Income, Income Inequality and Mortality: what we know from French data

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Abstract

Are more egalitarian societies healthier ? This paper explores the Wilkinson's hypothesis suggesting that " the scale of income di¤erences in a society is one of the most powerful determinants of health "(Wilkinson, 1996). The hypothesis of a negative e¤ect of income inequality on individual health is mainly supported by the correlation between inequality and life expectancy at the aggregate level. In this paper, we use French individual data to explore the competing explanations of this correlation at the aggregate level. Our analysis is based on two …scal databases, the "Wealth at Death Survey" and the "Taxable Income Survey". The determinants of the probability of dying in 1988 are derived from the comparison of the characteristics of people who died in 1988 (Wealth at Death Survey) to the characteristics of people surviving in 1990 (Taxable Income Survey). First we show a strong association between income and mortality. However, unlike the "statistical artefact hypothesis" (Gravelle, 1996), we do not …nd a concave relationship between health and income. Our results suggest a speci…c risk related to poverty and a strong protective e¤ect of higher incomes. Second, our results support the "inequality hypothesis" (Wilkinson, 1996, Kawachi, 1997). The intra-regional level of household income inequality, measured on the "Taxable Income Survey", is positively correlated to the probability of dying, after control for regional cofounders such as unemployment rate and health care supply.

1 Introduction

Are more egalitarian societies healthier?

In his seminal paper, Preston (1975) shown that di¤erences in income per capita do not fully explain di¤erences in population health: the cross-country relationship between life-expectancy and income per capita was not continuous. Among the poorest countries, life expectancy raised with income per capita but among the richest countries, the relationship was absent. By contrast, in all countries, life expectancy decreases with income inequality (Rodgers, 1979). In 1996, Wilkinson has emphasized that " the scale of income di¤erences in a society is one of the most powerful determinants of health ". This argument was supported by a very strong correlation (-0.81) between life expectancy and income inequality, measured by the Gini coe¢cient, across 11 industrialized countries.

Since then, there is a large literature exploring these apparently negative e¤ects of income inequality on health.

On the one hand, the initial methodological strategy has been criticized, as cross-country comparisons are not a controlled experiment. The social and sanitary situations and especially the public

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intervention on health di¤er largely between countries. Moreover, the comparability of the statistics has been discussed since the measurement of income is sensitive to survey design and the measurement error in income in‡ates the measured income inequality (Deaton 2001). In order to limit biases induced by cross-country comparisons, several studies have tested the correlation between average level of health and income inequality across the states of the US. For instance, Kaplan et al.(1996) and Kawachi et al.(1997a) …nd a positive relationship between the level of inequalities of each state and several indicators of health, such as age-adjusted all cause mortality, infant mortality, death from cancer, by coronary heart disease, homicide and disability. Moreover, this relation seems to be robust to the choice of the indicator of income inequality[1] (Kawachi and al, 1997 a).

On the other hand, some studies have attempted to clarify the various hypotheses that have been advanced to explain, at the individual level, the apparently negative e¤ect of income inequality on health at the population level (Deaton, 2001, Wagsta¤ and Van Doorslaer, 2000). Four main propositions have been made.

According to the "statistical artefact hypothesis"(Gravelle, 1996), initially proposed by Rodgers (1979), the population level association between health status and inequality is explained by the concave relationship between income and individual health status, which is equivalent to a convexe relationship between mortality and income. If health increases with income but at a decreasing rate, average health of the population will decrease with the increase in inequality, since transferring income from the poor to the rich will increase the mortality risk of the poor more that it reduces the mortality risk of the rich. The concavity assumption is supported by several analyses based on US data (e.g. Mellor and Milyo (1998), Smith and Kington (1997)). However, the convexity of the relation estimated between mortality and income seems insu¢cient to explain the extent of the correlation on aggregated data between inequalities and mortality (Wolfon and Al, 1999).

According to "income inequality hypothesis" proposed by Wilkinson (1996) and Kawachi (2000), income inequality has a direct e¤ect on individual health. This negative externality would be induced by a lower level of social capital and a less social cohesion (Kawachi and Berkman, 2000). The indicators of social capital used by Putnam (1995), such as the per capita number of groups and associations and indicators of social trust and fairness assessed from responses to the General Social Survey, are good predictors of the di¤erences in life expectancy across the states of the US (Kawachi and Al, 1997 b).

According to the "relative position hypothesis", "what matters within societies is not so much the direct e¤ect of absolute material living standards as the e¤ect of social relativities. "Health is powerfully a¤ected by social position" (Wilkinson, 1996). Individual health is then a¤ected by the rank of the individual in the society or by his "relative income", de…ned as the gap between his absolute income and a reference group income. Income inequality has then an indirect e¤ect on individual health, as the income gap between individual income and the reference group income increases with the scale of income di¤erences in a society.

Lastly, the correlation can be due to some cofounders rather than a direct impact of inequality. Potential cofounders are geographical characteristics, themselves correlated with income inequality, such as criminality or local policies (Deaton, 2001, Kawachi, 2000). The di¤erences in income induce con‡icts of interests, which can result in less generous social policies. Hence, the less egalitarian states have at the same time a higher mortality rate, higher unemployment, higher criminality, a higher proportion of uninsured people and a lower education level (Kaplan and Al, 1996, Kawachi and Al,

[1] The authors …nd a relationship between mortality and various measures of income inequality, such as the Gini coe¢cient, the Theil entropy measure, the Atkinson index, the Robin Hood index, the decile ratio, the proportions of income earned by the bottom 50%, 60% and 70% of households.

1999). However, according to Legrand (1987), the correlation between life expectancy and income inequality among 32 industrialized countries is robust to the control for public provision of health care.

In this paper, we propose to evaluate these various assumptions on individual data, which is the best way[2] to strictly discriminate between these competing hypotheses (Wagsta¤ and van Doorslaer, 2000). Our analysis is based on a case-control study constructed with two …scal databases, the "Wealth at Death Survey" and the "Taxable Income Survey". The determinants of the probability of dying in 1988 are derived from the comparison of the characteristics of people who died in 1988 (Wealth at Death Survey) to the characteristics of people surviving in 1990 (Taxable Income Survey).

The use of French mortality data has a double interest for this purpose.

First the link between income and mortality has never been evaluated in France. As emphasized by Feinstein (1993), "data on mortality di¤erentials in France are scanty". Nevertheless, social inequalities in death rates are the stronger in Europe (Kunst et al., 2000) and exist for all causes of death (Jougla et al., 2000). Existing studies only document the di¤erences by occupation (Mesrine, 1999) or by employment status (Mesrine, 2000). The lack of French studies on income and mortality can be explained by the lack of data. Demographic analysis are usually based on death certi…cates matched with census data, which do not contain information on income. Occupation, even if correlated to income, is an imperfect proxy of income, given the large variation of income within each social class. Moreover the socioeconomic classi…cation used in French surveys re‡ects in fact several dimensions, like income, education, prestige and working conditions. As a consequence, income and occupation should have distinct e¤ects on mortality.

More generally, France is a relevant framework to evaluate the impact of income inequality on health. To obtain a variability of income inequality on cross-sectional data, inequality is measured at the regional level. Since the most of individual-level studies are based on American data, the association between state level income inequality and health status may be attributable to di¤erences in state welfare and Medicaid policy (Mellor and Milyo (1998)). The homogeneity of social and health policies across regions in France enables to limit bias induced by omitted regional characteristics.

Our results are as follows. First we show a strong association between income and mortality. However, unlike the "statistical artefact hypothesis" (Gravelle, 1996), we do not …nd a concave relationship between health and income. Our results suggest a speci…c risk related to poverty and a strong protective e¤ect of higher incomes. Second, our results support the "inequality hypothesis" (Wilkinson, 1996, Kawachi, 1997a,b). The intra-regional level of household income inequality, measured on the "Taxable Income Survey", is positively correlated to the probability of dying, after control for regional cofounders such as unemployment rate and health care supply.

2 An Original Database

Our analysis is based on the "Wealth at Death Survey" (Enquête Patrimoine au Décès). Initially designed to analyze asset accumulation and bequest decisions at the end of life, this survey is the only French survey providing information on both age at death and income.

The Weath at Death Survey contains information on all individuals (4570) of the French ongoing demographic sample who died in 1988 when they were over 20. For these individuals, the French …scal administration collected data on demographic characteristics and occupation, from death certi…cates,

[2] Deaton (2001) and Laporte (2002) discuss the possibility of distinguishing between these hypotheses on agrregated level studies.

on assets at death, based on estate duties and on household taxable income of the year before the death from income-tax return.

Despite the comprehensive set of information, the sample process makes this survey unsuitable to mortality analysis as all individuals of the sample are dead. We need a control group, i.e. a comparable sample of living individuals to compare the characteristics of dead people to the characteristics of survivors. In a stationary population, we could study the impact of explaratory variables on life duration with a duration analysis, by assuming that the age-at-death distribution of people died in 1988 is equivalent to the age-at-death distribution of a representative cohort (Cox, 1984). However, in a non-stationary population, mortality determinants cannot be rigorously derived from this age-at-death distribution, because of cohort e¤ects on mortality and on social characteristics. For instance, as the proportion of farmers was higher than the proportion of managers in older cohorts, managers seem to have a higher mortality risk in this sample.

To solve this problem of "case-control sampling", we use the "1990 Taxable Income Survey" (Enquête sur les Revenus Fiscaux) which gives us a control group, i.e. a sample of individuals, alive in 1990, hence surviving at the end of the year 1988. The relevance of this second database derives from the fact that the same …scal administration also collected information from income-tax return for this random sample of households drawn from census.

Compared to self-reported income, these surveys give us a precise and reliable measure of household income[3]. However, the concept of income used here di¤ers from usual measures of income. First, household income cannot be individualized and the household unit corresponds to a tax unit (foyer …scal). Moreover the age of the other household members is not reported in the Weath at Death Survey, as any information on the characteristics of the other household members except the household size. To adjust total income for family size, we use an equivalence scale that assigns a weight of 1 for the …rst member of the unit and 0.35 for the others (INSEE, 1995). Second, taxable income is not equivalent to available income. It does not include income transfers and taxes. In order to reduce biases induced by the taxation law, we restrict the sample to wage-earners because of the lump-sum tax schedule of self-employed. The occupation coding is not homogeneous in both surveys. In the Taxable Income Survey, occupations are coded according to the census occupation coding system, which is used in the Wealth at Death Survey, only for household heads. To enhance the comparability of occupation in both samples, we restrict the sample of survivors to household heads [4]. Unfortunatly, household head status is not reported in the Wealth at Death Survey. We therefore exclude from the sample women and inactive individuals (non-pensioners) who are less likely to be household heads. The study relies then on a sample of 13399 individuals, 1438 who died in 1988 and 11961 still alive in 1990.

3 Empirical Strategy

A logistic analysis is used to estimate the conditional e¤ects of explanatory variables X_{it} on the probability of dying during the year.

This model assumes that the unobservable individual health capital H_i is functionally related to some observable characteristics and to a residual u_{it} distributed according a logistic distribution.:

$$H_{it} = ® + X_{it}^{-} + u_{it} \quad (1)$$

[3] Incomes of the year 1988 are adjusted for in‡ation.

[4] The change in occupation coding is not neutral insofar as it induces discordance for 30% of the sample of household heads (Campagne et al., 1996).

As assumed in health capital models (Grossman 1972, Erlich and Chuma 1990), the death occurs once the health capital drops under a critical minimum level H_{min}.

$$P(H_{it} < H_{min}) = F(H_{min} \quad (® + X_{it}\bar{})) \tag{2}$$

The estime of the $\bar{}$ coe¢cients is derived from the comparison between the distribution of the characteristics in the sample of dead people and the the distribution of the characteristics in the sample of survivors. The repectives sizes of each suspopulation impact the intercept value ® but do not have any in‡uence on the estimed coe¢cients $\bar{}$. As the probability of dying is very small, the estimed odds-ratios can be rigourousely interpreted as a relative risk of mortality (Manski, 1995).

In a …rst stage, we explore the impact on mortality of the standard demographic factors in order to evaluate the representativity of our database. Age, occupation, marital status and location of residence are included as covariates in the model 1. In a second stage, equivalent income is introduced in analysis (models 2 to 6). In a third stage, the regional level of income inéqualities is included in the set of exploratory variables (models 7 to 9).

3.1 A dual relationship between income and health

Theoretically, health status increases with available income since more resources can be devoted to health care consumption.There is a large empirical evidence on inequalities on health care consumption in France. Numerous studies show di¤erences in the structure of health consumption and in the total amount across income groups. The poor consume more hospital services and less out-patient services than the rich, and they under-consume dramatically preventive care, specialist services, dental and optic care. Financial hardship is well documented to induce the poorest people to forgo health care (Bocognano, 1999) and to have a later access to health care services (Breuil-Genier, 1999). Moreover, the comparison of age pro…les of health consumption between income groups seems to indicate that, under 40 years old, the poor consume less health care services than the rich while the relation reverses at older age (Grignon and Polton, 2000). Delay in care may jeopardize health, that may be a plausible explanation for the overconsumption of hospital services by the poor and for the di¤erences in age pro…les of consumption. Unfortunatly, longitudinal data on health and health care, was not so far available in France[5]. Hence, this interaction between age and income on health care expenditures, established on cross-sectional data, could be a statistical artefact, explained by cohort e¤ects or by a better quality of health care coverage of the poor at retirement. Moreover, curative care induced by illness makes the positive impact of health consumption on health status di¢cult to assess in general population (Dourgnon et al., 2001, Cou¢nhal et al., 2002). However the Rand experiment gives an empirical evidence of the positive impact of free care on health outcomes in high-risk populations, such as low-income population and hypertensive people (Newhouse, 1994).

But, two causal mechanisms can explain the correlation between income and mortality. First, income has a direct e¤ect on health. More resources can be devoted to health investment and income opportunities encourage healthy behaviors. Second, health conditions have a reverse e¤ect on economic resources. This "healthy worker e¤ect" is explained by the fact that healthier people are more able to work and to have a good career. According to the health capital models (Grossman, 1972, Erlich et Chuma, 1990), the amount of healthy time available to work is determined by the stock of health capital. In a labor-leisure trade-o¤, health status has an impact on the labor supply as the disutility

[5] The recent chaining of the "Santé Protection Sociale" Survey provides a French longitudinal database on health and health care.

of labor increases with poor health conditions (Coucnhal et al., 2002). Moreover, health status could have an impact on the individual productivity and then on wages (Leibenstein, 1957).

The causal e¤ect of income Y_{it} on health status H_{it} can only be rigorously identi…ed with a structural model of two simultaneous equations[6]:

$$\begin{cases} H_{it} = a_0 + a_1 Y_{it} + a_2 Z^h_{it} + a_3 X^h_{it} + u_{it} \\ Y_{it} = b_0 + b_1 H_{it} + b_2 Z^y_{it} + b_3 X^y_{it} + v_{it} \end{cases} \quad (3)$$

where X^j_{it} represents individual characteristics and Z^j_{it} employment characteristics, impacting respectively income and health status, such as human capital or working conditions. A proper instrument for the direct e¤ect of income on health, i.e. a strictly exogenous variable to health status, is hard to …nd (Adams et al. 2003). As a consequence, if the reverse e¤ect of health status on income is not take into account, the estimated coe cient a_1 is biaised, and this bias increases with the e¤ect of health status on income. Among men, labor-force participation is strongly explained by health conditions (Grand…ls and Le Fur,1993, Mesrine, 2000). Hence, the exclusion of inactives …rst reduces the bias induced by the "healthy worker e¤ect". Second, in a third model, we distinguish among alternative sources of income in order to control for the impact of health on the total household income (Smith and Kington 1997). The receipt of disability pensions re‡ects particularly poor health conditions. Unfortunately, disability pensions and retirement pensions are not separately reported in our data. Since the receipt of a pension before 60 either denotes incapacity or early retirement, which is well-documented to be correlated with bad health (Saurel-Cubizolles et al. 2001), people under 60 who derive a high proportion of their total income from pensions are likely to be in poor health. As a consequence, since all inactives are already excluded and since the longterm impact of health status of wages is not obvious among employed (Lechêne and Magnac, 1994), we assume that the proportion of income corresponding to disability pensions and retirement pensions before 60 years old is a relevant proxy for the "healthy worker e¤ect". Occupation is used as a proxy for education level and working conditions, given the magnitude of the variation of equivalent income within each occupational group (table 4).

3.2 "Poverty hypothesis" versus "Absolute Income Hypothesis"

In order to test the "statistical artefact hypothesis", we then explore the functional form of the link betwen mortality and income. There is in fact two main assumptions on the relationship between income and health status, which are consistent with the association between mortality and inequality at the aggregated level.

According to the "absolute income" hypothesis, individual health is in‡uenced by the absolute level of income. However, the relationship between health and income should be concave, assuming that health capital is produced through a diminishing return-to-scale technology (Erlich and Chuma, 1990). Several studies, principally based on US data, suggest this concave assumption (e.g.Mellor and Milyo, 1998, Smith and Kington, 1997, Wolfson, 1999). The non-linearity of this relationship implies that, at the population level, mortality is explained by both income inequality and average income but also that the e¤ect on population health of average income gets smaller as average income increases (Deaton, 2001).

The "poverty hypothesis" strongly underlines the non-linearity of the relationship between income and health. This hypothesis relies on an opposition between the poor and the non poor. The association between poverty (or deprivation) and mortality is then explained by poor living conditions, poor

[6] For a more comprehensive econometric model of the demand of health capital, see Haveman, 1994.

working conditions or poor access to health care. The interpretation of Wagsta¤ and van Doorslaer (2000) is that it is not absolute income that matters for individual health but rather the extent of deprivation as measured by the income gap, de…ned as the shortfall from the poverty line. The association between inequality and mortality should then be explained by the increase of deprivation induced by the increase of inequality.

In France, di¤erences in mortality between occupation suggest a socioeconomic gradient in mortality (Mesrine, 1999) but give no indication on the functional form of the link between mortality and income.

In order to distinguish between these two hypotheses, we test several speci…cations of income. To test the concavity assumption, we …rst use a logarithmic speci…cation (models 2 and 3), previously used by Wolfson (1999) and a quadratic speci…cation (model 4), previously used by Mellor and Milyo (1998). To highlight the impact of income at the top of the income distribution, we also include equivalent income in a cubic speci…cation (model 5). At the end, we use income quintiles (model 6) to explore the impact of income on mortality at several levels of the income distribution and hence to test the "poverty hypothesis".

The use of quintiles could be interpreted as a test of the "relative position hypothesis" (Kawachi et al, 2002). Indeed, income quintile represents both the individual relative position in the national income distribution and the amount of economic resources. To rigourously identify the impact of the relative position from the impact of absolute income, social position does not have to be de…ned at the national level. The "relative position hypothesis" suggests that individual health is a¤ected by the psychosocial stress induced by social hierarchy and social comparisons. A proper test of this hypothesis is to test the impact on individual health of the relative position (or the relative income, or relative deprivation) in a relevant reference group and the choice of nation as reference group is not obvious. As coworkers, neighborhoods or peers seem to be more relevant, we do not explore further the "relative position hypothesis" in this paper. However, the test of the "inequality hypothesis"could also be an indirect test of the "relative deprivation hypothesis" (Kawachi et al, 2002), as social comparisons are one of the potential explanations for the impact of income inequality on individual health.

3.3 "Inequality Hypothesis"

In a last stage, we test the impact of income inequality on the probability of dying (models 7 to 9). To obtain variability in income inequality on cross-section, inequality has to be measured at community level. For convenience, we assume that what matters for individual health is the degree of social cohesion or social capital within each of the 21 administrative regions (excepted Corse), which is the smaller available geographical level reported in the both surveys (table 3).

Kawachi (2000) highlights four lines of criticism attacking previous studies linking income distribution and health :

(1) The choice of income inequality indicators appears to be arbitrary.

In order to test the robusteness of the results, we retain 3 indicators : the Gini coe¢cient, the Theil entropy measure and the variance of log-income[7].

(2) The household income data used to derive the income distribution measures were not adjusted for taxes and transfert payments.

(3) The household income data were no adjusted for household size and composition.

To take these critiques into account, household income inequality is derived from the "1990 Taxable Income Survey". As this survey is designed at the real household level (and not at the individual level

[7] The results are robust to the use of Atkinson index.

like the "Wealth at Death Survey"), information on the composition of the households (available in census data) is matched to …scal information. Then, we use the INSEE equivalence scale, as de…ned above. Moreover, we use the household available income, which is de…ned at the real household level (and not at the tax unit level) and which is adjusted for income tax, property tax, family allowances, welfare and old-age support[8].

(4) Studies have not taken adequate account of sources of confounding.

At the stage of analysis, we exclude the regional dummies. In return we include in the model two potential confounding : the employment rate in 1988 (Source INSEE) and the health care supply. The regional health care supply is approximated by the density of practising physicians, general practioners and specialists, per 100 000 in 1988 (Base Eco-Santé, CREDES).

To explore more clearly the pathway between income inequality and health, we …nally test the impact of the regional level of criminality on the risk of health (model 10), as a high rate criminality symptom of a poor social cohesion according to Kawachi et al. (1999). The criminality level is approximated by the number crimes and misdemeanours per 1000 in 1988 (Ministère de l'Intérieur, 1989).

4 Results

The …rst model aims at evaluating the reliability of our database and then explores the impact on standard demographic factors on the probability of dying (model 1, table 5). In addition, this …rst analysis allows to evaluate these determinants in a multivariate analysis, whereas demographic analyses often are only adjusted for sex and age[9]. Our results are congruent with previous French demographic studies (e.g.Vallin, Meslé, Valkonen, 2001). As expected, mortality increases with age. Our results suggest a gradient of mortality across social class (the likelihood of death is inversely related to occupational classi…cation). Marital status is strongly signi…cant, married people having a higher survival probability than single, divorced and widowed people. Two geographical areas seem to have a particular e¤ect on health. The North is related to an over-mortality whereas the South West seems to be more protective environments.

4.1 Income and Mortality

The link between income and health can be illustrated by a simple descriptive analysis. The mean of age at death increases with income. There is a di¤erence of 3 years between the …rst quintile (mean = 67.6) and the last quintile (mean = 70.8). Moreover the proportion of dead people in each quintile decreases as income increases in the whole sample as well as among those under 65 and over 65 (table 2), whereas the proportion of survivors increases with income quintile. Symmetrically, the income distribution is not homogeneous in the both surveys (table 1). The risk of dying of the poor seems to be higher as the income distribution of the dead people is continuously dominated by the income distribution of the survivors.

When the economic status is approached by both occupation and the logarithm of equivalent income, the coe¢cient of the log of equivalent income is negatively signi…cant in each age group (model 2, table 5). The share of pensions receipted before 60 years old seems to be a relevant instrument for the selection e¤ect since it is negatively correlated with health status (model 3, table 6). The model 3 suggests a causal e¤ect of income on health as adjusted for pensions, the coe¢cient of income,

[8] Adjustments for taxes and transfers have not been made in the "Wealth at Death Survey".

[9] Most demographic studies are based on standardized mortality ratio.

even reduced, remains signi…cant. Among those over 65 years old, the direct e¤ect of income is not adjusted for the "healthy worker e¤ect". However, the bias induced is limited by the fact that current health has no impact on the amount of current year retirement income (Smith and Kington 1997) Nervertheless, we cannot exclude the possibility of long-term e¤ects of poor health conditions during working life, that could before retirement have reduced earning and hence reduce pension amount.

Adjusted for economic resources, all other determinants mentioned in the demographic analysis still explained mortality. While reduced, the signi…cance of occupational class seems to indicate that human capital is speci…cally related to health status in addition to earning returns. In return, the mortality risk of manuals (PCS 6) is not signi…cantly di¤erent than the mortality risk of non manual (PCS 5). As expected, health capital decreases with age. Whereas the correlation between marital status and mortality is often attributed to the impact of marital status on economics resources (Vallin, Meslé, Valkonen, 2001), the signi…cance of marital status persists after control for economic status. Our results lead to privilege the selection hypothesis or a causal e¤ect of marital status on health status. The over-mortality of single people could be due to a selection e¤ect of healthiest people in the marriage market as well as a negative e¤ect of celibacy or a protestive e¤ect of marriage. However the over-mortality of widowed people cannot be explained by a selection e¤ect. Again, a protective e¤ect of marriage through social support or healthy behaviors cannot be identi…ed from a direct e¤ect of widowhood. Geographical di¤erences in mortality are also often attributed to di¤erence in economic situation. For instance, the importance of industrial sector and unemployment are put forward to explain the over-mortality in the North (Salem et al.2000). When controlled for manual occupation and income, the coe¢cient of the North remains signi…cant, while reduced. In return, the under-mortality associated to the South West is stronger after adjustment for income and the Méditerranée becomes weakly signi…cant (model 5). These geographical di¤erences suggest that other explanations should be explored, such as income inequality or delivery of care. In addition, the case of South West could perhaps be viewed as an illustration of the French paradox and the under-mortality of the Mediterranée area could be explained by a selection e¤ect on migrations during the retirement period.

4.2 Poverty e¤et and Wealth e¤ect

Using several speci…cations for income enables to explore the functional form of the relationship between income and mortality (models 3 to 6, tables 6 to 8).

First our results suggest a strong association between mortality and poverty. The risk of dying is signi…cantly higher at the bottom of income distribution (model 6, table 8). The risk of ding of the …rst quintile is 2.5 higher than the the risk of dying of the …fth quintile This e¤ect may be explain by a poor access to health care, in addition to working conditions or cultural habits which are here approximed by occupation (model 6 bis, table 8), as the risk of dying of the …rst quintile is 2 times higher than the the risk of dying of the …fth quintile. However our results lead to reject the poverty hypothesis, as the impact of income is not restricted to the bottom of income distribution. In accordance with McDonough (1997) analysis, the probability of dying appears to decrease as income increases (model 6, 6 bis), as the odds-ratios decrease with equivalent income quintiles.

However, our results do not supported the "concavity hypothesis". The log speci…cation (model 3, table 6) and the quadratic speci…cation (model 4, table 6) could suggest a concave relationship between health and income as the signs of the coe¢cients of income and income square are opposit. However the cubic speci…cation (model 5, 5 bis, table 7) and the quintile speci…cation (model 6, 6 bis table 8) suggest a logistic relationship rather than a concave relationship. Unlike concavity assumption, the magnitude of income e¤ect does not continuously decrease with rising income levels. The coe¢cient of

each quintile is signi…cantly di¤erent. As richer people (…fth and fourth quintiles) have higher survival probability than the middle class, wealth seems to have a strong protective e¤ect. Moreover this "wealth e¤ect" seems not be due to di¤erences among the both survey design as the results are robust to the exclusion of income outliers. The protective e¤ect of hight incomes is surprising given that the impact of income on health care consumption should be limited by health insurance. However, the impact of social position on individual health, through psychosocial stress (Marmot, 2000), can provides an explanation as high income denotes high social status as well as high economic resources (Nauze-Fichet et Tomasini, 2002).

4.3 The impact of Income Inequality

The results of the model 7 to 9 highlight a positive impact of income inequality on the mortality risk. Hence, our results seem to support the Wilkinson hypothesis (1996) suggesting that "the scale of income di¤erences in a society is one of the most powerful determinants of health ". These results, established on mortality data, are consistent with the study realized by Kennedy et al. (1998) which shows a negative impact the Gini coe¢cient on self rated health in United States. Moreover, this e¤ect is robust to the choice of income inequality indicator and to the control for potential cofounders[10].

Our results suggest also a positive impact of ambulatory health care supply on health. In particular, the high physicians density in Midi-Pyrénées and in Méditerranée seems contribute to their under-mortality. As the less egalitarian regions have also the higher physicians density (Ile-de-France, PACA), health care supply is a strong source of confounding. As a consequence, the coe¢cient of income inequality is not signi…cant that without control for health care supply. The geographical distribution of physicians could a¤ect health, even in developed countries, where the weaker density are often judged satisfaying.

At last, the regional unemployment rate is not related to individual health. A weakness of this study is the lack of control for individual employment status, which is well-documented to be correlated to health status (Mesrine, 2000). According to the ESTEV survey, the risk of unemployement raises with poor health conditions (Saurel-Cubizolles et al., 2001) and unemployment is a risk factor for depression (Bungener and Pierret, 1994). The inclusion of regional unemployment rate can then limit the bias induced by the omission of this variable.

This study does not shed the mechanisms through which income inequality a¤ects health. The "social capital hypothesis" can not strictly be valided without speci…c indicators. However, mortality is not explained by the criminality level (model 10, table 10) which is theoretically correlated with social cohesion. This result seems then to indicate that income inequality has an impact on health throught social comparisons.

5 Conclusion

This paper has established the impacts of both income and income inequality on the individual risk of mortality in France. In this study, we used …scal data, not initially intended for mortality analysis. The comparison of two distinct surveys was the only way to introduce income in the study of di¤erential mortality in France. As a consequence, our results could be suspected of selection bias because the studied phenomenon corresponds perfectly to the sample process of each survey. However, the consistency of these results with previous studies supports the robustness of our results.

[10] In addition, the impact of inequality on mortality is valided by the …rst results of a work-in-progress multilevel analysis.

First, the regional level of income inequality is one of the determinants of individual health. Moreover, this result is robust to the indicator of income inequality and to the control for regional characteristics, such as health care supply, and unemployment.

Second, this study is the …rst empirical evidence of a strong association between income and mortality in France. Unlike poverty hypothesis, the link between income and health seems to exist across the whole income distribution. Indeed, our results suggest a strong under-mortality associated with highest income. The issue is not only to understand why "does poverty kill" (Menchik, 1993) but also why does wealth protect.

These both results are consistent with the "relative position hypothesis". First, the protective e¤ect of wealth could be induced by the high social status associated to high income. Second, controlled for income, the feeling of relative deprivation increases with income inequality. These results suggest then to examine social determinants of health in detail.

6 References

Adams P. Hurd M.D., McFadden D., Merrill A., Ribeiro T. [2003], "Healthy, Wealthy, and Wise? Tests for Direct Causal Paths between Health and Socioeconomic Status", Journal of Econometrics, 112, 1: 3-56.

Bocognano A. et al. [1999], "Santé, Soins et Protection Sociale en 1998", rapport CREDES, série Résultats, 1282.

Breuil-Genier P, Grand…ls N, Raynaud D [1999] "Revenus, assurance et santé : le problème de l'accès aux soins des plus démunis", Les cahiers du Gratice,15: 243-76.

Bungener M., Pierret J. [1994], "De l'in‡uence du chômage sur l'état de Santé ?", in Trajectoire sociales et Inégalités, ed Bouchayer F. et Verger D, Recherche sur les conditions de vie, ERES: 43-61.

Campagne N., Contencin D., Roineau C. [1996], "Les Revenus Fiscaux des Ménages en 1990", Insee Résultats, 453, Emploi-Revenus, 103.

Case A., Lubotsky D., Paxson C. [2002], "Economic Status and Health in Childhood: The Origins of the Gradient", The American Economic Review, 92, 5: 1308-34.

Cou¢nhal A., Dourgnon P., Geo¤ard P.Y., Grignon M., Jusot F., Naudin F. [2002], "Rôle de la Couverture Maladie dans l'Insertion sur le Marché du Travail", document de travail CREDES.

Cox D.R. Oakes D. [1984], Analysis of Survival Data, Chapman et Hall.

Deaton A. [2001], "Health, Inequality and Economic Development", NBER WP 8318.

Dourgnon P, Grignon M, Jusot F [2001], "L'assurance maladie réduit-elle les inégalités sociales de santé? Une revue de littérature", Questions en économie de la santé, série synthèse, 43, CREDES.

Erlich I., Chuma H. [1990], "A model of the demand for longevity and the value of the life extension", Journal of Political Economy, 98: 761-782.

Feinstein JS [1993], "The Relationship between Socioeconomic Status and Health: A Review of the Literature", The Milbank Quaterly, 71: 279-322.

Grand…ls N, Le Fur P. [1993], "Les Inactifs pour Raison de Santé", rapport CREDES, n±962.

Gravelle H. [1996], "How much of the relation between population mortality and unequal distribution of income is a statistical artefact", British Medical Journal, 316: 382-385.

Grignon M, Polton D [2000], "Inégalités d'accès et de recours aux soins", in Mesurer les Inégalités, Ministère de l'Emploi et de la Solidarité. Minission Recherhce-DREES.

Grossman M. [1972], "On the concept of health capital and the demand for health", Journal of Political Economy, 80: 223-255.

Haveman R. et al. [1994], "Market work, wages and men's health", Journal of Health Economics, 13, 2: 163-182.

INSEE [1995], "Revenus et Patrimoine des Ménages, édition 1995", Synthèse, 1.

Jougla E et al. [2000], "La mortalité", in Les Inégalités Sociales de Santé, ed. Leclerc A. et al, La Découverte/INSERM.

Kaplan G.A., Pamuk E.R., Lynch J.W., Cohen R.D., Balfour J.L. [1996], "Inequality in income and mortality in the United States: analysis of mortality and potential pathways", British Medical Journal, 312: 999-1003.

Kawachi I. [2000], "Income Inequality and Health", in Social Epidemiology, eds Berkman L.F. et Kawachi I., Oxford University Press.

Kawachi I., Berkman L. [2000], "Social Cohesion, Social Capital, and Health", in Social Epidemiology, eds Berkman L.F. et Kawachi I., Oxford University Press.

Kawachi I., Kennedy B.P [1997 a], "The Relationship of Income Inequality to Mortality: Does the Choice of Indicator Matter ?", Social Science et Medicine, 45, 7: 1121-27.

Kawachi I, Kennedy B.P, Lochner K, Prothrow-Stith D. [1997 b], "Social Capital, Income Inequality, and Mortality", American Journal of Public Health, 87, 9: 1491-98.

Kawachi I., Kennedy B.P, Wilkinson R.G [1999], "Crime: social disorganisation and relative deprivation", Social Science et Medicine, 48: 719-731.

Kawachi I., Subramanian S.V., Almeida-Fiho N.[2002], "A glossary for health inequalities", Journal of Epidemiology and Community Health, 56: 647-652.

Kennedy B.P., Kawachi I., Glass R., Prothrow-Stith D. [1998], "Income distribution, socioeconomic status, and self rated health in the United States: multilevel analysis", British Medical Journal, 317: 917-21.

Kunst A et al. [2000], "Inégalité Sociale de mortalité prématurée : La France comparée aux autres pays européens", in Les Inégalités Sociales de Santé, ed. Leclerc A. et al., La Découverte/INSERM.

Laporte A. [2002], "A note on the use of a single inequality index in testing the e¤ect of income distribution on mortality", Social Science and Medicine, 55, 9: 1561-70.

Lechene V., Magnac T. [1994], "Analyse des déterminants des salaires", dans Trajectoire sociales et Inégalités, ed Bouchayer F. et Verger D, Recherche sur les conditions de vie, ERES: 221-243.

Legrand J.L [1987], "Inequalities in Health. Some International Comparison", European Economic Review, 31: 182-191.

Leibenstein H. [1957], "The Theory of Underemployment in Backward Economies", Journal of Political Economy, 65, 2: 91-103.

Manski CF [1995], "Response-Based Sampling", in Identi…cation Problems in the Social Sciences, Cambridge, Mass : Harvard University Press.

Marmot M. [2000], "Multilevel Approches to Understanding Social Determinants", in Social Epidemiology, eds Berkman L. et Kawachi I., Oxford University Press.

McDonough P. Duncan G.J., Williams D., House J.[1997], "Income Dynamics and Adult Mortality in United States, 1972 throught 1989", American Journal of Public Health, 87, 9: 1476-83.

Mellor J. et Milyo J. [1998], "Income Inequality and Health Status in the United States: Evidence from the Current Population Survey", Tufts University, Economics Department, WP 98-15.

Menchik PL [1993], "Economic Status as Determinant of Mortality Among Black and White Older Men: Does Poverty Kill?", Population Studies, 47, 3: 427-36.

Mesrine A. [1999], "Les di¤érences de mortalité par milieu social restent fortes", La Société Française, Données Sociales: 228-35 .

Mesrine A. [2000], “la surmortalité des chômeurs : un e¤et catalyseur du chômage?”, Economie et Statistiques, 334, 2: 33-48.

Ministère de l’Intérieur [1989], Aspects de la criminalité et de la délinquance constatés en France en 1988 - par les services de police et de gendarmerie, La Documentation Française.

Nauze-Ficher E., Tomasini M. [2002], “Diplôme et Insertion sur le marché du travail : approches socio-profesionnelle et salariale du déclassement”, Economie et Statistiques, 354: 21-43.

Newhouse JP [1994] Free for all? Lessons from the RAND Experiment, Harvard University Press.

Preston S.H. [1975], “The changing relation between mortality and level of economic development”, Population Studies, 29: 231-48.

Putnam R.D [1995], “Bowling alone: America ’s declining social capital”, Journal of Democraty, 6: 65-78.

Saurel-Cubizolles M.J. et al. [2001], “Etat de santé perçu et perte d’emploi”, in Travail-Santé-Viellissement : Relation et Evolution, ed Cassou B., Edition Octarès.

Smith J.P., Kington R. [1997], “Demographic and Economic Correlates of Health in Old age”, Demography, 34, 1: 159-170.

Salem G. Rican S. et Jougla E. [2000], Atlas de la santé en France, vol 1, les causes de décès, John Libbey Eurotext.

Rodgers G.B. [1979], “Income and inequality as determinants of mortality: an international cross-section analysis”, Population Studies, 33: 343-51.

Vallin J., Meslé F., Valkonen T. [2001], Tendances en matière de mortalité et mortalité di¤érentielle, Editions du Conseil de l’Europe.

Wagsta¤ A., van Doorslaer E. [2000], “Income Inequality and Health: What Does the Literature Tell Us?”, Annu. Rev. Public Health, 21: 543-67.

Wilkinson R.G. [1996], Unhealthy Societies: the A- ictions of Inequality, Routledge, London.

Wolfson M., Kaplan G., Lynch J., Ross N., Backlund E. [1999], “Relation between income inequality and mortality: empirical demonstration”, British Medical Journal, 319: 953-957.

7 Tables

	All sample		under 65		65 and older	
Equivalent Income	Deads	Survivors	Deads	Survivors	Deads	Survivors
Decile 1[11]	37 727	37 893	27 321	36 471	41 484	46 514
Decile 2	48 771	51 471	40 913	49 934	52 039	58 129
Decile 3	56 627	62 413	51 167	61 348	59 353	67 993
Decile 4	64 235	72 721	57 250	72 061	67 364	75 775
Median	73 062	83 027	65 216	82 724	76 187	84 727
Decile 6	81 588	94 416	74 998	93 890	83 804	96 437
Decile 7	92 116	109 357	85 500	109 233	94 440	109 891
Decile 8	109 852	129 231	105 242	128 962	111 411	130 367
Decile 9	134 864	166 923	132 104	166 168	137 163	170 721
Decile 10	816 855	1 727 560	612 009	1 727 560	816 855	1 176 817
Mean	83 842	97 198	77 013	96 032	87 017	103 019
Standard deviation	56 186	69 737	52 885	67 888	57 406	78 079
Observations	1438	11961	447	10 282	991	1679

Table 1 : Income distribution by “death status”

[11] Max value of each decile.

	All sample		under 65		65 and older	
Quintiles	Deads	Survivors	Deads	Survivors	Deads	Survivors
1	21.8%	17.5%	27.7%	17.3%	25.9%	17.6%
2	25.9%	17.4%	27.7%	17.6%	21.7%	17.9%
3	21.7%	18.4%	18.3%	18.4%	21.2%	18.7%
4	16.4%	21.0%	13.0%	21.0%	16.6%	21.1%
5	14.2%	25.6%	13.2%	25.8%	14.5%	24.7%
Observations	1438	11961	447	10282	991	1679

Table 2 : distribution of dead people and survivors by income quintile

Regions	Gini index	Theil index	log -income variance	Health Care Supply	Unem-ployment rate	Crimes per 1000
ZEAT[12] Ile-de-France						
Ile-de-France	0.307	0.179	16.197	404.05	8.4	78.38
ZEAT Bassin-Parisien						
Champagne	0.311	0.238	14.972	218.53	10.8	43.34
Picardie	0.269	0.129	14.665	205.18	10.9	46.88
Haute-Normandie	0.280	0.147	14.558	220.32	12.1	53.18
Centre	0.268	0.125	14.164	224.62	8.8	42.45
Basse-Normandie	0.271	0.138	14.046	218.86	10	43.84
Bourgogne	0.266	0.128	13.466	227.1	9.5	40.55
ZEAT Nord						
Nord-Pas-de-Calais	0.271	0.146	15.474	232.88	13.5	56.77
ZEAT Est						
Lorraine	0.270	0.144	15.220	242.87	10.2	39.01
Alsace	0.287	0.194	15.024	295.04	6.8	49.98
Franche-Comté	0.258	0.123	12.931	237.71	9.4	39.29
ZEAT Ouest						
Pays-de-Loire	0.258	0.118	13.324	226.46	10.7	35.45
Bretagne	0.270	0.144	14.158	242.46	10.1	34.23
Poitou-Charentes	0.297	0.173	14.218	237.44	10.9	38.4
ZEAT Sud-Ouest						
Aquitaine	0.277	0.136	14.165	304.75	10.9	50.16
Midi-Pyrénées	0.289	0.147	14.410	315.27	9.5	45.93
Limousin	0.276	0.134	14.033	260.94	8.2	29.96
ZEAT Centre-Est						
Rhônes-Alpes	0.274	0.137	13.785	260.4	8.2	57.24
Auvergne	0.304	0.228	14.377	247.9	9.9	33.21
ZEAT Méditerranée						
Languedoc-Roussillon	0.291	0.160	14.411	341.89	13.6	75.57
Provence-Alpes-Côte-d'Azur	0.296	0.168	15.418	384.67	11.8	90.63
France métropolitaine	0.293	0.165	15.083	291.88	10	56.19

Table 3: Regional Characteristics

[12]ZEAT : Zone d'Equipement et Aménagement du Territoire

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	All
Executive	100 (3.3%)	115 (3.8%)	239 (7.9%)	657 (21.8%)	1897 (63.1%)	3008 (100%)
Intermediate	304 (9.1%)	484 (14.5%)	675 (20.3%)	959 (28.8%)	908 (27.3%)	3330 (100%)
Non Manuals	336 (17.0%)	465 (23.5%)	485 (24.5%)	448 (22.6%)	247 (12.5%)	1981 (100%)
Manuals	1671 (32.9%)	1395 (27.5%)	1117 (22.0%)	683 (13.4%)	214 (4.2%)	5080 (100%)
All	2411	2459	2516	2747	3266	13399

Table 4: Income distribution across occupational class

All sample	model 1			model 2		
Exploratory Variables	Coe¤[13]	O. R. [14]	C.I. 95%[15]	Coe¤	O. R.	C.I. 95%
Log Income				-0.366***	0.693	(0.620 - 0.775)
Manuals	1.035***	2.814	(2.177 - 3.637)	0.719***	2.053	(1.561 - 2.700)
Non Manuals	1.069***	2.911	(2.208 - 3.838)	0.858***	2.358	(1.775 - 3.133)
Intermediate	0.776***	2.173	(1.641 - 2.878)	0.631***	1.88	(1.414 - 2.500)
Executives	ref	1		ref	1	
under 40	0.046**	1.047	(1.008 - 1.087)	0.045**	1.046	(1.007 - 1.087)
40-54	0.112***	1.119	(1.091 - 1.147)	0.115***	1.122	(1.095 - 1.151)
55-64	0.076***	1.079	(1.050 - 1.109)	0.079***	1.082	(1.053 - 1.113)
65-75	0.057***	1.059	(1.031 - 1.087)	0.057***	1.059	(1.031 - 1.087)
75-85	0.123***	1.13	(1.094 - 1.168)	0.118***	1.125	(1.089 - 1.162)
85 and over	0.074**	1.077	(1.003 - 1.156)	0.076**	1.079	(1.004 - 1.159)
Married	ref	1		ref	1	
Single	0.483***	1.62	(1.288 - 2.038)	0.417***	1.517	(1.204 - 1.911)
Widowed	0.702***	2.018	(1.636 - 2.491)	0.709***	2.032	(1.645 - 2.509)
Divorced	0.402***	1.495	(1.120 - 1.996)	0.349**	1.418	(1.060 - 1.897)
Ile-de-France	-0.056	0.945	(0.766 - 1.167)	0.008	1.009	(0.815 - 1.247)
Bassin-Parisien	ref	1		ref	1	
Nord	0.299**	1.349	(1.040 - 1.749)	0.267**	1.306	(1.008 - 1.693)
Est	0.148	1.16	(0.914 - 1.471)	0.138	1.148	(0.905 - 1.457)
Ouest	0.121	1.129	(0.903 - 1.410)	0.105	1.11	(0.888 - 1.388)
Sud-Ouest	-0.203	0.816	(0.635 - 1.050)	-0.243*	0.784	(0.608 - 1.010)
Centre-Est	-0.012	0.988	(0.782 - 1.249)	-0.009	0.991	(0.783 - 1.253)
Méditerranée	-0.137	0.872	(0.689 - 1.104)	-0.171	0.843	(0.665 - 1.068)
Intercept	-5.009	.		-0.696	.	
Number of deaths	1438			1438		
Number of survivors	11961			11961		
-2 Log L (intercept only)	9134.858			9134.858		
-2 Log L	6635.167			6596.246		

Table 5: The impact of log-income on the probability of dying in 1988 (LOGIT)
(men aged 21 and over)

[13] Signi…cance level : * 10%, ** 5%, *** 1%.
[14] Odds Ratio
[15] 95 % con…dence Interval for conditional odds ratio.

All sample	model 3			model 4		
Exploratory Variable	Coe¤	O. R.	C.I. 95%	Coe¤	O. R.	C.I. 95%
Log Income	-0.347***	0.707	(0.632 - 0.792)			
Income				-0.007***	0.993	(0.991 - 0.995)
Income^2				5 E-6***	1	(1.000 - 1.000)
Pension (under 60)	0.011***	1.011	(1.007 - 1.015)	0.011***	1.011	(1.007 - 1.015)
Manuals	0.726***	2.067	(1.570 - 2.720)			
Non Manuals	0.829***	2.29	(1.723 - 3.045)			
Intermediate	0.641***	1.899	(1.427 - 2.527)			
Executives	ref	1				
under 40	0.048**	1.049	(1.010 - 1.089)	0.047**	1.048	(1.009 - 1.088)
40-54	0.099***	1.104	(1.076 - 1.133)	0.102***	1.107	(1.079 - 1.136)
55-64	0.103***	1.108	(1.076 - 1.141)	0.101***	1.106	(1.074 - 1.139)
65-75	0.056***	1.058	(1.030 - 1.086)	0.058***	1.059	(1.032 - 1.088)
75-85	0.118***	1.125	(1.089 - 1.162)	0.114***	1.12	(1.085 - 1.158)
85 and over	0.076**	1.079	(1.005 - 1.159)	0.079**	1.083	(1.008 - 1.163)
Married	ref	1		ref	1	
Single	0.395***	1.485	(1.178 - 1.871)	0.409***	1.506	(1.195 - 1.897)
Widowed	0.701***	2.017	(1.633 - 2.490)	0.721***	2.056	(1.666 - 2.537)
Divorced	0.320**	1.377	(1.028 - 1.843)	0.328**	1.388	(1.038 - 1.856)
Ile-de-France	0.021	1.021	(0.825 - 1.264)	0.023	1.023	(0.827 - 1.265)
Bassin-Parisien	ref	1		ref	1	
Nord	0.242*	1.274	(0.982 - 1.653)	0.235*	1.265	(0.976 - 1.640)
Est	0.131	1.14	(0.898 - 1.448)	0.120	1.128	(0.889 - 1.432)
Ouest	0.091	1.095	(0.875 - 1.369)	0.084	1.087	(0.870 - 1.359)
Sud-Ouest	-0.250*	0.779	(0.605 - 1.004)	-0.247*	0.781	(0.607 - 1.006)
Centre-Est	0.009	1.009	(0.797 - 1.277)	0.003	1.003	(0.793 - 1.270)
Méditerranée	-0.182	0.834	(0.658 - 1.057)	-0.196	0.822	(0.649 - 1.041)
Intercept	-0.889	.		-3.567	.	
Number of deaths	1438			1438		
Number of survivors	11961			11961		
-2 Log L (intercept only)	9134.858			9134.858		
-2 Log L	6565.691			6593.607		

Table 6: The dual relationship between income and health

All sample	model 5			model 5 bis		
Exploratory Variables	Coe¤	O. R.	C.I. 95%	Coe¤	O. R.	C.I. 95%
Log Income						
Income	-0.012***	0.988	(0.985 - 0.992)	-0.011***	0.989	(0.985 - 0.993)
$Income^2$	2 E-5***	1	(1.000 - 1.000)	3 E-5***	1	(1.000 - 1.000)
$Income^3$	-2 E-8**	1	(1.000 - 1.000)	-2 E-8**	1	(1.000 - 1.000)
Pension (under 60)	0.011***	1.011	(1.007 - 1.014)	0.011***	1.011	(1.007 - 1.014)
Manuals				0.660***	1.935	(1.442 - 2.596)
Non Manuals				0.793***	2.21	(1.636 - 2.987)
Intermediate				0.636***	1.889	(1.402 - 2.546)
Executives						
under 40	0.047**	1.048	(1.009 - 1.089)	0.049**	1.05	(1.011 - 1.091)
40-54	0.102***	1.107	(1.079 - 1.136)	0.100***	1.105	(1.077 - 1.134)
55-64	0.102***	1.107	(1.075 - 1.140)	0.101***	1.106	(1.074 - 1.140)
65-75	0.057***	1.059	(1.031 - 1.087)	0.056***	1.057	(1.030 - 1.085)
75-85	0.114***	1.12	(1.084 - 1.158)	0.117***	1.125	(1.088 - 1.162)
85 and over	0.077**	1.08	(1.005 - 1.160)	0.075**	1.078	(1.004 - 1.158)
Married	ref	1				
Single	0.396***	1.485	(1.178 - 1.872)	0.388***	1.474	(1.169 - 1.857)
Widowed	0.726***	2.067	(1.675 - 2.551)	0.709***	2.031	(1.644 - 2.509)
Divorced	0.322**	1.38	(1.031 - 1.845)	0.314**	1.37	(1.023 - 1.834)
Ile-de-France	0.021	1.021	(0.825 - 1.264)	0.036	1.037	(0.837 - 1.284)
Bassin-Parisien	ref	1				
Nord	0.231*	1.26	(0.972 - 1.634)	0.237*	1.267	(0.977 - 1.644)
Est	0.123	1.131	(0.891 - 1.436)	0.129	1.138	(0.896 - 1.445)
Ouest	0.083	1.087	(0.869 - 1.359)	0.086	1.09	(0.872 - 1.363)
Sud-Ouest	-0.253*	0.777	(0.603 - 1.000)	-0.253*	0.777	(0.602 - 1.001)
Centre-Est	0.004	1.004	(0.793 - 1.271)	0.009	1.009	(0.796 - 1.277)
Méditerranée	-0.201*	0.818	(0.646 - 1.037)	-0.188	0.829	(0.653 - 1.052)
Intercept	-3.357	.		-4.032		
Number of deaths	1438			1438		
Number of survivors	11961			11961		
-2 Log L (intercept only)	9134.858			9134.858		
-2 Log L	6584.444			6555.328		

Table 7 : Test of the Concavity Assumption

All sample	model 6			model 6 bis		
Exploratory Variables	Coe¤	O. R.	C.I. 95%	Coe¤	O. R.	C.I. 95%
Quintile 1	0.916***	2.499	(1.995 - 3.130)	0.688***	1.989	(1.542 - 2.566)
Quintile 2	0.793***	2.211	(1.778 - 2.749)	0.557***	1.745	(1.368 - 2.226)
Quintile 3	0.622***	1.862	(1.495 - 2.319)	0.394***	1.482	(1.166 - 1.884)
Quintile 4	0.358***	1.431	(1.139 - 1.798)	0.175	1.191	(0.938 - 1.513)
Quintile 5	ref	1		ref	1	
Pension (under 60)	0.011***	1.011	(1.007 - 1.015)	0.011***	1.011	(1.007 - 1.014)
Manuals				0.670***	1.955	(1.466 - 2.607)
Non Manuals				0.797***	2.219	(1.651 - 2.981)
Intermediate				0.642***	1.901	(1.421 - 2.542)
Executives				ref		
under 40	0.049**	1.05	(1.011 - 1.091)	0.050***	1.052	(1.012 - 1.092)
40-54	0.101***	1.106	(1.078 - 1.134)	0.099***	1.103	(1.075 - 1.132)
55-64	0.101***	1.106	(1.074 - 1.139)	0.101***	1.106	(1.073 - 1.139)
65-75	0.057***	1.058	(1.031 - 1.087)	0.055***	1.057	(1.029 - 1.085)
75-85	0.115***	1.122	(1.086 - 1.160)	0.118***	1.126	(1.089 - 1.163)
85 and over	0.074**	1.077	(1.003 - 1.156)	0.074**	1.077	(1.003 - 1.157)
Married	ref	1		ref	1	
Single	0.420***	1.522	(1.209 - 1.918)	0.405***	1.499	(1.190 - 1.889)
Widowed	0.728***	2.071	(1.678 - 2.556)	0.710***	2.033	(1.646 - 2.512)
Divorced	0.335**	1.398	(1.046 - 1.869)	0.326**	1.386	(1.035 - 1.855)
Ile-de-France	0.016	1.016	(0.821 - 1.257)	0.039	1.039	(0.839 - 1.288)
Bassin-Parisien	ref	1		ref	1	
Nord	0.229*	1.258	(0.969 - 1.631)	0.237*	1.267	(0.977 - 1.645)
Est	0.119	1.127	(0.887 - 1.430)	0.129	1.138	(0.896 - 1.445)
Ouest	0.080	1.083	(0.867 - 1.355)	0.084	1.088	(0.870 - 1.361)
Sud-Ouest	-0.250*	0.779	(0.605 - 1.003)	-0.249*	0.78	(0.605 - 1.005)
Centre-Est	-0.004	0.996	(0.787 - 1.262)	0.006	1.006	(0.794 - 1.274)
Méditerranée	-0.193	0.824	(0.651 - 1.044)	-0.182	0.834	(0.657 - 1.058)
Intercept	-4.702	.		-5.119	.	
Number of deaths	1438			1438		
Number of survivors	11961			11961		
-2 Log L (intercept only)	9134.858			9134.858		
-2 Log L	6592.141			6561.539		

Table 8 : Income Distribution and Mortality risk

All sample	model 7			model 8		
Exploratory Variables	Coe¤	O. R.	C.I. 95%	Coe¤	O. R.	C.I. 95%
Region						
Gini	0.551*	1.735	(0.961 - 3.132)			
Theil				0.306**	1.358	(1.058 - 1.743)
Var Log						
Criminality						
Health Care Supply	-0.002**	0.998	(0.997 - 1.000)	-0.001**	0.999	(0.998 - 1.000)
Unemployment	-0.003	0.997	(0.961 - 1.035)	-0.003	0.997	(0.961 - 1.035)
Individuals						
Quintile 1	0.656***	1.927	(1.497 - 2.480)	0.653***	1.921	(1.493 - 2.473)
Quintile 2	0.543***	1.721	(1.353 - 2.190)	0.537***	1.712	(1.345 - 2.178)
Quintile 3	0.380***	1.462	(1.152 - 1.854)	0.372***	1.451	(1.143 - 1.841)
Quintile 4	0.167	1.182	(0.931 - 1.499)	0.162	1.176	(0.927 - 1.492)
Quintile 5	ref	1		ref	1	
Pension (under 60)	0.011***	1.011	(1.007 - 1.015)	0.011***	1.011	(1.007 - 1.015)
Manuals	0.677***	1.969	(1.476 - 2.626)	0.681***	1.976	(1.481 - 2.637)
Non Manuals	0.789***	2.202	(1.639 - 2.958)	0.793***	2.21	(1.645 - 2.970)
Intermediate	0.644***	1.903	(1.423 - 2.545)	0.649***	1.913	(1.430 - 2.559)
Executives	ref	1		ref	1	
under 40	0.050**	1.051	(1.012 - 1.092)	0.050***	1.051	(1.012 - 1.092)
40-54	0.098***	1.103	(1.075 - 1.132)	0.098***	1.103	(1.075 - 1.132)
55-64	0.099***	1.104	(1.072 - 1.137)	0.100***	1.105	(1.073 - 1.138)
65-75	0.053***	1.055	(1.027 - 1.083)	0.053***	1.054	(1.027 - 1.083)
75-85	0.119***	1.127	(1.090 - 1.164)	0.120***	1.127	(1.091 - 1.164)
85 and over	0.071*	1.073	(0.999 - 1.152)	0.070*	1.072	(0.998 - 1.151)
Married	ref	1		ref	1	
Single	0.410***	1.507	(1.196 - 1.899)	0.411***	1.508	(1.197 - 1.900)
Widowed	0.726***	2.066	(1.674 - 2.551)	0.728***	2.072	(1.678 - 2.558)
Divorced	0.322**	1.38	(1.031 - 1.846)	0.326**	1.385	(1.036 - 1.854)
Intercept	-6.151	.		-5.198	.	
Number of deaths	1438			1438		
Number of survivors	11961			11961		
-2 Log L (intercept only)	9134.858			9134.858		
-2 Log L	6572.428			6570.071		

Table 9 : The impact of income inequality on the mortality risk

All sample	model 9			model 10		
Exploratory Variables	Coe¤	O. R.	C.I. 95%	Coe¤	O. R.	C.I. 95%
Region						
Gini						
Theil						
Var Log	0.017***	1.017	(1.007 - 1.027)			
Criminality				9 E-5	1	(0.992 - 1.008)
Health Care Supply	-0.002***	0.998	(0.996 - 0.999)	-0.001	0.999	(0.997 - 1.001)
Unemployment	-0.018	0.982	(0.945 - 1.020)	-0.003	0.997	(0.954 - 1.041)
Individuals						
Quintile 1	0.683***	1.979	(1.536 - 2.550)	0.652***	1.918	(1.490 - 2.470)
Quintile 2	0.556***	1.744	(1.370 - 2.221)	0.536***	1.708	(1.342 - 2.174)
Quintile 3	0.392***	1.48	(1.166 - 1.879)	0.381***	1.463	(1.153 - 1.856)
Quintile 4	0.179	1.196	(0.943 - 1.518)	0.163	1.177	(0.928 - 1.494)
Quintile 5	ref	1		ref	1	
Pension (under 60)	0.011***	1.011	(1.007 - 1.015)	0.011***	1.011	(1.007 - 1.015)
Manuals	0.675***	1.963	(1.472 - 2.618)	0.672***	1.958	(1.468 - 2.610)
Non Manuals	0.794***	2.211	(1.646 - 2.971)	0.785***	2.192	(1.632 - 2.943)
Intermediate	0.645***	1.907	(1.426 - 2.550)	0.636***	1.888	(1.412 - 2.524)
Executives	ref	1		ref	1	
under 40	0.050***	1.051	(1.012 - 1.092)	0.050**	1.051	(1.012 - 1.091)
40-54	0.098***	1.103	(1.075 - 1.132)	0.098***	1.103	(1.075 - 1.132)
55-64	0.100***	1.105	(1.073 - 1.139)	0.099***	1.104	(1.072 - 1.137)
65-75	0.055***	1.057	(1.029 - 1.085)	0.054***	1.055	(1.027 - 1.083)
75-85	0.118***	1.125	(1.089 - 1.162)	0.120***	1.127	(1.091 - 1.165)
85 and over	0.075**	1.078	(1.003 - 1.158)	0.070*	1.073	(0.999 - 1.152)
Married	ref	1		ref	1	
Single	0.406***	1.5	(1.191 - 1.890)	0.408***	1.504	(1.193 - 1.895)
Widowed	0.712***	2.039	(1.651 - 2.518)	0.722***	2.058	(1.667 - 2.540)
Divorced	0.322**	1.379	(1.030 - 1.846)	0.323**	1.382	(1.033 - 1.849)
Intercept	-6.783	.		-4.855	.	
Number of deaths	1438			1438		
Number of survivors	11961			11961		
-2 Log L (intercept only)	9134.858			9134.858		
-2 Log L	6564.26			6575.714		

Table 10 : The impact of income inequality on the mortality risk