Top Income Shares and Mortality: Evidence from Advanced Countries

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This article examines the effect of top income shares on crude death and infant mortality rates. We use balanced panel data that covers nine advanced countries over the period 1952-1998. Top income shares are measured as the shares of pre-tax income going to the richest 0.1 per cent, 1 per cent, and 10 per cent of the population. The main finding is that there is no overall relationship between top income shares and mortality measures. We also estimate separate effects on both female and male mortality rates. If anything, these estimates suggest that the male death rate is negatively correlated with inequality.

Keywords: income inequality, top income shares, mortality, infant mortality
JEL Classifications: I12, N30

Introduction

Increasing income inequality is associated with increased morbidity and premature mortality (Wilkinson 1996, Wagstaff and van Doorslaer 2000, Subramanian and Kawachi 2004, Wilkinson and Pickett 2006, Leigh *et al.* 2009, Etienne *et al.* 2011).[2] The robustness of this relationship has, however, been questioned (*e.g.*, Judge *et al.* 1998, Deaton 2001, Gravelle *et al.* 2001, Deaton and Lubotsky 2003, Gerdtham and Johannesson 2004, Gravelle and Sutton 2008). Most of the literature has used cross-sectional data that do not allow for controlling for the unobservable heterogeneity that is associated with regions/countries and years. Using panel data on countries, it is possible to hold constant both stable country-to-country differences and annual changes in the outcome of interest that affect all countries similarly in the same year (Leigh and Jencks 2007). There are earlier studies on income inequality and various domains of health that have used a panel data approach, but they usually rely on a relatively short time dimension to identify the effects (*e.g.*, Kravdal 2008, Lorgelly and Lindley 2008, Hildebrand and Van Kerm 2009).[3]

This article examines the effect of top income shares on crude death and infant mortality rates. We use balanced panel data that covers nine advanced countries over the period 1952-1998. The main advantage of the measures of top income shares from tax registers is that they are available for a much longer time period

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than other measures of income inequality. There is earlier research that has used the measures of top income shares to examine the effect of income inequality on mortality (Waldmann 1992, Leigh and Jencks 2007).[4]

The article contributes to earlier research that has used income tax data:

1) We use three different measures of top income shares. These are the shares of pre-tax income going to the richest 0.1 per cent, 1 per cent, and 10 per cent of the population.[5] This is a crucial extension of the literature because the use of several different measures of top income shares allows us to detect whether there exists a systematic, robust relationship between top income shares and mortality.[6]

2) We estimate separate effects on both female and male mortality rates. This is important because the overall effects can hide different effects on the mortality rates by gender. It is particularly interesting to explore the potential gender differences in the relationship because evidence points out that there are gender differences in the perception of equality and fairness (*e.g.*, Eckel and Grossman 2008). Females are generally more sensitive to deviations from equality and fairness than males are. This implies that income inequality may have stronger negative effects on female health. It is, however, also possible that males may suffer greater "income envy" than females because money may matter more for males. Due to the fact that we include the income share of the super-rich, the specifications are able to better capture the potential envy effects rather than using the income share of the richest 10 per cent only.

3) We perform robustness checks on a relationship that has not been considered in this particular strand of research earlier. This is essential because the patterns that are based on the use of country aggregates of income inequality and mortality can be fragile, at least to some degree. Specifically, we use 5- and 10-year averages of the data to account for the fact that the relationship between income inequality and mortality may not be instantaneous.

4) We use a balanced panel from nine advanced countries for the period 1952-1998. Thus, we do not use the pre-Second World War observations on top income shares because they often contain more measurement error (see *e.g.*, Roine *et al.* 2009). Nor do we use observations that cover the period of the Second World War because the shock of war may have had different idiosyncratic effects on advanced countries that are difficult to control for. Furthermore, the parameters of interest are not necessarily stable over the very long time period that would cover most of the twentieth century. As we focus on the analysis of a balanced panel, there is also no need to interpolate and/or extrapolate for missing observations.[7] This arguably reduces measurement error in the variables and therefore produces more precise estimates with tighter confidence intervals.

Data

We use data on mortality and top income shares for the period 1952-1998. The nine countries are the following: Australia, Canada, France, Japan, New Zealand, Sweden, the Netherlands, the United States, and the United Kingdom. The time period and the countries have been selected in order to construct a balanced panel of advanced countries.

The dependent variables of the models are based on the World Health Organization Mortality Database.[8] The database includes deaths by country from 1950 and these are classified according to the International Classification of Diseases System (ICD7-ICD10). The analysis is based on two measures of mortality. These are:

1) The natural logarithm of the crude death rate (*i.e.*, the log of the total number of deaths per year per 1000 inhabitants).

2) The natural logarithm of the infant mortality rate (*i.e.*, the log of the number of deaths of children less than 1 year old per 1000 live births).

Both measures of mortality are also calculated separately for females and males by using corresponding population shares.

The explanatory variables of interest are various measures of top income shares. Therefore, top income shares are used as measures of income inequality. Collective research efforts have constructed a database of top income shares covering most of the twentieth century (Atkinson and Piketty 2007, 2010).[9] These measures are based on historical income tax statistics and common methodology across countries.[10] Top income shares are calculated by comparing the amount of income reported to the tax authorities by the richest X per cent of individuals/households with an estimate of total personal income in the same year from each country's national accounts.

We use the shares of pre-tax income going to the richest 0.1 per cent, 1 per cent, and 10 per cent of the population.[11] Capital gains are not included in the top income shares whenever they are separately reported, following Atkinson and Piketty (2010). Piketty and Saez (2003) who have argued that capital gains should not be included in the top income shares because they are realized in a lumpy fashion. Hence, capital gains form a very volatile component of income with large variation from year to year. The income share of the richest 10 per cent is not available for Japan. Thus, the models that use the income share of the richest 10 per cent are estimated for eight advanced countries.

As a standard control variable in the baseline specifications, we use the natural logarithm of the real GDP per capita (measured in 1990 international Geary-Khamis dollars), based on Maddison (2003).[12] Table 1 provides descriptive statistics of the variables.

Table 1
Descriptive Statistics of the Variables

	N	Mean	St. Dev
Dependent Variables			
Log of the crude death rate	423	2.1751	0.1781
Log of the infant mortality rate	423	2.5240	0.5720
Log of the crude death rate for females	423	2.0862	0.2020
Log of the infant mortality rate for females	423	2.3914	0.5690
Log of the crude death rate for males	423	2.2567	0.1645
Log of the infant mortality rate for males	423	2.6348	0.5754
Explanatory variables			
Income share of the richest 0.1%	423	2.0093	0.8447
Income share of the richest 1%	423	7.7863	1.9155
Income share of the richest 10%	376	31.4975	4.1976
Log of the real GDP per capita ($1000s)	423	9.4194	0.3934

Note: The income share of the richest 10% is not available for Japan.

Empirical Approach

We estimate models of the following type:

$$Y_{it} = \alpha_i + \beta X_{it} + \varphi G_{it} + \lambda_t + \varepsilon_{it}, \tag{1}$$

where Y is the outcome (the log of the crude death rate or the log of the infant mortality rate) for country i in year t. X represents control variables. The variable of our interest is G_{it}, which is a measure of top income share for country i in year t. ε is an error term. α_i and λ_t represent fixed effects associated with the country and the year. The most important advantage of the fixed effects approach is that we are able to control for unobservable heterogeneity that is associated with countries and years.[13] Therefore, in this fixed effects set-up, the effects of income inequality on mortality are identified by intra-country variations, relative to the corresponding changes in other countries.[14] Standard errors for the estimates are clustered at the country level in all specifications to take into account the possible within-country serial correlation, following Leigh and Jencks (2007).

Results

Baseline Estimates

The fixed effects for countries and years are included in the baseline specifications because a full set of indicators for countries and years is statistically significant.[15] For comparison, the point estimate of the income share of the richest 1 per cent on the crude death rate is -0.0079 (with a robust standard error of 0.0179, clustered at the country level) in the specification that does not include a full set of indicators for countries (and years) (Table 2, Panel B, Column 1). Even more interestingly, the estimate of the income share of the richest 1 per cent on the infant mortality rate is 0.0505 (0.0261) in the model without a full set of indicators for countries (and years) (Table 2, Panel B, Column 3). Therefore, the estimate suggests that an increase in income inequality, increases infant mortality. This result is in accordance with the cross-country estimates in Waldmann (1992) and the specifications that do not include a full set of indicators for countries and years in Leigh and Jencks (2007) and the cross-country correlations in Wilkinson and Pickett (2009).

Table 2
Top Income Shares and Mortality
The Importance of Fixed Country Effects

	(1) Crude death rate	(2) Crude death rate	(3) Infant mortality rate	(4) Infant mortality rate
Panel A				
Income share of the richest 0.1%	-0.0153	-0.0280	0.0899	-0.0922**
	(0.0340)	(0.0176)	(0.0533)	(0.0290)
Fixed country effects	No	Yes	No	Yes
Fixed year effects	No	No	No	No
Observations	423	423	423	423
R^2	0.016	0.893	0.688	0.935
Panel B				
Income share of the richest 1%	-0.0079	-0.0132	0.0505*	-0.0343**
	(0.0179)	(0.00798)	(0.0261)	(0.0108)
Fixed country effects	No	Yes	No	Yes
Fixed year effects	No	No	No	No
Observations	423	423	423	423
R^2	0.018	0.893	0.698	0.931
Panel C				
Income share of the richest 10%	-0.00883	-0.00759	0.0246*	-0.0163**
	(0.00983)	(0.0452)	(0.0127)	(0.00701)
Fixed country effects	No	Yes	No	Yes
Fixed year effects	No	No	No	No
Observations	376	376	376	376
R^2	0.109	0.878	0.726	0.933

Note: The models include a full set of indicators for countries and years, as indicated. All 12 models include an unreported control variable for the log of the real GDP per capita. The income share of the richest 10 per cent is not available for Japan. Robust standard errors in parentheses, clustered at the country level. Statistical significance: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

The main finding from the baseline specifications is that there is no overall relationship between top income shares and mortality measures among the nine advanced countries over the period 1952-1998 (Table 3, Panels A-C, Columns 1-2). The non-existence of a relationship between the income share of the richest 10 per cent and mortality is in accordance with the results in Leigh and Jencks (2007). Only in the specification that uses the share of income going to the richest 1 per cent is there evidence of a negative relationship at the 10 per cent significance level between income inequality and the crude death rate (Table 3, Panel B, Column 1). For the infant mortality rate not even this relationship prevails.

The mortality rates that are calculated separately for females and males reveal an interesting additional pattern.[16] There is evidence that an increase in income inequality is associated with a decrease in the crude death rate for males.[17] This pattern prevails for all three measures of income inequality (Table 3, Panels A-C, Column 5). The 95 per cent confidence intervals for these estimates indicate that zero is generally not included in them; for example, the confidence intervals for the point estimate of the income share of the richest 1 per cent on the crude death rate for males (Table 3, Panel B, Column 5) range from -0.0485 to -0.0074. In contrast, for females there is no evidence whatsoever that income inequality is related to mortality (Table 3, Panels A-C, Columns 3-4).

Robustness Checks

To examine the robustness of the baseline estimates, we have estimated several additional specifications:

1) We dropped one country at a time from the panel and re-estimated the models. This allowed us to detect whether the overall pattern in Table 3 is driven by the observations that are related to one country only. None of these specifications indicates that there is evidence for the positive relationship between top income shares and mortality; for example, the point estimates for the income share of the richest 1 per cent on the crude death rate (Table 3, Panel B, Column 1) vary from -0.0771 (with a robust standard error of 0.0211, clustered at the country level) to -0.0210 (0.0297) when one country at a time is dropped from the panel. We have also estimated separate models for the Anglo-Saxon countries because one of the best known stylized facts of the development of top income shares is the diverging evolution in the Anglo-Saxon countries *vs.* in continental Europe (Atkinson and Piketty 2007).[18] The non-existence of the relationship between income inequality and mortality remains intact.

2) We have estimated separate models for the periods 1950-1973 and 1974-1998, following the classification of growth phases in the advanced countries by Maddison (1991). The coefficients for top income shares are not statistically significantly different for these two time periods (not reported).

Table 3
Top Income Shares and Mortality; Baseline Specifications

	(1) Crude death rate	(2) Infant mortality rate	(3) Crude death rate for females	(4) Infant mortality rate for females	(5) Crude death rate for males	(6) Infant mortality rate for males
Panel A						
Income share of the richest 0.1%	-0.0436 (0.0256)	-0.0366 (0.0439)	-0.0280 (0.0326)	-0.0355 (0.0440)	-0.0568** (0.0202)	-0.0375 (0.0440)
Observations	423	423	423	423	423	423
R^2	0.906	0.982	0.915	0.980	0.889	0.981
Panel B						
Income share of the richest 1%	-0.0222* (0.0117)	-0.0207 (0.0196)	-0.0155 (0.0153)	-0.0201 (0.0197)	-0.0280** (0.00892)	-0.0211 (0.0197)
Observations	423	423	423	423	423	423
R^2	0.907	0.982	0.916	0.980	0.890	0.982
Panel C						
Income share of the richest 10%	-0.00870 (0.00668)	-0.00455 (0.00756)	-0.00496 (0.00731)	-0.00494 (0.00766)	-0.0122* (0.00626)	-0.00425 (0.00759)
Observations	376	376	376	376	376	376
R^2	0.888	0.977	0.898	0.975	0.876	0.976

Note: All 18 models include a full set of indicators for countries and years. All models of all panels also include an unreported control variable for the log of the real GDP per capita. The income share of the richest 10 per cent is not available for Japan. Robust standard errors in parentheses, clustered at the country level. Statistical significance: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

3) We have added the estimates of the average number of years of total schooling among the adult population to the set of control variables for the period 1960-1995 because education is a potential determinant of health (Cutler and Lleras-Muney 2008). The data are based on de la Fuente and Doménech (2006).[19] The data contain the estimated number of years of schooling for every five years over the period 1960-1995. We have interpolated linearly the missing observations for each country separately. The results show that the number of years of schooling is not statistically significant in these models at conventional levels (not reported). The most likely reason for this is that the number of years of schooling is rather imprecisely measured. Therefore, the baseline results for the effects of top income shares remain almost unchanged; for example, the point estimate of the income share of the richest 1 per cent on the crude death rate (Table 3, Panel B, Column 1) is -0.0214 (with a robust standard error of 0.0126, clustered at the country level) for the period 1960-1995 when one includes the number of years of schooling in the set of control variables.

4) We have added the square of GDP per capita to the set of control variables because there is earlier evidence according to which the relationship between GDP and mortality is quadratic (Preston 1975). These specifications reinforce the earlier finding for the existence of a negative relationship between income inequality and mortality when one uses the income share of the richest 1 per cent (Table 4, Panel B, Column 1). The quantitative magnitude of the estimate remains rather small. The coefficient of -0.0231 implies that a 10 percentage point increase in the income share of the richest 1 per cent decreases the crude death rate by ~0.2 percentages. In contrast to the results of the baseline specifications (Table 3, Panel A, Column 1), the income share of the richest 0.1 per cent has also a statistically significant negative effect on the crude death rate (Table 4, Panel A, Column 1). By using the income share of the richest 10 per cent, however, there is no evidence for the statistically significant relationship (Table 4, Panel C, Column 1). The results for the square of GDP (not reported) reveal that the negative effect of additional GDP on the crude death rate decreases as GDP rises.

5) We have estimated a set of fixed effects models, allowing for the first order autocorrelation terms. These models also produce statistically significant evidence for the negative relationship between the variables of interest (not reported). The statistical significance of these estimates is, however, probably partly driven by the fact that it is technically impossible to cluster standard errors at the country level at the same time, as one allows for the first order autocorrelation terms to be applied to the models.

Table 4
Top Income Shares and Mortality; Additional Specifications

	(1) Crude death rate	(2) Infant mortality rate	(3) Crude death rate	(4) Infant mortality rate	(5) Crude death rate	(6) Infant mortality rate	(7) Crude death rate for males	(8) Infant mortality rate for males
Panel A								
Income share of the richest 0.1%	-0.0482**	-0.0404	-0.0483	-0.0428	-0.0452	-0.0409	-0.0598**	-0.0415
	(0.0187)	(0.0367)	(0.0291)	(0.0488)	(0.0322)	(0.0560)	(0.0256)	(0.0561)
Observations	423	423	81	81	45	45	45	45
R^2	0.917	0.983	0.920	0.986	0.915	0.988	0.903	0.987
Panel B								
Income share of the richest 1%	-0.0231**	-0.0215	-0.0239	-0.0226	-0.0225	-0.0212	-0.0290**	-0.0219
	(0.00907)	(0.0166)	(0.0132)	(0.0217)	(0.0148)	(0.0249)	(0.0113)	(0.0250)
Observations	423	423	81	81	45	45	45	45
R^2	0.916	0.983	0.920	0.986	0.916	0.988	0.903	0.988
Panel C								
Income share of the richest 10%	-0.0103	-0.00813	-0.00927	-0.00426	-0.00840	-0.00362	-0.0124	-0.00342
	(0.00770)	(0.00719)	(0.00768)	(0.00826)	(0.00865)	(0.0104)	(0.00793)	(0.0105)
Observations	376	376	72	72	40	40	40	40
R^2	0.891	0.978	0.899	0.981	0.898	0.984	0.894	0.983

Note: The models in columns 1-2 of all panels include a full set of indicators for countries and years. The models in columns 1-2 also include an unreported control variable for the log of the real GDP per capita and the square of the log of the real GDP per capita. The models in columns 3-4 are estimated by using 5-year averages of the data, as explained in the text. These models include a full set of indicators for countries and 5-year time periods. They also include an unreported control variable for the 5-year average of the log of the real GDP per capita. The models in columns 5-6 are estimated by using 10-year averages of the data. These models include a full set of indicators for countries and 10-year time periods. They also include an unreported control variable for the 10-year average of the log of the real GDP per capita. The models in columns 7-8 are estimated by using 10-year averages of the data for males. The controls are the same as in Columns 5-6. The income share of the richest 10 per cent is not available for Japan. Robust standard errors in parentheses, clustered at the country level. Statistical significance: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

6) We have estimated the specifications by using 5-year averages of the data for the period 1952-1998 (the last time period covers the years 1992-1998) because the relationship between income inequality and mortality may not be instantaneous. Instead, the negative effects of income inequality on health may take several years to develop (*e.g.*, Gadalla and Fuller-Thomson 2008). The use of 5-year averages removes a substantial amount of temporary fluctuations from the variables of interest. This approach has also been used earlier in the literature on income inequality and economic growth (*e.g.*, Voitchovsky 2005). The data that is used to estimate these models consists of 81 observations because we have nine countries and nine time periods. These results point out that there is no statistically significant relationship between top income shares and mortality (Table 4, Panels A-C, Columns 3-4). The pattern is identical for all three measures of top income shares.

7) We have estimated specifications by using 10-year averages of the data. (The last time period covers the years 1992-1998.) The results remain again intact (Table 4, Panels A-C, Columns 5-6).

8) We have estimated models for the mortality rates that are calculated separately for males using 5-year and 10-year averages of the data because the baseline estimates (Table 3, Panels, A-C, Column 5) showed that an increase in income inequality seems to be associated with a decrease in the crude death rate for males. These specifications reveal that the earlier effect prevails when using the income shares of the richest 0.1 per cent and 1 per cent for both 5- and 10-year averages of the data, but it disappears when using the income share of the richest 10 per cent. (The results obtained by using 10-year averages of the data are documented in Columns 7-8 of Table 4.) This pattern is consistent with the fact that the relationship was also statistically weakest in the baseline estimates when the income share of the richest 10 per cent was used (Table 3, Panel C, Column 5). Also, in accordance with the baseline estimates, we find that income inequality is not related to infant mortality for males through the use of 10-year averages of the data (Table 4, Panels A-C, Column 8).

Conclusions

The article uses top income shares measured as the shares of pre-tax income going to the richest 0.1 per cent, 1 per cent, and 10 per cent of the population to examine the relationship between income inequality and mortality. The main finding is that there is no overall relationship between top income shares and mortality measures in the balanced panel of nine advanced countries over the period 1952-1998. If anything, the estimates based on gender breakdown suggest that there is some evidence that an increase in income inequality is associated with a decrease in the crude death rate for males. This result is related to earlier research that has found differences in the effect of income inequality on mortality between genders (*e.g.*, Lochner *et al.* 2001, Materia *et al.* 2005). These studies generally find stronger effects of income inequality on mortality for females.

The most important limitation of the study is arguably the use of top income shares as measures of income inequality. Top income shares capture well changes at the top end of the income distribution and changes in the Gini coefficient (Leigh 2007). They do not, however, describe changes at the bottom end of the income distribution well. That being said, it is important to note that, according to Leigh and Jencks (2007, p. 20), almost all of the theoretical arguments for the existence of a positive relationship between income inequality and mortality should also be valid when one is measuring income inequality through top income shares.

Notes

[1]*Acknowledgements*: I am grateful to Elina Tuominen and three anonymous referees for valuable comments.

[2]There are many potential channels between income inequality and health that are discussed in detail in Leigh and Jencks (2007, pp. 2-6); for example, income inequality may erode social capital that is a determinant of population health. This article estimates reduced-form specifications using aggregate data, and it is therefore not possible to identify the specific channels.

[3]Babones (2008) finds evidence for the positive relationship between income inequality and mortality by using panel data on countries over the period 1970-1995.

[4]Income shares have been used to avoid the aggregation problem (*e.g.*, Wildman *et al.* 2003).

[5]Leigh and Jencks (2007) use only the income share of the richest 10 per cent. We also include the income share of the super-rich.

[6]We use mortality data to complement the analysis in Leigh and Jencks (2007). They use life expectancy at birth as their main outcome variable.

[7]Leigh and Jencks (2007) also report a 1960-2000 specification.

[8]The data are available at http://www.who.int/healthinfo/morttables/en/index.html

[9]Piketty and Saez (2003) and Saez (2005) describe the trends in top income shares in the United States and Canada.

[10]Atkinson and Brandolini (2001) discuss the drawbacks of the commonly used "secondary" data sources on income inequality in detail.

[11]The data on top income shares are described in Roine *et al.* (2009).

[12]The data are available at http://www.ggdc.net/maddison/

[13]Kravdal (2008) discusses about the fixed effects approach in detail. Böckerman *et al.* (2009) have also used the fixed effects approach to examine the relationship between income inequality and various subjective and objective measures of health.

[14]Roine *et al.* (2009) show that there is plenty of both cross-sectional and time-series variation in the measures of top income shares.

[15]Leigh and Jencks (2007) also find that the indicators for countries and years are highly statistically significant.

[16]Top income shares are not gender-specific.

[17]Leigh and Jencks (2007) obtain some evidence for the positive coefficient for the income share of the richest 10 per cent in the specifications for life expectancy at birth, but their estimates are generally not statistically significant.

[18]We classify Australia, Canada, New Zealand, the United Kingdom, and the United States as the Anglo-Saxon countries, following *e.g.* Roine *et al.* (2009).

[19]The data are available at http://iei.uv.es/ rdomenec/human/human.html

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