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The relative income hypothesis: does it exist over time? Evidence from the BHPS

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Abstract: The relative income hypothesis suggests that income inequality has a detrimental affect on individuals' health. This association has been well established, but more recent debate suggests that at the population level any reported associations are actually statistical artefacts. Other researchers also argue that studies using aggregate level data are insufficient to discriminate between competing income hypotheses. This has resulted in a request for further empirical research, using a combination of individual and population level data, to establish the independent effect of income inequality on individual health. This paper addresses this need by estimating the relationship between income inequality and health using individual level panel data. A random effects ordered probit is used to estimate the relationship between net household income, regional income inequality and self-reported health and wellbeing, for 3144 individuals over 9 years, while controlling for individual socioeconomic characteristics like gender, social class and age. Significant differences in income inequality across regions and considerable changes in health and wellbeing are found across years. However, the panel data estimating regressions find no significant association between any of the measures of income inequality and health or wellbeing. It would appear, therefore, that the relative income hypothesis does not exist over time and does not exist within Britain.

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Introduction

The absolute income hypothesis suggests that health improves with average income but at a decreasing rate, that is there is a 'curvi-linear' relationship between income and health. The relative income hypothesis goes one step further than this, suggesting that health also depends on the degree of income inequality in society (Wilkinson, 1996). According to this hypothesis, for any given average level of income the more equally distributed this income the higher will be the average standard of health.

There is a vast amount of published evidence supporting this relationship between health and income inequality. Statistical associations have been reported using cross-sectional and longitudinal data; both within and between countries; in high, middle and low income countries; for numerous indicators of mortality and morbidity; and various measures of income inequality (see Ellison (2002) and Wagstaff and van Doorslaer (2000) for detailed discussions and references). Given that these independent analyses arrived at a similar consensus, Wilkinson was led to concluded that the "income distribution relationship is now firmly established" (Wilkinson, 1996, p.105).

More recently, however, this consensus has become diluted. Empirical studies at an individual level are no longer reporting such strong support (e.g. Daly *et al*., 1998). Moreover, a theoretical debate has arisen that suggests that the reported associations are actually a statistical artefact (Gravelle, 1999). Gravelle argues significant relationships between income inequality and health at the population level (using aggregate data) are a result of the nonlinear (concave) relationship between absolute income and health. He suggests that further research into the independent effect of income inequality is required and that this research should use a combination of individual and population level data. Wagstaff and van Doorslaer (2000) also advocate the use of individual level studies. In a review of the literature on the effect of income inequality on health, they identify a number of hypotheses which might give rise to a link between income inequality and health, including the relative income hypothesis, the deprivation hypothesis, the relative position hypothesis and the income inequality hypothesis. They argue that only individual level studies have the potential to discriminate between the absolute income hypotheses and the different versions of the relative income hypothesis.

From a policy perspective it is important to distinguish these effects, as while both the absolute income hypothesis and the relative income hypothesis predict that a reduction in inequality can improve the health of a population, the relative income hypothesis suggests that redistribution can have a double effect. As Gravelle explains "…if policies that alter the distribution of income are to be judged at least partly by their effects on population health, knowing how large these effects are is important" (Gravelle, 1999, p.384).

This paper attempts to add to the debate on the relationship between income inequality and health in a number of ways. We use individual level data from the British Household Panel Survey, so we can appropriately test for and distinguish between the absolute income hypothesis and relative income hypothesis. This data is longitudinal, thus allows us to investigate whether the hypotheses exist over time. Finally, the data includes measures of both self-reported health and subjective wellbeing, such that we are able to test if a relationship can be identified for both physical and psychological health. Previous within country studies have used North American data (Kennedy *et al*., 1998; Ross *et al*., 2000), and to our knowledge few researchers have exploited British data to this effect before (e.g. Weich, Lewis and Jenkins, 2002; Wildman and Jones, 2002).

Methods

Data

The British Household Panel Survey (BHPS) is a longitudinal survey of households in Great Britain (England, Scotland and Wales) (Taylor *et al*., 2002). The first wave of data was collected in 1991 and it has been repeated every year since, such that currently there are 10 waves of data available (1991-2000). Initially, a nationally representative sample of some 10,000 individuals in over 5,000 households were interviewed. In subsequent years these same individuals were re-interviewed, as were any new members of the household (and members of newly formed households).

Health status

Self-reported health is assessed in each wave using the question "Compared to people of you own age, would you say that your health over the past 12 months has on the whole been excellent, good, fair, poor or very poor?" However, in wave i (1999) the SF-36 questionnaire was included in the survey, resulting in a rewording of the question to "In general would you say your health is excellent, very good, good, fair or poor?" To deal with this anomaly we

recoded self-reported health as "excellent", "good", "fair" or "poor". The categories poor and very poor were combined for all waves; and for wave i, a random sample of 30% of the very good's were recoded as excellent, 70% of the very good's recoded as good and 30% of the (orginal) good's recoded as fair. These recodings and weights were chosen so that the proportions in each category were comparable across waves.

Wellbeing

Subjective wellbeing is derived in the BHPS using twelve individual elements of the General Health Questionnaire (including concentration, sleep loss, confidence, self-worth, etc) which are combined using a Likert scale. This Likert scale obtains an overall score by summing the individual elements (which are rated on a four point scale from 0 to 3), such that the resulting variable ranges from 0 to 36 and is increasing in poor wellbeing. Although the data are essentially continuous, employing a generalised least squares (GLS) panel data regression resulted in a misspecified model. Therefore, the data were recoded as binary with "poor wellbeing" referring to those with a Likert scale greater than 18, and "good wellbeing" referring to those with a Likert scale of less than or equal to 18.

Income

In the original BHPS data set, income measures are expressed only as gross amounts. However, it is regarded as inappropriate to use gross income, so net annual household income, as derived by Bardasi, Jenkins and Rigg (2001), was used instead. This measure has been equivalised using the McClements before housing costs scale (to take account of household composition and size) and has been deflated to January 1998 prices. In addition to this, the top and bottom 1% of the income distribution were trimmed (Cowell and Victoria-Fraser, 1994). To test for the absolute income hypothesis, that there is a 'curvi-linear' relationship between income and health, household income was included in the regression as a log.

Income inequality

Inequality was measured in a number of ways. On a very simple level it was assumed that, given the theory of social comparison (Kawachi and Kennedy, 1999), individuals may be comparing their own level of income with the average level of income within the region that

they live in.[1] This was estimated by calculating the difference between each individual's household income and the average income within their region. This basic measure of income inequality was supplemented with more complex measures including the Gini coefficient, generalised entropic measures, Atkinson indices and a percentile ratio.[2] Individuals within the same region were assigned the same inequality index, such that inequality differs across regions and across waves, but not across individuals within a region. Much of the analysis uses the Gini coefficient as it is the most common measure of income inequality.

Other explanatory variables

Age (and its square), gender (female), ethnicity (non-white), smoker, education and socioeconomic status were included to represent individual and demographic factors that are thought to affect health and/or wellbeing. Education, defined as an individual's highest education qualification, was categorised into four different variables representing different levels of attainment (higher or first degree, A-levels or apprenticeship, O-levels or similar and no qualification). Socioeconomic group is a derived variable in the BHPS and individuals are classified according to their occupation. These groupings were aggregated further into variables representing professionals, non-manual employee, skilled manual workers, unskilled and semi-skilled occupations and other (own account workers and farmers etc). If an individual's socioeconomic group was recorded as "not applicable", due to the fact they were not employed, then these individuals were classified as either unemployed or not in the labour market (from information on their current labour force status). Finally, time dummies, derived from the wave identifiers, were also included to pick up any effect of time on self-reported health and subjective wellbeing.

A balanced panel was employed, such that only individuals from the first wave who were interviewed in each subsequent wave were included.[3] This, together with the exclusion of individuals with missing values on variables of interest, combined with the fact that the net household income data are only currently available for the first 9 waves, resulted in a sample of 3144 individuals, across 9 years, giving a total sample of 28296 observations.

[1] The data are ordered into 18 regions, 16 standard regions in England, plus Scotland and Wales.
[2] These indices were calculated using a STATA programme written by Jenkins (1999).
[3] Note, using an unbalanced panel does not significantly change any of the results. The only problem is that the models become misspecified.

Analysis

The effects of income, income inequality and other explanatory variables on self-reported health were estimated using a random effects ordered probit (Frechette, 2001). This is a regression method for panel data with an ordered dependent variable, which uses maximum likelihood estimation, whereby the likelihood for each unit is approximated by a Gauss-Hermite quadrature. Given that subjective wellbeing was transformed into a binary variable (see earlier discussion) a random effects probit was employed. The validity of this was tested using the Hausmann test; while a RESET test was used to test for misspecification in all estimated equations. All analyses were undertaken using STATA (STATA Corporation, 2001).

In the initial instance all regression equations were estimated for the panel data set as a whole. However, a number of researchers report that the effect of income inequality on health is stronger for the poor (Kennedy *et al*., 1998; Soobader and LeClere, 1999; Weich, Lewis and Jenkins, 2002). To test this additional hypothesis the sample was stratified and the regressions were estimated for a sample of individuals whose income was below average.

Results

Descriptive statistics for the whole sample (28296 observations) are reported in Table 1, for the variables of interest: health, wellbeing, income and income inequality.

Table 2 reports the proportions for each category of self-reported health for each year and all years. It would appear that over time there has been some change in the way that individuals' self report their health. Further support for this is shown in Table 3, which shows that these changes in health across waves are significant; similarly for wellbeing. There was also a significant difference when comparing inequality (measured by the Gini coefficient) across regions. Some of this difference is evident in the Lorenz curves which are presented in Figures 1 and 2.

The results of the random effects ordered probit are reported in Table 4. A number of the significant results are as expected. There is a positive relationship between the log of income and self-reported health, and a similar positive relationship between education and self-reported health. Furthermore, the positive coefficient on higher education is greater than the

estimated coefficients on O-levels and A-levels. Negative and significant coefficients are reported for females, smokers and non-whites. A quadratic relationship is found between age and health, which has a turning point at 36 years. More importantly, however, is the finding that the Gini coefficient is insignificant. Moreover, this insignificance is robust to other measures of inequality; see Table 5, where none of the ten measures report any significant relationship between self-reported health and income inequality.

Results for random effects (binary) probit for subjective wellbeing are similar to those for the self-reported health equation (see Table 6). Income and socio-economic status are positively correlated with wellbeing, while being female and a smoker is negatively correlated with wellbeing. Interestingly, while there is a significant quadratic relationship between wellbeing and age, it is the opposite to that for health, in that a U-shaped relationship is found. With regard to the income inequality variable, be it the Gini coefficient as reported in Table 6 or the alternative measures as reported in Table 7, again the coefficient is insignificant.

Tables 8 and 9 report the results of estimating the equations when only those individuals whose income is below average are included. When comparing Table 4 with Table 8, we find that the coefficient on the inequality measure is much larger (more negative) and furthermore increasing in significance, such that it is nearly significant at the 10% level. This, however, is not the case for the subjective wellbeing model, where the coefficient on the Gini coefficient has diminished as has the t-statistics (cf. Table 6 & Table 9).

Discussion

Employing data from the BHPS has allowed us to overcome a number of problems associated with establishing whether there is an independent effect of income inequality on health. The aggregation problem and statistical artefact issues have been addressed (Gravelle, 1999) and we were also able to appropriately distinguish between competing hypotheses (Wagstaff and van Doorslaer, 2000). Furthermore, the use of longitudinal data has allowed us to take account of any unobservable individual effects that may confound the relationship between income and health (Wildman and Jones, 2002). Household level income was included in the model in a nonlinear fashion, thus reducing the possibility that the relationship between

health and income was misspecified and the coefficient on income inequality biased.[4] A further test for misspecification, in the form of a RESET test, was also undertaken to inform us on the robustness of the results.

We used a random effects ordered probit for the self-reported health equation, which allowed us to maximise the variation in the ordinal dependent variable (compared to using binary data), while controlling for any random events or factors which may exist across the panel. The panel data results provide some understanding as to what factors effect self-reported health and subjective wellbeing, and whether there is evidence of the absolute income hypothesis and/or the relative income hypothesis.

In terms of the other explanatory variables, the panel data results suggest that women, smokers and non-whites report their health lower than men, non-smokers and white individuals. Similar inequalities in self-reported health for gender and ethnicity have been reported previously (Kennedy *et al.*, 1998; Gravelle and Sutton). Likewise our finding that those with an education report their health higher than those without has been found previously, as has the additional result that individuals with degrees or other higher qualifications report their health higher than those with O-levels or A-levels (Kennedy *et al.*, 1998). We also found that professionals rated their health higher than those in other socioeconomic groups. Finally, a nonlinear relationship was found between age and health, implying that individuals' self-reported health increases up to the age of 36 years, at which point their self-reported health declines. This nonlinearity is common, although there has been a tendency to include age as a cubic when estimating health regressions (e.g. Gravelle and Sutton), so there are two turning points. However, the random effects ordered probit would not converge when age cubed was included.

For the wellbeing equation, similar results were found. Females and smokers were more likely to be categorised as having low subjective wellbeing; while the positive and significant coefficients on socioeconomic status suggests that employed individuals and those not in the labour market were more likely to report good wellbeing, compared to individuals who were unemployed. This psychological impact of unemployment was also found by Wildman and Jones (2002). The U-shaped relationship between age and wellbeing, suggests that an

[4] Wildman and Jones (2002) overcome the specification problem by using nonparametric estimation methods.

individual's wellbeing declines until the age of 39 years and then it improves. This relationship is the opposite to that found for self-reported health, suggesting that factors that influence physical health and psychological health may differ in their effects.

Turning to the reported relationships between income and health and wellbeing, we find a positive and significant relationship between self-reported health and the log of net household income. This implies support for the absolute income hypotheses. A similar significant relationship is found between subjective wellbeing and income. However, no significant relationship is found between the Gini coefficient and health or wellbeing. Furthermore, this insignificance is robust to the use of numerous measures of income inequality, suggesting that there is strong evidence that the relative income hypothesis does not exist. This non-existence finds some support from other researchers who have also used the BHPS to test for the relationship between income inequality and health.

Weich, Lewis and Jenkins (2002) found limited evidence of any relationship between inequality indices and self-rated health using the first wave of data from the BHPS. Although they found the Gini coefficient was associated with worse self-rated health when comparing individuals living in higher inequality regions to those in low inequality regions, the finding was not robust to alternative inequality indices. Wildman and Jones (2002) used the BHPS to test whether it is absolute income or relative deprivation that leads to poor psychological wellbeing. While they found that there was no absolute income effect (the opposite to what we found), there was also little evidence of an affect of relative deprivation on wellbeing.

Weich, Lewis and Jenkins (2002) reported associations between regional income inequality and worse health were strongest amongst those with low incomes. Others have also found that the detrimental effect is greatest at the bottom of the distribution (Kennedy *et al.*, 1998; Soobader and LeClere, 1999). Some evidence of this is found for the panel data regression of self-reported health, when only including those individuals whose income was below average; while the coefficient on the Gini coefficient (and other inequality indices, not reported) did increase in magnitude, it still failed to become significant.

Conclusion

The extensive literature of the effect of income inequality on health has begun to diverge from the consensus that income inequality is detrimental to health and wellbeing. There is a need for further research to inform this discussion, especially given the policy implications of the relative income hypothesis (versus the absolute income hypothesis). Furthermore, income and its effect(s) will be vital in informing the current debate of health inequalities.

The results presented here would suggest that while there are significant differences in income inequality across regions, and considerable changes in self-reported health and subjective wellbeing across time, there is no significant association between income inequality and health or wellbeing. There is strong evidence to support the absolute income hypothesis, but it would appear that the relative income hypothesis does not exist over time and does not exist within Britain.

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Table 1: Descriptive statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
Health	2.926	0.839	1	4
Wellbeing	25.065	4.963	0	36
Income	15921.92	7257.51	2907.72	51022.64
Gini coefficient	0.243	0.017	0.180	0.288
GE(-1)	3.250	0.356	2.337	4.695
GE(0)	0.112	0.017	0.057	0.161
GE(1)	0.098	0.014	0.052	0.138
GE(2)	0.095	0.013	0.050	0.135
A(0.5)	0.100	0.015	0.051	0.156
A(1)	0.047	0.006	0.025	0.066
A(2)	0.093	0.012	0.051	0.129
Percentile ratio	0.182	0.023	0.102	0.243
Actual-Average	0.000	7129.261	-15661.31	33339.82

Table 2: Self-reported health for each year

	Excellent	Good	Fair	Poor
1991	31.4	46.1	16.1	6.4
1992	28.1	48.5	17.0	6.4
1993	25.9	50.2	18.1	5.8
1994	24.1	51.2	18.6	6.1
1995	22.4	51.9	19.4	6.2
1996	23.6	49.6	19.6	7.2
1997	24.7	47.1	20.2	8.0
1998	22.9	47.4	20.9	8.8
1999	23.4	46.5	26.1	4.0
All Years	25.2	48.7	19.6	6.6

Table 3: Tests of independence

	Degrees of freedom	Statistic	p-value
Health across years			
F	8 , 28296	14.10	>0.001
Pearson's χ^2	24	285.42	>0.001
Wellbeing across years			
F	8 , 28296	5.79	>0.001
Pearson's χ^2	288	379.48	>0.001
Inequality across regions			
F	17 , 28296	3436.12	>0.001
Pearson's χ^2	2737	481032	>0.001

Table 4: Regression results for self-reported health (random effects ordered probit)

	Coefficient	T-stat
Age	0.016	2.61
Age squared/100	-0.022	-3.66
O-levels or equivalent	0.353	6.04
A-levels or equivalent	0.342	5.58
Higher education	0.369	6.55
Female	-0.155	-3.49
Non-white	-0.381	-2.49
Smoker	-0.174	-4.97
Log(income)	0.125	4.51
Gini Coefficient	-0.580	-0.91
Professional	0.172	2.85
Non-manual	0.049	0.85
Manual Skilled	0.046	0.76
Manual Semi/Unskilled	0.048	0.77
Not in Labour Market	0.121	1.71
Other	-0.197	-3.47
1992	-0.080	-2.65
1993	-0.133	-4.41
1994	-0.185	-6.10
1995	-0.237	-7.71
1996	-0.253	-8.13
1997	-0.264	-8.37
1998	-0.339	-10.57
1999	-0.254	-7.80
Cut 1	-1.166	-3.49
Cut 2	0.222	0.66
Cut 3	2.205	6.6
rho	0.530	73.78
RESET $\chi^2(1)$	2.82	
LR $\chi^2(30)$	649.54	
Observations	28296	

Table 5: Selective income inequality indices regression results for self-reported health

	Coefficient	T-stat
Gini coefficient	-0.580	-0.91
GE(-1)	-0.137	-0.22
GE(0)	-0.457	-0.58
GE(1)	-0.590	-0.74
GE(2)	-0.508	-0.78
A(0.5)	-1.144	-0.68
A(1)	-0.505	-0.58
A(2)	-0.104	-0.22
Percentile share	-0.017	-0.61
Actual-Average	-0.000	-0.58

Table 6: Regression results for reported wellbeing (random effects probit)

	Coefficient	T-stat
Age	-0.032	-3.93
Age squared/100	0.041	5.06
O-levels or equivalent	0.075	1.11
A-levels or equivalent	-0.004	-0.05
Higher education	-0.003	-0.04
Female	-0.400	-8.01
Non-white	-0.100	-0.58
Smoker	-0.180	-3.83
Log(income)	0.104	2.48
Gini Coefficient	-1.456	-1.45
Professional	0.498	5.45
Non-manual	0.476	5.54
Manual Skilled	0.694	7.50
Manual Semi/Unskilled	0.570	5.81
Other	0.540	4.76
Not in Labour Market	0.389	4.52
1992	-0.184	-3.32
1993	-0.201	-3.61
1994	-0.162	-2.89
1995	-0.304	-5.49
1996	-0.310	-5.58
1997	-0.246	-4.36
1998	-0.335	-5.96
1999	-0.319	-5.62
rho	0.480	
LR(rho) $\chi^2(1)$	5972.49	
RESET $\chi^2(1)$	0.000	
Wald $\chi^2(30)$	239.20	
Observations	28296	

Table 7: Selective income inequality indices regression results for reported wellbeing

	Coefficient	T-stat
Gini coefficient	-1.456	-1.45
GE(-1)	-1.292	-1.31
GE(0)	-1.804	-1.44
GE(1)	-1.941	-1.53
GE(2)	-1.652	-1.58
A(0.5)	-3.963	-1.50
A(1)	-2.003	-1.45
A(2)	-0.989	-1.33
Percentile share	-0.050	-1.10
Actual-Average	-0.000	-1.92

Table 8: Regression results for self-reported health (random effects ordered probit) – below average income

	Coefficient	T-stat
Age	0.003	0.41
Age squared/100	-0.008	-1.19
O-levels or equivalent	0.307	4.43
A-levels or equivalent	0.274	3.65
Higher education	0.272	3.95
Female	-0.130	-2.43
Non-white	-0.612	-3.96
Smoker	-0.187	-4.16
Log(income)	0.124	2.79
Gini Coefficient	-1.262	-1.51
Professional	0.239	2.96
Non-manual	0.071	1.00
Manual Skilled	0.114	1.58
Manual Semi/Unskilled	0.042	0.57
Not in Labour Market	0.117	1.35
Other	-0.271	-4.03
1992	-0.083	-2.14
1993	-0.138	-3.50
1994	-0.173	-4.38
1995	-0.251	-6.29
1996	-0.271	-6.64
1997	-0.259	-6.26
1998	-0.369	-8.75
1999	-0.250	-5.83
Cut 1	-1.661	-3.36
Cut 2	-0.231	-0.47
Cut 3	1.743	3.52
rho	0.541	57.52
LR $\chi^2(30)$	455.86	
Observations	16316	

Table 9: Regression results for reported wellbeing (random effects probit) – below average income

	Coefficient	T-stat
Age	-0.032	-3.26
Age squared/100	0.042	4.39
O-levels or equivalent	0.051	0.65
A-levels or equivalent	0.084	0.87
Higher education	0.052	0.64
Female	-0.355	-5.67
Non-white	-0.081	-0.36
Smoker	-0.201	-3.44
Log(income)	0.175	2.56
Gini Coefficient	-0.458	-0.36
Professional	0.395	3.24
Non-manual	0.352	3.29
Manual Skilled	0.574	5.12
Manual Semi/Unskilled	0.441	3.83
Other	0.674	4.64
Not in Labour Market	0.223	2.19
1992	-0.144	-2.06
1993	-0.126	-1.77
1994	-0.111	-1.57
1995	-0.252	-3.60
1996	-0.265	-3.72
1997	-0.173	-2.37
1998	-0.262	-3.60
1999	-0.251	-3.39
rho	0.492	
LR(rho) $\chi^2(1)$	1308.84	
Wald $\chi^2(30)$	155.28	
Observations	16316	

Figure 1: Lorenz curves for 1996 for selected regions

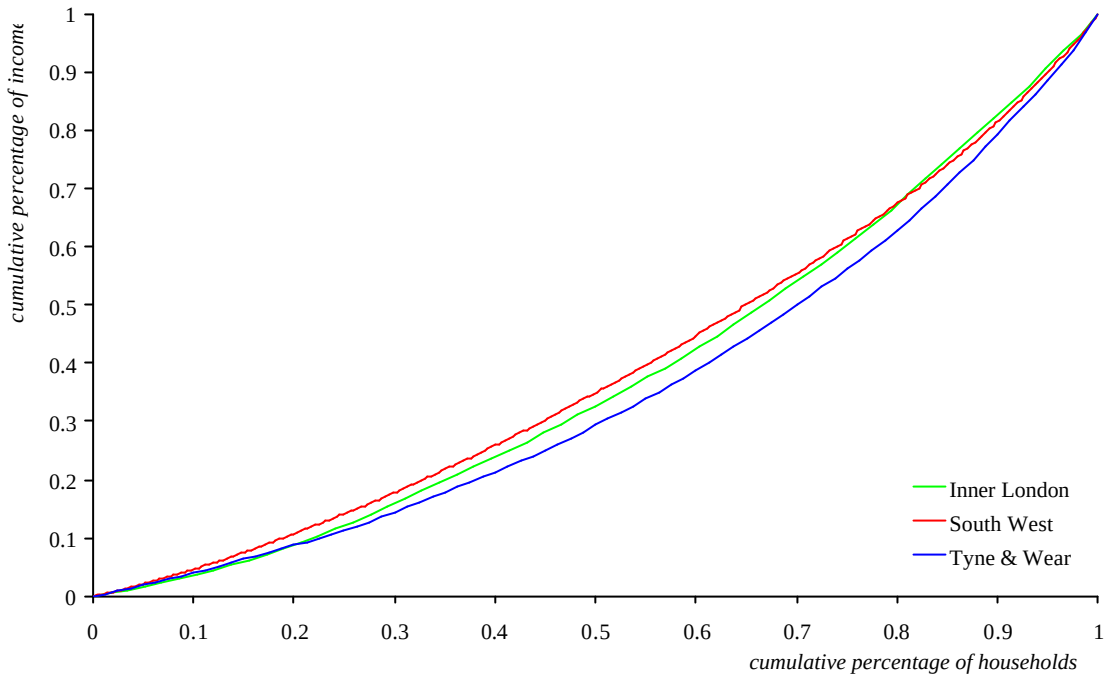

Figure 2: Lorenz curves for Merseyside for selected years