot be trusted. Furthermore, waves prior to 1994 could not be used for longitudinal analysis because they represent a different cohort compared to those of 1994. Since the decomposition follows a cohort, only individuals who are present in the initial and follow up wave are considered. All respondents under the age of 15 were deleted because they were not asked the employment question. All participants that did not self-report health, age, income, employment status, or settlement type have also been dropped. The 1% highest incomes from each wave<sup>6</sup> and observations with a negative income<sup>7</sup> have also been removed.

### Panel analysis

Baeten, et al.'s method, as described above, is characterized as a cohort-decomposition and calculates the difference between the Erreygers index of two given years in one cohort. To examine the evolution of IRHI over multiple rounds, three types of multiple rounds evolution can be calculated:

- 2-wave cohort approach;
- Multi-wave panel approach, the beta from the regression output assumed to be constant;
- Multi-wave panel approach, the beta from the regression output assumed to be non-constant

The 2-wave cohort approach takes one cohort, which is represented in two consecutive rounds, and the difference between the two waves is characterized as the evolution of IRHI in those two waves. Evolution of IRHI is presented as the wave to wave change for two consecutive cohorts. The advantage of this method is the large number of observations used in the calculation. A disadvantage is that only wave-to-wave effects are shown with different cohorts; It displays effects more than an evolution over a period of time.

The multi-wave panel approach takes one cohort which is represented in multiple consecutive waves and the difference between the initial wave and the follow-ups displays the evolution of IRHI. The advantage is that an actual evolution of one cohort over multiple waves can be shown. The disadvantage is that a smaller number of observations can be included in the cohort because of drop-out.

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<sup>6</sup> With the 1% highest incomes included, the marginal effects of income displayed unrealistic trends for the highest income levels. This effect is probably driven by the bounded nature of health in combination with the polynomial transformation of income and large differences in income at the highest 1%. The exclusion of the highest 1% is of little practical importance since the decomposition results including the highest 1% confirm the results reported in this report.

<sup>7</sup> Negative income is problematic since individuals reporting negative income in the first wave will see their incomes decline in the hypothetical scenario of equi-proportional income growth. This seems an unwanted assumption and therefore all observations with an equivalence income smaller or equal to zero in the first wave are excluded (Baeten, et al., 2013).

The multi-wave panel approach can further be divided by assuming a constant beta (as used in Baeten, et al., 2013) from the regression output or assuming the beta to be non-constant. The constant beta determines the effect of income and non-income variables on health from the whole cohort (meaning all the included rounds) instead of only the two analyzed waves.

For this study, the 2-wave cohort approach leads because a larger number of observations in the sample should lead to more reliable results. Taking the disadvantage of the 2-wave cohort into consideration, the two multi-wave panel cohorts approach is also applied. The panel cohorts serve to verify conclusions and to test whether the changes in the 2-wave approach are comparable to the trends from the multi-wave panel evolution.

To limit the loss in number of observations of the panel cohorts, three panel cohorts have been constructed. Two panels containing 8 waves (wave 5-12 and 10-17) and one panel containing 7 waves (15-21) have been constructed. The ending of the initial panel and the beginning of the consecutive panel overlap to adjudicate on overall evolution.

In case of comparable results, the panel cohort will not be mentioned, and differences will otherwise be mentioned.

## 4. Results

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As shown earlier, the cohorts reported an increase in average income and, on average, a decline in income inequality during the period of 1994-2012. These events will be linked to changes in IRHI.

### Evolution of IRHI and changes in the income distribution in Russia

Figure 1 illustrates the development of predicted health, mean equivalent household income, the Erreygers Index, and the Gini coefficient. The 2-wave change is combined with a weighted average trend. Mean predicted health shows a minor increase over the period of 1994-2012. A negative trend is shown in the first 5 cohorts (waves 5-6 up to waves 9-10). On average, the cohort reported lower health in the follow up wave compared to the first wave, but due to higher reported health in each first wave, a minor increase is observed. To test the importance of the underlying regression models, figure 2 shows the development of mean predicted health and the mean reported health. Looking at the lines, we can state that the regression models underlying the analysis provide a good representation of the real reported health.

An increasing trend in mean equivalent household income is observed from wave 9 onwards (wave 18 is an exception). Income almost tripled from a weighted average of 3,166 in wave 9 to 8,990 in wave 21. Data from the World Bank and results on mean income in Russia display that GDP per capita development and mean income develop in a comparable trend. The development Russia displays in GDP per capita (3,407 in 1996 to 6,923 in 2013) is comparable to other former Soviet Union countries (Ukraine, Belarus, and Kazakhstan were added in the analysis). Belarus displayed a larger increase in GDP per capita (1,520 in 1995 to 4,914 in 2013) and Kazakhstan (1,950 in 1995 to 5,425 in 2013) was comparable to Russia. Ukraine showed lower growth numbers (1,123 in 1998 to 2,205 in 2008).

Income inequality is determined with the Gini coefficient. A breaking point at wave 8 is observed when the Gini coefficient started to decrease, meaning that income inequality became less pro-rich and thus, on average, the poor became less poor compared to the rich.

The Erreygers Index illustrates IRHI and displays a fluctuating trend around an index of 0.1 (minimal index value 0.06 and maximum 0.14). Since different cohorts are represented in each 2-wave comparison, different Erreygers indices are calculated for one wave. The difference between two calculated indices in one wave is most noticeable in 2004 (wave 14); these events have some influence on the fluctuations the weighted average trend displays. Looking at the wave-to-wave development within one cohort, a more increasing trend is observed. A decline of the Erreygers Index is displayed at wave 8 and from waves 17 to 19. Taking the years of these waves into consideration, the conclusion can be drawn that the declines in IRHI occurred during the first Russian Ruble crisis of 1998 and the global economic crisis of 2008.

The incidental declining IRHI and the time of its occurrence is the first finding and will be the basis for subsequent analysis.

### The relation between health, income, and non-income variables in Russia

The relationship between health and income, which is conditional on non-income variables, is an essential ingredient in understanding the trend in IRHI. The estimates of the linear regression are displayed in table 1. The estimates show that age, gender, and work status play an important role: the probability of reporting good health deteriorates monotonically with age and males report better health than females; This is consistent with the findings of Carlson (2005) on mean health and regressed determinants of health. Unemployed individuals report lower health than employed individuals (working less than 140, 140-169, 170-199, or more than 200 hours in the last 30 days) or those who are on (paid) leave from work. Living in

a rural or PGT settlement shows no significant effect on health, compared to living in an urban settlement type, also not on a joint significance level<sup>8</sup>; this is also in line with Carlson (2005).

The relation between income and health is mostly described by a linear effect, only waves 10-11, 11-12, 19-20, 20-21 (all quintic association), as well as 12-13 (quadratic association) deviate.

The linear association indicates that additional income is associated with better health across the income spectrum. The quadratic association of waves 12-13 describes an increasing health with additional income, but additional health decreased for the high incomes in the income spectrum (inflection point at 13,400 rubles). The quintic associations of waves 10-11, 11-12, 19-20, and 20-21 all describe a varying effect of additional income on additional health. At very high and low incomes, health has a negative marginal effect in terms of additional income. This effect can be driven by outliers, where table (5) shows that only a minor share of the cohort has an income that leads to (more) negative health outcomes.

When comparing the 2-wave cohort findings to the different panel cohorts in table (X), we observe a positive linear relation between health and the equivalent household income. All panel cohorts resulted in a linear relation between income and health. The large difference of wave 12 amongst panels 5-12 and 10-17 was remarkable. The effect of additional income on health was larger for the wave 5-12 cohort compared to the wave 10-17 cohort. This varying effect could be related to income distribution among the age-gender categories. The higher effect of additional income on health could be related to younger and healthier individuals having a higher equivalence income in the wave 5-12 cohort compared to the wave 10-17 cohort. Additionally, older and less healthy individuals have a higher mean equivalence income in the wave 10-17 cohort compared to those in the wave 5-12 cohort.

Another finding is that no significant relation is shown between health and income in the two waves after the Ruble crisis. The reason for this finding could not be explained by supporting literature or the data.

#### Decomposition of evolution of IRHI in Russia

To examine what influenced the development of the Erreygers Index the decomposition of Baeten, et al., 2013 is used.

Figures 4, 11, and 14 show the estimates of the four terms of the decomposition:

- Income growth (gray solid line)
- Other mean-preserving changes in the income distribution (gray stripe, 2 dotted line)
- Income mobility across non-income variables (gray striped line)
- Changes in other variables and initial income distribution (gray dotted line)

Proportional income growth shows no association with IRHI, meaning that changes in income are not related to the development of IRHI.

Other mean-preserving changes in the income distribution show no association with IRHI, similar to income growth. On average, compared to the other three terms, income distribution influences the IRHI least. As the name reveals, it measures the effect of mean preserving changes in the income levels with the associated income re-ranking. Increasing mean income, decreasing income inequality, equal predicted

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<sup>8</sup> The analysis has also been conducted by changing the region variable from settlement type to area (region of living: Moscow and St. Petersburg, Northern and North Western, Central and Central Black-Earth, Volga-Vaytski and Volga Basin, North Caucasian, Ural, Western Siberian and Eastern Siberian, and Far Eastern). The area in which people live shows a joint significant relation to predicted health from wave 7 onwards. Since the Moscow/St. Petersburg area is not present during several waves, settlement type has remained in the analysis.

health (decreasing for panel cohorts), and fluctuating IRHI over the timespan of the research project illustrate that other elements of the decomposition must be more important.

Income mobility across non-income variables is the determinant that shows the largest relation to changes in IRHI. As figure 4 displays, the evolution of IRHI shows an overall increasing trend. We observe that in waves 8, 18, and 19, IRHI decreased compared to their precedent waves, meaning that individuals who slid downward in the income distribution are healthier compared to those who moved upward. For the remaining waves, individuals who slid downward are less healthy compared to those who moved upward. Figure 6 illustrates the effect of non-income variables on the evolution of IRHI. We observe that the difference is mostly driven by the age-gender variables, followed by work status, and lastly by settlement type, which shows the smallest effect. The effect of age-gender and work status together account for more than 95% of the total evolution in IRHI. The differences between younger males and females (reference category) are mostly not significant. The remainder of the categories shows a negative, significant effect. The strongest effect is observed in elderly females (females aged 60 and older).

The question that arises is why the effect of elderly females is larger than other determinants. Term 3 reveals that the effect for a given age-gender category is driven by three components: a) whether the group has been upwardly or downwardly income-mobile, b) the health of the category, compared to the reference category (the beta), and/or c) the share of individuals in the category. Therefore, elderly females can show a larger effect than other age-gender categories because: a) they are more downwardly income mobile, b) they report lower health, and c) there are more elderly females in the cohorts. Figure 6 shows that the income mobility of females aged 60 and older is highly related to the development of the total effect of income mobility across age-gender categories. Adding figure 8, figure 9, and table 1 to the comparison, we can conclude that the differential income mobility of elderly males and females (mostly elderly females) is the most essential element for understanding the evolution of IRHI in Russia. Older (less healthy) males and females older than 60 were downwardly income mobile in times of increasing IRHI, but upwardly income mobile in times of decreasing IRHI. This pattern, and especially the breaking points, is mostly visible for waves 7-8, 17-18, and 18-19. The combination of income mobility with inferior health and the large representation within the different cohorts explains why IRHI is mostly driven by elderly females. The question that arises from this conclusion is: why is negative income mobility for the elderly related to a positive IRHI result and vice versa? This will be further explained in the section 'Further explanation income mobility'.

Differences in evolution of non-income variables show a small, negative effect on IRHI. This effect is influenced by changes in age and work status, since settlement type and gender are time-invariant in the RLMS. Looking at figure (X), we can observe that the effect of non-income variables is mostly driven by changes in work status and incidentally by age. This effect is different from the panel cohorts where the age effect is more present compared to the work effect.

IRHI would have been higher without working status and aging; Waves 6-7 (both) and 18-19 (only age) are exceptions. The initially rich experience a larger fall in probability of having good health due to aging compared to the initially poor. The same holds for working status; The initially rich experience a larger fall in probability of having good health due to changes in their work status than the initially poor.

#### Further explanation income mobility

The evolution of IRHI in Russia is mostly driven by the income mobility of elderly females. The tables and figures do not explain why the elderly experience a greater downward shift in their income position compared to younger, healthier individuals.

One insight is that the equivalence income is used to measure individuals' income. Since the equivalence income contains two components, real household income and household size, the downward shift can be

driven by one or both of these effects. After analyzing both effects, household income, not household size, appears to be the driving factor. One explanation for household size being the driving factor could be the pension benefits in Russia. Men are entitled to a pension at 60 years old and women at 55. The trends presented in figure 20 will assist with explaining IRHI development.

Russian IRHI is characterized by an increasing trend during the period of 1994-2012, and decreasing trends were observed during years of economic crisis. The decreasing IRHI can be related to the changes in income—during years of crisis, negative income trends are visible for the working population while the elderly reported increasing or equal wage. The increasing wage of elderly and not the working population can be explained by the relation that the income of the elderly has with the pension scheme. The pension scheme in Russia prior to 2002 (wave 11) was characterized by a defined benefit system. The value of the pension depended on an individual's earnings and employment history. Since pension schemes were state pensions, people were assured of their earnings. The employment history based pension scheme led to relatively generous retirement benefits for certain employment categories (OECD, 2013). Between 2002 and 2008 (wave 17), the pension was indexed to consumer prices and between 2008 and 2010, the pension benefits increased by about 30% in real terms (OECD, 2011). The unique feature of the Russian pension scheme is that the pension benefits are fully compatible with earnings from paid work, meaning pension earnings and earnings from paid work can be combined. This resulted in about one third of pensioners remaining employed. On average, men remain employed longer than women (Gerber & Radl, 2014). When we take this into consideration, and combine this with the development of equivalence household income as seen in figure 20, we can provide an explanation for the evolution of IRHI. The most eye-catching evolutions of IRHI occurred in waves 8, 9, 18, and 19, particularly the drop in IRHI in waves 8, 18, and 19, and the rise in IRHI in wave 9. These waves will be further explained from now on.

The social pension schemes pre-2002 explain the peaks of waves 8 and 9, mean income of elderly people increased as result of their pension while the income of remaining age groups decreased. This could occur because minimum pension benefits were aligned with minimum wages and indexed to price inflation (Fornero & Ferraresi, 2007). Pensioners would therefore be guaranteed income, while the working population was struck by an increasing unemployment rate (OECD, 2011). This explains the upward income mobility of, especially, elderly females and thus the negative IRHI evolution. After wave 8, the pension benefits were indexed to consumer prices, resulting in a decrease of income. The purchasing power of the average pension fell from 120% to 60-70% in 1999 (between waves 8 and 9) (Afanasiev, 2003). The mean income of other age groups increased, resulting in a large downward income mobility and thus an increasing IRHI. The increase of mean income is related to the declining unemployment rate after the Ruble Crisis. Lower unemployment rate would therefore be related to higher mean income (Gerber & Radl, 2014). Wave 8 is characterized as the wave of the first economic crisis of Russia, the Ruble crisis. The crisis was characterized by a large devaluation of the Ruble.

Wave 18 and 19 show an equal, more observable trend. The income of the under 60 age groups decreased from waves 17 to 18 and did not recover fully in wave 19. This decrease in income was countered by an increase in income within the 60+ age groups, which refers back to the 30% increase in pension benefits in 2008-2010 (waves 17-19). This adverse effect resulted in the upward income mobility of the elderly during these two waves and thus resulted in decreasing IRHI. Waves 18 and 19 are characterized as the period of the second economic crisis of Russia, the European economic crisis.

In short, the conclusion can be made that Russia had an increasing IRHI during the period of 1994-2012, but experienced 2 incidental decreases as a result of the economic crisis combined with a social pension scheme.

## 5. Conclusions

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The development of IRHI can also be traced back to the dynamic changes and events Russia has encountered since the collapse of the Soviet Union. On average, inequalities increased during the period of 1994-2012, not only with respect to income but also health. This development raises the question of how changes in the level and distribution of household incomes in Russia over the period of 1994-2012 have been related to the extent to which self-reported health is also distributed unequally by income. Using the cohort decomposition technique posed by Baeten, et al. (2013), the changes in IRHI have been divided into four components: 1. growth of mean income, 2. mean-preserving changes in the distribution of incomes, 3. income mobility across other important variables, like gender-age, settlement type, and work status, and 4. the evolution of other important variables, like aging and changes in work status. This approach was empirically implemented with data from the RLMS, a longitudinal panel study. Health was estimated as a (polynomial) function of income, controlling for gender-age, settlement type, and work status. While the decomposition does not allow for causal inference, the analysis does reveal which factors are associated with the evolution of IRHI.

The findings are that IRHI, on average, rose during the period of 1994-2012, but has a fluctuating trend. The fluctuating trend was caused by decreasing IRHI in waves 8 and 17-19. What stands out is that the rise in income is not related to development of IRHI. Despite the income growth, IRHI is mostly related to the different income mobility of the age-gender groups. Elderly women, 60 years and older, especially drive this trend, suggesting that elderly women were left behind in the reforms Russia enacted. This effect can be explained by the fact that the elderly enter the pension system and suffer a loss in income. The decrease of IRHI in waves 8 and 17-19 is explained by the fact that the income of elderly people (mostly) includes pension income, and they are thus not dependant on income from employment. Also, these waves are characterized as the waves in which representing the Ruble Crisis (wave 8) and the Global Crisis (wave 17-19), which resulted in lower guaranteed pension income, causing upward income mobility for individuals older than 60 years. The reason why this effect is stronger for elderly females compared to males could be explained by the lower pension age for females (55 compared to 60 for males). Further, a larger share of males aged 60 and older are employed compared to females aged 60 and older. Another explanation for why the effect for females is larger could be that working males have a better relative income rank compared to females. Since females would therefore be more dependent on pension, their relative income rank would increase more compared with males during a crisis and decrease more after a crisis.

This study is a first step in understanding the evolution of IRHI in Russia and the relation with income distribution. Using the findings from this study, the following questions and issues could be further researched.

How are age profiles of income related to age profiles of health in Russia, and in particular why are low replacement incomes associated with low health outside of times of economic crises? Also, the elderly have the tendency to work while receiving a pension. The drop in income resulting from full dependency on pension income could therefore be related to an individual's health. Poor elderly are more likely to work after reaching the pension age (Gerber & Radl, 2014). Poor and healthy elderly would therefore be able to work and retain a normal income, while poor and unhealthy elderly become dependant on pension income.

The dynamics of recent years could lead to a future follow-up study on this topic. As seen in this study, IRHI developed in a pro-poor tendency during economic crises, but would this assumption also hold for the Ruble crisis that began in 2015?

## 6. Acknowledgments

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## 8. Appendix

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The following figures and tables can be found in the appendix:

### **Figures:**

#### 2-wave cohorts

- 1: Overview Erreygers Index, Predicted health, Gini Coefficient and average equivalence income for 2-wave cohorts.
- 2: Overview Reported and Predicted health.
- 3: Effect of income on health for 2-wave cohorts.
- 4: Decomposition of evolution in IRHI between year t and t+1.
- 5: Differences in income mobility across age-gender (panel a), work status (panel b) and settlement type (panel c) between year t and t+1.
- 6: Difference between average weights zit between year t and t+1. Age-gender (panel a), work status (panel b) and settlement type (panel c)
- 7: Share of non-income variables (X) contributing to evolution of IRHI for 2-wave cohorts. Age-gender (panel a), work status (panel b) and settlement type (panel c)
- 8: Differences in non-income variables across initial income between year t and t+1. Age-gender (panel a) and work status (panel b).
- 9: Mean equivalent household income & mean real household income of age-gender variables.

#### Panel cohorts

- 10: Overview Erreygers Index, Predicted health, Gini Coefficient and average equivalence income for panel cohorts.
- 11: Overview Reported and Predicted health
- 12: Decomposition of evolution IRHI between 1994 and year t (max 2003), 2001 and year t (max 2008) and 2006 and year t (max 2012), beta assumed constant.
- 13: Differences in income mobility across age-gender (panel a), work status (panel b) and settlement type (panel b) between 1994 and year t (max 2003), 2001 and year t (max 2008) and 2006 and year t (max 2012), beta assumed constant.
- 14: Difference between average weights zit for panel cohorts.
- 15: Share of non-income variables (X) contributing to evolution of IRHI for panel cohorts. Age-gender (panel a), work status (panel b) and settlement type (panel c)
- 16: Differences in non-income variables across initial income between 1994 and year t (max 2003), 2001 and year t (max 2008) and 2006 and year t (max 2012), beta assumed constant
- 17: Decomposition of evolution IRHI between 1994 and year t (max 2003), 2001 and year t (max 2008) and 2006 and year t (max 2012), beta assumed non-constant.
- 18: Differences in income mobility across age-gender (panel a), work status (panel b) and settlement type (panel b) between 1994 and year t (max 2003), 2001 and year t (max 2008) and 2006 and year t (max 2012), beta assumed non-constant.
- 19: Differences in non-income variables across initial income between 1994 and year t (max 2003), 2001 and year t (max 2008) and 2006 and year t (max 2012), beta assumed non-constant

### **Tables:**

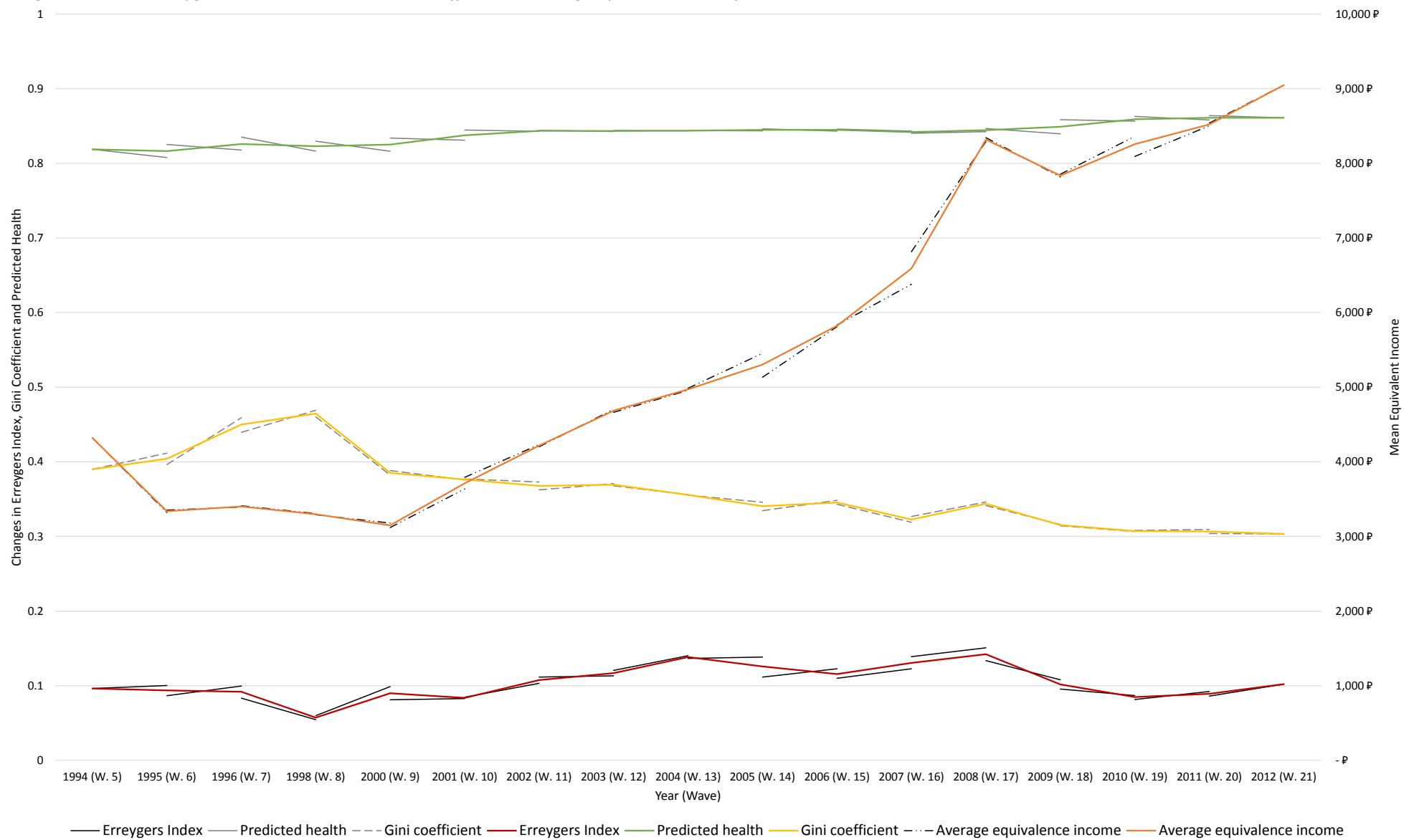
#### 2-wave cohorts

- 1: Income distribution for 2-wave cohorts.
- 2: Regression output 2-wave cohorts.

#### Panel cohorts

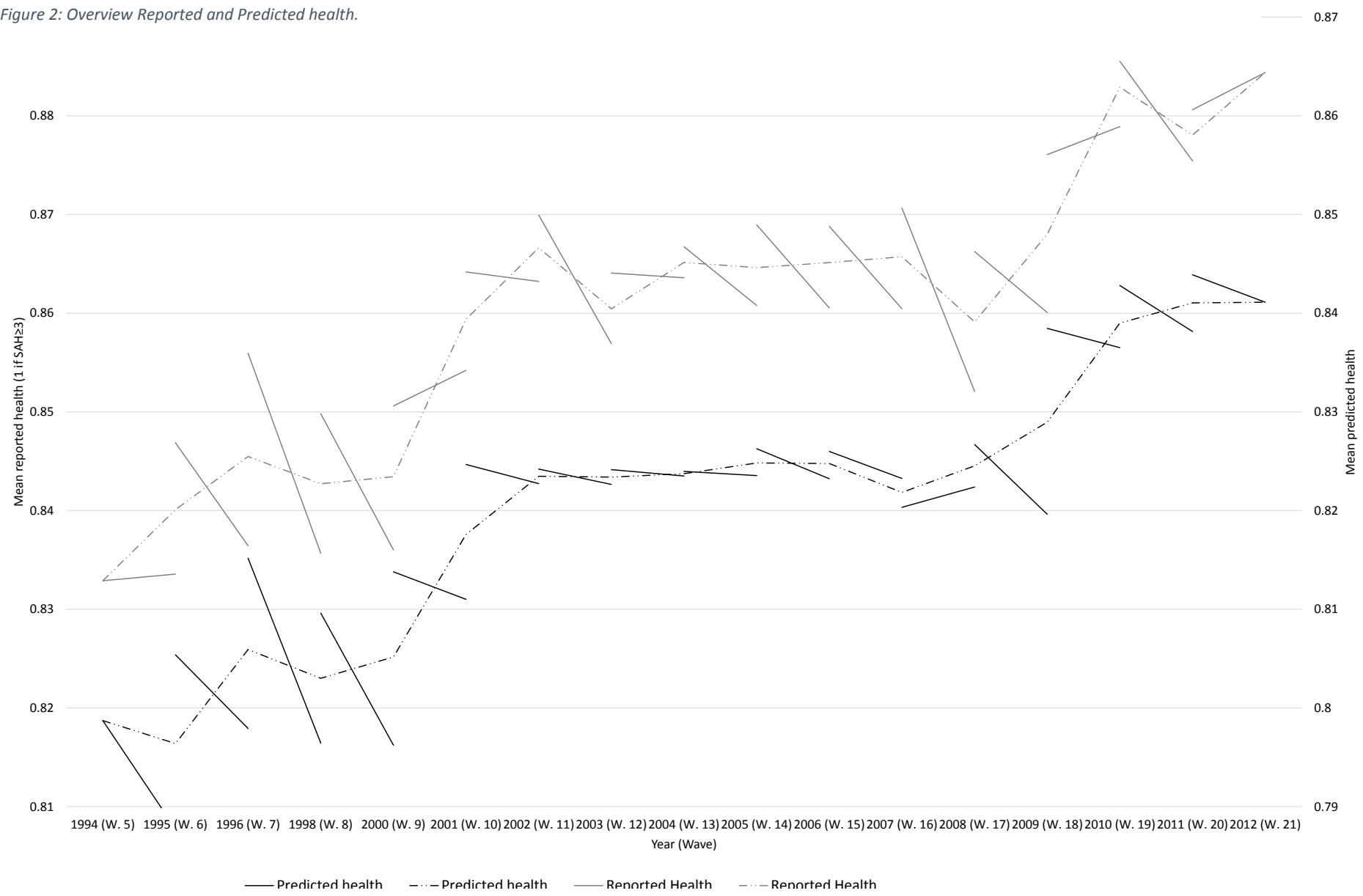
- 3: Effect of income on health for panel cohorts. Beta assumed to be constant
- 4: Regression output panel cohorts, beta assumed to be constant.
- 5: Regression output panel cohorts, beta assumed to be non-constant.
- 6: Effect of income on health for panel cohorts. Beta assumed to be non-constant

Figure 1: Overview Erreygers Index, Predicted health, Gini Coefficient and average equivalence income for 2-wave cohorts.



The black and gray lines illustrate the wave to wave development. The colored line illustrates the weighted mean value of two waves.

Figure 2: Overview Reported and Predicted health.



The solid line illustrates the wave to wave development. The dotted line illustrates the weighted mean value of two waves.

Figure 3: Effect of income on health for 2-wave cohorts.

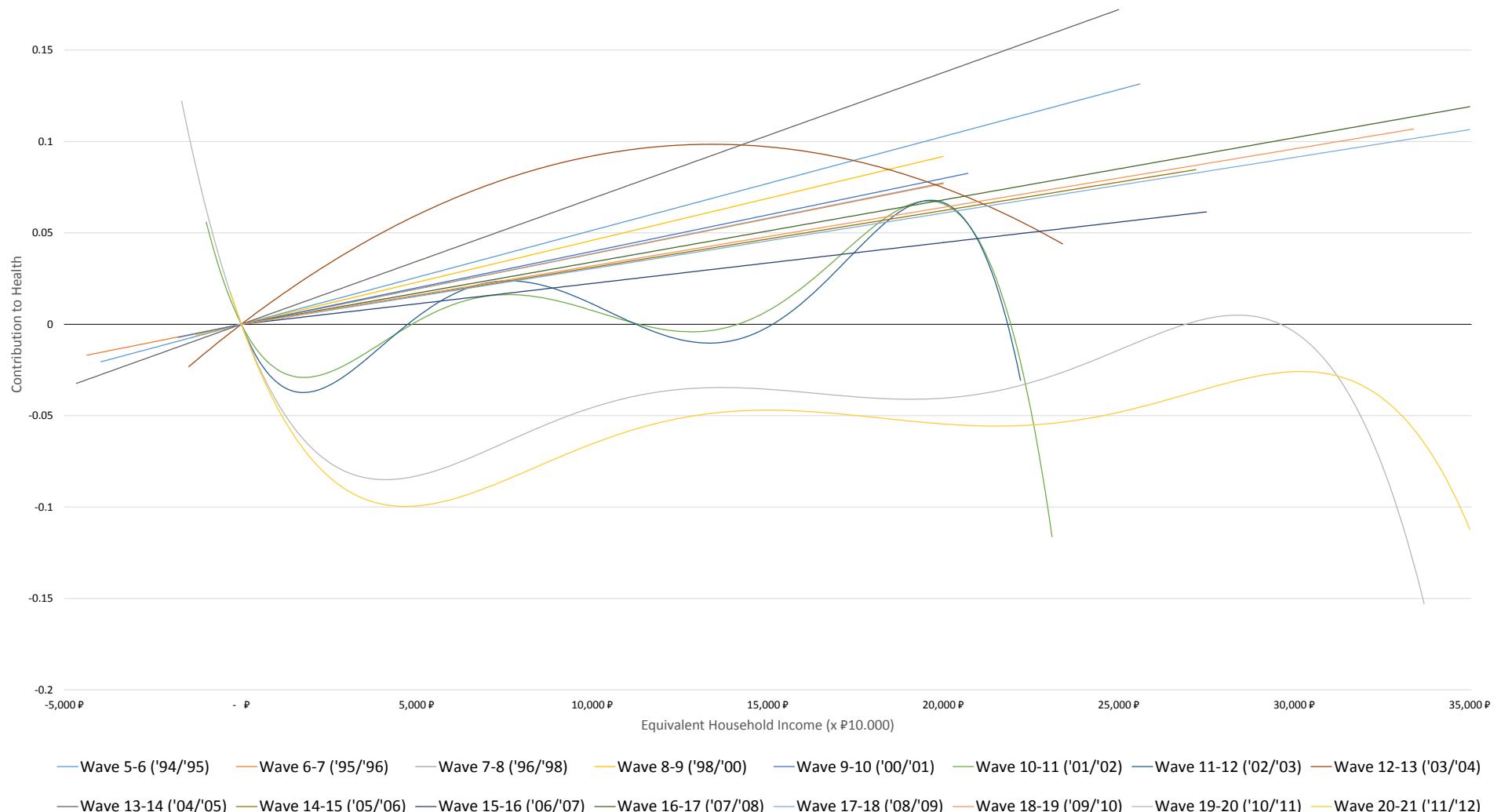


Table 1: Income distribution for 2-wave cohorts.

	Income percentiles								
	1%	5%	10%	25%	50%	75%	90%	95%	99%
<b>Wave 5-6</b>	66 ₽	614 ₽	1,026 ₽	1,838 ₽	2,985 ₽	4,775 ₽	7,353 ₽	9,652 ₽	16,465 ₽
<b>Wave 6-7</b>	- ₽	295 ₽	701 ₽	1,471 ₽	2,594 ₽	4,321 ₽	6,765 ₽	9,047 ₽	14,723 ₽
<b>Wave 7-8</b>	31 ₽	314 ₽	674 ₽	1,344 ₽	2,398 ₽	4,187 ₽	7,044 ₽	9,875 ₽	15,670 ₽
<b>Wave 8-9</b>	88 ₽	531 ₽	871 ₽	1,436 ₽	2,365 ₽	3,983 ₽	6,472 ₽	8,912 ₽	15,516 ₽
<b>Wave 9-10</b>	139 ₽	702 ₽	1,050 ₽	1,638 ₽	2,649 ₽	4,158 ₽	6,305 ₽	8,460 ₽	13,598 ₽
<b>Wave 10-11</b>	139 ₽	871 ₽	1,261 ₽	2,020 ₽	3,189 ₽	4,944 ₽	7,518 ₽	9,659 ₽	15,956 ₽
<b>Wave 11-12</b>	278 ₽	995 ₽	1,408 ₽	2,245 ₽	3,597 ₽	5,599 ₽	8,367 ₽	10,376 ₽	16,566 ₽
<b>Wave 12-13</b>	458 ₽	1,191 ₽	1,597 ₽	2,426 ₽	3,850 ₽	6,036 ₽	8,981 ₽	11,348 ₽	17,636 ₽
<b>Wave 13-14</b>	407 ₽	1,359 ₽	1,804 ₽	2,746 ₽	4,295 ₽	6,670 ₽	9,572 ₽	12,135 ₽	18,027 ₽
<b>Wave 14-15</b>	477 ₽	1,390 ₽	1,921 ₽	2,936 ₽	4,561 ₽	6,941 ₽	9,942 ₽	12,483 ₽	18,891 ₽
<b>Wave 15-16</b>	698 ₽	1,626 ₽	2,190 ₽	3,333 ₽	5,190 ₽	7,812 ₽	11,064 ₽	13,488 ₽	19,718 ₽
<b>Wave 16-17</b>	981 ₽	2,015 ₽	2,657 ₽	3,992 ₽	6,289 ₽	9,694 ₽	13,818 ₽	17,461 ₽	23,442 ₽
<b>Wave 17-18</b>	1,081 ₽	2,330 ₽	2,990 ₽	4,412 ₽	6,763 ₽	10,157 ₽	14,783 ₽	17,906 ₽	25,004 ₽
<b>Wave 18-19</b>	940 ₽	2,461 ₽	3,272 ₽	4,742 ₽	6,950 ₽	10,174 ₽	14,394 ₽	17,598 ₽	23,213 ₽
<b>Wave 19-20</b>	1,068 ₽	2,651 ₽	3,474 ₽	4,938 ₽	7,093 ₽	10,333 ₽	14,451 ₽	18,247 ₽	25,158 ₽
<b>Wave 20-21</b>	1,324 ₽	2,875 ₽	3,665 ₽	5,236 ₽	7,554 ₽	10,989 ₽	15,171 ₽	18,636 ₽	27,069 ₽

Figure 4: Decomposition of evolution IRHI between year  $t$  and  $t+1$ .

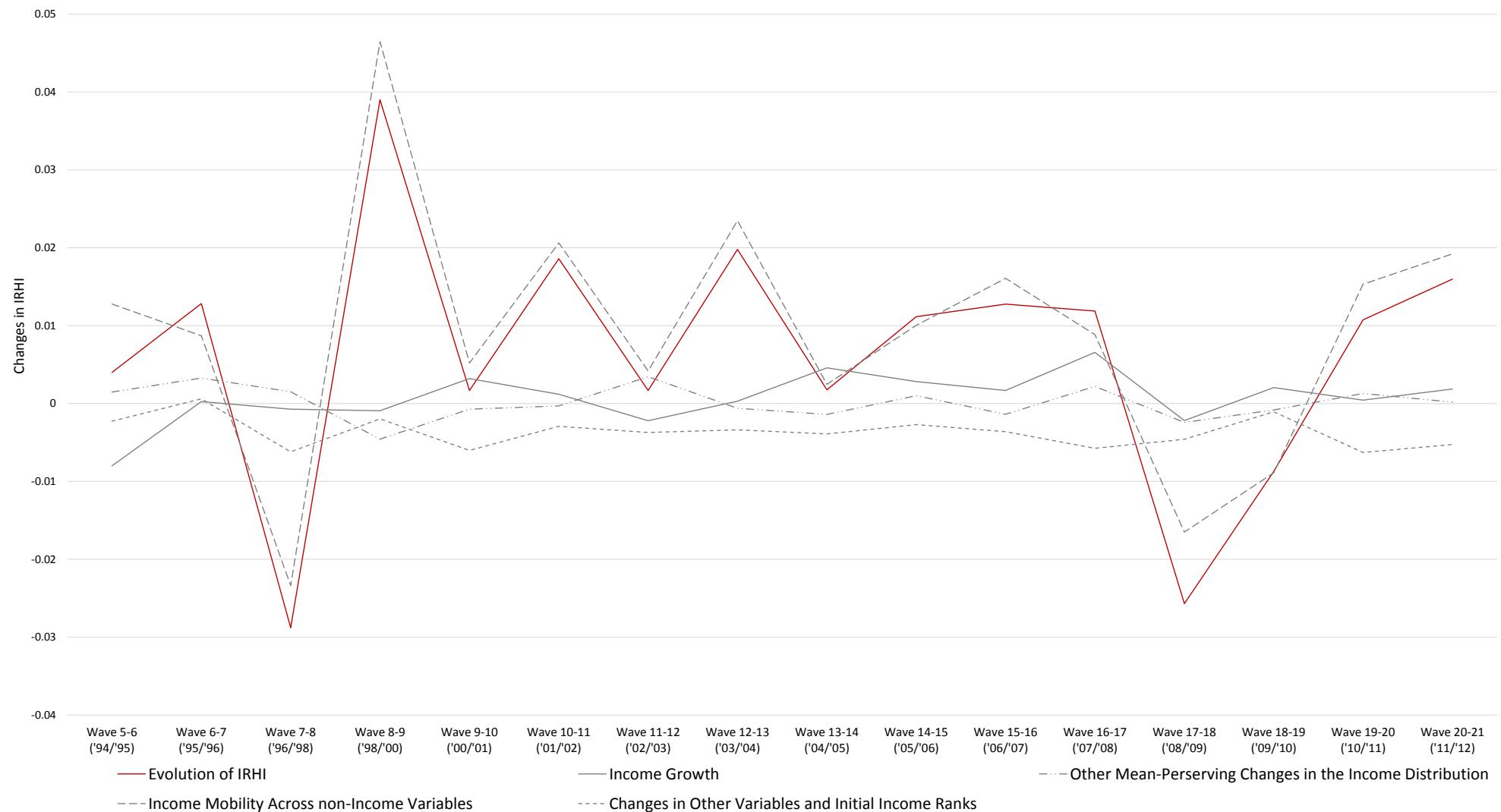


Figure 5: Differences in income mobility across age-gender (panel a), work status (panel b) and settlement type (panel c) between year  $t$  and  $t+1$ .

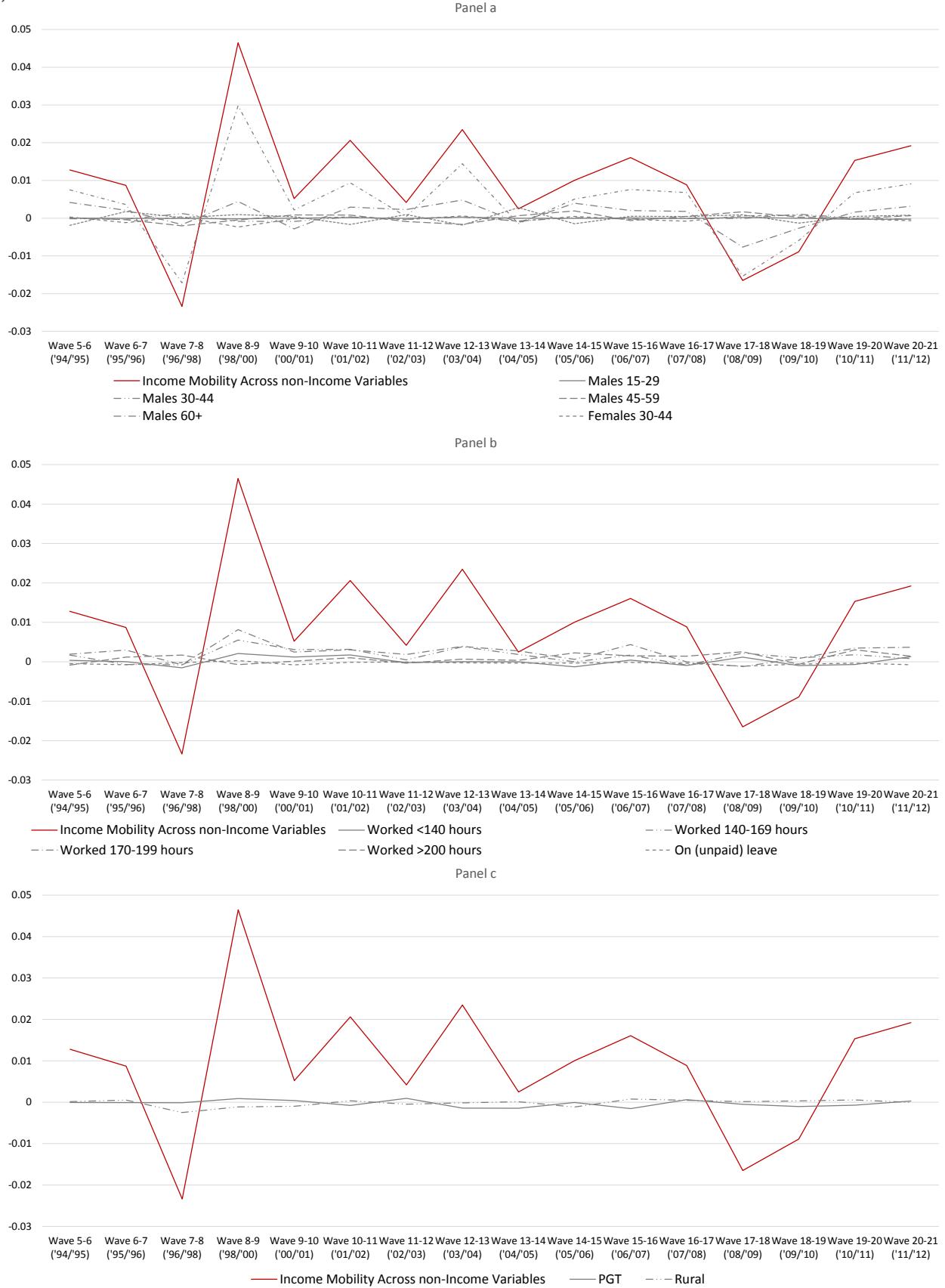


Table 2: Regression output 2-wave cohorts.

	5- 6	6- 7	7- 8	8- 9	9- 10	10- 11	11- 12	12- 13	13- 14	14- 15	15- 16	16- 17	17- 18	18- 19	19- 20	20- 21
Females 15-29	Base category															
Females 30-44	-0.089***	-0.083***	-0.083***	-0.09***	-0.076***	-0.062**	-0.068***	-0.064**	-0.06***	-0.059***	-0.056***	-0.071***	-0.059***	-0.046***	-0.061***	-0.06***
Females 45-59	-0.198***	-0.184***	-0.2***	-0.202***	-0.154***	-0.125***	-0.148***	-0.157***	-0.154***	-0.153***	-0.148***	-0.157***	-0.138***	-0.122***	-0.143***	-0.141***
Females 60+	-0.446***	-0.433***	-0.433***	-0.427***	-0.392***	-0.395***	-0.418***	-0.424***	-0.404***	-0.419***	-0.415***	-0.405***	-0.387***	-0.374***	-0.369***	-0.342***
Males 15-29	0.017*	0.01	0.013	-0.005	-0.001	0.012	0.005	0.013*	0.003	-0.003	0.006	-0.008	-0.011	-0.008	-0.01*	-0.016***
Males 30-44	-0.041***	-0.041***	-0.042**	-0.057***	-0.06***	-0.031***	-0.036***	-0.036***	-0.051***	-0.042***	-0.047***	-0.071***	-0.054***	-0.041***	-0.056***	-0.061***
Males 45-59	-0.123***	-0.125***	-0.111***	-0.125***	-0.121***	-0.109***	-0.129***	-0.115***	-0.107***	-0.119***	-0.106***	-0.122***	-0.118***	-0.104***	-0.121***	-0.119***
Males 60+	-0.286***	-0.3***	-0.272**	-0.274***	-0.29***	-0.262***	-0.275***	-0.29***	-0.272***	-0.304***	-0.289***	-0.288***	-0.275***	-0.269***	-0.261***	-0.236***
Worked <140 hours	0.086***	0.099***	0.11***	0.116***	0.101***	0.064***	0.062***	0.055***	0.074***	0.088***	0.112***	0.141***	0.116***	0.099***	0.103***	0.105***
Worked 140- 169 hours	0.11***	0.12***	0.12***	0.107***	0.108***	0.091***	0.088***	0.089***	0.1***	0.098***	0.117***	0.13***	0.125***	0.115***	0.113***	0.115***
Worked 170- 199 hours	0.097***	0.112***	0.108***	0.116***	0.109***	0.095***	0.093***	0.09***	0.099***	0.102***	0.108***	0.128***	0.132***	0.106***	0.117***	0.123***
Worked >200 hours	0.083***	0.096***	0.089***	0.094***	0.095***	0.06***	0.054***	0.058***	0.073***	0.065***	0.08***	0.112***	0.117***	0.096***	0.092***	0.103***
On (unpaid) leave	0.088***	0.105***	0.081***	0.081***	0.097***	0.1***	0.03	0.056***	0.076***	0.066***	0.075***	0.091***	0.119***	0.088***	0.087***	0.09***
Unemployed	Base category															
Urban	Base category															
PGT	0.015	0.006	0.026*	0.022	0.013	0.014	0.027**	0.041***	0.042***	-0.001	0.018	0.014	0.011	0.035***	0.036***	0.008
Rural	-0.006	-0.016*	-0.007	0.004	0.009	0.008	0.011	0.009	0.003	0.011	0.015*	0.013	0.024***	0.022***	0.02***	0.011*
Equivalent income/10,000																
Linear	0.051***	0.038***	0.039***	0.046***	0.04***	-0.381**	-0.493***	0.147***	0.069***	0.031***	0.022***	0.034***	0.03***	0.032***	-0.516***	-0.536***
Quadratic															1.042***	0.966***
Cubic															-0.814***	-0.682***
Quartic															0.276***	0.21***
Quintic															-0.034***	-0.024***
Constant	0.882***	0.891***	0.895***	0.902***	0.894***	0.929***	0.94***	0.877***	0.891***	0.917***	0.903***	0.888***	0.876***	0.884***	0.979***	1.001***

\*\*\* p<0.01

\*\* p<0.05

\* p<0.1

Figure 6: Difference between average weights  $z_{it}$  between year  $t$  and  $t+1$ . Age-gender (panel a), work status (panel b) and settlement type (panel c)



Males and females older than 60 are colored to highlight income mobility, especially during the crises.

Figure 7: Share of non-income variables ( $x_{it}^k$ ) contributing to evolution of IRHI for 2-wave cohorts. Age-gender (panel a), work status (panel b) and settlement type (panel c)

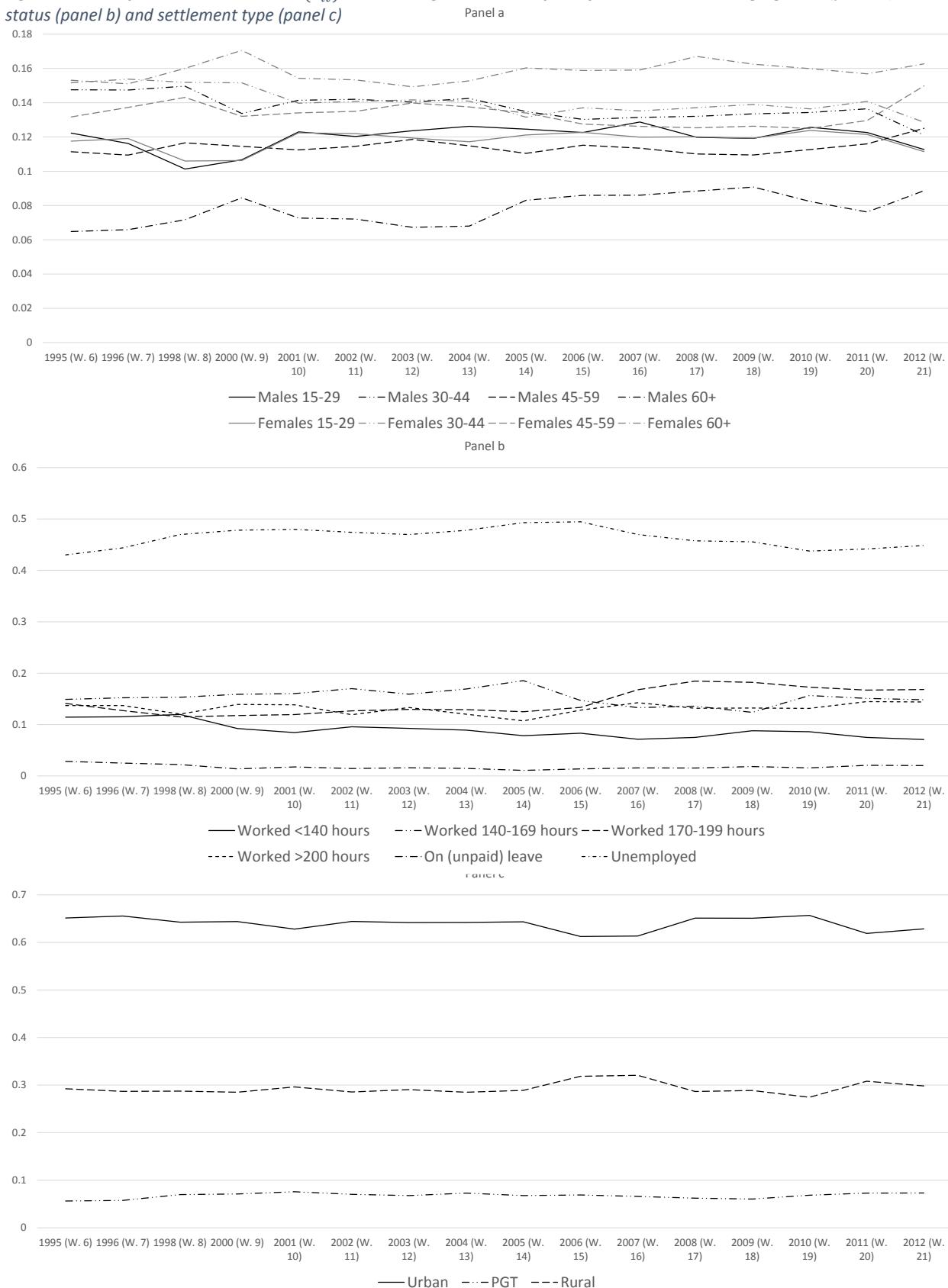


Figure 8: Differences in non-income variables across initial income between year  $t$  and  $t+1$ . Age-gender (panel a) and work status (panel b).

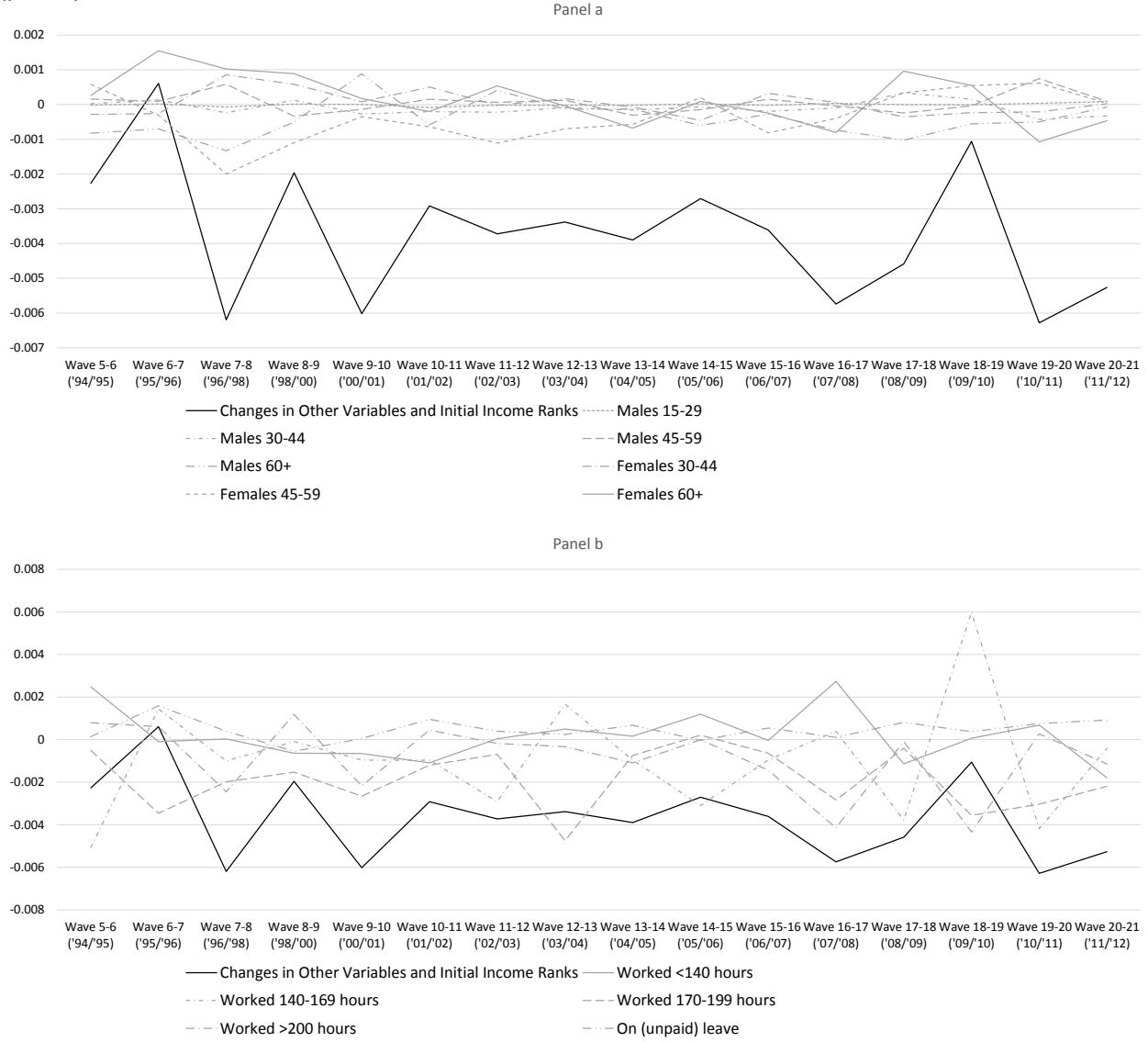
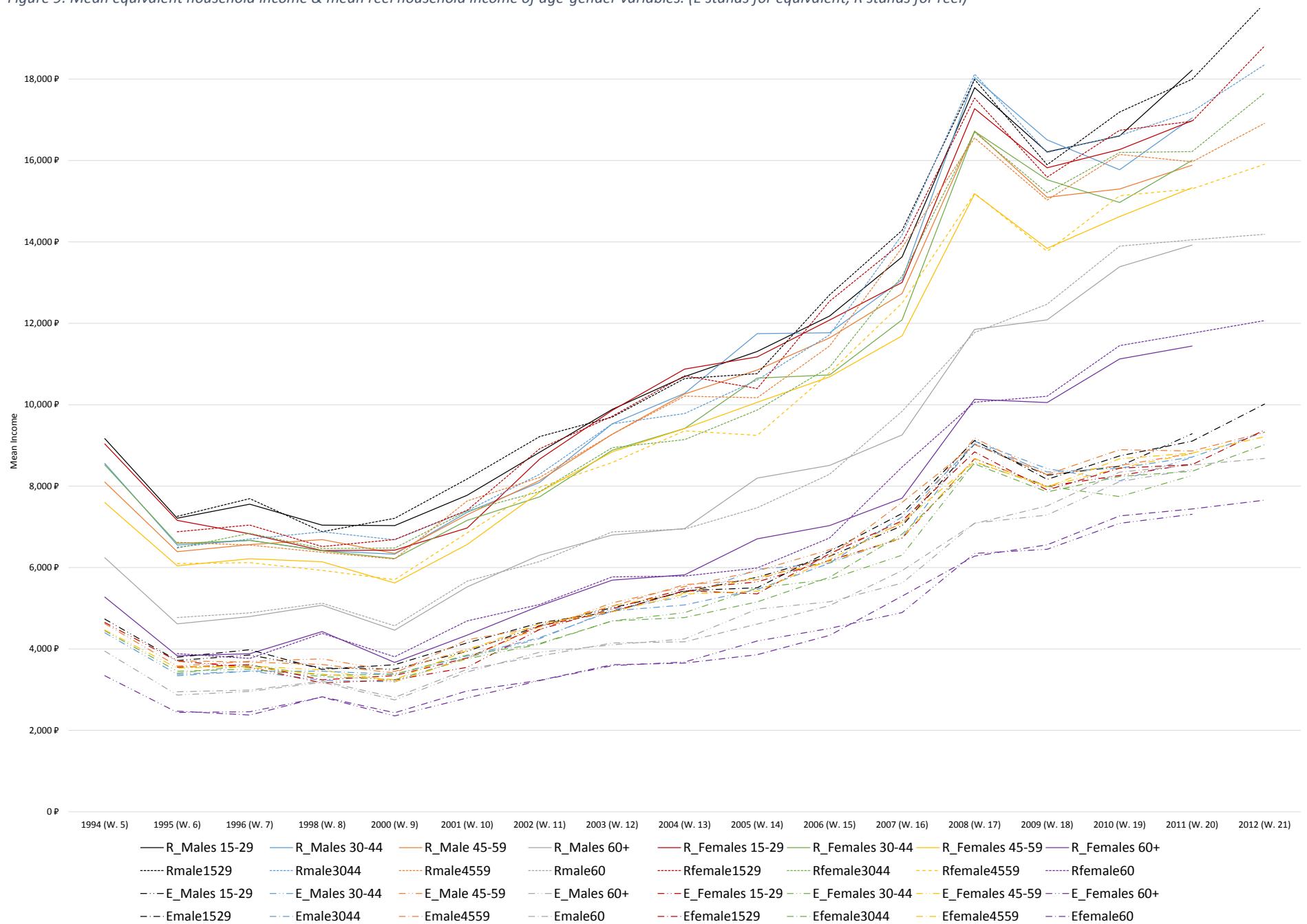


Figure 9: Mean equivalent household income & mean reel household income of age-gender variables. (E stands for equivalent, R stands for reel)



## Panel cohorts

The panel analysis was split into two series. For the first cohort, the Beta was assumed to be constant. For the second cohort, the Beta was assumed to be non-constant.

The decomposition is displayed with both series to improve the view on differences or resemblances.

Since the same samples were used for the two panel cohorts, one graph was made for share of non-income variables ( $x_{it}^k$ ) and one for difference between average weights  $z_{it}$ .

Figure 10: Overview Erreygers Index, Predicted health, Gini Coefficient and average equivalence income for panel cohorts.

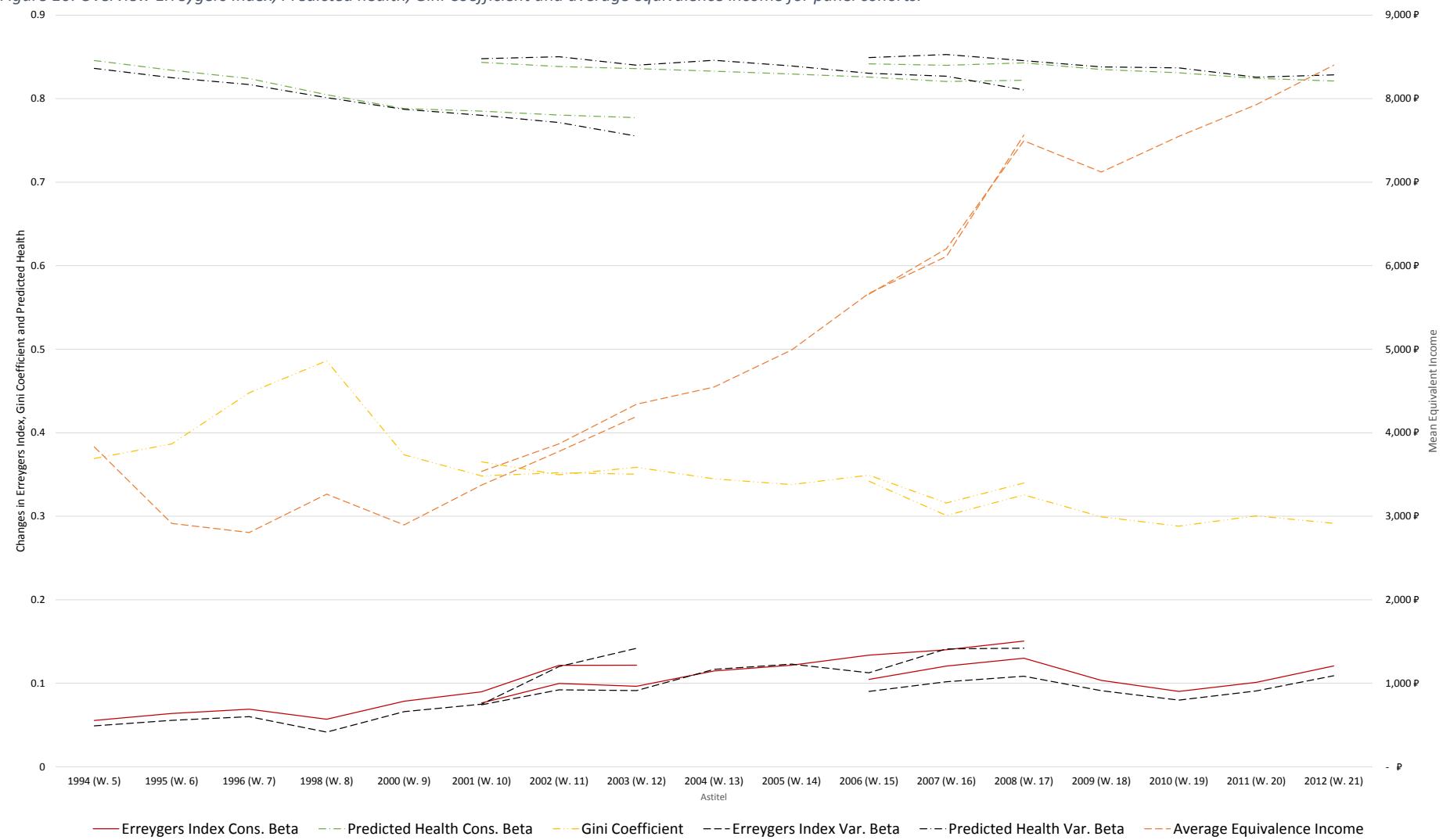


Figure 11: Overview Reported and Predicted health

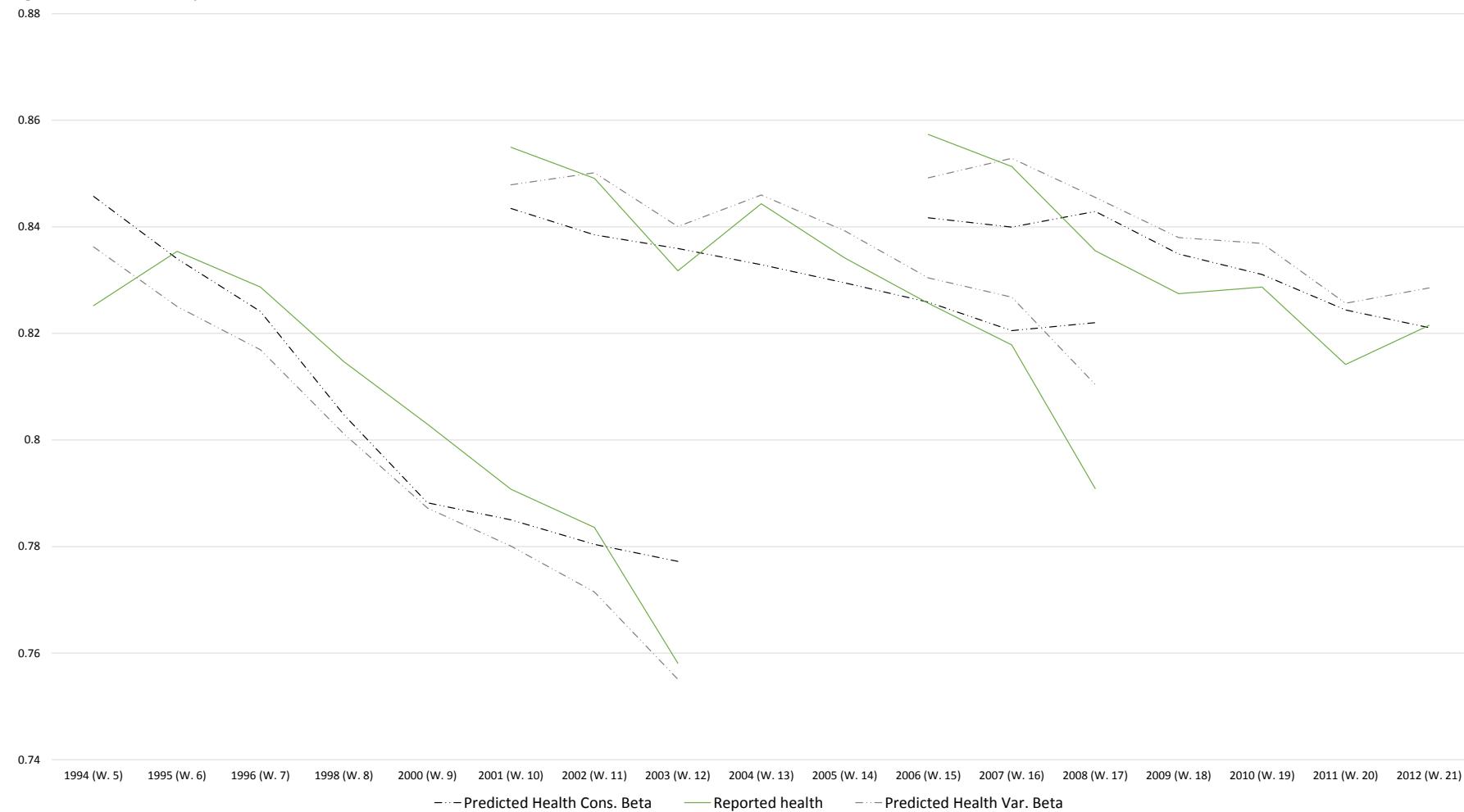


Table 3: Effect of income on health for panel cohorts. Beta assumed to be constant

	Wave 5-12	Wave 10-17	Wave 15-21
Equivalent income/10,000	0.047***	0.048***	0.042***

\*\*\* p<0.01  
\*\* p<0.05  
\* p<0.1

Figure 12: Decomposition of evolution IRHI between 1994 and year  $t$  (max 2003), 2001 and year  $t$  (max 2008) and 2006 and year  $t$  (max 2012), beta assumed constant.

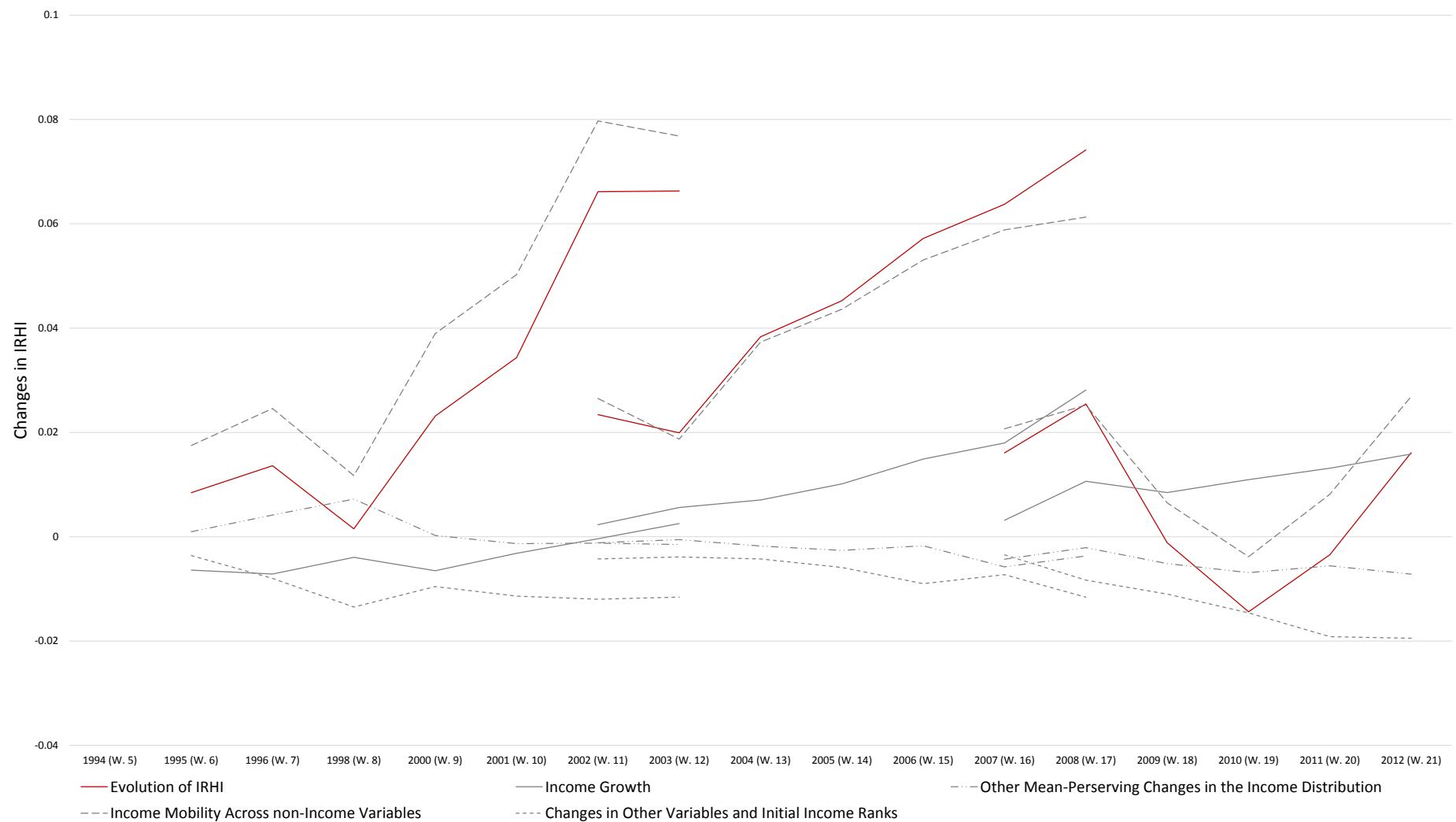


Figure 13: Differences in income mobility across age-gender (panel a), work status (panel b) and settlement type (panel c) between 1994 and year  $t$  (max 2003), 2001 and year  $t$  (max 2008) and 2006 and year  $t$  (max 2012), beta assumed constant.

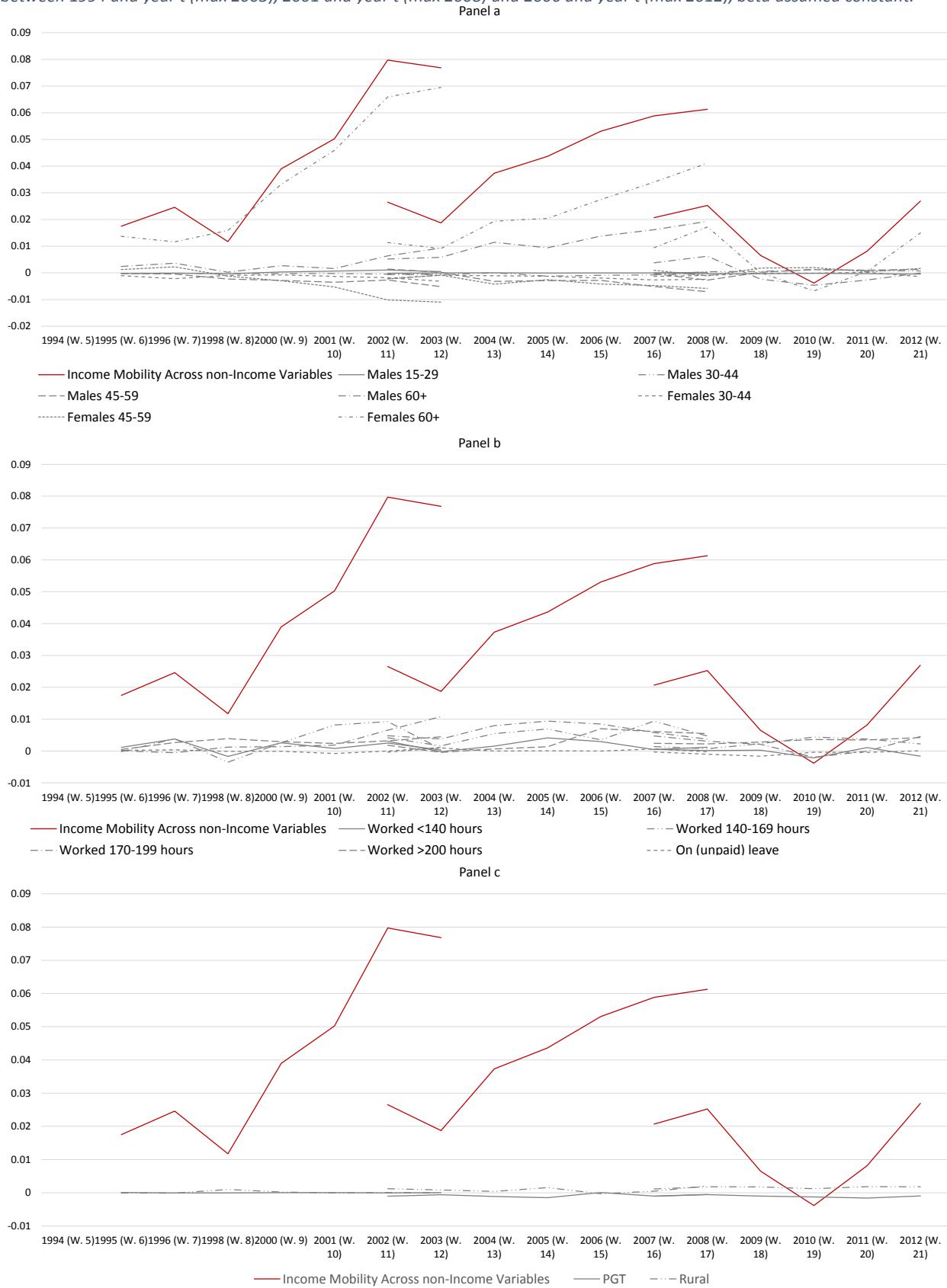


Table 4: Regression output panel cohorts, beta assumed to be constant.

	<b>Wave 5-12</b>	<b>Wave 10-17</b>	<b>Wave 15-21</b>
Females 15- 29	Base category	Base category	Base category
Females 30- 44	-0.059***	-0.065***	-0.054***
Females 45- 59	-0.161***	-0.146***	-0.136***
Females 60+	-0.353***	-0.385***	-0.345***
Males 15- 29	0.032**	0.012	-0.01
Males 30- 44	-0.012	-0.05***	-0.038***
Males 45- 59	-0.08***	-0.106***	-0.11***
Males 60+	-0.203***	-0.247***	-0.239***
Worked <140 hours	0.102***	0.103***	0.131***
Worked 140- 169 hours	0.112***	0.11***	0.129***
Worked 170- 199 hours	0.102***	0.112***	0.131***
Worked >200 hours	0.085***	0.079***	0.111***
On (unpaid) leave	0.104***	0.091***	0.105***
Unemployed	Base category	Base category	Base category
Urban	Base category	Base category	Base category
PGT	0.003	0.01	0.011
Rural	0.003	0.015	0.018*
Equivalent income/10,000	0.047***	0.048***	0.042***
Constant	0.871***	0.893***	0.869***

\*\*\* p<0.01

\*\* p<0.05

\* p<0.1

Figure 14: Difference between average weights  $z_{it}$  for panel cohorts of age-gender (panel a), work status (panel b) and settlement type (panel c).



Figure 15: Share of non-income variables ( $x_{it}^k$ ) contributing to evolution of IRHI for panel cohorts. Age-gender (panel a), work status (panel b) and settlement type (panel c)

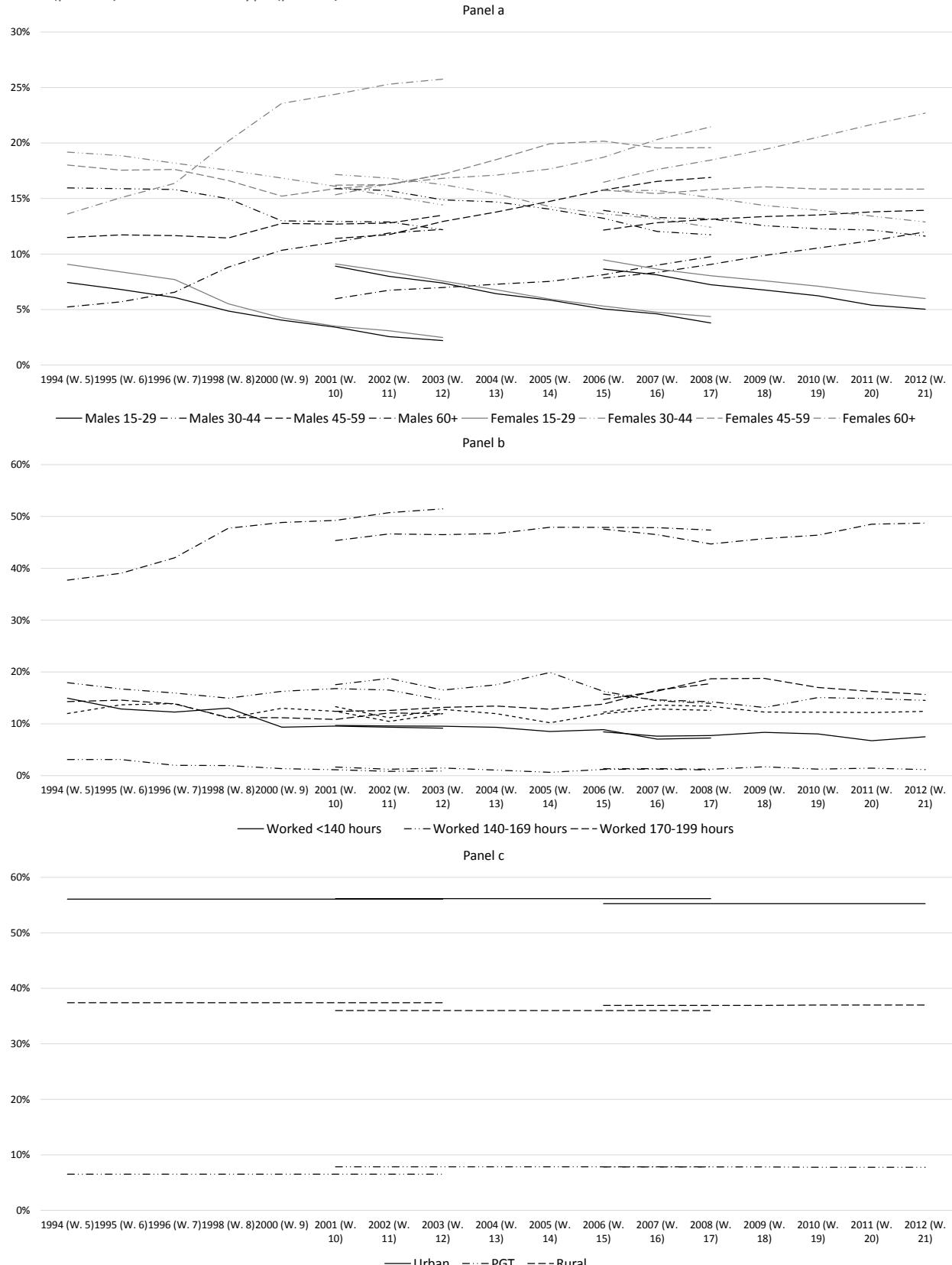


Figure 16: Differences in non-income variables across initial income between 1994 and year  $t$  (max 2003), 2001 and year  $t$  (max 2008) and 2006 and year  $t$  (max 2012), beta assumed constant.

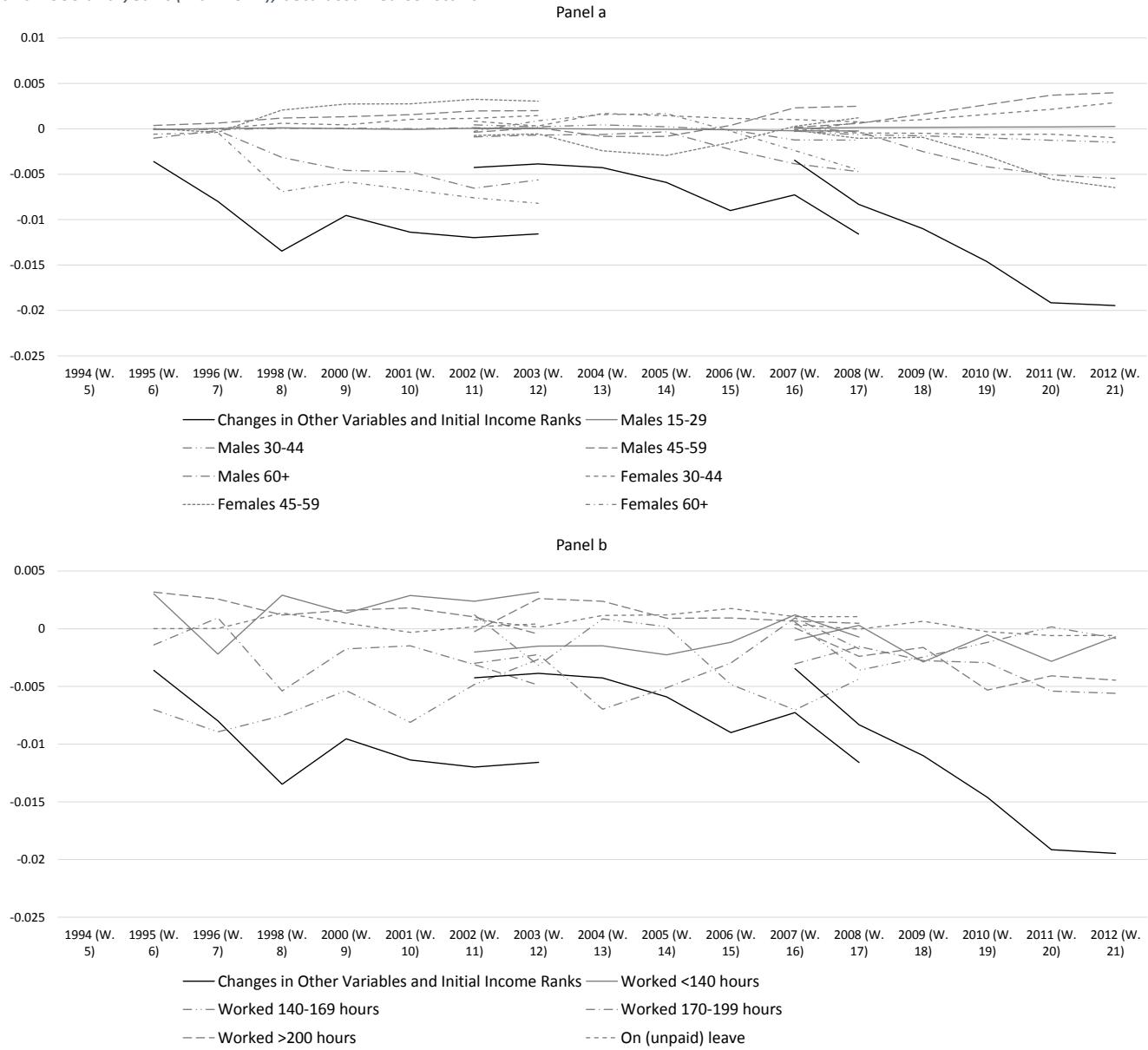


Table 5: Effect of income on health for panel cohorts. Beta assumed to be non-constant.

	Wave 6	Wave 7	Wave 8	Wave 9	Wave 10	Wave 11	Wave 12
Equivalent income/10,000	0.043**	0.039**	0.034**	0.03	0.028	0.043**	0.081***
	Wave 11	Wave 12	Wave 13	Wave 14	Wave 15	Wave 16	Wave 17
Equivalent income/10,000	0.052***	0.05***	0.062***	0.062***	0.029**	0.053***	0.036***
	Wave 16	Wave 17	Wave 18	Wave 19	Wave 20	Wave 21	
Equivalent income/10,000	0.028**	0.027***	0.034***	0.036***	0.033***	0.033***	

Figure 17: Differences in income mobility across age-gender (panel a), work status (panel b) and settlement type (panel c) between 1994 and year  $t$  (max 2003), 2001 and year  $t$  (max 2008) and 2006 and year  $t$  (max 2012), beta assumed non-constant.



Table 6: Regression output panel cohorts, beta assumed to be non-constant.

	1995	1996	1998	2000	2001	2002	2003	2002	2003	2004	2005	2006	2007	2008	2007	2008	2009	2010	2011	2012
Females 15-29	Base category							Base category							Base category					
Females 30- 44	-0.054***	-0.05**	-0.044**	-0.054***	-0.036*	-0.055***	-0.054***	-0.072***	-0.063***	-0.053***	-0.058***	-0.051**	-0.045***	-0.055***	-0.053***	-0.064***	-0.049***	-0.048***	-0.059***	-0.051**
Females 45-59	-0.19***	-0.187***	-0.204***	-0.184***	-0.166***	-0.171***	-0.177***	-0.144***	-0.142***	-0.139***	-0.143***	-0.131***	-0.133***	-0.148***	-0.139***	-0.151***	-0.133***	-0.14***	-0.143***	-0.135***
Females 60+	-0.345***	-0.335***	-0.378***	-0.359***	-0.339***	-0.37***	-0.391***	-0.346***	-0.359***	-0.353***	-0.351**	-0.351***	-0.351***	-0.362***	-0.335***	-0.343***	-0.339***	-0.333***	-0.346***	-0.326***
Males 15-29	0.037**	0.059***	0.044***	0.039**	0.058***	0.04**	0.039**	0.021*	0.034***	0.032**	0.019	0.036***	0.032**	0.017	0.007	-0.016	0.001	0.003	-0.007	0.001
Males 30-44	-0.005	0.006	0.003	-0.012	0	-0.005	-0.007	-0.058***	-0.051***	-0.045**	-0.058***	-0.039**	-0.046**	-0.054***	-0.022	-0.038***	-0.015	-0.017	-0.027**	-0.032**
Males 45-59	-0.08***	-0.077***	-0.073***	-0.085***	-0.078***	-0.095***	-0.112***	-0.108***	-0.099***	-0.064***	-0.102***	-0.088***	-0.066***	-0.11***	-0.096***	-0.12***	-0.105***	-0.105***	-0.112***	-0.097***
Males 60+	-0.156***	-0.172***	-0.175***	-0.183***	-0.164***	-0.194***	-0.233***	-0.176***	-0.205***	-0.189***	-0.207***	-0.218***	-0.223***	-0.229***	-0.222***	-0.236***	-0.247***	-0.237***	-0.259***	-0.227***
Worked <140 hours	0.073***	0.088***	0.08***	0.085***	0.077***	0.085***	0.078***	0.056***	0.085***	0.077***	0.088***	0.099***	0.116**	0.128***	0.115***	0.114***	0.103***	0.113**	0.123***	0.122***
Worked 140-169 hours	0.084***	0.099***	0.071***	0.082***	0.102**	0.11***	0.114***	0.094***	0.099***	0.097***	0.104***	0.099***	0.106***	0.135***	0.105***	0.104***	0.106***	0.109***	0.121***	0.122***
Worked 170-199 hours	0.077***	0.093***	0.065***	0.096***	0.077***	0.104***	0.086***	0.095***	0.081***	0.098***	0.097***	0.111***	0.101***	0.144***	0.099***	0.117***	0.11***	0.109***	0.13***	0.135***
Worked >200 hours	0.056***	0.057***	0.042**	0.067***	0.066***	0.061***	0.059***	0.059***	0.053***	0.072***	0.074***	0.07***	0.092***	0.114***	0.082***	0.097***	0.086***	0.078***	0.094***	0.097***
On (unpaid) leave	0.087***	0.1***	0.085***	0.1***	0.102***	0.094***	0.086***	0.102***	0.064*	0.079**	0.105***	0.095***	0.1***	0.124***	0.083***	0.098***	0.098***	0.108***	0.118***	0.1***
Unemployed	Base category							Base category							Base category					
Urban	Base category							Base category							Base category					
PGT	0.011	0.035*	0.008	0.012	0.003	-0.006	0.001	-0.009	-0.003	0.02	-0.002	-0.01	0.016	0	-0.005	-0.024	-0.011	-0.007	0	-0.008
Rural	-0.001	-0.013	-0.009	-0.002	0	0.005	0.005	0.012	0.009	0.008	0.008	0.013	0.012	0.02	0.01	0.013	0.022**	0.016	0.012	0.012
Equivalent income/10,000	0.043**	0.039**	0.034**	0.03	0.028	0.043**	0.081***	0.052***	0.05***	0.062***	0.062***	0.029**	0.053***	0.036***	0.028**	0.027***	0.034***	0.036***	0.033***	0.033***
Constant	0.879***	0.872***	0.897***	0.888***	0.869***	0.872***	0.86***	0.908***	0.9***	0.888***	0.893***	0.894***	0.874***	0.866***	0.901***	0.903***	0.885***	0.887***	0.888***	0.883***

\*\*\* p<0.01

\*\* p<0.05

\* p<0.1

Figure 18: Differences in non-income variables across initial income between 1994 and year  $t$  (max 2003), 2001 and year  $t$  (max 2008) and 2006 and year  $t$  (max 2012), beta assumed non-constant

