Suicides associated with the 2008-10 economic recession in England: new sight

Carme Saurina
Basili Bragulat
Marc Saez
Guillem López-Casasnovas

May, 2013

Suicides associated with the 2008-10 economic recession in England: new sight   [provisional version]

Carme Saurina (1,2), Basili Bragulat(1), Marc Saez(1,2)[1],Guillem López-Casasnovas (3)

(1) CIBER of Epidemiology and Public Health (CIBERESP)
(2) Research Group on Statistics, Econometrics and Health (GRECS), University of Girona, Spain
(3) UPF-CRES Centre de Recerca en Economia i Salut Department of Economics and Business Univ Pompeu Fabra

Introduction

In their excellent paper, Barr *et al.*[1] conclude that the increase in suicides in England in 2008-2010 could be associated with the rise in unemployment consequence of the economic recession, which began in 2008. The problem is that, although they point out that exploited regional differences in rates of suicide and unemployment between 2000 and 2010 to test the hypothesis that those regions with greater rises in unemployment have had corresponding increases in suicides, we are convinced that, unfortunately, they have succeeded only partially. We mean, with more observations, they manage to increase the efficiency of the estimates of both, the time trend of suicides and of the association between unemployment and suicides. However, they have not been able to estimate those trends and associations at regional level, despite its great variability. In fact they face a mixed design[2], specifically, a longitudinal one. That is to say, data were collected such that geographical units (local areas in their case) were observed over time.

In Figure 1 we show the temporal trends, from 2000 to 2010, of the number of suicides in the nine regions of England[a] and, in dasher thicker line, the number of suicides in England as a whole. Temporal trends in the number of suicides present important regional differences. Since 2008 (the first year of economic recession in UK), the regional trend is similar to the national trend in only three regions (North West, South

---

[1] Corresponding author: Prof. Marc Saez, PhD, CStat, CSci
Research Group on Statistics, Econometrics and Health (GRECS)- CIBER of Epidemiology and Public Health (CIBERESP) University of Girona. Campus de Montilivi, 17071 Girona. Tel 34-972-418338, Fax 34-972-418032.
http://www.udg.edu/grecs.htm & e-mail: marc.saez@udg.edu
[a] North East, North West, Yorkshire and the Humber, East Midlands, West Midlands, East of England, London, South East and North East (Office for National Statistics and NUTS2 EUROSTAT).

East and South West) in the case of males, and two (North West and East Midlands) in the case of females; and slightly similar (with a less pronounced increase between 2008 and 2009) in other two (North East and East Midlands) in the case of males, and one (South East) in the case of females. In Figure 2 we show a scatter plot between the age-standardised rate of suicides and the variation in the unemployment rates, from 2000 to 2010, and the (loess smooth) fitted lines for each one of the nine regions and, in dasher thicker line, for England as a whole. In this case only West Midlands (in the case of males) somehow resemble the line for England as a whole.

In Table 1 we can see that, although, on average, suicides (both in numbers and age-standardised rates) decreased in 2008-2010 compared to 2000-2007, in both sexes in England as a whole, there were some regional differences. In East of England and South West there were remarkable increases in the number of suicides (326 in 2000-2007 vs. 346 in 2008-2010; 340 vs. 363, respectively). Age-standardised rates, however, were only little higher in the case of South West (17.09 vs. 17.43). For women, there was a slight increase in the number of suicides (87 vs. 90) in East Midlands, although age-standardised rates remained constant

What the table and the figures show are the characteristic features of a mixed longitudinal design, that is to say, i) units (regions in this case) do not behave in the same way over time; ii) the effect of the explanatory variables on the dependent variable may not be the same for the different units; and iii) longitudinal observations within the same higher-level unit (regions), are not independent of one-another.

These features require the use of appropriate statistical methods. In this sense, with respect to the first two features, instead of a pooled model[b] must be used either marginal (also called population-average) or conditional (also subject-specific) models. Marginal models[c] are constructed directly to describe marginal means and treating any covariance structure as nuisance parameters[2]. That is to say, in our case we would be

---

[b] As used by Barr et al.[1] on assessing the total excess number of suicides attributable to the financial crisis, i.e. the estimation of a time trend model.

[c] As the fixed effects models used by Barr et al.[1] for the estimation of the association of changes in unemployment with suicides.

interested in the average time trend of the nine regions or in the relationship, on average, between unemployment and suicides, if any, but not in the regional trends or the relationships at regional level. By contrast, in conditional models (also known as a conditionally-specified models, or a mixed models) the coefficients have region-specific interpretations, allowing observe regional differences in suicides and/or unemployment, again, if any. But, in addition, any conditional model leads to a specific marginal model[2].

With respect to the third feature, not only heteroscedasticity (as in Barr *et al.*[1]), consequence of heterogeneous between units, but also the autocorrelation, i.e. the (serial) dependence of the longitudinal observations within the same region, should be controlled.

Our objective in this paper was to replicate the paper of Barr *et al.*[1] using a conditional model allowing, explicitly, the estimation of the regional time trends and of the effects of unemployment on suicides at the regional level, for England during the period 1993-2010. Our hypothesis is that neither trends nor the effects were the same for all the regions of England, at least for the period of the economic recession, 2008-2010. In fact, regional differences were so significant that average them, would mean the loss of valuable information.

Methods

Data setting

Here, suicides were defined as deaths given an underlying cause of intentional self-harm or injury/poisoning of undetermined intent[3,4]. For England, this corresponds to intentional self-harm (ICD-9 codes: E950-E959; ICD-10: X60-X84); and to injury/poisoning of undetermined intent (ICD-9: E980-E989, excluding E988.8; ICD-10: Y10-Y34, excluding Y33.9 where the coroner's verdict was pending for the years 2001-2006; from 2007 onwards, deaths which were previously coded to Y33.9 are coded to U50.9).

Annual data from 1993 to 2010 from suicides on the nine regions of England (for adults aged 15 years and over), both the number of deaths as the age-standardised suicide rates (rates per 100,000 population standardised to the European Standard Population), excluding deaths of non-residents, were obtained from the Office of National Statistics (ONS)[4], UK.

Although, on average (i.e. for England as a whole), there were no important differences between the number and the rates of suicides, differences are substantial for some regions, in particular, North-East and East of England for males; and West Midlands (2008 onwards) for females (see Figure 3). These differences could affect the results of the estimates.

Data on unemployment, from 1999 to 2010, both, number of unemployed (persons aged 15-74 years) and unemployment rate (as a percentage of the economic active population) was obtained frrom the EUROSTAT (regions and cities, 'regional labour market statistics')[5]. All data were obtained from a stratified manner for men and women.

Statistical analysis

Hierarchical mixed (also conditional) models were used to assess both suicides attributable to the financial crisis (using a dummy variable for the crisis years, 2008-2010) and the association between unemployment and suicides. In both cases we used the number and the (age-standardised) rate of suicides, for men and women separately, as the dependent variables.

On assessing the suicides attributable to the financial crisis we included, as explanatory variables, a time trend and the dummy variable. In this case, as in Barr *et al.*[1], the dummy variable would capture a break from past time trends. On assessing the association between unemployment and suicides we included, as explanatory variables, unemployment (number of unemployed and rate of unemployment) and a

time trend. In this case, a time trend was include in order to control for possible spurious relationship because suicides and unemployment evolve in time in the same way.

Both the intercept and the coefficients associated to all the explanatory variables were considered random effects. That is to say, we have allowed all coefficients vary in the higher-level unit we considered, i.e region. In the cases of the intercept and of the coefficients associated to the dummy and unemployment we assumed that the random effects were identical and independent Gaussian random variables with constant variance. In the case of the time trend we assumed that the random effects vary per region and by year, through a random walk of order 1 (i.e. independent increments) for the Gaussian random effects vector[6] (although we have also assumed a constant variance). Thus, we use a non-parametric approach to the regional trends that we assume that evolve non-linearly (see Figure 1).

In all models we controlled for heteroscedasticity, consequence of the heterogeneity between regions, through the random intercept (at the region level) and for autocorrelation, i.e. serial dependence of the longitudinal observations within the same region, through an autoregressive model of order 1 (within each region).

The inferences have been performed using a Bayesian approach, with the Integrated Nested Laplace (INLA)[7] (Rue *et al.*, 2009). All analyses have been done with the free software R (version 2.15.2)[8], through the INLA library[9,7].

Results

In Table 2 we show the results of the estimation of the variation of suicides during the economic recession 2008-2010, compared to 1993-2007. Note that, although there was an increase in the number of suicides in 2008-2010 compared to 1993-2007, higher in men than in women (13.043 vs. 4.530, respectively), in no case were statistically significant. In addition, variations in suicides at the regional level were

virtually identical (all the coefficients were very close to zero) that occurred in England as a whole. With respect to the suicides age-standardised rates, however, the picture was totally different. Although the variation in such rates was not statistically significant in England as a whole, there were important (compare to Table 1) and statistically significant increases in the suicide rates in North West (in males, 2.001, and females, 0.460) and North East (males, 1.828); and decreases in East of England (in males, -1.597, and females, -0.532) and West Midlands (females, -0.333).

The results of the estimation of the association of unemployment with suicide in 1999-2010 are shown in Table 3. In no case was found a statistically significant association for England as a whole. However, again, we estimated quite statistically significant associations in the case of regions (with the exception of the relationship between unemployment rates and suicides age-standardised rates in the case of females). With respect to the association of the number of unemployed and the number of suicides, statistically significant positive associations were found for South West (1.099 men and 0.584 women), North West (0.968 men and 0.309 women) and London (0.362 men and 0.210 women), and negative associations for North East (-3.051 men and -1.868 women), East Midlands (-1.470 men and -0.798 women), East of England (-0.642 men and -0.391 women) and Yorkshire and the Humber (-0.505 men and -0.479 women) (in all cases for both, males and females). For males, unemployment rates were statistically significant positively associated with suicide age-standardised rates in South East (0.384), North West (0.260) and North East (0.136), and negatively in East of England (-0.444), East Midlands (-0.236) and London (-0.168).

Discussion

The two regions with statistically significant increases in the suicide rates during the economic recession 2008-2010, compared to 1993-2007, were North West and North East. The economy of the North West region, based mainly in manufacturing industry, has not been able to thrive against global competition and economic recession causing

large migrations in the area. North East is not known as an industrialized region but its economy is primarily oriented towards tourism. In East of England and West Midlands, on the contrary, suicide rates (statistically significant) decrease during the economic recession. The region of the East of England is one of the fastest growing regions with important high-tech industries such as electronics, aerospace and telecommunications. The West Midlands region is the UK's industrial heartland. The unemployment rate has increased lately (17.26% in the case of men and 10.25% in the case of women) between the two periods of study and although it has grown the number of jobs in the service sector has not been enough to offset job losses in the manufacturing sector.

For males, unemployment rates were statistically significant positively associated with suicide age-standardised rates in South East, North West and North East. For the regions of the North West and North East of the result is not surprising as the annual percentage change in the number of suicides are positive (Table 2) and unemployment rates increased in both regions. In the case of South West the Table 1 clarifies the meaning of the estimate as it is the only region with a positive increase in the suicide rate between the two study periods.

The negative associations between unemployment rates and suicide age-standardised rates correspond to the regions East of England, East Midlands and London. In the case of the East of England region the result is consistent with the observed values in the two tables above. Table 1 shows a decrease in the number of suicides of 1.19% and an increase in unemployment of 13.82% between the two periods of study and Table 2 indicates a decrease in the annual variation of the suicide rate in the case of 1,597 of men. For regions East Midlands and Greater London Table 2 shows no significant results on the annual change. However, Table 1 indicates a decrease of 7.84% in the number of suicides with a 4.61% increase in the unemployment rate between the two periods for the London region and a decrease of 14.53% in the suicide rate along an increase of 13.59% in the unemployment rate between the two periods of study for the East Midlands. One explanation for the negative association found in the case of

the East Midlands and since it can be a region made up of a patchwork of counties, but some other rural industrial and engaged in agriculture.

Conflicts of Interest

There are no conflicts of interest for any of the authors. All authors disclose any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations that could inappropriately influence, or be perceived to influence, their work.

References

1.- Barr B, Taylor-Robinson D, Scott-Samuel A, McKee M, Stuckler D. Suicides associated with the 2008-2010 economic recession in England: time trend analysis. *British Medical Journal* 2012; 345:e5142.

2.- Lee Y, Nelder JA. Conditional and marginal models: Another view. *Statistical Science* 2004; 19(2):219–238.

3.- Brock A, Baker A, Griffiths C, Jackson G, Fegan G, Marshall D. Suicide trends and geographical variations in the United Kingdom, 1991-2004. *Health Statistics Quarterly* 2006; 31:6-21.

4.- Office for National Statistics (ONS). http://ons.gov.uk/ons/index.html [last accessed on October 30 2012]

5.-   EUROSTAT. http://epp.eurostat.ec.europa.eu/portal/page/portal/region_cities/regional_statistics/data/database [last accessed on October 30 2012]

6.- Random walk of order 1. Latent models. The R-INLA project [available in: http://www.math.ntnu.no/~hrue/r-inla.org/doc/latent/rw1.pdf, last accessed on November 2, 2012]

7.- Rue H, Martino S, Chopin N. Approximate Bayesian inference for latent Gaussian models by using integrated nested Laplace approximations (with discussion)'. *Journal of the Royal Statistical Society*, Series B, 2009; 71:319-392. [available in: http://www.r-inla.org/papers, last accessed on November 2, 2012].

9

8.- R Core Team. *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing, 2012. ISBN 3-900051-07-0, URL http://www.R-project.org/.

9.- - The R-INLA project [available at: http://www.r,inla.org/, last accessed on November 2, 2012].

Table 1.- Descriptive of the variables of interest

| | Period 2000-2007 | | | | | | | |
| | Population 2011 | Number of suicides, thousands[1] | | Age-Standardised suicide rates[1,2] | | Unemployment rates, %[1] | | GDP per capita[1] |
	Persons, thousands [rank]	Males	Females	Males	Females	Males	Females	Purchasing Power Standard [rank]
North East	2,597 [9th]	193 (19)	58 (12)	19.69 (2.19)	5.40 (1.21)	7.95 (1.05)	5.28 (0.68)	19750 (1789) [9th]
North West	7,052 [3rd]	503 (35)	158 (16)	19.03 (1.47)	5.58 (0.55)	5.79 (0.65)	4.39 (0.29)	22063 [1683] [7th]
Yorkshire and the Humber	5,284 [7th]	336 (15)	107 (16)	16.91 (0.93)	5.01 (0.81)	6.01 (0.62)	4.44 (0.47)	21963 (1627) [8th]
East Midlands	4,533 [8th]	283 (16)	87 (13)	16.65 (1.35)	4.83 (0.70)	4.93 (0.34)	4.41 (0.57)	22838 (1836) [5th]
West Midlands	5,602 [5th]	344 (47)	109 (16)	16.58 (2.48)	4.88 (0.73)	6.08 (0.51)	5.07 (0.59)	22263 (1505) [6th]
East of England	5,847 [4th]	326 (15)	112 (13)	15.01 (0.81)	4.70 (0.54)	4.05 (0.43)	3.93 (0.53)	24600 (2225) [3rd]
Greater London	8,174 [2nd]	448 (18)	162 (19)	15.15 (0.84)	5.25 (0.69)	7.36 (0.35)	6.53 (0.56)	41475 (4376) [1st]
South East	8,635 [1st]	505 (23)	182 (25)	15.64 (0.98)	5.19 (0.71)	3.93 (0.46)	3.69 (0.36)	27338 (2402) [2nd]
South West	5,289 [6th]	340 (21)	120 (18)	17.09 (1.44)	5.35 (0.79)	3.86 (0.27)	3.44 (0.37)	23463 (2040) [4th]
England	**53,013**	**364 (101)**	**122 (41)**	**16.86 (2.08)**	**5.13 (0.78)**	**5.55 (1.51)**	**4.57 (1.02)**	**25083 (6537)**

| | Period 2008-2010 | | | | | | | |
| | Population | Number of suicides (thousands)[1] | | Age-Standardised suicide rates[1,2] | | Unemployment rates (%)[1] | | GDP per capita[1] |
	Persons, thousands (rank)	Males	Females	Males	Females	Males	Females	Purchasing Power Standard [rank]
North East	2,597 [9th]	182 (11)	53 (10)	17.97 (1.16)	4.86 (0.85)	8.73 (1.59)	6.04 (1.33)	19860 (1628) [9th]
North West	7,052 [3rd]	498 (34)	146 (18)	18.30 (1.31)	5.10 (0.69)	6.68 (1.53)	4.90 (0.94)	22140 (1546) [7th]
Yorkshire and the Humber	5,284 [7th]	320 (34)	91 (10)	15.33 (1.70)	4.13 (0.82)	6.95 (1.74)	5.00 (1.11)	21960 (1489) [8th]
East Midlands	4,533 [8th]	253 (16)	90 (11)	14.23 (0.87)	4.83 (0.40)	5.60 (1.23)	4.86 (0.98)	22920 (1677) [5th]
West Midlands	5,602 [5th]	345 (17)	109 (8)	16.10 (0.88)	4.73 (0.15)	7.13 (1.90)	5.59 (1.05)	22230 (1395) [6th]
East of England	5,847 [4th]	346 (23)	106 (16)	14.83 (1.10)	4.37 (0.66)	4.61 (1.10)	4.30 (0.87)	24640 (2032) [3rd]
Greater London	8,174 [2nd]	436 (7)	142 (4)	13.97 (0.35)	4.47 (0.16)	7.70 (0.76)	6.98 (1.03)	42310 (4283) [1st]
South East	8,635 [1st]	509 (18)	180 (13)	13.51 (0.66)	4.93 (0.31)	4.38 (1.13)	4.00 (0.65)	27520 (2209) [2nd]
South West	5,289 [6th]	363 (30)	121 (8)	17.43 (1.55)	5.43 (0.46)	4.47 (1.11)	3.84 (0.79)	23590 (1868) [4th]
England	**53,013**	**361 (105)**	**115 (37)**	**15.93 (1.82)**	**4.76 (0.57)**	**7.92 (1.97)**	**6.27 (1.35)**	**25872 (7581)**

[1] Mean (st.dev.) [2] Rates per 100,000 population standardised to the European Standard Population

Source: ONS (http://ons.gov.uk/ons/index.html) and EUROSTAT (http://epp.eurostat.ec.europa.eu/portal/page/portal/region_cities/regional_statistics/data/database)

Table 2.- Results of the estimation of the variation of suicides during the economic recession 2008-2010, compared to 1993-2007

Males

	Number of Suicides[1]	Age –standardized rates[1,2]
North East	-4.881e-06 (-0.022, 0.022)	1.828 (0.302, 3.198)
North West	2.792e-06 (-0.022, 0.022)	2.001 (0.713, 3.290)
Yorkshire and The Humber	-1.236e-06 (-0.022, 0.022)	0.151 (-0.939, 1.335)
East Midlands	-2.810e-06 (-0.022, 0.022)	-0.693 (-1.717, 0.404)
West Midlands	-1.168e-06 (-0.022, 0.022)	-0.385 (-1.429, 0.652)
East of England	-1.512e-06 (-0.022, 0.022)	-1.597 (-2.72, -0.580)
London	1.475e-06 (-0.022, 0.022)	-1.078 (-2.271, 0.0170)
South East	2.770e-06 (-0.022, 0.022)	-0.787 (-2.058, 0.474)
South West	-1.288e-06 (-0.022, 0.022)	0.592 (-0.744, 2.061)
England	13.043 (-2.934, 29.300)	0.008 (-0.002, 0.018)

Females

	Number of Suicides[1]	Age–standardized rates[1,2]
North East	-6.973e-05 (-0.023, 0.0231)	0.170 (-0.173, 0.523)
North West	3.947e-05 (-0.023, 0.023)	0.460 (0.130, 0.817)
Yorkshire and The Humber	-1.753e-05 (-0.023, 0.023)	-0.146 (-0.479, 0.1789)
East Midlands	-3.795e-05 (-0.023, 0.023)	-0.244 (-0.576, 0.074)
West Midlands	-1.579e-05 (-0.023, 0.023)	-0.333 (-0.668, -0.018)
East of England	-1.669e-05 (-0.023, 0.023)	-0.532 (-0.879, -0.213)
London	4.476e-05 (-0.023, 0.023)	0.223 (-0.100, 0.560)
South East	6.489e-05 (-0.023, 0.023)	0.143 (-0.189, 0.485)
South West	-2.481e-06 (-0.023, 0.023)	0.267 (-0.074, 0.625)
England	4.530 (-13.448, 23.063)	-0.001 (-0.011, 0.009)

[1] Variation of suicides (95% interval of credibility)

[2] Rates per 100,000 population standardised to the European Standard Population

Bold and shaded in grey, the 95% interval of credibility did not contain the zero

Table 3.- Results of the estimation of the association of unemployment with suicide in nine regions of England, 1999-2010

	Region	Number of suicides[1]	
		Males	Females
Association of the number unemployed and number of suicides	**England**	0.239 (-0.181 , 0.648)	0.030 (-0.364, 0.421)
	North East	-3.051 (-3.833, -2.247)	-1.868 (-2.482, -1.262)
	North West	0.968 (0.612, 1.330)	0.309 (0.052, 0.566)
	Yorkshire and The Humber	-0.505 (-0.948, -0.060)	-0.479 (-0.811, -0.146)
	East Midlands	-1.470 (-2.097, -0.839)	-0.798 (-1.192, -0.404)
	West Midlands	-0.323 (-0.734, 0.086)	-0.292 (-0.584, 0.003)
	East of England	-0.642 (-1.216, -0.065)	-0.391 (-0.733, -0.049)
	London	0.362 (0.096, 0.628)	0.210 (0.048, 0.373)
	South East	1.099 (0.685, 1.513)	0.584 (0.339, 0.829)
	South West	-0.494 (-1.162, 0.171)	-0.178 (-0.587, 0.230)
	Region	Age -standardized rates[1,2]	
		Males	Females
Association of unemployment rates and suicides age-standardised rates	**England**	0.134 (-0.207, 0.466)	-0.006 (-0.215, 0.204)
	North East	0.135 (0.005, 0.275)	-0.003 (-0.023, 0.021)
	North West	0.260 (0.102, 0.421)	0.003 (-0.022, 0.023)
	Yorkshire and The Humber	-0.097 (-0.234, 0.038)	-0.003 (-0.032, 0.015)
	East Midlands	-0.236 (-0.397, -0.078)	-0.001 (-0.025, 0.020)
	West Midlands	-0.068 (-0.195, 0.058)	0.001 (-0.020, 0.024)
	East of England	-0.444 (-0.659, -0.239)	-0.003 (-0.031, 0.016)
	London	-0.168 (-0.310, -0.032)	-0.001 (-0.027, 0.018)
	South East	-0.099 (-0.378, 0.165)	-0.001 (-0.026, 0.0196)
	South West	0.384 (0.087, 0.675)	0.002 (-0.018, 0.028)

[1] Variation of suicides (95% interval of credibility) [2] Rates per 100,000 population standardised to the European Standard Population   Bold and shaded in grey, the 95% interval of credibility did not contain the zero

13

Figure 1.- Temporal trends of the number of suicides in the nine regions of England and in England as a whole (dasher thicker line)
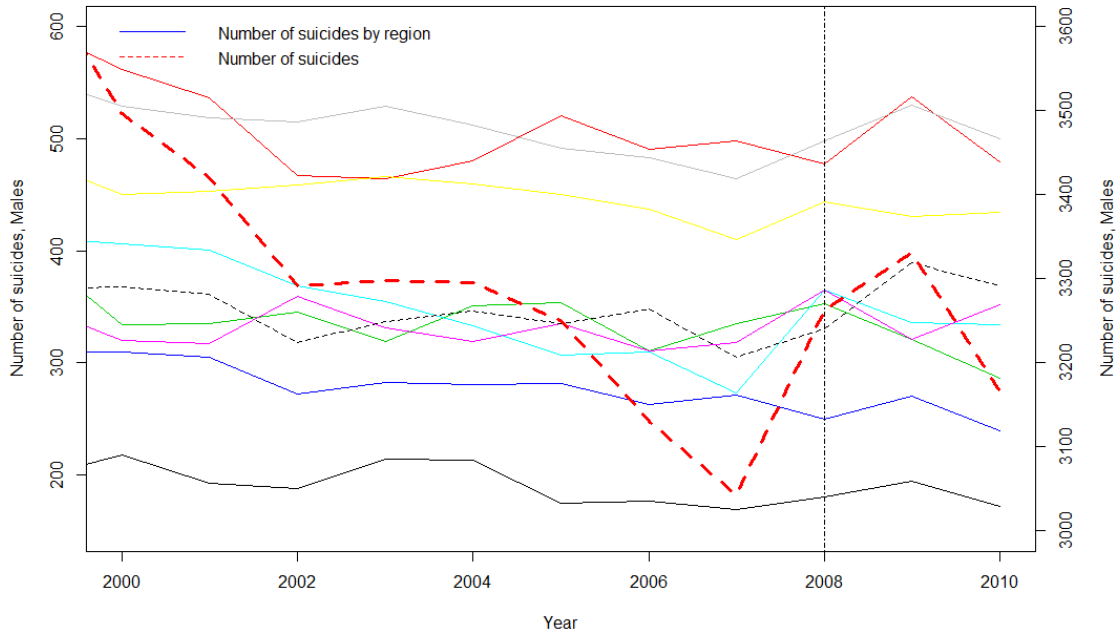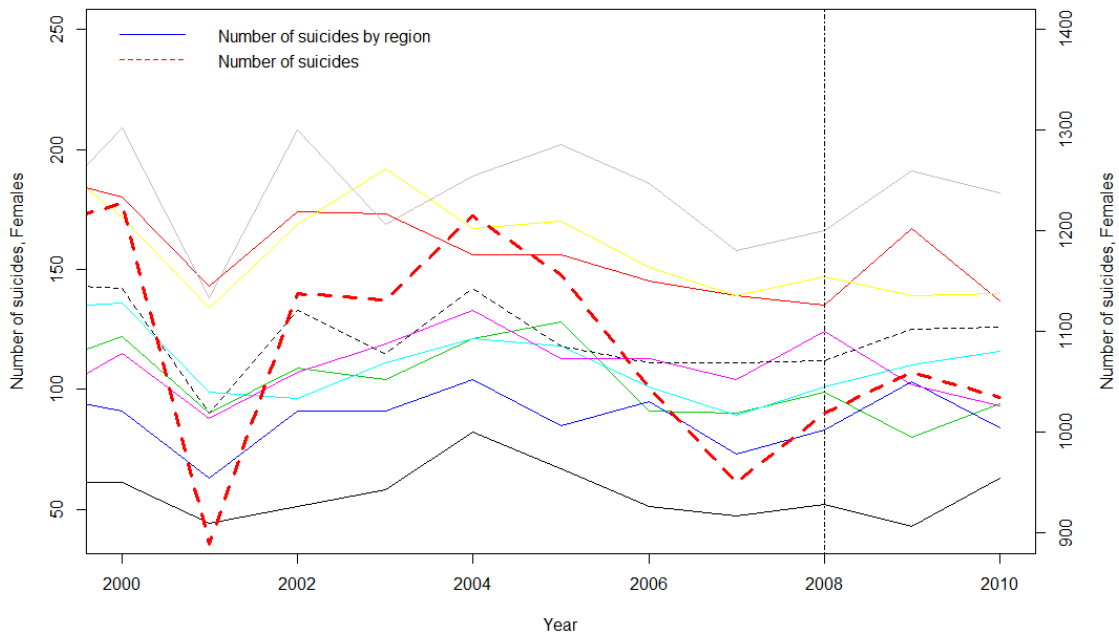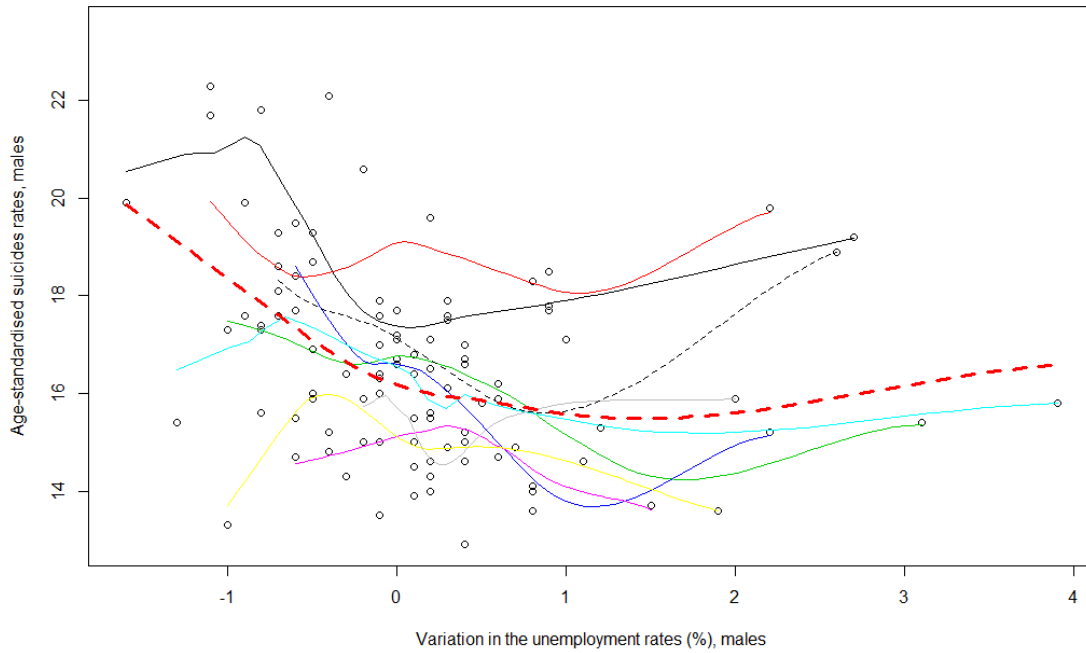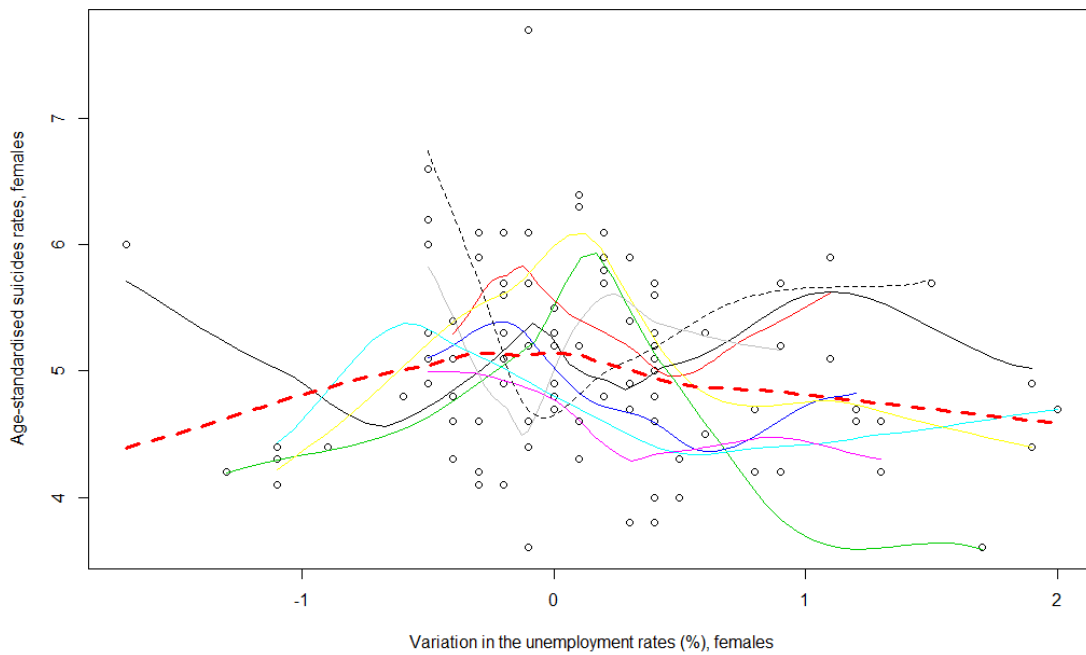

Males

Females

Figure 2.- Age-standardised rates of suicides and variation in unemployment rates, 2000-2010, and (loess smooth) fitted lines in nine regions of England and in England as a whole (dasher thicker line)
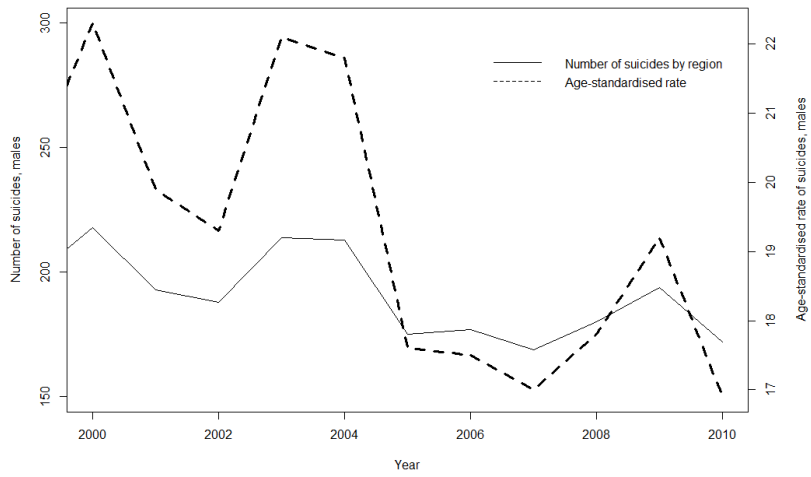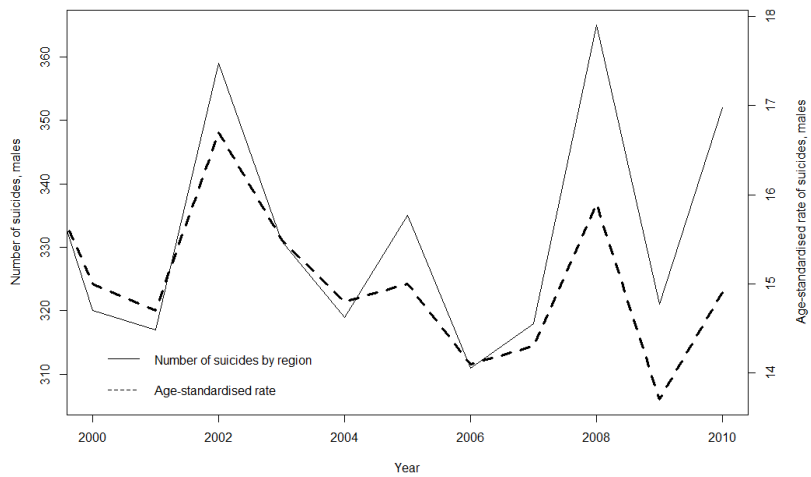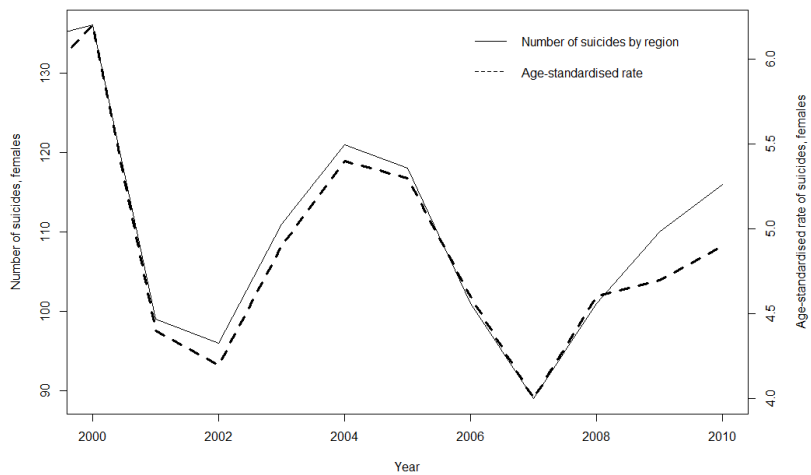

Males

Females

Figure 3.- Number and age-standardised rates of suicides in selected regions of England, 2000-2010

North-East, males

East of England, males

West Midlands, females