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Unemployment and Mortality in France, 1982-2002

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Abstract

This study uses aggregate panel data on 96 French *départements* for the period from 1982 to 2002 to investigate the relationship between macroeconomic conditions and mortality, controlling for local area and time fixed effects. Consistent with research using data from other countries, we find that increases in the local unemployment rates are associated with significant reductions in mortality. Models of mortality by source indicate that the negative relationship between unemployment and mortality is strongest for deaths due to cardiovascular disease and accidents. A finding that mortality among the elderly fluctuates with the unemployment rate suggests the possible importance of externalities associated with economic upturns.

1. Introduction

There is considerable interest among social science researchers and policy makers in the relationship between macroeconomic fluctuations and population health.[1] Research in this area goes back to Brenner's seminal work on admissions to mental hospitals in New York State (Brenner, 1973a). That and other studies based on time series data for one geographical unit found a negative relationship between unemployment (used as the main indicator of the business cycle) and health: Economic downturns were found to lead to deterioration in various health indicators, such as higher rates of admission in psychiatric hospitals (Brenner, 1973a, Marshall and Funch, 1979), higher cardiovascular mortality (Bunn, 1979, Brenner and Mooney, 1982), higher infant mortality (Brenner, 1973b) and higher overall mortality (Brenner, 1979). Important exceptions among this early literature are two studies by Eyer (1977a, 1977b) that found that mortality increases during good economic times.

The basic conceptual model used to explain these patterns derives from social epidemiology and, building on the concept of anomy (Durkheim, 1930), posits that the disruption of social expectations or anticipation generates stress and is therefore detrimental for health, either directly or through an increased prevalence of health damaging behaviors such as drinking or smoking.

While widely cited, these early studies have been criticized on methodological grounds (Gravelle et al. (1981), Wagstaff (1985), Laporte (2004), and Ruhm (2005)). More recent research using an alternative research design comes to quite different conclusions. Ruhm (2000) applies panel data techniques to aggregate data on US states to estimate the effect of unemployment on mortality. He finds strong evidence that mortality *declines* during economic downturns. This result holds for overall mortality as well as for specific causes of death, such as heart disease, accidents (vehicles and

[1] See Ruhm (2006b) for a comprehensive review.

others), homicides, and, to a lesser extent, pneumonia and infant mortality. Suicide is the one cause of death found to vary counter-cyclically.

Additional research by Ruhm and others points to several causal pathways that may explain this result. Increases in economic activity may have direct effects on the health of workers. Longer working hours may result in an increase in workplace accidents and injuries as well as increased stress (Caruso et al. 2004; Yang et al. 2006). Studies based on the European survey on working conditions show that controlling for type of employment, full time workers report worse health outcomes than part time workers (Benach et al, 2004; Benavides et al, 2000).

Economic upturns may have indirect negative effects on worker health through an effect on lifestyle. Such effects may come from a reduction in leisure time or from a positive income effect on the consumption of unhealthy goods, such as tobacco or alcohol. Using individual-level data, Ruhm (2000, 2005) finds that economic downturns are associated with more exercise, healthier diets, and reductions in smoking and obesity[2]. Other studies find that heavy alcohol consumption and deaths due to drunk driving vary pro-cyclically (Evans and Graham 1988; Wagenaar and Streff 1989; Ruhm 1995; Dee 2001; Ruhm and Black 2002; Dehejia and Lleras-Muney 2004). However, research using regional data from Finland finds that body mass index and alcohol-related mortality fall when the economy improves (Böckerman et al 2006, Johansson et al. 2006).

Non-workers may also be affected by fluctuations in economic activity. For example, the increase in pollution associated with higher levels of industrial production has been shown to lead to higher rates of infant mortality (Chay and Greenstone 2003) and premature mortality of adults (Or 2000). Economic expansions also generate

[2] Simple cross-tabulations from France show that employed individuals sleep and exercise less than the unemployed (Dumontier and Pan Khé Shon 1999).

greater traffic congestion. Several studies find a negative relationship between the unemployment rate and motor vehicle fatalities (Wagenaar 1984; Page 2001; Cohen and Dehejia 2004; Grabowski and Morrissey 2004, 2006).

Migration among regions represents another possible mechanism influencing the relationship between unemployment and measured mortality in an area. However, as Ruhm (2000) points out, if individuals who migrate to areas in response to strong economic conditions are healthier than average, as is likely to be the case, migration will contribute to a positive correlation between unemployment and mortality.

Most of these studies on potential causal pathways are based on data from the US. Because US business cycles and labor market institutions are different from those in other industrialized countries, the question of whether these results are relevant for other countries is an important topic for research. On one hand, we might expect business cycles to have less of an impact on health in European countries because they have more rigid labor markets than the US, including stricter regulations on work hours and stronger job protection and workplace safety laws: as a result, we should expect a lower impact of economic fluctuations on workers' mortality in France. However, other differences between the US and Europe may work in the opposite direction. Because of the way health insurance is tied to employment in the US, insurance coverage falls when unemployment increases (Cawley and Simon 2003; Glied and Jack 2003) making downturns potentially more detrimental to health in the US and attenuating the pro-cyclical nature of mortality in that country. In contrast, since all European countries have universal health care systems, changes in macroeconomic conditions should not affect access to medical care. In addition, there is much less mobility (in general and in response to economic conditions) within European countries as compared to the US. Thus, whether and how the relationship between macroeconomic conditions and mortality is different in Europe relative to the US is an empirical question and comparing jurisdictions with different institutional settings might help testing for the various causal pathways between economic fluctuations and health suggested in Ruhm (2000).

McAvinchey (1988) demonstrates that the time series relationship between unemployment and mortality varies substantially across countries. Two recent studies apply the same aggregate panel data models as Ruhm to data from Germany (Neumayer 2004) and Spain (Tapia-Granados 2005) and obtain results that are generally consistent with the findings from the US. However, another study using regional data from Sweden (Svensson 2007) finds no relationship between unemployment and mortality. Gerdtham and Ruhm (2006) analyze country level panel data from the OECD and find a negative relationship between unemployment and mortality. To test whether business cycle affects are mitigated by institutional factors, they stratify the countries in their sample into three groups according to average share of GDP devoted to public social expenditures. While they find a significant negative effect of unemployment on mortality for all three groups, the effect is weakest for countries with the higher social expenditure share and strongest in the group with the lowest share (this is not in their 2006 working paper, but is referred to in Ruhm, 2006b). To further test this hypothesis we re-run their model (based on a slightly different dataset, details available upon request) with a stratification based on the degree of labor market regulation: we use the results in Nickell (1997) and Chor and Freeman (2006) to group the 23 OECD countries studied by Gerdtham and Ruhm into three clusters according to their degree of labor market regulation. More specifically, we use the ranking on employment protection and the score on labor standards in Chor and Freeman, as well as the score on employment regulation in Nickell 1997. Seven countries (Austria, Belgium, France, Germany, Italy, Norway, Portugal, Sweden) ranked consistently as “strongly regulated” on the three dimensions (top 10 countries for the ranking, score higher than 3 on a scale from 0 to 7 for labor standards, and score higher than 3.5 on a scale from 1 to 7 in

Nickell) and are labeled “highly regulated”. Spain and Portugal scored in the ‘regulated’ group on the two dimensions in Chor and Freeman, but are not included in Nickell; as a result, we clustered these countries in the “highly regulated” category. Finland and the Netherlands are uncertain according to the Chor and Freeman study (one indicator in the highly regulated group and one in the low regulation one), but are considered highly regulated in Nickell; we have decided to cluster these two countries in our high regulation category, which, as a result, is comprised of 11 countries.

Seven countries, Australia, Canada, Japan, New Zealand, Switzerland, the United Kingdom, and the United States never score high on the regulation variables and are clearly in the low regulation category.

Denmark scores high on Nickell but low on both indicators in Chor and Freeman, and Ireland scores low on Nickell and high on both indicators in Chor and Freeman. We have grouped these two countries in the ‘uncertain’ category, together with three countries not appearing in the two studies (Czech Republic, Luxembourg, and Poland).

Running the same analysis as Gertdham and Ruhm on the 23 countries, with income, a series of year dummies, and the proportion of the population over 65 as controls, we find a negative association between the unemployment rate and mortality, with a coefficient of -0.0057 (they find -0.0067). Re-running on the group of highly regulated countries only (315 observations), the coefficient is not significant at the 10% level (point estimate -0.0044, 95% confidence interval of -0.0105; +0.00164). Adding the uncertain group to these countries (374 observations) brings the point estimate to -0.00594, significant at the 5% level (confidence interval: -0.0119; 0). These coefficients are clearly smaller in magnitude than what is estimated on the group of seven countries with a low level of regulation (236 observations): point estimate of -0.140, even though confidence intervals overlap. This confirms the stratified analysis run by Gerdtham and

Ruhm and suggests a potential role for institutions in the relationship between economic cycles and health.

We extend this literature by investigating the relationship between local area unemployment rates and mortality in France. We see four reasons why an analysis of the relationship between economic cycles and mortality in France offers insights: first, the collection of country case studies already at hand (the US, Germany, Spain, and Sweden) demonstrates that the strength and significance of the relationship vary across country. Adding any country would therefore be of interest. However, our analysis is of special interest due to the nature of the country we study: France has a much stronger set of regulations of the labor market (regarding employment protection and working conditions) than three of the other countries (US, Germany, and Spain), and is only comparable to Sweden in that respect (Nickell 1997; Chor and Freeman 2005). However, it is bigger than Sweden (60 million inhabitants versus 9) and the French economy is more diversified than the Swedish one. France also undertook a major reform of its labor market regulation in 1987 (more market oriented), and we can split our study period into two sub-periods, testing if the pro-cyclical nature of mortality increased after the reform. A third reason why France is an interesting case is that unemployment was considerably higher in France than in the US, Germany or Sweden (though lower than in Spain) during the whole study period (1982-2002). Long term (more than a year) unemployment represented almost half of total unemployment in France versus a third in Germany and less than 10% in the US and Sweden (Nickell, 1997). Therefore, it is also possible that the case of France could be one of pathological unemployment, where downturns could bring more anomy, offsetting the positive effect of shorter hours on health.[3]

[3] The relationship between the unemployment rate and health outcomes may be different in time of extreme economic crisis. Analyzing time series data from the former soviet Republics, McKee and Suhrcke, (2005) find that

Last, the type of data collected in France (at the level of the department) allowed us studying the relationship at a much smaller level of geographical aggregation than all other prior studies. We are also able to test the effect on the relationship between mortality and economic cycles of measuring it at various levels of aggregation (the 96 *départements*, or the 22 *régions*).

Overall, we find a statistically significant negative relationship between the unemployment rate and mortality in a local area. Our point estimates of the effect of the unemployment rate on total mortality are squarely within the range of estimates from Germany, Spain and the US. Moreover, results are robust to changes in the level of geographical aggregation. Like prior studies, we find strong effects on mortality from cardio-vascular disease and accidents. Interestingly, the negative effect of the local unemployment rate is not confined to working age adults, but is observed for the elderly as well. The next section describes our data and outlines our econometric specification. Results are presented in Section 3 and concluding remarks are in the fourth and final section.

2. Data and Methods

2.1 Data Sources

The geographic unit for our analysis is the *département*, the fundamental administrative and political jurisdiction in France. Created in 1790, France's *départements* are governed by an elected assembly (*conseil général*), with responsibility for secondary education, local transportation networks, social assistance and health care.[4] Importantly for our study, the national unemployment program is administered by *départements*.

decreases in GDP per capita are associated with increases in mortality. Similarly, Cutler et al. (2002) find that recent economic crises in Mexico led to increases in mortality and Brainerd (2001) finds that downturns are associated with increases in suicide in the former Soviet Union.

[4] To put this in rough perspective relative to the US, *départements* are more important as units of government than US counties, but less important than US states.

Individuals who enroll must do so at the local branch of the *département* where they live. As a result, the total number of enrolled individuals searching for a job (through the state employment service) in every *département* is known for each quarter.[5]

There are currently 96 *départements* in 'metropolitan France.'[6] With an average land area of 5,666 square kilometers and an average 2003 population of 525,000, *départements* that are much smaller than US states or German *Länder* (Neumayer 2004) and slightly smaller than Spanish provinces (Tapia-Granados 2005).[7] One advantage of a more localized analysis is that there is less within-unit heterogeneity in economic conditions and other factors affecting health. The main drawback is a lack of precision in the measurement of cause-specific or age-specific death rates.

It is also possible that mortality rates measured at a small local area are affected by migration—e.g. older individuals may go back to rural, isolated areas where they originated from a few months to a few years before dying.[8] The evidence from French census and vital statistics data suggest that two regions—Ile de France and Alsace—"lose" approximately 3% of their annual deaths. For other areas, however, this does not appear to be an issue (Baccaïni 2001). Even to the extent that this type of migration occurs, there is little reason to expect it to be correlated with short-term changes in local unemployment rates, since it likely concerns retired individuals.

Our analysis is based on data for the 21 year period from 1982 to 2002. Population-weighted summary statistics are presented in Table 1. Total gross mortality

[5] For details on how unemployment statistics are calculated in France, see Hachid and Vallon (2005).

[6] Since 1790, there have been few changes in *département* boundaries. The last change was in 1982 (the first year of our data) when the island of Corsica was divided into two *départements*. Today, France is composed of continental France (94 *départements*), Corsica (2 *départements*), and overseas (4 *départements* and several territories). In this study, we use the 96 ones belonging to continental France and Corsica, sometimes referred to as metropolitan France (*France métropolitaine*). We exclude from our analysis overseas *départements* located in the Caribbean (Martinique and Guadeloupe), South America (Guyane) and the Indian Ocean (la Réunion).

[7] In terms of land area, departments range in size from 100 square kilometers (Paris) to 10,000 square kilometers (Gironde). The range in population is from 75,000 (Lozère) to 2,574,000 (Nord). As another point of comparison, the 50 Spanish provinces analyzed by Tapia-Granados (2005) range in population from 100,000 to 5 million.

[8] Because population mobility is lower in France than in the U.S., inter-*département* mobility in France is similar to inter-State mobility in the US, with a yearly ratio around 1.5% (for France, Baccaïni, 2001; for the US, Schachter, Franklin and Perry, 2003).

(i.e. not age-adjusted) is somewhat higher than in Ruhm's (2000) sample of US states (934 per 100,000 versus 880 per 100,000) due to an older population: 14.5% of the population in the average French *département* is 65 or older compared to 11.5% in the average US state. Within each of the three age categories reported, the mortality rate is lower in the average French *département* than in US states. National data for France show a gradual, but steady decline in mortality rates, from roughly 1000 per 100,000 in 1982 to 907 in 2002 (Figure 1).

In addition to analyzing the effect of unemployment on total mortality, we estimate regression models of mortality by cause and by age group. The disaggregation by cause of death is based on ICD-9 codes, following as closely as possible the breakdowns used in previous studies (Ruhm 2000; Neumayer 2004; Gerdtham and Ruhm 2006). As in other OECD countries (Gerdtham and Ruhm 2006), cardiovascular disease is the most important cause of death. France stands out from other countries for having a high suicide rate.[9] In our data, the mean *département* level rate for the whole period is 20.1 suicides per 100,000.

Data on unemployment were collected from INSEE *Département de l'Action Régionale*. We calculate annual rates by taking a straight average of four quarterly rates for each year. During this period, the national unemployment rate ranged from roughly 8% to just over 12% (Figure 1). There was more cross-sectional variation among *départements*. In 1982, the local unemployment rate ranged from 4.5% to 11.7%; in 2002 the range was between 5.2% and 14.9%.

To give a fuller sense of how unemployment and mortality varies over this period and to foreshadow the econometric analysis, Figure 2 plots de-trended values of both variables normalized by their respective standard deviations. The graph suggests a

[9] In 2001, the suicide rate in France was 26.6 per 100,000 for males and 9.1 for females, versus 17.6 and 4.1 in the US, and 10.8 and 3.1 in the UK. For more details, see http://www.who.int/mental_health/prevention/suicide_rates/en/. This higher suicide rate in France was already reported in Durkheim for the 1880-90s.

negative relationship between the unemployment rate and mortality. At both the start and the end of the two decade period, unemployment is relatively low and mortality is relatively high. In the early to mid-1990s, the reverse is true. The years with the lowest relative unemployment rates (1982-83 and 2000-02) coincide with higher than average relative mortality rates. The five year period with the highest national unemployment rate was 1993 to 1998. In four of these five years, the mortality rate was below trend.

2.2. Econometric Specification

Our regression model specifies measures of mortality as a function of the unemployment rate, average income and fixed area and year effects:

(1) $$LnM_{i,t} = \alpha + \beta UR_{i,t} + \gamma\, INCOME_{i,t} + \delta_i + \theta_t + \varepsilon_{i,t}.$$

In our main specification, the dependent variable is the natural log of the (unstandardized) mortality rate in *département i* in year *t*. We also report models where the dependent variable is the number of deaths per 100,000 persons.[10] The unemployment rate (*UR*) and the average income in the department (*INCOME*) are also measured annually at the level of the *département*. The model includes *département* fixed effects ($_i$) that account for longstanding differences across geographic areas. Indicator variables for each year ($_t$) account in a flexible way for national trends in mortality. Some specifications (not reported here) also include the proportion of individuals aged 65 and older in the *département i* in year *t*, to take into account different trends in the age distribution across areas. These variables never reach any significance threshold and their inclusion does not affect the other coefficients.

In some specifications, we include the national unemployment rate, which allows capturing the effect of the 'relative' local unemployment rate (distance to national

[10] A third alternative is a grouped logit model in which the dependent variable is ln(*M*/1-*M*), where M is the raw mortality rate. This model yields the same qualitative results as those that we report.

pattern). Due to multicollinearity issues, we were not able to include both the year dummies and the national unemployment rate for year *t*.

Data on mortality and unemployment are available for each *département* for all 21 years, giving us a total sample of 2016 observations. Data on income are based on tax returns from *Direction Générale des Impôts* (DGI) and are available from 1990 only.[11] We report models estimated on the full sample that exclude income as well as models for the years 1990 to 2002 that include the income variable. In all models reported, each observation is weighted by the square root of its population.

With this specification, the effect of unemployment is identified by within-*département* variation. Therefore, it is important that macroeconomic fluctuations vary across these geographic areas. Ruhm (2000) shows that this condition is easily met in his panel of US states: for most states the correlation of the state unemployment rate and the national rate is low, and over time the ranking of states in terms of unemployment changes considerably. Consistent with the general perception that the French economy is less dynamic than the US economy, there is less independence across areas in our data. The squared correlation between the departmental and the national unemployment ratio is above .9 in 18 *départements* (versus 3 states in Ruhm (2000)), and below .5 in 17 *départements* (versus 20 states). The "between" *département* variance represents 71% of total variance. Six of the 10 *départements* with the highest unemployment rate in 1982 were also in the top 10 in 2002. There is more variation at the other end of the distribution: only 3 of the 10 *départements* with the lowest unemployment rates in 1982 were also among the lowest in 2002. Overall, we can use the French case to estimate a 'within' effect of economic fluctuations on

[11] This is average taxable income per tax household. A tax household is similar to a household except that newly formed or dissolved households account for 3 tax households for a given year (this is a source of underestimation of the true household income but there is no reason to suspect it to differ across jurisdictions or over time). This could be an issue if household breakup correlated with economic cycles; at the national level, though, the divorce rate hardly correlates with the unemployment rate between 1982 and 2002 (linear correlation rate is .5 on the crude series and .6 on the first difference series).

mortality, but the 'between' (differences across areas that are constant over time) will have a stronger impact than in the US.

3. Results

3.1. Total Mortality Results

Table 2 reports regression results for our baseline models, in which the dependent variable is the log of the total mortality rate (panel A) and the mortality rate per 100,000 population (panel B). Standard specification tests (Breusch and Pagan's LM test and a Hausman test) indicate significant *département*-specific intercepts and reject a random effects specification. Therefore, all models that we report include *département* fixed effects. The first column includes only these fixed effects and the local unemployment rate. Column 2 adds year dummies. This is our preferred model because it accounts for general time trends in a flexible fashion. An alternative way to control for national trends is to replace the year dummies with the national unemployment rate (column 3). Results in these first three columns pertain to the full sample of 21 years, and therefore do not control for income. The average income variable is added in columns 4 and 5 and the sample size is reduced accordingly.

Consistent with much of the previous literature, the results indicate a negative relationship between the local unemployment rate and mortality in France. In all 10 models presented in Table 2, the coefficient on the unemployment rate is negative and statistically significant at the .05 level or better. In the full sample, when the dependent variable is the natural log of the mortality rate and the model includes year dummies, the estimated coefficient on the unemployment rate is -0.0075 (t-statistic = - 3.09). The magnitude of this effect is slightly smaller than what Neumayer (2004) finds for Germany (-0.011) and slightly larger than Ruhm's (2000) results for the US (-0.005) and what

Tapia-Granados (2005) finds for Spain (-0.003). However, these differences should not be over-stated as the point estimates from these other studies all fall within the 95% confidence interval of ours. When the dependent variable is the mortality rate (not logged), a one point increase in the unemployment rate is estimated to decrease mortality by 6 deaths per 100,000 persons (t-statistic = -3.10), which is comparable in magnitude to Ruhm's estimate from a similar model (-4.6).

Our results do not support the hypothesis that mortality might increase during economic expansions through a positive income effect on the consumption of unhealthy goods like tobacco or alcohol. Consistent with what Gerdtham and Ruhm's (2006) results for OECD countries and some of Neumayer's (2004) results on German *Länder*, we find that increases in average income are associated with reductions in mortality. The results in column 4 of Panel A imply that a one percent increase in average income (€127 per year) would decrease mortality by 1 per 100,000 or 0.1%. Adding average income as a covariate has little effect on the unemployment rate coefficient.

In columns 3 and 5 we replace the year dummies with the national unemployment rate. Because the model includes no other controls for general time trends, the coefficient on the national rate is difficult to interpret. We report this specification mainly for the sake of comparison with prior studies. In the model that excludes average income (column 3), the coefficient on the local unemployment rate is quite large in magnitude. Previous studies testing for the unemployment at the national (Ruhm, 2000, Tapia-Granados, 2005) or Oecd (Gerdtham and Ruhm, 2006) level also find that including such a variable increases the magnitude of the effect of the local unemployment rate. However, our effect on magnitude is much stronger (almost 100% increase versus 15 to 20% in these previous studies). When we control for income (column 5) it is closer to what we find in our preferred specification, which includes year dummies.

3.2. *Sensitivity Tests*

To test the sensitivity of our results, Table 3 reports the results using alternative sample inclusion criteria. For the sake of brevity, we only report results from the model that includes year dummies and excludes average income. For ease of comparison, the first row restates the results from Table 2. In column 1 the dependent variable is the natural log of the mortality rate and in column 2 it is the number of deaths per 100,000 persons.

One important way that our analysis differs from previous studies is that we use a much finer geographic unit of analysis. Some of the *départements* are quite small—the smallest has an average population (over the 21 year period) of 73,000; the 25th percentile is 285,000. To test whether our results are sensitive to the size of the geographic unit, we do two things. First, we split the sample in half according to the average population over the entire period. These results are reported in rows 2 (for *départements* with populations below the median) and row 3 (above the median). Second, we re-run the analysis at the level of regions (there are 22 regions in France, grouping between 2 and 8 *départements*). These results are reported in row 4. The coefficient estimates for the larger *départements* are quite close to what Ruhm finds for U.S. states; the results for the smaller ones and for the analysis done at the regional level indicate an even stronger negative effect of unemployment on mortality. Taken together, the results from these alternative samples suggest that the estimated relationship between unemployment and mortality is not sensitive to the geographic unit at which the two variables are measured.

As noted above, the migration of younger, healthier persons in response to economic opportunities may induce a positive correlation between mortality and the local unemployment rate. One way to test for this type of an effect is to compare *départements* that gained population during the period of our analysis (of which there are 76) with those that declined in population (20). *Départements* in the latter category were smaller at the start of the period, with an average 1982 population of 394,325 compared to 611,164 for the 76 that grew. They also had an older population (16% of the population aged 65 or older in 1982, compared to 13%) and a higher baseline mortality rate (11.5 per 100,000 vs. 9.7). However, these differences in age distribution and mortality remained fairly constant over the period and the unemployment rates for these two groups were quite similar over the entire period. Therefore, it is not surprising that when we exclude the 20 *départements* that lost population, the results (row 4) are not significantly different than the results for the full sample.

Following Svensson (2007), we also re-run the model excluding the eight départements with an average unemployment rate (over the period) greater than 13% (Ardennes, Nord, Pas-de-Calais, Var, Bouches-du-Rhône, Pyrénées Orientales, Landes, Hérault) and find a stronger and more precisely estimated impact of unemployment on mortality (coefficient or -0.0093 instead of -0.0075), suggesting that persistently high levels of local unemployment may have a detrimental effect on health, partially offsetting the pro-cyclical nature of mortality observed in areas with less pathological levels of unemployment (results are reported in row 6).

In the next 3 rows we cut the data by year, estimating models for three (overlapping) 10 year periods. The results are more sensitive to this change. When we use data from the first decade (1982 to 1991), the coefficient on the unemployment rate is not significantly different from zero. The effect is significant for the middle 10 years. In the ln(mortality) model, the coefficient is -0.005 (t-statistic = - 3.05). When the dependent variable is the number of deaths per 100,000 persons, the coefficient is -3.65 (t-statistic = -2.51). The coefficients for the ten years from 1993 to 2002 have a similar magnitude, but are estimated with slightly less precision.

The fact that the results are stronger for the more recent periods is interesting in light of important changes in the institutions governing the labor market took place in France in 1986-88. Prior to these changes, hiring and firing was subject to stricter regulations, which were administered by local authorities (the *Préfecture* at the *département*'s level); fixed term contracts were the exception rather than the rule and labor turn over was low. The reforms of the 1980s reduced the government's role and made the French labor market much more flexible (Givord and Maurin, 2001). The policy change coincided with a change in the trend in average hours for French workers. Whereas average hours were trending down in France in the decade or so before the reforms—from 44.24 hours in 1972 to 41.24 hours in 1986—average hours increased after the reforms, to 42.36 hours in 1999 (Chenu and Herpin 2002). Thus, one interpretation of our results is that the introduction of these reforms, which moved the French labor market in the direction of the US model, led to a stronger relationship between the business cycle and mortality.

However, alternative interpretations cannot be ruled out. Traffic and its consequences on mortality (through pollution and accidents) may be more sensitive to the business cycle in the more recent period: according to population censuses in France, the average distance from home to work increased from 6.04km (assuming a distance of 0 for individuals working in the locality where they live[12]) in 1982, to 7.37 in 1990 and 9.20 in 1999 (Baccaïni, Sémécurbe, and Thomas, 2007, Talbot, 2001).

Prior studies estimate models that include lagged values of the unemployment rate as explanatory variables. When we estimate such models, the coefficients on the lags are generally statistically insignificant. Taken literally this suggests that changes in macroeconomic conditions have an immediate effect on mortality, but that this effect is short-lived. An alternative (and we believe more likely) explanation is that the

[12] This is a reasonable assumption to make in a country with 36,000 municipalities – "communes" for 60 million inhabitants

insignificant coefficients of the lagged variables is simply the result of multicollinearity. As noted in Section 2.2, conditional on *département* and year fixed effects, there is less variation in unemployment rates than is the case with US states. Because of this lack of variation, we are unable to draw clear inferences concerning dynamic effects.

3.3. Cause-Specific Mortality

Results for cause-specific mortality are reported in Table 4, which is organized in the same manner as Table 2. Consistent with prior studies (Ruhm 2000, 2006a; Gerdtham and Ruhm 2006; Neumayer 2004; Tapia-Granados 2005) we find a negative effect of the unemployment rate on deaths from cardiovascular disease in our models controlling for the time trend. The models with year dummies (columns 2 and 4) imply that a one point decrease in the unemployment rate will raise deaths from cardiovascular disease by roughly one percent. The estimated coefficient on the unemployment rate is more negative in the models that use the national unemployment rate in place of the year dummies.

As expected, we find a negative relationship between unemployment and mortality from traffic accidents. These results are relevant to recent policy developments in France, which for years had one of the highest traffic fatality rates in Europe. After being elected to a second term in 2002, President Jacques Chirac announced road safety as one of his three main policy objectives and the government instituted a number of new policies. Recent data suggests that the various efforts to improve safety have been effective: between 2001 and 2005, traffic mortalities in France fell by 36% (from 7720 to 4990).[13] Our results suggest that a slowdown in the French economy may have also contributed to this trend. The national unemployment rate increased from 8.7% to

[13] Mortality figures are from France's Transportation Ministry. See the *Observatoire National Interministériel de la Securité Routière.*

9.9% over this period. Applying our parameter estimates to this change suggests that between 6 and 19 percent of the decline in motor vehicle fatalities was due to the increase in the unemployment rate. Between April 2005 and April 2006, unemployment fell by roughly half a percentage point and traffic fatalities increased by 6%. This pattern is also consistent with our results.

Mortality from other accidents, a category that includes but is not limited to accidents at the workplace, also decreases when unemployment rises. In contrast, the *département* level unemployment rate is not significantly related to the number of deaths from liver disease and estimates are inconsistent in the case of the number of deaths from cancer, two conditions which are likely caused by long-term exposure rather than short-term fluctuations. Similarly, we find no clear relationship between the local area unemployment rate and suicide. In column 3 (the model that includes the national unemployment rate, excluding average income) the coefficient on the unemployment rate is negative and statistically significant at the .10 level. However, in all other models reported the coefficient is not significantly different from zero. When we specify the dependent variable in levels (results not shown) the unemployment coefficient is generally insignificant, though for one model it is positive with a p-value of .085.

3.4. Age-Specific Mortality

Table 5 presents results for age-specific mortality rates for three groups of adults: those between the ages of 20 and 44, 45 to 64, and 65 and older. The results for the two working age cohorts are sensitive to the inclusion or exclusion of the average income variable. For the youngest age group, when we don't control for average income, the coefficient on the local unemployment rate is not statistically different from zero. However, when we add income as a control, the unemployment rate has a large negative effect. The results for the middle age group show a similar, if less pronounced pattern. For both of these cohorts, the results for models in which the dependent variable is the mortality rate per 100,000 persons (not reported) are qualitatively similar.

We find a significant and negative effect of unemployment on the mortality of the elderly (65 and over). Such a result may seem surprising, since most of the elderly are out of the labor force in France. However, Ruhm (2000) and Neumayer (2004) also find a significant impact of the business cycle on the mortality of the elderly. One plausible explanation for this result is that economic upturns lead to increased vehicle use and therefore pollution (and fatalities even of those who don't drive to work), which has an impact on all, including non-working individuals (Medina et al 2004). Using epidemiological studies of the impact of pollution on health in France for the years 1994-2003 (Quénel et al. 1999) we calculate that a change in small particles emission from percentile 25 to percentile 75 yields approximately 3 lives per 100,000 population, or half our estimated impact of one percentage point of unemployment on mortality. Interestingly, the same study shows this is mostly due to "harvesting" (premature deaths of frail individuals), which means that older individuals are more subject to it.

Another possible pathway may be related to the fact that a strong economy raises the opportunity cost of informal care, leaving the elderly without care and more vulnerable. An event occurring outside the time period of our analysis—the 2003 heat wave—provided a stark illustration of how vulnerable elderly individuals in France are to environmental factors and to care provided by family members. That summer, record temperatures resulted in an elevated mortality rate among elderly living the community, but not among those living in nursing homes (Ledrans 2006).

4. Conclusions

This study adds to the growing literature on the relationship between macroeconomic conditions and health. A main motivation for our work is that the relationship may depend in important ways on the institutional context. It is plausible that the effect of economic cycles on mortality may be quite different in a country like the US, with its highly competitive labor markets and fast-paced culture than in France and other European countries, where the labor market is more rigid and regulated and different notions concerning quality of life seem to prevail. We also were interested in testing the impact of observing the relationship at a different level of aggregation. In spite of these considerations, our results for France line up quite closely with the results of prior studies using data from the US and other countries. We find that total mortality varies pro-cyclically, increasing when the economy is strong and decreasing when it slackens.

A more detailed investigation suggests that the total mortality results are driven in large part by the effect of economic conditions on mortality from heart conditions and motor vehicle accidents. The result for cardiovascular disease is consistent with the hypothesis that heart conditions are sensitive to employment-related stress and overwork as well as, perhaps, the effect of increased economic activity on environmental factors, such as air quality. The results for accidents are consistent with the well known positive effect of economic activity on road congestion and traffic accidents.

Increased pollution and traffic fatalities induced by economic expansions affect workers and non-workers alike. Our finding of significant business cycle effects on the mortality of elderly adults underscores the potential importance of external effects. Determining the relative importance of direct effects on workers and externalities affecting non-workers is important, as the set of possible policy responses to the different effects are likely to be quite different.

The similarity of results from studies from different countries does not necessarily mean the macroeconomic effects on health are invariant to public policies or other institutional factors. We find that the negative relationship between the unemployment rate and mortality was stronger in the period after the introduction of reforms that made the French labor market more flexible and increased average work hours. This result is broadly consistent with Gerdtham and Ruhm's (2006) and our own stratification on OECD data that the relationship between the business cycle and mortality is weaker in countries with more extensive social safety nets. Further research using data from other countries would shed additional light on how the health effects of macroeconomic conditions vary depending on the institutional context.

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Table 1: Summary Statistics

	Mean	**Standard Deviation**
Death rates per 100,000 population		
All causes	933.7	173.1
All causes by age:		
20 to 44 year olds	136.3	22.2
45 to 64 year olds	676.0	141.8
65 years and older	5022.7	576.0
By cause of death:		
Malignant neoplasms	272.6	83.7
Major cardiovascular diseases	302.3	84.0
Pneumonia and influenza	24.2	8.5
Chronic liver disease and cirrhosis of the liver	18.3	6.6
Motor vehicle accidents	15.6	5.7
Other accidents, adverse effects	2.0	3.1
Suicides	20.1	7.1
Unemployment Rate	10.3	2.7
Average yearly household income in €	12682	2144

Notes: The sample size is 2016 observations (96 *départements* x 21 years) for all variables except average household income, which is available for the years 1990 to 2002 only. Means are weighted by the population.

Table 2: The Effect of Unemployment on Total Mortality, 1982 to 2002

	(1)	(2)	(3)	(4)	(5)
A. Dependent Variable: ln(mortality rate)					
Département -level unemployment rate	-0.0087 (0.0013)	-0.0075 (0.0024)	-0.0138 (0.0038)	-0.0080 (0.0027)	-0.0052 (0.0030)
National unemployment rate			0.0075 (0.0039)		0.0058 (0.0031)
Average household income (€000)				-0.0232 (0.0138)	-0.0063 (0.0031)
B. Dependent Variable: mortality per 100,000					
Département -level unemployment rate	-7.922 (1.058)	-6.016 (1.940)	-11.906 (3.230)	-6.6938 (2.3019)	-4.0839 (2.4449)
National unemployment rate			5.778 (3.353)		4.8744 (2.6283)
Average income (€000)				-19.2219 (10.7883)	-4.7363 (2.6190)
Year fixed effects	No	Yes	No	Yes	No
Sample size	2016	2016	2016	1152	1152

Notes: Observations are weighted by the square root of the population. Each model includes a full set of *département* fixed effects. Robust standard errors are in parentheses.

Table 3: Total Mortality Results for Different Subsamples

	Nat. Log of Mortality Rate	Mortality per 100,000
1. Full sample (N = 2016)	-0.0075 (0.0024)	-6.016 (1.940)
2. Population less than median (N=1008)	-0.0085 (0.0033)	-6.252 (2.642)
3. Population greater than median (N = 1008)	-0.0044 (0.0021)	-4.932 (2.273)
4. Analysis at the level of the Region (N = 462)	-0.0135 (0.0063)	-10.874 (5.587)
5. Population grew 1982 to 2002 (N = 1596)	-0.0065 (0.0027)	-5.081 (2.165)
6. Excluding 8 *départements* with UR>13% (N= 1848)	-0.0093 (0.0028)	-6.016 (1.940)
7. 1982 to 1991 (N = 960)	0.0007 (0.0030)	-0.311 (2.948)
8. 1986 to 1995 (N = 960)	-0.0048 (0.0016)	-3.653 (1.453)
9. 1992 to 2002 (N = 960)	-0.0039 (0.0027)	-3.668 (2.333)

Notes: Observations are weighted by the square root of the population. Each model includes a full set of *département* and year fixed effects. Robust standard errors are in parentheses.

Table 4: Mortality Results by Cause of Death

	(1)	(2)	(3)	(4)	(5)
Cardiovascular Disease:					
Département-level unemployment rate	0.0029 (0.0049)	-0.0103 (0.0031)	-0.0393 (0.0135)	-0.0147 (0.0031)	-0.0205 (0.0059)
National unemployment rate			0.0613 (0.0142)		0.0531 (0.0062)
Average household income (€000)				-0.0297 (0.0180)	-0.1068 (0.0041)
Cancer:					
Département-level unemployment rate	-0.0486 (0.0060)	-0.0109 (0.0030)	0.0142 (0.0141)	-0.0074 (0.0032)	0.0075 (0.0064)
National unemployment rate			-0.0910 (0.0145)		-0.0902 (0.0061)
Average household income (€000)				-0.0191 (0.0131)	0.1685 (0.0096)
Liver Disease:					
Département-level unemployment rate	-0.0336 (0.0049)	0.0030 (0.0052)	-0.0372 (0.0168)	-0.0056 (0.0087)	0.0020 (0.0094)
National unemployment rate			0.0052 (0.0181)		0.0017 (0.0098)
Average household income (€000)				-0.0772 (0.0209)	-0.0556 (0.0052)
Motor Accidents:					
Département-level unemployment rate	-0.0459 (0.0050)	-0.0200 (0.0062)	-0.0545 (0.0161)	-0.0161 (0.0090)	-0.0263 (0.0089)
National unemployment rate			0.0125 (0.0172)		-0.0094 (0.0094)
Average household income (€000)				-0.0127 (0.0207)	-0.1003 (0.0062)
Other Accidents:					
Département-level unemployment rate	-0.0975 (0.0151)	-0.0249 (0.0041)	-0.0841 (0.0343)	-0.0302 (0.0099)	-0.0605 (0.0204)
National unemployment rate			-0.2633 (0.0361)		0.2510 (0.0213)
Average household income (€000)				-0.0018 (0.0233)	-0.4267 (0.0189)

…/Table continues

Table 4: Mortality Results by Cause of Death (continued)

	(1)	(2)	(3)	(4)	(5)
Suicide:					
Département-level unemployment rate	-0.0000 (0.0056)	-0.0047 (0.0089)	-0.0214 (0.0117)	-0.0038 (0.0107)	-0.0171 (0.0123)
National unemployment rate			0.0310 (0.0112)		0.0213 (0.0128)
Average household income (€000)				-0.0132 (0.0246)	-0.0554 (0.0062)
Year fixed effects	No	Yes	No	Yes	No

Notes: The dependent variable is the natural log of the cause-specific mortality rate. In columns 1-3 the sample size is 2016 observations (96 *départements* x 21 years). In columns 4 and 5 the sample size is 1152 (96 *départements* x 12 years). Observations are weighted by the square root of the population. Each model includes a full set of *département* fixed effects.

Table 5: Age-Specific Mortality Results

	(1)	(2)	(3)	(4)	(5)
A. 20 to 44 year olds					
Département-level unemployment rate	0.0016 (0.0021)	0.0070 (0.0047)	-0.0046 (0.0067)	-0.0120 (0.0083)	-0.0219 (0.0101)
National unemployment rate			0.0091 (0.0076)		0.0187 (0.0110)
Average household income (€000)				-0.0618 (0.0324)	-0.0791 (0.0064)
B. 45 to 64 year olds					
Département-level unemployment rate	-0.0259 (0.0036)	0.0012 (0.0032)	-0.0284 (0.0120)	- 0.0041 (0.0034)	-0.0141 (0.0045)
National unemployment rate			0.0036 (0.0125)		-0.0052 (0.0046)
Average household income (€000)				-0.0240 (0.0072)	-0.0709 (0.0030)
C. 65 and older					
Département-level unemployment rate	-0.0145 (0.0028)	-0.0006 (0.0024)	-0.0217 (0.0094)	-0.0049 (0.0021)	-0.0097 (0.0031)
National unemployment rate			0.0104 (0.0097)		0.0031 (0.0032)
Average household income (€000)				-0.0102 (0.0066)	-0.0425 (0.0019)
Year fixed effects	No	Yes	No	Yes	No
Sample size	2016	2016	2016	1152	1152

Notes: The dependent variable is the log of the mortality rate for each age category. Observations are weighted by the square root of the population. Each model includes a full set of *département* fixed effects.