## Empirical Analysis of National Income and So<sub>2</sub> Emissions in Selected European Countries

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NOTA DI LAVORO 1.2004

### JANUARY 2004 IEM – International Energy Markets

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# **Empirical Analysis of National Income and So2 Emissions in Selected European Countries**

#### **Summary**

Data on GDP per capita and sulfur emissions for twelve European countries were analyzed to determine the relationship between emissions and income in these countries. As a whole, the relationship between sulfur emissions and per capita income is a fourth order polynomial and not a quadratic one as found in most studies. When countries were examined individually, seven out of the twelve countries depicted the same relationship. Looking closely at the regulations restricting sulfur emissions in the UK, the impact of all regulations supported the inverted U-shaped Kuznets curve. Individually, however, it is found that only two regulations have statistically significant impacts: Smoke Abatement Act in 1926 (reduced the amount of sulfur associated with a given level of GDP); and Clean Air Act in 1956 (increased the amount of sulfur emissions associated with a given level of GDP).

Keywords: Environmental Kuznet's Curve, Europe, Sulfur dioxide emission

JEL: C33, Q53, Q58

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## 1. Introduction

In this paper the following work is reported:

- A. Data were collected on GDP and GDP per capita going back to 1850 for selected European Countries. Data were also collected on sulfur emissions for the same period and for the same countries. The data were analyzed to see what long term relationships could be ascertained between the emissions and economic output and growth.
- B. Econometric analyses were employed to test the hypothesis that the environmental Kuznets curve exists in the selected European countries. Furthermore, the empirical analyses allow us: to obtain a point estimate of the impact of income on sulfur emissions, and regulations on income; and to determine whether the impacts are significant statistically. The particularly steps taken are:
  - 1. Panel regressions of sulfur emissions against GDP and higher order terms of GDP.
  - 2. Separate Ordinary Least Squares (OLS) estimations for each of the 12 countries.
  - 3. Using only the UK data, regression of sulfur emissions against GDP and higher order terms of GDP, as well as dummies for years in which new regulations were passed to restrict sulfur emissions. Also, the effect of regulations on per capita income was empirically analyzed.

The paper reports on the results of this work. Section 2 describes the data. Section 3 describes the relationships between emissions and GDP, and Section 4 reports on the environmental legislation relating to sulfur and its possible impacts on GDP. Section 5 shows the results of econometric analysis on the relationships among per capita income, sulfur emissions and regulations. Section 6 concludes.

Annex 1 provides the raw data and list of air regulations. Annex 2 provides the graphs.

## 2. The Data

## 2.1 Per capita Gross Domestic Product (1820, 1850, 1870-2001)

The per capita GDP data of the European countries were gathered from Angus Maddison's web page at <u>http://www.eco.rug.nl/~Maddison/</u>. Income is measured in 1990 international Geary-Khamis dollars<sup>1</sup>. In some cases, gaps in the GDP estimates are filled by imputation. For example, per capita GDP movement in Switzerland was assumed to be parallel with that of Germany for 1871-1998. Data for countries like Finland and Italy for 1850 were interpolated between the 1820 and 1870 estimates for these countries.

<sup>&</sup>lt;sup>1</sup> Or purchasing power parity (PPP) dollars

## 2.2 Sulfur Emissions (1850 to 1999)

The sulfur emissions data for the European countries were obtained from David Stern's web page at <u>http://www.rpi.edu/~sternd/datasite.html</u>. Sulfur data estimates are obtained in two ways: (a) by compiling available data from published sources; and (b) by using a decomposition model, the first differences Kuznets curve model, or simple extrapolation of the growth rate of emissions to impute unavailable data. The primary source for the data between 1850 and 1979 is the ASL and Associates database; while the data between 1980 and 1999 were primarily obtained from the Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air pollutants in Europe (EMEP). The estimates of sulfur emissions have a common unit of thousands of metric tons per annum. A more detailed description about the data and estimation methods can be found in David Stern's website<sup>2</sup>.

For the broader purposes of this study, sulfur is used as a proxy for environmental pollution. The intent is to see how emissions of a major pollutant respond to regulations and how emissions are related to GDP. Although one would not expect exactly the same effects for other pollutants, the general lessons learnt from this analysis can be expected to apply more broadly.

The GDP and sulfur data are given in Annex One for the following 12 countries: Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland and the United Kingdom.

The *per capita* GDP from 1820 to 2001 are given in Annex Table 1, which is a remarkable dataset, assembled with great effort and care by Angus Maddison. It shows that the *per capita* GDP terms, which is a measure of economic living standards, rose by an average of 15.7 times over these 181 years, with a minimum of 11.8 for the UK and 25.2 for Finland (the UK was already quite industrialized in 1820 and Finland was largely agricultural at that time). The average annual growth rate for the 12 countries is 1.5 percent and the rates are much more closely bunched than the ratios of 2001 to 1820 *per capita* GDP. The lowest rate is 1.4 percent (UK) and the highest is 1.8 percent (Finland).

The sulfur emissions data are given from 1850 to 1999 in Annex Table 2. Unlike the GDP data, they do not show a general upward trend, but rather an increase up to a certain year and then decline. The year of maximum emissions varies, but for 9 of the countries it is in the period 1970-1985. For the UK it was 1955, for Switzerland, 1939 and for Austria, 1908. The growth in emissions over the whole period is small in most countries and even negative in the case of the UK – i.e., the emissions of sulfur in 1999 in that country were less than in 1850!

From this, one can see that emissions and GDP are not positively related over the whole period. In the next section we will look at the relationship in more detail.

<sup>&</sup>lt;sup>2</sup> http://www.rpi.edu/~sternd/Sulfur.pdf

## 3. Relationships Between *Per Capita* GDP and Sulfur.

Figures A1 to A12 in Annex Two show the sharp disjuncture in the relationship by country. Essentially after the Second World War *per capita* GDP started to grow quite sharply but sulfur emissions, which hitherto had grown faster than this measure of GDP, started to grow more slowly and eventually to decline. The pattern is related in each country, with the most pronounced declines post 1970s (with the exception of Switzerland the UK, where the decline began much earlier.

Figures B1 to B12 plot the real *per capita* GDP against the level of sulfur emissions. As expected, the relationship shows something of an "inverted U". Emissions rise against *per capita* GDP to some point, after which as the GDP increases, emissions tail off. This is of course the well-known 'Environmental Kuznets Curve' relationship but we should be careful. All the graphs show more than one turning point, suggesting a higher order polynomial as being appropriate. Further work using econometric techniques will be needed to analyze this relationship.

Figures C1 to C12 plot the annual rates of growth of sulfur and real *per capita* GDP. The graphs are interesting in showing a short-term correlation (i.e., year on year growth in GDP correlates with year on year growth in sulfur). However, since the 1950s, the relationship has weakened and diverted in terms of levels. While it is still true that the annual growth rates are correlated, and a year when GDP *per capita* growth increases is also one when sulfur growth increases, the latter is from a much lower base growth rate – often from a negative growth rate.

Figures D1 to D12 plot the Percentage growth in sulfur emissions against the percentage growth in *per capita* GDP. The purpose here is to show a lack of clear relationship. The points are to found predominantly in the positive sulfur growth/positive GDP *per capita* growth **and** negative sulfur growth/positive GDP *per capita* growth. In Figure E1 we show, for the United Kingdom, the points pre 1957 and post 1957 in different colors. We do that to show that the post 1957 points are mainly in the negative sulfur growth/positive GDP *per capita* growth quadrant.

## 4. Impact of Environmental Legislation on Sulfur.

Annex Table 3 gives the key dates of legislation that could have impacted on sulfur emissions in the UK from 1820 onwards and *Annex* Table 4 gives the same (but less complete) information for other European countries. The UK legislation is most instructive in showing that attempts to control sulfur emissions go back to 1821 -- almost as far back as the records for GDP. Indeed there were measures earlier than that – in the  $13^{th}$  Century for example - but they are not recorded here, as our GDP series do not go back that far.

The interesting question is how these Acts have affected the sulfur-GDP relationship. Figure E2 in Annex Two is plotted for the UK but with the dates of some of the key Acts shown. The most pronounced decline in emissions took place in 1926, following the smoke abatement act, but this was only a temporary drop returned to more or less the same levels after that. Years of the Acts

from 1956 onwards show a steady decline in emissions but no sudden jump in the *per capita* GDP series. We can conclude from this that the controls on sulfur have made a major contribution to reducing this pollutant, but have not made a major dent in the growth of real living standards.

This analysis is interesting and very instructive about long-term relationships. The lesson for the carbon debate is that it is possible to reduce emissions of a key byproduct of a modern economy, without sacrificing long-term growth. The analysis can and should be sharpened with econometric work to see when, and to what extent, the legislation has influenced GDP and GDP growth, as presented in the subsequent sections.

## 5. Econometric model and results

## **5.1 All Countries**

Table 1 gives the descriptive statistics for *per capita* GDP and *per capita* sulfur emissions for the 12 countries individually and for them as a group. Using the information from all countries, the panel data estimation technique is used to deal with inter-country heterogeneity in the analysis. An attractive facet of panel data is the creation of more variability by combining variation across countries with variation over time thus alleviating multi-collinearity problems and providing a more efficient estimation (Kennedy, 2000). Several other advantages of using the panel data are mentioned in the literature.

There are two panel data estimations: fixed effects and random effects. The fixed effects estimator allows the intercept to differ across the cross-section units by estimating different constants for each cross-section. The random effects model also assumes a different intercept for each cross-section, but the intercepts are interpreted in a different manner. This model considers the intercepts as having been drawn from a 'bowl' of possible intercepts. Consequently, these intercepts may be taken as random and treated as if they were part of the error term. As a result, the specification has an overall intercept, a set of explanatory variables with their respective coefficients, and a composite error term. The composite error has two parts: a random intercept term and the traditional random error (Kennedy, 2000). To determine which estimation method is appropriate given the available information, we begin by testing the null hypothesis that the intercepts are equal. If the null is accepted, the data are pooled and Ordinary Least Squares (OLS) is the appropriate estimation method to employ. If the null hypothesis is rejected, a Hausman test is applied to test if the random effects estimator is unbiased – this means that there is no correlation between the composite error and the regressor. If the null is accepted, the fixed effects estimator is used; if the null is rejected, the fixed effects estimator is used.

Most studies model the emissions as a quadratic or cubic function of per capita income. However, this paper establishes the model based on the general distribution of the raw data. Figure 1 shows the plot of per capita income against per capita sulfur emissions in all of the twelve countries. The appropriate order of the function is not very clear from visually inspecting the data; hence, country-level emissions were modeled in two ways: as a quadratic function of per capita income, and as a 4<sup>th</sup> order polynomial function of per capita income. Equations 1 and 2 give the two specifications. These will be compared later to determine which one is a better fit for the data.

$$SULFURPC_{it} = \beta_0 + \phi_j CS_i + \delta_k TS_i + \beta_2 GDPPC_{it} + \beta_3 GDPPC_{it}^2 + \varepsilon_{it}$$
(Eq. 1)

$$SULFURPC_{it} = \theta_0 + \varphi_j CS_i + \sigma_k TS_i + \theta_3 GDPPC_{it} + \theta_4 GDPPC_{it}^2$$

$$+ \theta_4 GDPPC_{it}^3 + \theta_4 GDPPC_{it}^4 + \mu_{it}$$
(Eq. 2)

where CSi - country dummy variable TSi - time dummy variable i - country = Austria, ..., UK t - year = 1870, 1871, ..., 1999

Note that other studies use only a dummy variable for time. However, this paper also included a dummy variable for each country in order to deal with the heterogeneity across countries.

Equations 1 and 2 were run and an F-test was performed on the country and time dummy variables to determine whether a pooled or panel regression is appropriate. The F-test rejects the null hypothesis of homogeneity across each country and each time period, which indicates that OLS is not applicable but panel data estimation via fixed effects or random effects. Then, the Hausman test was employed to test the null hypothesis that there is no correlation between the composite error and explanatory variables. Under the null hypothesis, the random effects model is applicable. The Hausman test rejected the null hypothesis, which means that the fixed effects model is appropriate. Therefore, only the fixed coefficient estimates are provided (Table 2).

Furthermore, the White Test was performed to test for heteroskedasticity. The null hypothesis of homoskedasticity was rejected, which means that even if the estimators remain unbiased, their significance is no longer reliable because the variance is biased. Therefore, a White heteroskedasticity consistent covariance estimator was used in the fixed effects model to generate standard errors that are robust to heteroskedasticity.

Based on the adjusted R-squared, the per capita emissions as a 4<sup>th</sup> order polynomial function of per capita income (Eq. 2) is a better fit for the available data on the 12 European countries. Figure 2 plots the predicted dependent variable against per capita income.3

#### **5.2 Individual countries**

Individual regressions were performed on each country to closely examine the environmental Kuznet's curve evidence at the country level. The model specifications used are the following:

<sup>&</sup>lt;sup>3</sup> The predicted dependent variable was derived by using the intercept and slope coefficients only.

$$SULFURPC_{it} = \alpha + \beta_1 GDPPC_{it} + \beta_2 GDPPC_{it}^2 + \varepsilon_{it}$$
(Eq. 3)

$$SULFURPC_{it} = \phi + \theta_1 GDPPC_{it} + \theta_2 GDPPC_{it}^2 + \theta_3 GDPPC_{it}^3 + \theta_4 GDPPC_{it}^4 + \mu_{it} \qquad (Eq. 4)$$

Ordinary Least Squares was used to estimate the above equations. Table 3 shows the summary of country-level coefficient estimates. The choice of the model for a given country was based on the following criteria: (a) comparing the relative magnitude of adjusted R-squared; and (b) testing the null hypothesis that the third and fourth order income terms are insignificantly different from zero. For 4 countries (Finland, Germany, Italy and Netherlands), Equation 3 was employed because: (a) its adjusted R-squared is higher relative to Equation 4; and (b) F-test on the  $3^{rd}$  and  $4^{th}$  order income variables are insignificantly different from zero at 10% level.

#### 5.3 United Kingdom data and air regulations

There is available information for United Kingdom on regulations focusing on air quality (see Annex Tables 3 and 4 for details). These regulations have a component targeted to reduce sulfur emissions, hence they were introduced as explanatory variables in the estimation to determine empirically their impact on sulfur emissions in the UK. The model specifications explored are those that capture the short-term effects of the regulation (Eq. 5) and the long run effects of the regulation (Eq. 6):

$$Sulfur = \alpha + \beta_1 GDPPC + \beta_2 GDPPC^2 + \beta_3 GDPPC^3 + \beta_4 GDPPC^4 + \theta_k AR_t + \varepsilon$$
(Eq. 5)

where  $AR_t - dummy$  variable for the *t* period when a particular air regulation was implemented;  $AR_t = 1$  if *t*; zero otherwise

*t* - year = 1874, 1926, 1956, 1968, 1972, 1974, 1979, 1980, ....

 $Sulfur = \phi_0 + \phi_1 GDPPC + \phi_2 GDPPC^2 + \phi_3 GDPPC^3 + \phi_4 GDPPC^4 + \sigma_k AR_t + \varepsilon$ (Eq. 6)

where  $AR_t$  – dummy variable; To represent the long-term effect of an implemented an air regulation, a dummy variable is introduced, where a value of "1" is assigned for the starting year of the regulation and the years after that; and "zero" otherwise.

*t* – start year = 1874, 1926, 1956, 1968, 1972, 1974, 1979, 1980, ....

Table 4 shows the regression results from Equation 5 and Equation 6. The coefficient estimates of per capita GDP variables from both equations are statistically significant at 1%.

Each dummy variable in Equation 5 was introduced to capture any **short-term effect** of a particular air regulation. This means that the effect of air regulation on sulfur emissions is experienced only in the year it was implemented. **Regression results show that only 2 of the dummy variables have coefficient estimates that are statistically significant at 10% level of significance.** These are for the air regulation implemented in *1926* and *1956*. In contrast, the dummy variables in Equation 6 intend to capture any **long-term effect** of a particular air

regulation, i.e., the regulation's impact is experienced on the year it was implemented and on the succeeding years. Regression results show that only 1 out of the 17 dummy variables have coefficient estimates that are statistically significant at 1% level of significance. This is for the air regulation implemented in 1926.

An F-test on the statistically insignificant coefficient estimates was performed to test the null hypothesis that the joint effect of the corresponding variables is insignificantly different from zero<sup>4</sup>. For both equations, the test result rejected the null hypothesis at 1% level of significance. This means that although each variable has insignificant individual effects, the said variables have a *collective* significant effect on the dependent variable (sulfur emissions). Furthermore, results from both equations accept the environmental Kuznets curve hypothesis - that there is an inverted U-shape relationship between an environmental degradation indicator (e.g., sulfur emission) and per capita income.

#### 5.4 Effect of Regulation on the Per Capita Income

The above analysis looks at how the sulfur regulations affected the environmental Kuznets curve and finds that, in general, the effects have been small with most regulations not having any effects on the sulfur/GDP relationship, but one (1926) reducing the amount of sulfur associated with a given level of GDP and one (1956) increasing the amount of sulfur associated with a given level of GDP. In neither case, however, has the direct relationship between GDP and the regulation been examined. This is done in below, where the short-term and long-term effects of the regulations on the per capita GDP growth of United Kingdom are estimated. The difference between short-term and long-term effects is provided by the assignment of dummy variables. The general model is as follows:

 $UK\_GDPPC = \beta_0 + \beta_1 t + \beta_2 t^2 + \beta_3 t^3 + \phi_j AR_j + \varepsilon$ (Eq. 7) where  $t - trend variable^5$  $AR_i$  – dummy variable for the *j* period when a particular air regulation was

implemented

For the short-term effect:

AR<sub>i</sub> = 1 if *j*; zero otherwise

*j* – year = 1874, 1926, 1956, 1968, 1972, 1974, 1979, 1980, ....

This means that the effect of air regulation on sulfur emissions is experienced only in the year it was implemented.

For the long-term effect:

- $AR_i 1$  is assigned for the starting year of the regulation and the years after that; and "zero" otherwise.
- $j \text{start year} = 1874, 1926, 1956, 1968, 1972, 1974, 1979, 1980, \dots$

<sup>&</sup>lt;sup>4</sup> From Eq. 5, Ho:  $\hat{\theta}_1 = \hat{\theta}_4 = ... = \hat{\theta}_{17} = 0$ ; from Eq. 6, Ho:  $\hat{\theta}_1 = \hat{\theta}_3 = ... = \hat{\theta}_{17} = 0$ <sup>5</sup> Higher order trend variables (e.g., t<sup>4</sup>, t<sup>5</sup>, ...) were found to be statistically insignificant.

This infers that the regulation's impact is experienced from the year it was implemented and carried over the succeeding years.

A check for the appropriate functional form, through Box-Cox regression, was conducted. This is done to find out if a linear or a semi-log functional form is more appropriate to examine the model described above. The null hypothesis of linearity (supporting a linear form) was accepted at 5% level of significance. Table 5 presents the regression results that capture the regulations' short-term and long-term effects. Significant coefficient estimates at 10% level were highlighted.<sup>6</sup>

The model that incorporates *the long-term effects of the regulations appears to be a better fit* for the available data based on the R-squared and Adjusted R-squared values, which are both higher relative to those of the model with short-term regulation effects. The trend variable in this model infers a sustained upward or downward movement in the behavior of per capita GDP. Results show that over the period 1870 to 1999, on average, the per capita GDP increased at the absolute rate of about 71 GK\$ per annum. Therefore, over the said period, there was an upward trend in per capita GDP. Now, looking at the regulation variables, the regulations that were implemented on 1980 and 1990 have a significant long-term negative impact on per capita GDP; while those that were implemented on 1985 and 1988 have a significant long-term positive impact.

It must be noted that interpreting the results in Table 5 should be treated with utmost caution because other variables that have significant influence on per capita GDP were not included in the estimation due to unavailability; for example, capital share, labor share, total factor productivity, etc. By not including these variables, the coefficient estimates are biased. Furthermore, there are other variables that may serve as proxy to environmental regulation such as government expenditures for pollution abatement and control.

## 6. Conclusions

This report has the following results:

- 6.1 For the 12 European countries as a whole, the appropriate relationship between per capita sulfur emissions and GDP is a fourth order polynomial and not a quadratic one. The best fit equation implies that
  - a. the fixed effects regression has a better fit than the random effects regression. With fixed effects, the intercept terms for each country are allowed to vary implying that the per capita sulfur emissions–GDP per capita relationship will differ from country to country by a shift factor;
  - b. the 'turning point for the sulfur-GDP relationship is much lower than previously thought around \$7,000 and not \$15,000; and
  - c. there is second turning point at a much higher income level about \$25,000, but with lower sulfur emissions.

<sup>&</sup>lt;sup>6</sup> Regression results for the semi-log model are presented in the Appendix.

- 6.2 The individual country regressions support a fourth order polynomial for all the countries except Austria, Finland, Germany, Italy and the Netherlands. Of these five, there is no relationship for Austria and for the other four, the relationship is a quadratic one. For the countries where there is a quadratic fit the turning point is between approximately \$10,000 and \$14,000; whereas for the countries with a fourth order fit, the turning point is between about \$5,000 and \$10,000.
- 6.3 For the UK, an analysis was carried out to see if regulations limiting sulfur emissions had an impact on the relationship between sulfur and GDP. Individually only two regulations had any impact – the one in 1926 reduced the amount of sulfur associated with a given level of GDP and one in 1956 increased the amount of sulfur associated with a given level of GDP. The other regulations did not have any impact although as a group all the regulations did shift the Kuznets curve down.
- 6.4 An attempt was made to see if there was any direct relationship between GDP and the sulfur regulations. The simple trend analysis showed no impact for most regulations. The regulations that were implemented on 1980 and 1990 have a significant long-term negative impact on per capita GDP; while those that were implemented on 1985 and 1988 have a significant long-term positive impact. These results should be treated with utmost caution because other variables that have significant influence on per capita GDP were not included in the estimation. Excluding these variables in the estimation will yield biased coefficient estimates. Also, there are other variables that may serve as proxy to environmental regulation; for example, pollution abatement and control expenditures by the government.
- 6.5 In general, the regression results support the view that a sharp decline in sulfur emissions in the latter part of the  $20^{\text{th}}$  century was consistent with continued growth in GDP, and the individual regulations limiting emissions did not have a major impact on the growth of GDP.
- 6.6 It is difficult to see why some countries show fourth order relationship without undertaking some further work. In some countries sulfur emissions declined earlier while GDP continued to grow, and then, there was a second phase of growth when emissions started to rise again. This needs further investigation. Also, further work is needed in terms of investigating the reasons why some air regulations have negative impacts on GDP. A closer examination of the institutional changes, technological changes and political economy changes that occurred over the years in the focus countries may be warranted.

Countries		Per capi	ta GDP			Per capit	a sulfur	
	Mean	Std	Max	Min	Mean	Std	Max	Min
		dev				dev		
All 12 countries	7,192	5,897	31,773	1,110	0.023	0.019	0.134	0.001
Austria	6,105	5,161	19,608	1,725	0.037	0.027	0.134	0.003
Belgium	7,031	4,897	19,978	2,682	0.029	0.009	0.049	0.009
Denmark	7,599	5,807	22,417	1,993	0.020	0.009	0.044	0.004
Finland	5,458	5,158	19,058	1,110	0.016	0.016	0.061	0.001
France	6,799	5,549	20,269	1,876	0.018	0.007	0.030	0.006
Germany	10,139	8,648	31,773	2,217	0.036	0.011	0.051	0.005
Italy	5,615	5,121	18,432	1,467	0.013	0.009	0.038	0.003
Netherlands	7,328	5,110	20,976	2,649	0.012	0.006	0.025	0.003
Norway	6,587	6,214	23,922	1,432	0.013	0.007	0.030	0.003
Switzerland	6,940	5,529	19,652	1,664	0.014	0.007	0.031	0.003
Sweden	9,076	6,607	21,886	2,176	0.011	0.006	0.026	0.002
United								
Kingdom	7,631	4,306	19,223	3,191	0.058	0.015	0.077	0.010

Table 1. Descriptive statistics.

Notes: Sulfur emission is measured in metric ton.

Table 2. Su	ummary of o	coefficient	estimates	from E	quations 1	and 2.
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Table 2. Summary of coefficient estimates from Equations 1 and 2.									
<b>Explanatory Variables</b>	Quadratic	4 <sup>th</sup> Order							
GDPPC	1.88E-06	1.83E-05							
$GDPPC^2$	-6.17E-11	-2.20E-09							
GDPPC <sup>3</sup>	-	1.00E-13							
GDPPC <sup>4</sup>	-	-1.52E-18							
Turning point of the peak	GK\$15236.33	GK\$7061.001							
Adjusted R-squared	0.65	0.69							
F-test statistic for no fixed	19.15	25.46							
effects (DF)	(140; 1417)	(140; 1415)							
Hausman test statistic for	180.22	140.25							
random effects (DF)	(2)	(4)							

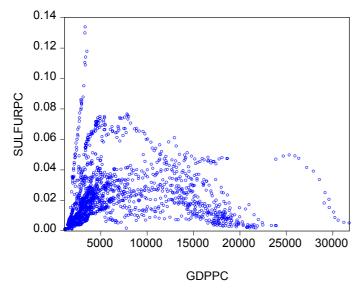
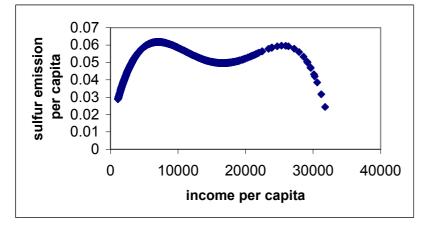


Figure 1. Plot of per capita income and per capita sulfur emission, all 12 countries.

Figure 2. Plot of predicted sulfur emission per capita and income per capita.



Countries		Coefficie	nt estimates		Maximum
	GDPPC	GDPPC <sup>2</sup>	GDPPC <sup>3</sup>	GDPPC <sup>4</sup>	
Quadratic M	odel				
Finland	1.10E-05	-5.30E-10	-	-	GK\$10,386
Germany	2.81E-06	-9.67E-11	-	-	GK\$14,553
Italy	7.31E-06	-3.61E-10	-	-	GK\$10,125
Netherlands	5.43E-06	-2.61E-10	-	-	GK\$10,418
4 <sup>th</sup> order Mod	del				
Countries	GDPPC	GDPPC <sup>2</sup>	GDPPC <sup>3</sup>	GDPPC <sup>4</sup>	Maximum
Austria	15.2E-6	-3.5E-9	256.6E-115	-6.2E-18	GK\$3,145
Belgium	2.52E-05	-2.96E-09	1.43E-13	-2.68E-18	GK\$7,894
Denmark	2.15E-05	-2.94E-09	1.70E-13	-3.54E-18	GK\$7,965
France	1.50E-05	-1.76E-09	8.889E-14	-1.80E-18	GK\$10,000
Norway	9.08E-06	-1.45E-09	8.44E-14	-1.66E-18	GK\$5,075
Sweden	2.39E-05	-4.12E-09	2.86E-13	-6.92E-18	GK\$5,439
Switzerland	2.33E-05	-3.47E-09	1.98E-13	-3.91E-18	GK\$6,089
UK	3.71E-05	-5.05E-09	2.62E-13	-4.95E-18	GK\$6,183

Table 3. Summary of coefficient estimates, country level.

 Table 4. Regression results, impact of per capita income and air regulations

 on sulfur emissions in the United Kingdom.

		ant Taum	UK-Long Term			
Variable		ort Term				
	Coefficient	t-Statistic	Coefficient	t-Statistic		
Constant	-4.10E+03	-6.49E+00	-1.87E-02	-1.11E+00		
UK_GDPPC	2.76E+00	8.63E+00	3.05E-05	3.15E+00		
UK_GDPPC <sup>2</sup>	-3.41E-04	-6.24E+00	-2.83E-09	-1.53E+00		
UK_GDPPC <sup>3</sup>	1.69E-08	4.45E+00	5.98E-14	4.16E-01		
UK_GDPPC <sup>4</sup>	-3.08E-13	-3.39E+00	7.51E-19	1.99E-01		
AR1874	-1.47E+02	-6.02E-01	1.20E-03	4.97E-01		
AR1926	-1.30E+03	-5.39E+00	-1.23E-02	-7.34E+00		
AR1956	4.08E+02	1.68E+00	3.11E-03	1.27E+00		
AR1968	1.80E+02	7.33E-01	-4.76E-03	-1.45E+00		
AR1972	-2.13E+02	-8.67E-01	-1.30E-03	-3.26E-01		
AR1974	-1.61E+02	-6.58E-01	1.67E-04	4.62E-02		
AR1979	4.28E+01	1.73E-01	3.42E-03	6.85E-01		
AR1980	7.21E+01	2.92E-01	-4.36E-03	-9.67E-01		
AR1985	-1.75E+02	-6.98E-01	4.71E-03	9.27E-01		
AR1988	3.49E+02	1.35E+00	3.87E-03	6.05E-01		
AR1989	3.57E+02	1.38E+00	-8.42E-04	-1.42E-01		
AR1990	3.70E+02	1.43E+00	-1.63E-03	-3.37E-01		
AR1993	4.48E+01	1.73E-01	-4.14E-03	-8.62E-01		
AR1994	-1.55E+01	-5.92E-02	-3.95E-03	-5.99E-01		
AR1995	-6.63E+01	-2.52E-01	-5.57E-03	-8.96E-01		
AR1997	-1.35E+02	-4.71E-01	-9.89E-03	-1.11E+00		
AR1999	-5.39E+01	-1.54E-01	-8.29E-03	-1.04E+00		
R-squared	0.91		0.94			
Adjusted R-squared	0.89		0.93			

	Short	: Term Eff	ect	Long	g Term Effe	ct
Variable	Coefficient	t-Statistic	Prob.	Coefficient	t-Statistic	Prob.
Constant	2987.58	22.89	1.93E-43	3129.16	18.68	9.05E-36
Т	66.12	7.52	1.69E-11	74.00	4.20	5.54E-05
T2	-1.13	-7.05	1.69E-10	-1.26	-2.96	0.00
Т3	0.01	14.49	3.62E-27	0.01	4.48	1.88E-05
AR1874	94.61	0.27	0.79	-268.38	-1.16	0.25
AR1926	-380.73	-1.10	0.27	31.68	0.18	0.86
AR1956	-240.09	-0.69	0.49	-34.33	-0.17	0.87
AR1968	243.25	0.70	0.48	331.71	1.44	0.15
AR1972	293.56	0.85	0.40	363.07	1.26	0.21
AR1974	413.77	1.19	0.23	-251.06	-0.88	0.38
AR1979	512.36	1.47	0.14	230.76	0.63	0.53
AR1980	17.62	0.05	0.96	-805.51	-2.19	0.03
AR1985	-144.30	-0.41	0.68	472.43	1.73	0.09
AR1988	915.34	2.59	0.01	753.97	1.97	0.05
AR1989	895.91	2.52	0.01	-17.90	-0.04	0.97
AR1990	583.04	1.63	0.11	-864.07	-2.25	0.03
AR1993	-459.92	-1.27	0.21	-486.72	-1.27	0.21
AR1994	-146.27	-0.40	0.69	314.63	0.68	0.50
AR1995	-86.42	-0.24	0.81	78.06	0.19	0.85
AR1997	141.58	0.38	0.71	257.74	0.76	0.45
AR1999	214.50	0.56	0.57	28.01	0.07	0.94
Trend coef.						
estimate	73.3970			70.76279		
R-squared	0.9947			0.9952		
Adjusted R-	0.7717			0.7752		
squared	0.9937			0.9943		

Table 5. Regression results, impact of air regulations on per capita income.

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#### ANNEX 1 Raw Data

Annex Table 1. Per capita GDP in 12 European countries, annual estimates 1820-2001 (1990 "international" Geary-Khamis dollars).

(1990 "international" Geary-Khamis dollars).												
	Austria	Belgium	Denmark	Finland	France	Germany	Italy	Netherlds.	Norway	Sweden	Switzerl.	UK
1820	1,287	1,319	1,274	781	1,230	1,077	1,117	1,821	1,104	1,198	1,280	1,707
1850	1,650	1,847	1,767	909	1,685	1,428	1,292	2,373	1,187	1,289	1,710	2,310
1870	1,863	2,692	2,003	1,140	1,876	1,839	1,499	2,758	1,432	1,664	2,202	3,191
1871	1,979	2,682	1,993	1,127	1,899	1,817	1,506	2,734	1,445	1,684	2,176	3,345
1872	1,976	2,824	2,087	1,145	2,078	1,931	1,475	2,771	1,527	1,746	2,312	3,319
1873	1,913	2,820	2,057	1,193	1,922	1,999	1,524	2,853	1,548	1,885	2,394	3,365
1874	1,981	2,890	2,096	1,204	2,157	2,124	1,513	2,727	1,586	1,938	2,543	3,386
1875	1,973	2,861	2,112	1,211	2,219	2,112	1,550	2,880	1,615	1,835	2,529	3,434
1876	2,000	2,875	2,130	1,259	2,028	2,071	1,506	2,890	1,639	1,935	2,480	3,430
1877	2,050	2,884	2,046	1,211	2,127	2,033	1,493	2,927	1,626	1,851	2,434	3,425
1878	2,100	2,942	2,102	1,173	2,091	2,103	1,506	2,991	1,555	1,818	2,518	3,403
1879	2,068	2,945	2,149	1,167	1,953	2,029	1,514	2,778	1,554	1,769	2,430	3,353
1880	2,079	3,065	2,181	1,155	2,120	1,991	1,581	3,046	1,588	1,846	2,384	3,477
1881	2,145	3,070	2,183	1,110	2,194	2,025	1,467	3,074	1,597	1,851	2,425	3,568
1882	2,140	3,136	2,240	1,203	2,288	2,044	1,584	3,117	1,593	1,924	2,447	3,643
1883	2,209	3,145	2,299	1,230	2,288	2,143	1,568	3,305	1,588	1,937	2,566	3,643
1884	2,248	3,136	2,285	1,219	2,253	2,178	1,566	3,328	1,611	1,976	2,608	3,622
1885	2,215	3,138	2,274	1,231	2,207	2,216	1,584	3,362	1,618	1,951	2,653	3,574
1886	2,268	3,153	2,336	1,276	2,237	2,211	1,643	3,374	1,616	1,929	2,647	3,600
1887	2,404	3,250	2,395	1,276	2,249	2,275	1,678	3,467	1,624	1,926	2,724	3,713
1888	2,379	3,247	2,389	1,302	2,269	2,341	1,662	3,544	1,690	1,971	2,803	3,849
1889	2,337	3,379	2,400	1,327	2,322	2,379	1,579	3,502	1,743	2,065	2,849	4,024
1890	2,443	3,428	2,523	1,381	2,376	2,428	1,667	3,323	1,777	2,086	2,907	4,009
1891	2,506	3,395	2,555	1,350	2,432	2,397	1,651	3,224	1,778	2,105	2,870	3,975
1892	2,535	3,442	2,598	1,280	2,493	2,469	1,548	3,240	1,806	2,144	2,956	3,846
1893	2,525	3,455	2,629	1,341	2,535	2,565	1,609	3,236	1,844	2,143	3,071	3,811
1894	2,645	3,468	2,657	1,399	2,626	2,598	1,576	3,273	1,832	2,171	3,111	4,029
1895	2,688	3,512	2,770	1,492	2,569	2,686	1,592	3,334	1,827	2,257	3,216	4,118
1896	2,701	3,551	2,836	1,570	2,685	2,740	1,627	3,166	1,857	2,367	3,281	4,249
1897	2,730	3,586	2,863	1,624	2,639	2,775	1,545	3,436	1,923	2,429	3,326	4,264
1898	2,855	3,615	2,870	1,668	2,760	2,848	1,672	3,460	1,900	2,457	3,410	4,428
1899	2,886	3,656	2,952	1,607	2,911	2,905	1,700	3,465	1,927	2,491	3,511	4,567
1900	2,882	3,731	3,017	1,668	2,876	2,985	1,785	3,424	1,937	2,561	3,580	4,492
1901	2,864	3,719	3,104	1,636	2,826	2,871	1,890	3,440	1,967	2,515	3,644	4,450
1902	2,945	3,739	3,141	1,591	2,775	2,893	1,821	3,543	1,990	2,496	3,704	4,525
1903	2,941	3,772	3,290	1,686	2,831	3,008	1,893	3,562	1,971	2,669	3,761	4,440
1904	2,956	3,821	3,326	1,731	2,847	3,083	1,896	3,535	1,961	2,680	3,817	4,428
1905	3,090	3,882	3,346	1,742	2,894	3,104	1,984	3,594	1,974	2,691	3,932	4,520
1906	3,176	3,917	3,402	1,794	2,943	3,152	2,042	3,669	2,037	2,845	3,924	
1907	3,338	3,932	3,486	1,834	3,070	3,245	2,254	3,622	2,104	2,885		4,679
1908	3,320	3,933	3,552	1,829	3,045	3,254	2,288	3,577	2,157	2,853		4,449
1909	3,276	3,971	3,643	1,884	3,167	3,275	2,444	3,660	2,195	2,808	4,077	
1910	3,290	4,064	3,705	1,906	2,965	3,348	2,332	3,789	2,256	2,980	4,125	

			Donmork		•						Switzerl	UK
1011			Denmark		· · · · ·		Italy	Netherlds.		î		
1911	3,365	4,148	3,857	1,939	3,250	3,408	2,461	3,888	2,309	3,002		
1912	3,505	4,206	3,812	2,022	3,514	3,524	2,465	3,955	2,392	3,064		4,762
1913	3,465	4,220	3,912	2,111	3,485	3,646	2,564	4,049	2,501	3,096		4,921
1914	2,876	3,923	4,110	2,001	3,236	3,059	2,543	3,868	2,530	3,048		4,927
1915	2,653	3,858	3,778	1,882	3,248	2,899	2,810	3,926	2,611	3,028		5,288
1916	2,628	4,080	3,891	1,893	3,463	2,935	3,139	3,956	2,669	2,968		5,384
1917	2,586	3,519	3,617	1,581	2,979	2,952	3,301	3,627	2,399	2,584		5,421
1918	2,555	2,861	3,459	1,370	2,396	<u>2,983</u>	3,392	3,352	2,286	2,532		5,459
1919	2,259	3,389	3,860	1,658	2,811	2,586	2,845	4,122	2,647	2,669	4,060	4,870
1920	2,412	3,962	3,992	1,846	3,227	2,796	2,587	4,220	2,780	2,802		4,548
1921	2,650	4,056	3,826	1,884	3,075	3,078	2,528	4,431	2,518	2,674		4,439
1922	2,877	4,413	4,166	2,058	3,610	3,331	2,631	4,599	2,784	2,906		4,637
1923	2,842	4,533	4,559	2,187	3,754	2,750	2,763	4,635	2,826	3,047		4,760
1924	3,163	4,638	4,528	2,224	4,179	3,199	2,765	4,895	2,796	3,130		4,921
1925	3,367	4,666	4,378	2,328	4,166	3,532	2,921	5,031	2,949	3,233		5,144
1926	3,413	4,784	4,598	2,392	4,249	3,605	2,926	5,358	2,996	3,404		4,936
1927	3,505	4,923	4,658	2,557	4,154	3,941	2,838	5,504	3,098	3,500		5,315
1928	3,657	5,139	4,785	2,707	4,431	4,090	3,016	5,720	3,188	3,656		5,357
1929	3,699	5,054	5,075	2,717	4,710	4,051	3,093	5,689	3,472	3,869		5,503
1930	3,586	4,979	5,341	2,666	4,532	3,973	2,918	5,603	3,712	3,937	6,246	
1931	3,288	4,860	5,359	2,581	4,235	3,652	2,877	5,185	3,404	3,782		5,138
1932	2,940	4,607	5,169	2,550	3,959	3,362	2,948	5,035	3,609	3,666		5,148
1933	2,833	4,681	5,291	2,702	4,239	3,556	2,906	4,956	3,674	3,721		5,277
1934	2,852	4,624	5,402	2,988	4,192	3,858	2,894	4,805	3,771	3,991		5,608
1935	2,907	4,894	5,480	3,093	4,086	4,120	3,148	4,929	3,912	4,232		5,799
1936	2,995	4,913	5,575	3,279	4,244	4,451	3,130	5,190	4,130	4,465		6,035
1937	3,156	4,961	5,668	3,441	4,487	4,685	3,319	5,433	4,255	4,664	6,171	6,218
1938	3,559	4,832	5,762	3,589	4,466	4,994	3,316	5,250	4,337	4,725	6,390	6,266
1939	4,096	5,150	5,993	3,408	4,793	5,406	3,521	5,544	4,516	5,029	6,360	6,262
1940	3,959	4,562	5,116	3,220	4,042	5,403	3,505	4,831	4,088	4,857	6,397	6,856
1941	4,217	4,358	4,574	3,322	3,309	5,711	3,432	4,531	4,163	4,914	6,312	7,482
1942	3,983	3,997	4,629	3,327	2,981	5,740	3,369	4,107	3,976	5,179	6,107	7,639
1943	4,065	3,907	5,080	3,697	2,860	5,890	3,039	3,981	3,867	5,360		7,744
1944	4,152	4,112	5,543	3,685	2,422	6,084	2,463	2,649	3,631	5,484	6,089	7,405
1945	1,725	4,333	5,066	3,450	2,573	<u>4,514</u>	1,922	2,686	4,029	5,568		7,056
1946	1,956	4,574	5,777	3,683	3,855	2,217	2,502	4,457	4,409	6,102	8,181	6,745
1947	2,166	4,800	6,035	3,717	4,138	2,436	2,920	5,048	4,855	6,175	9,050	6,604
1948	2,764	5,024	6,133	3,957	4,393	2,834	3,063	5,490	5,182	6,292	9,116	6,746
1949	3,293	5,193	6,494	4,143	4,946	3,282	3,265	5,880	5,230	6,455	8,757	6,956
1950	3,706	5,462	6,946	4,253	5,270	3,881	3,502	5,996	5,463	6,738	9,064	6,907
1951	3,959	5,747	6,936	4,572	5,553	4,207	3,738	6,032	5,663	6,951	9,684	7,083
1952	3,967	5,668	6,955	4,674	5,659	4,550	3,997	6,084	5,809	6,996		
1953	4,137	5,818	7,292	4,652	5,783	4,900	4,260	6,542	6,016	7,145		7,304
1954	4,555	6,029	7,371	5,001	6,020	5,242	4,449	6,906	6,253	7,403	10,287	
1955	5,053	6,280	7,395	5,197	6,312	5,788	4,676	7,326	6,311	7,566		7,826
1956	5,397	6,422	7,393	5,295	6,568	6,164	4,859	7,320	6,577	7,797	11,439	
1957	5,716	6,495	7,965	5,490	6,890	6,482	5,118	7,614	6,706	8,089	11,705	1,982

Annex Table 1 (continued). Per capita GDP in 12 European countries...

Nustria         Belgium         Denmark         Finand         France Germany         Italy         Netherids         Norway         Sweden				minucu	<u></u>	capita			opean e	Junin			
1959         6,051         6,608         8,561         5,753         7,116         7,176         5,653         7,736         6,865         8,279         11,870         8,208           1960         6,518         6,753         9,307         6,568         7,807         7,803         7,317         1,309         8,857           1961         6,226         7,533         9,747         6,620         8,203         7,573         9,137         1,309         8,857           1964         7,567         8,341         10,560         7,366         9,010         8,217         7,476         9,439         8,300         10,514         14,191         9,568           1965         7,747         6,517         11,161         7,824         9,756         9,387         7,914         9,938         8,416         10,941         9,429         11,218         10,041         10,249         14,727         9,855         11,351         10,404         9,527         11,462         9,041         10,513         10,401         10,491         10,611         10,629         1,574         10,410         10,611         10,557         11,601         10,611         10,657         12,110         10,424         12,761         10,401		Austria	Belgium	Denmark	Finland	France	Germany	Italy	Netherlds.	Norway	Sweden	Switzerl.	UK
1960         6,518         6,953         8,812         6,230         7,533         7,635         5,916         8,289         7,200         8,688         12,457         8,645           1961         6,526         7,253         9,007         6,568         7,835         9,608         13,738         9,468         13,358         8,868         5,836         7,878         9,917         13,710         9,149           1964         7,734         8,523         10,560         7,360         9,010         8,221         7,476         9,438         8,300         10,511         14,191         9,568           1965         7,734         8,523         10,560         7,669         9,362         9,857         7,914         9,938         9,571         10,510         10,499           1966         8,112         8,776         11,161         7,824         9,756         9,387         7,914         9,938         9,557         11,520         10,420         9,257         11,428         9,401         10,503         10,471         11,420         10,421         12,424         1,328         10,321         10,471         11,420         10,421         12,441         13,52         10,471         11,503         13,537	1958	5,907	6,442	8,095	5,474	6,988	6,731	5,360	7,482	6,587	8,076	11,297	7,932
1961         6,826         7,253         9,307         6,668         7,880         7,322         6,372         8,203         7,573         9,137         13,099         8,857           1962         7,683         9,747         6,820         8,224         8,643         7,783         9,461         13,564         8,686           1963         7,167         7,863         9,731         6,994         8,535         8,363         7,255         8,834         7,978         9,917         13,710         9,149           1966         7,174         8,523         10,966         7,669         9,362         9,145         10,341         4,291         1,216         15,010         10,049           1966         8,112         8,776         11,161         7,824         9,065         9,063         10,893         9,557         11,626         15,374         10,410           1968         8,211         11,135         10,449         9,869         11,961         10,291         12,766         16,311         10,52           1970         10,748         10,611         12,685         9,571         11,461         10,057         12,591         10,481         10,021         12,761         13,302         11	1959	6,051	6,608	8,561	5,753	7,116	7,176	5,653	7,736	6,865	8,279	11,870	8,208
1962         6,950         7,583         9,747         6,820         8,254         8,200         6,822         8,643         7,738         9,468         13,354         8,865           1963         7,757         8,341         10,560         7,066         9,010         8,221         7,476         9,439         8,000         10,514         14,101         9,568           1966         7,734         8,523         10,560         7,066         9,022         9,185         7,580         9,777         10,815         14,504         9,752           1966         8,112         8,776         11,181         7,946         9,372         10,414         9,429         11,52         15,374         10,401           1968         8,221         9,411         11,837         8,094         10,489         9,689         11,867         10,024         12,746         16,094         10,767           1971         10,719         10,503         1,354         1,464         10,057         12,597         10,624         12,746         13,942         13,920           1972         10,771         11,503         13,752         11,361         14,441         10,057         12,597         10,484         14,202	1960	6,518	6,953	8,812	6,230	7,543	7,685	5,916	8,289	7,200	8,688	12,457	8,645
1963       7,187       7,863       9,731       6,944       8,535       8,633       7,255       8,834       7,978       9,917       13,710       9,149         1964       7,567       8,441       10,560       7,060       9,010       8,221       7,476       9,439       8,000       10,514       14,191       9,568         1966       8,112       8,776       11,161       7,824       9,786       9,387       7,914       9,936       8,641       10,937       14,727       9,885         1966       8,122       9,415       11,837       8,044       10,497       9,865       9,063       10,893       9,557       15,62       15,374       10,410         1969       9,131       10,018       12,525       8,877       11,135       10,449       9,689       11,967       10,022       12,716       16,904       10,752         1971       10,703       13,537       10,447       12,547       11,418       10,057       12,391       10,424       12,749       13,420       12,041       13,022       17,76       11,200         1973       11,525       13,731       13,637       14,421       13,625       11,410       13,626       12,411       <	1961	6,826	7,253	9,307	6,658	7,880	7,932	6,372	8,203	7,573	9,137	13,099	8,857
1964         7,567         8,341         10,560         7,30         9,010         8,821         7,476         9,439         8,300         10,514         14,191         9,568           1966         8,112         8,776         11,161         7,824         9,756         9,397         7,914         9,936         8,941         10,937         14,727         9,885           1966         8,112         8,776         11,143         7,824         9,397         8,416         10,341         9,429         11,218         15,010         10,010           1967         9,371         10,018         12,525         8,677         11,155         10,440         9,689         11,627         10,229         2,716         16,904         10,572           1970         9,748         10,611         12,685         9,765         11,181         10,057         12,319         10,424         12,749         17,326         10,907           1971         10,503         13,537         10,447         12,261         11,069         13,402         11,246         13,402         17,776         11,206           1974         11,656         12,457         13,451         14,601         13,485         14,421         13,652 <td>1962</td> <td>6,950</td> <td>7,583</td> <td>9,747</td> <td>6,820</td> <td>8,254</td> <td>8,200</td> <td>6,822</td> <td>8,643</td> <td>7,738</td> <td>9,468</td> <td>13,354</td> <td>8,865</td>	1962	6,950	7,583	9,747	6,820	8,254	8,200	6,822	8,643	7,738	9,468	13,354	8,865
1965         7,734         8,523         10,956         7,669         9,362         9,185         7,580         9,797         8,677         10,815         14,504         9,752           1966         8,217         9,771         11,143         7,946         0,327         7,914         10,334         9,429         11,218         15,010         10,049           1968         8,221         9,415         11,337         8,094         10,429         9,665         9,063         10,833         9,557         11,562         15,374         10,410           1969         9,131         10,018         12,525         8,877         11,185         10,440         9,527         11,462         9,904         12,052         16,031         10,552           1971         10,199         10,969         12,934         9,765         12,181         10,057         12,297         10,878         13,032         17,776         11,200         13,537         11,440         13,452         11,241         13,452         11,241         13,452         11,241         13,452         11,721         13,553         14,461         13,562         14,242         13,171         14,453         14,451         13,553         14,657         13,351	1963	7,187	7,863	9,731	6,994	8,535	8,363	7,255	8,834	7,978	9,917	13,710	9,149
1966         8.112         8.776         11,161         7.824         9.756         9.387         7.914         9.936         8.941         10.937         14.727         9.885           1967         8.207         9.071         11.437         7.946         10.128         9.397         8.416         10.341         9.425         15.374         10.040           1968         9.131         10.018         12.525         8.877         11.135         10.404         9.527         11.462         9.904         12.055         16.031         10.552           1970         9.748         10.611         12.685         9.578         11.668         10.449         9.669         11.967         10.029         12.716         16.904         10.767           1971         10.701         11.503         13.537         10.447         12.547         11.481         10.667         11.246         13.493         18.204         12.022           1973         11.268         12.441         13.621         11.440         13.262         12.247         17.836         10.767         13.367         12.805         14.222         17.171         12.133           11779         13.450         14.657         13.545	1964	7,567	8,341	10,560	7,306	9,010	8,821	7,476	9,439	8,300	10,514	14,191	9,568
1967         8.297         9.071         11,436         7.946         10,218         9.397         8.416         10.341         9.429         11.218         15.010         10.049           1968         8.621         9.415         11.837         8.044         10.497         9.665         9.063         10.833         9.557         11.626         9.041         10.015         15.025         16.031         10.512           1970         9.748         10.011         12.685         9.578         11.681         10.849         9.689         11.967         10.029         12.745         16.034         10.757           1971         10.199         10.969         12.934         9.765         12.181         11.087         9.827         12.319         10.424         12.749         17.362         10.771           11.503         13.752         11.360         13.752         11.361         13.752         12.661         10.067         12.597         10.781         14.84         17.223         11.845           1797         12.200         13.122         14.465         13.752         13.651         11.750         13.856         11.750         13.876         12.851           12.767         13.164	1965	7,734	8,523	10,956	7,669	9,362	9,185	7,580	9,797	8,677	10,815	14,504	9,752
1968         8,621         9,415         11,837         8,094         10,497         9,865         9,063         10,893         9,557         11,662         15,374         10,410           1969         9,131         10,018         12,255         8,877         11,135         10,440         9,527         11,462         9,044         12,055         16,031         10,571           1971         10,199         10,060         12,934         9,765         12,118         11,078         9,827         12,319         10,424         12,749         17,382         10,937           1972         10,771         11,503         13,537         10,447         12,547         11,481         10,057         12,597         10,878         13,002         17,76         11,290           1973         11,664         12,441         13,357         10,447         13,420         12,041         13,362         12,181         14,184         17,223         11,845           1976         12,200         13,122         14,453         13,071         14,101         13,832         12,950         14,222         17,171         12,113           1977         12,767         13,100         14,657         11,558         14,667	1966	8,112	8,776	11,161	7,824	9,756	9,387	7,914	9,936	8,941	10,937	14,727	9,885
1969         9,131         10,018         12,525         8,877         11,135         10,440         9,527         11,462         9,044         12,055         16,031         10,552           1970         9,748         10,611         12,685         9,578         11,068         10,499         10,021         12,116         10,027         12,319         10,424         12,749         17,382         10,937           1971         10,199         10,909         12,934         9,765         12,118         11,065         12,597         10,878         13,022         17,76         11,290           1973         11,255         12,170         13,945         11,040         13,220         12,061         11,069         13,495         14,493         18,204         12,022           1974         11,665         12,441         13,621         11,440         13,265         12,681         11,110         13,862         14,223         17,171         12,113           1976         12,200         13,454         14,826         11,558         14,667         13,450         14,422         13,051         14,020         17,661         12,825           1979         13,449         13,861         15,272         12,481	1967	8,297	9,071	11,436	7,946	10,128	9,397	8,416	10,341	9,429	11,218	15,010	10,049
1970       9,748       10,611       12,685       9,578       11,686       10,849       9,689       11,967       10,029       12,716       16,904       10,777         1971       10,199       10,969       12,934       9,765       12,118       11,078       9,827       12,319       10,424       12,749       17,382       10,937         1972       11,255       11,250       13,945       11,261       11,085       13,123       11,069       13,495       11,759       13,846       18,204       12,022         1974       11,658       12,643       13,752       11,360       13,420       12,061       11,069       13,495       11,759       13,886       18,414       11,855         1976       12,200       13,122       14,465       11,358       13,752       13,611       11,410       13,882       12,960       14,202       17,711       12,113         1977       12,767       13,190       14,657       11,354       14,203       14,070       13,886       14,410       13,882       14,209       17,661       12,825         1979       13,449       13,861       15,313       14,970       13,984       14,423       14,409       14,876       15,207	1968	8,621	9,415	11,837	8,094	10,497	9,865	9,063	10,893	9,557	11,562	15,374	10,410
1971       10,199       10,969       12,934       9,765       12,118       11,078       9,827       12,319       10,424       12,479       17,382       10,937         1972       10,771       11,503       13,537       10,447       12,547       11,481       10,057       12,597       10,878       13,002       17,776       11,290         1973       11,658       12,643       13,752       11,360       13,420       12,061       11,069       13,495       11,759       13,886       18,444       14,856         1975       11,646       12,441       13,621       11,440       13,266       12,061       11,369       14,141       13,367       14,164       17,723       11,845         1976       12,200       13,122       14,466       11,558       13,671       14,169       14,174       13,357       14,005       17,661       12,825         1977       13,440       14,667       15,257       13,453       12,083       14,422       13,905       14,206       17,661       12,825         1979       13,446       14,677       15,277       12,948       15,103       14,470       14,603       14,271       18,040       15,281       14,646       15,	1969	9,131	10,018	12,525	8,877	11,135	10,440	9,527	11,462	9,904	12,055	16,031	10,552
197210,77111,50313,53710,47412,54711,48110,05712,59710,87813,00217,77611,290197311,25512,17013,94511,08513,12311,96610,64313,08211,24613,49318,20412,022197411,65812,64313,75211,36013,40512,06111,06913,49511,75913,88618,41411,856197511,64612,44113,56111,35413,78512,68111,14013,86212,95014,28217,17112,113197612,20013,12214,46511,35813,78512,68111,41013,88212,95014,28217,17112,131197712,73113,55414,86711,35814,67713,98912,73114,64314,40014,72118,05013,164198013,70014,46715,22712,94815,10314,11313,15314,40015,12814,93618,76012,959198113,70114,47715,05713,34415,17314,14613,94214,20115,12814,93618,66412,960198213,95914,46615,56313,48515,67714,32913,32014,47815,68015,13114,164198414,07714,96615,56313,48515,13114,11015,28617,92115,05818,66412,960198514,17114,946<	1970	9,748	10,611	12,685	9,578	11,668	10,849	9,689	11,967	10,029	12,716	16,904	10,767
1973       11,235       12,170       13,945       11,085       13,123       11,966       10,643       13,082       11,246       13,493       18,204       12,022         1974       11,658       12,643       13,752       11,360       13,420       12,061       11,069       13,495       11,759       13,886       18,414       11,856         1975       11,646       12,441       13,621       11,440       13,266       12,041       10,767       13,367       12,181       14,184       17,223       11,845         1976       12,200       13,122       14,657       13,453       12,083       14,422       13,055       14,265       12,361       14,174       13,357       14,060       14,721       18,050       13,164         1978       12,731       13,456       15,531       12,313       14,970       13,989       12,731       14,660       14,721       18,050       13,164         1980       13,710       14,427       15,095       13,144       15,173       14,146       13,198       14,524       15,281       14,910       15,288       15,158       18,644       12,960         1983       14,367       14,467       15,563       13,445       1	1971	10,199	10,969	12,934	9,765	12,118	11,078	9,827	12,319	10,424	12,749	17,382	10,937
197411,65812,64313,75211,36013,42012,06111,06913,49511,75913,88618,41411,856197511,64612,44113,62111,44013,26612,04110,76713,36712,18114,18417,22311,845197612,20013,12214,46511,35813,78512,68111,41013,88212,95014,28217,17112,113197712,76713,15014,65711,55414,65713,45312,08314,42213,05514,06112,825197812,73113,55414,86211,55814,56713,45312,08314,42213,05514,60112,825197913,44913,86115,51312,33114,97013,98912,73114,64314,40014,72118,05013,164198013,70014,46715,22712,94815,10314,11313,15314,70015,12814,93618,78012,928198113,71014,26715,05713,74515,17314,14613,19814,52415,22114,91718,94612,754198213,95914,46615,56313,48515,76114,32913,39214,47815,68015,31518,64413,406198414,40714,80916,67514,70414,51115,22214,91714,94613,727198514,77714,94617,38314,52115,731<	1972	10,771	11,503	13,537	10,447	12,547	11,481	10,057	12,597	10,878	13,002	17,776	11,290
197511,64612,44113,62111,44013,26612,04110,76713,36712,18114,18417,22311,845197612,20013,12214,46511,35813,78512,68111,14013,88212,95014,28217,17112,113197712,76713,19014,65711,35414,23513,07111,69014,17413,35714,00517,66112,825197913,44913,86115,31312,33114,97013,98912,73114,64314,46014,72118,05013,164198013,76014,46715,22712,94815,10314,11313,15314,70015,12214,93618,78012,928198113,71014,42715,09513,13415,17314,14613,19814,52415,22114,91718,94612,754198213,95914,46615,56313,48515,66614,04013,24214,20015,12215,05818,61413,060198314,40714,66715,66313,45115,76714,32913,39214,47815,68015,31518,61413,060198414,40714,66915,66314,12015,72314,72714,82716,55315,91919,11013,709198514,71714,94617,38314,52115,68615,14114,11015,26217,92316,53319,87714,727198615,615<	1973	11,235	12,170	13,945	11,085	13,123	11,966	10,643	13,082	11,246	13,493	18,204	12,022
1976       12,200       13,122       14,465       11,358       13,785       12,681       11,410       13,882       12,950       14,282       17,171       12,113         1977       12,767       13,190       14,657       11,354       14,235       13,071       11,690       14,174       13,357       14,005       17,636       12,381         1978       12,731       13,554       14,826       11,558       14,657       13,453       12,083       14,422       13,905       14,209       17,661       12,825         1979       13,449       13,861       15,313       12,331       14,970       13,989       12,731       14,663       14,460       14,721       18,050       13,164         1980       13,760       14,467       15,227       12,948       15,103       14,113       13,153       14,700       15,128       14,936       18,764       12,928         1981       13,710       14,276       15,967       13,746       15,661       14,040       13,242       14,920       15,155       18,614       13,406         1983       14,367       14,457       15,667       13,745       13,730       14,487       16,553       15,151       18,041       1	1974	11,658	12,643	13,752	11,360	13,420	12,061	11,069	13,495	11,759	13,886	18,414	11,856
1977       12,767       13,190       14,657       11,354       14,235       13,071       11,690       14,174       13,357       14,005       17,636       12,881         1978       12,731       13,554       14,826       11,558       14,567       13,453       12,083       14,422       13,095       14,209       17,661       12,825         1979       13,449       13,861       15,313       12,331       14,970       13,989       12,731       14,643       14,400       14,721       18,050       13,164         1980       13,760       14,467       15,227       12,948       15,103       14,113       13,153       14,700       15,128       14,936       18,780       12,928         1981       13,710       14,276       15,097       13,766       15,767       14,329       13,392       14,474       15,508       18,514       12,960         1983       14,667       14,466       15,567       14,329       13,392       14,478       15,608       15,179       14,170       15,508       15,151       18,614       13,406         1984       14,047       14,809       16,563       15,515       14,106       15,283       14,514       14,514       1	1975	11,646	12,441	13,621	11,440	13,266	12,041	10,767	13,367	12,181	14,184	17,223	11,845
197812,73113,55414,82611,55814,56713,45312,08314,42213,90514,20917,66112,825197913,44913,86115,31312,33114,97013,98912,73114,64314,46014,72118,05013,164198013,76014,46715,22712,94815,10314,11313,15314,70015,12814,93618,78012,928198113,71014,27615,09513,13415,17314,14613,19814,52415,22114,91718,94612,754198213,95914,46615,56313,44515,66614,04013,24214,29015,19215,05818,66412,960198314,36714,45715,96713,76615,75714,32913,39214,47815,66015,31518,61413,406198414,40714,80916,67514,10615,72314,78513,73014,89716,55315,91919,11013,709198514,71714,94617,38314,52115,86915,14114,11015,28617,36216,20119,67614,148198615,08515,15517,99214,81816,16915,77114,96015,73818,20016,99417,272198715,31915,49318,02315,33116,44115,55216,04518,04417,30020,34016,110198815,76216,212<	1976	12,200	13,122	14,465	11,358	13,785	12,681	11,410	13,882	12,950	14,282	17,171	12,113
197913,44913,86115,31312,33114,97013,98912,73114,64314,46014,72118,05013,164198013,76014,46715,22712,94815,10314,11313,15314,07015,12814,93618,78012,928198113,71014,27615,09513,13415,17314,14613,19814,52415,22114,91718,94612,754198213,95914,46615,56313,48515,66614,04013,24214,29015,19215,05818,66412,960198314,40714,80916,67514,10615,72314,78513,73014,48716,55315,91919,11013,709198514,71714,94617,38314,52115,86915,14314,11015,28617,36216,20119,67614,148198615,08515,15517,99214,81816,16915,77114,96015,73318,20116,90519,88415,380198715,71915,49318,02315,38116,49515,70114,96015,73818,20016,99619,88415,386198815,76216,21218,22316,94017,72816,55115,98816,69918,17317,59321,30316,404199916,60517,20118,45216,66818,10115,93216,31517,61521,86816,411199117,25017,479<	1977	12,767	13,190	14,657	11,354	14,235	13,071	11,690	14,174	13,357	14,005	17,636	12,381
198013,76014,46715,22712,94815,10314,11313,15314,70015,12814,93618,78012,928198113,71014,27615,09513,13415,17314,14613,19814,52415,22114,91718,94612,754198213,95914,46615,56313,48515,46614,04013,24214,29015,19215,05818,56412,960198314,46714,57715,96713,76615,56714,32913,39214,47815,68015,31518,61413,046198414,40714,80916,67514,10615,72314,78513,73014,89716,55315,91919,11013,709198514,71714,94617,38314,52115,86915,14314,11015,22617,32216,20119,67614,148198615,08515,15517,99214,81816,16915,74114,51115,62217,92316,53319,87714,727198715,31915,49318,02315,38116,49515,70114,96015,73818,20016,99619,88415,886198815,76216,21218,22316,09017,13016,14315,55216,04518,04417,30020,34016,110198916,36816,73818,26716,94017,72816,55115,98816,69918,17317,59321,30316,4041990<	1978	12,731	13,554	14,826	11,558	14,567	13,453	12,083	14,422	13,905	14,209	17,661	12,825
198113,71014,27615,09513,13415,17314,14613,19814,52415,22114,91718,94612,754198213,95914,46615,56313,48515,66614,04013,24214,29015,19215,05818,56412,960198314,36714,45715,96713,76615,56714,32913,39214,47815,68015,31518,61413,006198414,40714,80916,67514,10615,72314,78513,73014,89716,55315,91919,11013,709198514,71714,94617,38314,52115,86915,14314,11015,26617,36216,20119,67614,148198615,08515,15517,99214,81816,16915,74414,51115,62217,92316,53319,87714,727198715,31915,49318,02315,38116,49515,70114,96015,73818,20016,99619,88415,386198815,76216,21218,22316,09017,13016,14315,55216,04518,08417,30020,34016,110198916,36816,73818,26716,94017,72816,55115,98816,69918,17317,59321,30316,404199016,90517,20118,45216,86818,10115,93216,31517,67718,47017,69521,88616,4111991<	1979	13,449	13,861	15,313	12,331	14,970	13,989	12,731	14,643	14,460	14,721	18,050	13,164
198213,95914,46615,56313,48515,46614,04013,24214,29015,19215,05818,56412,960198314,36714,45715,96713,76615,56714,32913,39214,47815,68015,31518,61413,406198414,40714,80916,67514,10615,72314,78513,73014,89716,55315,91919,11013,709198514,71714,94617,38314,52115,86915,14314,11015,28617,36216,20119,67614,148198615,08515,15517,99214,81816,16915,71414,51115,62217,92316,53319,87714,727198715,31915,49318,02315,38116,49515,70114,96015,73818,20016,99619,88415,386198815,76216,21218,22316,09017,13016,14315,55216,04518,08417,30020,34016,110198916,36816,73818,26716,94017,72816,55317,26718,47017,69521,88616,411199117,25017,20118,45216,68416,61416,53517,51718,95217,30021,43016,096199217,34617,69018,38315,11718,93716,64416,63217,77819,45717,03221,16916,050199317,19717,361<	1980	13,760	14,467	15,227	12,948	15,103	14,113	13,153	14,700	15,128	14,936	18,780	12,928
198314,36714,45715,96713,76615,56714,32913,39214,47815,68015,31518,61413,406198414,40714,80916,67514,10615,72314,78513,73014,89716,55315,91919,11013,709198514,71714,94617,38314,52115,86915,14314,11015,22617,36216,20119,67614,148198615,08515,15517,99214,81816,16915,47414,51115,62217,92316,53319,87714,727198715,31915,49318,02315,38116,49515,70114,96015,73818,20016,99619,88415,386198815,76216,21218,22316,09017,13016,14315,55216,04518,08417,30020,34016,110198916,36816,73818,26716,94017,72816,55115,98816,69918,17317,59321,30316,404199016,90517,20118,45216,86818,10115,93216,31517,26718,47017,69521,88616,411199117,25017,47918,66215,67718,19016,60416,53517,51718,95217,38021,43016,096199217,34617,69018,83815,11718,37316,84816,63217,73819,45717,03221,43016,0501993<	1981	13,710	14,276	15,095	13,134	15,173	14,146	13,198	14,524	15,221	14,917	18,946	12,754
198414,40714,80916,67514,10615,72314,78513,73014,89716,55315,91919,11013,709198514,71714,94617,38314,52115,86915,14314,11015,28617,36216,20119,67614,148198615,08515,15517,99214,81816,16915,47414,51115,62217,92316,53319,87714,727198715,31915,49318,02315,38116,49515,70114,96015,73818,20016,99619,88415,386198815,76216,21218,22316,09017,13016,14315,55216,04518,08417,30020,34016,110198916,68816,73818,26716,94017,72816,55115,98816,69918,17317,59321,30316,404199016,90517,20118,45216,86818,10115,93216,31517,26718,47017,69521,88616,411199117,25017,47918,66215,67718,19016,60416,53517,51718,95217,38021,43016,050199217,34617,69018,83815,11718,37316,84816,63217,77819,45717,03221,16916,050199317,19717,36118,93114,87318,11916,54416,60617,74719,87316,55620,87616,3671994<	1982	13,959	14,466	15,563	13,485	15,466	14,040	13,242	14,290	15,192	15,058	18,564	12,960
198514,71714,94617,38314,52115,86915,14314,11015,28617,36216,20119,67614,148198615,08515,15517,99214,81816,16915,47414,51115,62217,92316,53319,87714,727198715,31915,49318,02315,38116,49515,70114,96015,73818,20016,99619,88415,386198815,76216,21218,22316,09017,13016,14315,55216,04518,08417,30020,34016,110198916,36816,73818,26716,94017,72816,55115,98816,69918,17317,59321,30316,404199016,90517,20118,45216,86818,10115,93216,31517,26718,47017,69521,88616,411199117,25017,47918,66215,67718,19016,60416,53517,51718,95217,38021,43016,096199217,34617,69018,83815,11718,37316,84816,63217,73819,45717,03221,16916,050199317,19717,36118,93114,87318,11916,54416,60617,74719,87316,55620,87616,367199417,55117,82419,95915,39418,41116,88216,91918,21020,84417,11620,74517,0271995<	1983	14,367	14,457	15,967	13,766	15,567	14,329	13,392	14,478	15,680	15,315	18,614	13,406
198615,08515,15517,99214,81816,16915,47414,51115,62217,92316,53319,87714,727198715,31915,49318,02315,38116,49515,70114,96015,73818,20016,99619,88415,386198815,76216,21218,22316,09017,13016,14315,55216,04518,08417,30020,34016,110198916,36816,73818,26716,94017,72816,55115,98816,69918,17317,59321,30316,404199016,90517,20118,45216,86818,10115,93216,31517,26718,47017,69521,88616,411199117,25017,47918,66215,67718,19016,60416,53517,51718,95217,38021,43016,096199217,34617,69018,83815,11718,37316,84816,63217,73819,45717,03221,16916,050199317,19717,36118,93114,87318,11916,54416,60617,74719,87316,55620,87616,367199417,55117,82419,95915,91818,65617,12317,37618,52621,53717,65520,78517,402199517,87618,21920,60315,91818,65617,12317,37618,52621,53717,65520,78517,4401996<	1984	14,407	14,809	16,675	14,106	15,723	14,785	13,730	14,897	16,553	15,919	19,110	13,709
198715,31915,49318,02315,38116,49515,70114,96015,73818,20016,99619,88415,386198815,76216,21218,22316,09017,13016,14315,55216,04518,08417,30020,34016,110198916,36816,73818,26716,94017,72816,55115,98816,69918,17317,59321,30316,404199016,90517,20118,45216,86818,10115,93216,31517,26718,47017,69521,88616,411199117,25017,47918,66215,67718,19016,60416,53517,51718,95217,38021,43016,096199217,34617,69018,83815,11718,37316,84816,63217,73819,45717,03221,16916,050199317,19717,36118,93114,87318,11916,54416,60617,74719,87316,55620,87616,367199417,55117,82419,95915,39418,41116,88216,91918,21020,84417,11620,74517,027199517,87618,21920,60315,91818,65617,12317,37618,52621,53717,65520,78517,440199618,20618,43620,98216,50018,80217,21117,54219,00522,47917,82120,75617,8341997<	1985	14,717	14,946	17,383	14,521	15,869	15,143	14,110	15,286	17,362	16,201	19,676	14,148
198815,76216,21218,22316,09017,13016,14315,55216,04518,08417,30020,34016,110198916,36816,73818,26716,94017,72816,55115,98816,69918,17317,59321,30316,404199016,90517,20118,45216,86818,10115,93216,31517,26718,47017,69521,88616,411199117,25017,47918,66215,67718,19016,60416,53517,51718,95217,38021,43016,096199217,34617,69018,83815,11718,37316,84816,63217,73819,45717,03221,16916,050199317,19717,36118,93114,87318,11916,54416,60617,74719,87316,55620,87616,367199417,55117,82419,95915,39418,41116,88216,91918,21020,84417,11620,74517,027199517,87618,21920,60315,91818,65617,12317,37618,52621,53717,65520,78517,440199618,20618,43620,98216,50018,80217,21117,54219,00522,47917,82120,75617,834199718,46219,04821,52617,49619,09617,41717,85319,63623,40018,18121,05718,3951998<		15,085	15,155	17,992	14,818	16,169		14,511	15,622	17,923	16,533	19,877	14,727
198916,36816,73818,26716,94017,72816,55115,98816,69918,17317,59321,30316,404199016,90517,20118,45216,86818,10115,93216,31517,26718,47017,69521,88616,411199117,25017,47918,66215,67718,19016,60416,53517,51718,95217,38021,43016,096199217,34617,69018,83815,11718,37316,84816,63217,73819,45717,03221,16916,050199317,19717,36118,93114,87318,11916,54416,60617,74719,87316,55620,87616,367199417,55117,82419,95915,39418,41116,88216,91918,21020,84417,11620,74517,027199517,87618,21920,60315,91818,65617,12317,37618,52621,53717,65520,78517,440199618,20618,43620,98216,50018,80217,21117,54219,00522,47917,82120,75617,834199718,46219,04821,52617,49619,09617,41717,85319,63623,40018,18121,05718,395199819,10719,44221,98518,38319,69917,76218,15020,35023,83518,82221,48918,8601999<						16,495			15,738	18,200		19,884	
199016,90517,20118,45216,86818,10115,93216,31517,26718,47017,69521,88616,411199117,25017,47918,66215,67718,19016,60416,53517,51718,95217,38021,43016,096199217,34617,69018,83815,11718,37316,84816,63217,73819,45717,03221,16916,050199317,19717,36118,93114,87318,11916,54416,60617,74719,87316,55620,87616,367199417,55117,82419,95915,39418,41116,88216,91918,21020,84417,11620,74517,027199517,87618,21920,60315,91818,65617,12317,37618,52621,53717,65520,78517,440199618,20618,43620,98216,50018,80217,21117,54219,00522,47917,82120,75617,834199718,46219,04821,52617,49619,09617,41717,85319,63623,40018,18121,05718,395199819,10719,44221,98518,38319,69917,76218,15020,35023,83518,82221,48918,860199919,60819,97822,41719,05820,26918,07418,43220,97623,92219,65221,73519,2232000<	1988	15,762	16,212	18,223	16,090	17,130	16,143	15,552	16,045		17,300	20,340	16,110
199117,25017,47918,66215,67718,19016,60416,53517,51718,95217,38021,43016,096199217,34617,69018,83815,11718,37316,84816,63217,73819,45717,03221,16916,050199317,19717,36118,93114,87318,11916,54416,60617,74719,87316,55620,87616,367199417,55117,82419,95915,39418,41116,88216,91918,21020,84417,11620,74517,027199517,87618,21920,60315,91818,65617,12317,37618,52621,53717,65520,78517,440199618,20618,43620,98216,50018,80217,21117,54219,00522,47917,82120,75617,834199718,46219,04821,52617,49619,09617,41717,85319,63623,40018,18121,05718,395199819,10719,44221,98518,38319,69917,76218,15020,35023,83518,82221,43918,860199919,60819,97822,41719,05820,26918,07418,43220,97623,92219,65221,73519,223200020,15920,72323,00820,18320,98118,59218,91421,54524,31120,32322,26219,836	1989	16,368		i						18,173	1		
199217,34617,69018,83815,11718,37316,84816,63217,73819,45717,03221,16916,050199317,19717,36118,93114,87318,11916,54416,60617,74719,87316,55620,87616,367199417,55117,82419,95915,39418,41116,88216,91918,21020,84417,11620,74517,027199517,87618,21920,60315,91818,65617,12317,37618,52621,53717,65520,78517,440199618,20618,43620,98216,50018,80217,21117,54219,00522,47917,82120,75617,834199718,46219,04821,52617,49619,09617,41717,85319,63623,40018,18121,05718,395199819,10719,44221,98518,38319,69917,76218,15020,35023,83518,82221,48918,860199919,60819,97822,41719,05820,26918,07418,43220,97623,92219,65221,73519,223200020,15920,72323,00820,18320,98118,59218,91421,54524,31120,32322,26219,836	1990	16,905	17,201	18,452	16,868	18,101	15,932	16,315	17,267	18,470	17,695	21,886	16,411
199317,19717,36118,93114,87318,11916,54416,60617,74719,87316,55620,87616,367199417,55117,82419,95915,39418,41116,88216,91918,21020,84417,11620,74517,027199517,87618,21920,60315,91818,65617,12317,37618,52621,53717,65520,78517,440199618,20618,43620,98216,50018,80217,21117,54219,00522,47917,82120,75617,834199718,46219,04821,52617,49619,09617,41717,85319,63623,40018,18121,05718,395199819,10719,44221,98518,38319,69917,76218,15020,35023,83518,82221,48918,860199919,60819,97822,41719,05820,26918,07418,43220,97623,92219,65221,73519,223200020,15920,72323,00820,18320,98118,59218,91421,54524,31120,32322,26219,836	1991	17,250	17,479	18,662	15,677		16,604	16,535	17,517	18,952	17,380	21,430	16,096
199417,55117,82419,95915,39418,41116,88216,91918,21020,84417,11620,74517,027199517,87618,21920,60315,91818,65617,12317,37618,52621,53717,65520,78517,440199618,20618,43620,98216,50018,80217,21117,54219,00522,47917,82120,75617,834199718,46219,04821,52617,49619,09617,41717,85319,63623,40018,18121,05718,395199819,10719,44221,98518,38319,69917,76218,15020,35023,83518,82221,48918,860199919,60819,97822,41719,05820,26918,07418,43220,97623,92219,65221,73519,223200020,15920,72323,00820,18320,98118,59218,91421,54524,31120,32322,26219,836		17,346	17,690	18,838	15,117	18,373		16,632		19,457	17,032	21,169	16,050
199517,87618,21920,60315,91818,65617,12317,37618,52621,53717,65520,78517,440199618,20618,43620,98216,50018,80217,21117,54219,00522,47917,82120,75617,834199718,46219,04821,52617,49619,09617,41717,85319,63623,40018,18121,05718,395199819,10719,44221,98518,38319,69917,76218,15020,35023,83518,82221,48918,860199919,60819,97822,41719,05820,26918,07418,43220,97623,92219,65221,73519,223200020,15920,72323,00820,18320,98118,59218,91421,54524,31120,32322,26219,836	1993	17,197	17,361	18,931	14,873	18,119	16,544	16,606	17,747	19,873	16,556	20,876	16,367
199618,20618,43620,98216,50018,80217,21117,54219,00522,47917,82120,75617,834199718,46219,04821,52617,49619,09617,41717,85319,63623,40018,18121,05718,395199819,10719,44221,98518,38319,69917,76218,15020,35023,83518,82221,48918,860199919,60819,97822,41719,05820,26918,07418,43220,97623,92219,65221,73519,223200020,15920,72323,00820,18320,98118,59218,91421,54524,31120,32322,26219,836	1994	17,551	17,824	19,959	15,394	18,411	16,882	16,919	18,210	20,844	17,116	20,745	17,027
199718,46219,04821,52617,49619,09617,41717,85319,63623,40018,18121,05718,395199819,10719,44221,98518,38319,69917,76218,15020,35023,83518,82221,48918,860199919,60819,97822,41719,05820,26918,07418,43220,97623,92219,65221,73519,223200020,15920,72323,00820,18320,98118,59218,91421,54524,31120,32322,26219,836			18,219						18,526			20,785	17,440
199819,10719,44221,98518,38319,69917,76218,15020,35023,83518,82221,48918,860199919,60819,97822,41719,05820,26918,07418,43220,97623,92219,65221,73519,223200020,15920,72323,00820,18320,98118,59218,91421,54524,31120,32322,26219,836													
199919,60819,97822,41719,05820,26918,07418,43220,97623,92219,65221,73519,223200020,15920,72323,00820,18320,98118,59218,91421,54524,31120,32322,26219,836	1997	18,462	19,048				17,417	17,853	19,636		18,181	21,057	18,395
2000 20,159 20,723 23,008 20,183 20,981 18,592 18,914 21,545 24,311 20,323 22,262 19,836		19,107	19,442				17,762	18,150	20,350	23,835	18,822	21,489	18,860
		19,608	19,978	22,417	19,058	20,269	18,074	18,432	20,976	23,922	19,652		
2001 20,287 20,905 23,135 20,269 21,291 18,670 19,205 21,714 24,520 20,514 22,424 20,066		20,159	20,723	i				18,914	21,545	24,311	20,323	22,262	19,836
	2001	20,287	20,905	23,135	20,269	21,291	18,670	19,205	21,714	24,520	20,514	22,424	20,066

Annex Table 1 (continued). Per capita GDP in 12 European countries...

V			Denmark			<u>`</u>				C		LIV
Year	Austria	Belgium				Germany		Netherlds.	Norway	Sweden	Switzerl.	UK
1850		31	2	0	87	177	3	9	1	1	0	737
1851	16	34	2	0	89	198	3	9	1	2	0	796
1852	20	39	2	0	96	238	4	11	1	2	0	852
1853	24	40	2	0	113	235	5	12	1	2	0	906
1854	24	44	3	0	130	255	6	17	2	2	1	961
1855	27	46	3	0	148	290	6	13	2	3	1	960
1856	32	45	4	0	157	313	7	14	3	4	1	986
1857	37	47	5	1	162	311	8	12	3	5	1	945
1858	40	50	3	1	160	334	9	11	3	5	1	939
1859	43	51	4	1	163	352	10	10	3	6	2	1,041
1860	49	52	4	1	177	389	10	14	3	6	3	1,162
1861	55	56	5	1	190	432	11	13	4	8	4	1,210
1862	62	56	5	1	198	467	17	17	4	8	4	1,173
1863	63	59	5	1	201	481	16	12	4	8	4	1,245
1864	63	62	5	1	213	532	21	10	5	9	5	1,337
1865	70	65	7	1	225	561	18	11	5	9	6	1,414
1866	63	71	6	1	247	579	22	12	6	9	6	1,456
1867	79	78	6	1	250	625	27	12	6	9	6	1,493
1868	93	70	8	1	254	668	78	12	6	10	6	1,467
1869	102	75	7	1	261	711	112	13	6	10	6	1,536
1870	115	86	8	2	227	679	133	14	7	11	7	1,568
1871	143	82	8	2	226	704	89	15	7	12	9	1,658
1872	150	88	8	2	275	852	122	15	7	14	10	1,745
1873	165	99	8	2	295	893	117	15	8	14	10	1,835
1874	163	91	9	2	282	864	105	14	8	15	10	1,783
1875	162	95	10	2	295	900	102	16	10	17	11	1,879
1876	168	93	11	2	297	967	117	18	9	19	12	1,866
1877	169	91	11	2	290	1,024	137	18	11	19	12	1,881
1878	174	96	10	2	296	1,077	109	19	10	17	11	1,854
1879	195	98	10	2	308	1,122	125	21	11	17	12	1,860
1880	203	108	13	2	346	1,122	143	23	12	21	14	2,035
1881	218	100	13	2	356	1,379	138	23	12	21		2,000
1882	210	103	15	2	378	1,468		23	13	23		2,153
1883	243	123	13	2	398	1,539	169	24	13	23		2,133
1884	243	123	17	3	385	1,505	177	20	13	25		2,230
1885	259	121	17	3	369	1,560		20	15	23		
1886	259	114	18	2	363	1,500	187	28	15	26	17	
1887		114	17		363			28 29	15	20 27	17	
	278			2		1,517						2,191
1888	291	128	20	2	394	1,519		32	16	29		2,278
1889	308	131	21	3	401	1,621	199	31	18	33		2,359
1890	324	144	20	3	444	1,687		30	17	33		
1891	344	137	22	3	446	1,725		35	19	35		2,465
1892	343	136	22	3	447	1,672	206	34	20	35	30	2,414

Annex Table 2. Sulfur emissions, 1850 to 1999 (in 1000 metric tons)

$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	<u>1 XIIIIC</u>			macaji	Sunui	emiss	10115, 100	0.00					
1894       383       144       25       3       464       1,713       225       35       22       39       33       2,         1896       409       146       25       4       466       1,765       203       35       23       39       33       2,         1896       4425       153       33       4       480       1,943       190       37       23       40       36       2,         1898       466       164       34       6       514       2,000       198       38       25       44       38       2,         1900       505       166       37       7       602       2,192       214       44       42       9,99       50       2,         1901       519       174       39       5       583       2,232       208       43       46       2,       190       55       46       2,       190       534       203       45       6       583       2,376       241       49       31       66       53       2,73       3       3,3       190       166       55       33       73       3,2       39       33       1	Year	Austria	Belgium	Denmark	Finland	France	Germany	Italy	Netherlds.	Norway	Sweden	Switzerl.	UK
18954091462544661,785203352339332,18974491603365011,968194392544382,18984661643465142,000198382546412,18984661643465142,000198382546412,18994771753785482,101217402858452,19015051863776022,198214442959502,19015191743955532,232208433066462,19025061834055512,198222433066462,19035151984165952,242233463166532,376241493166532,3762,873373623,19055532064475632,568300553373623,1931808992,6373256563683733,19072424159137172,738345624182793,19118033 <td>1893</td> <td>371</td> <td>130</td> <td>22</td> <td>3</td> <td>438</td> <td>1,700</td> <td>198</td> <td>34</td> <td>20</td> <td>35</td> <td>24</td> <td>2,163</td>	1893	371	130	22	3	438	1,700	198	34	20	35	24	2,163
18964251533344801.943190372340362.18974491603365011.968194392544382.18984661643465142.000198382546412.18994771753785482.101217402858462.19005051863776022.198214442959502.190151917439555832.232208432955462.19025061834055512.198222433056462.19035151984165952.294233463162502.19055532064475862.421259503265552.190555320644765632.5683005533733.3190190770024144999992.687325583683733.1910190972424159137172.738345624182793.191086025754117192	1894	383	144	25	3	464	1,713	225	35	22	39	31	2,476
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1895	409	146	25	4	466	1,785	203	35	23	39	33	2,500
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1896	425	153	33	4	480	1,943	190	37	23	40	36	2,572
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1897	449	160	33	6	501	1,968	194	39	25	44	38	2,641
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1898	466	164	34	6	514	2,000	198	38	25	46	41	2,646
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1899	477	175	37	8	548	2,101	217	40	28	58	45	2,835
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1900	505	186	37	7	602	2,198	214	44	29	59	50	2,870
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1901	519	174	39	5	583	2,232	208	43	29	55	46	2,809
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1902	506	183	40	5	551	2,198	222	43	30	56	46	2,917
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1903	515	198	41	6	595	2,294	233	46	31	62	50	2,942
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1904	534	203	45	6	583	2,376	241	49	31	66	53	2,956
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1905	553	206	44	7	586	2,421	259	50	32	65	55	2,996
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1906	605	237	48	7	653	2,568	300	55	33	73	62	3,105
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1907	700	241	44	9	699	2,687	325	58	36	83	73	3,245
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1908	869	223	54	14	701	2,662	326	59	41	89	73	3,164
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1909	724	241	59	13	717	2,738	345	62	41	82	73	3,193
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1910	860	257	54	11	719	2,888	349	64	42	84	70	3,220
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1911	761	264	58	13	756	2,874	358	69	44	82	79	3,299
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1912	793	279	69	15	758	3,122	376	78	48	91	80	3,130
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1913	322	292	73	17	840	3,228	407	87	49	104	86	3,429
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1914	249	218	73	8	590	2,880	371	82	54	98	79	3,325
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1915	337	188	80	3	549	2,931	317	79	59	100	85	3,371
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1916	288	202	78	4	587	3,382	323	73	57	107	83	3,496
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1917	259	177	47	4	623	3,309	232	58	36	46	61	3,462
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	1918	223	157	48	4	567	3,091	270	50	41	54	58	3,228
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1919	187	184	54	5	641	2,234	264	78	47	53	48	3,160
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1920	157	206	67	6	895	2,185	270	79	49	76	78	3,258
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1921	187	209	58	5	731	2,362	294	76	37	42	44	2,224
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1922	181	223	81	9	878	1,918	336	90	53	69	61	2,977
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1923	176	300	91	17	982	1,519	361	90	55	85	77	3,164
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1924	195	317	104		1,061	1,888	423	100	59	100		3,316
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1925	181	325	89	18	999	1,921	395	103	58	89	72	3,114
$\begin{array}{c c c c c c c c c c c c c c c c c c c $					16			426				66	1,734
1929215391112361,1342,27750412570123883,1930170374105311,1501,96645012466119823,1931157329106361,0281,67137013553117832,1932133264102388961,50930212565120852,1933127275101409351,58032511670129832,1934121282106509381,75342511673139822,	1927	184		102	26	1,025	2,027	488	113	59	113	77	3,235
1930170374105311,1501,96645012466119823,1931157329106361,0281,67137013553117832,1932133264102388961,50930212565120852,1933127275101409351,58032511670129832,1934121282106509381,75342511673139822,	1928	190	347	94	29	1,005	2,134	438	116	62	100	77	3,023
1931157329106361,0281,67137013553117832,1932133264102388961,50930212565120852,1933127275101409351,58032511670129832,1934121282106509381,75342511673139822,	1929	215	391	112	36	1,134	2,277	504	125	70	123	88	3,185
1932133264102388961,50930212565120852,1933127275101409351,58032511670129832,1934121282106509381,75342511673139822,	1930	170	374	105	31	1,150	1,966	450	124	66	119	82	3,048
1933127275101409351,58032511670129832,1934121282106509381,75342511673139822,	1931	157	329	106	36		1,671	370	135	53	117	83	2,847
<u>1934</u> 121 282 106 50 938 1,753 425 116 73 139 82 2,	1932	133	264	102	38	896	1,509	302	125	65	120	85	2,742
		127	275	101	40	935			116	70	129	83	2,716
1935 121 266 108 54 901 1.926 483 109 73 145 80 2		121	282	106	50	938	-	425	116	73	139	82	2,930
	1935	121	266	108	54	901	1,926	483	109	73	145	80	2,969

Annex Table 2 (continued). Sulfur emissions, 1850 to 1999...

N7		· · ·				<u> </u>			N	C 1	G '4 1	I IIZ
Year	Austria					Germany	Italy	Netherlds.				UK
1936	117	279	116	64	915		331	117	78	159	81	3,136
1937	132	340	118	78	1,029		461	129	81	180	87	3,235
1938	130	291	109	67	931	2,537	456	126	76	163	83	3,096
1939	139	310	132	66	913	2,777	491	136	88	198		3,147
1940	143	280	85	50	620	2,820	520	131	56	130	73	3,304
1941	141	297	85	62	494	2,896	460	143	50	113	57	3,244
1942	143	291	84	60	514		455	137	48	104	50	3,241
1943	147	288	107	74	537		396	141	53	122	52	3,144
1944	145	210	105	56	354		311	108	47	98	37	3,066
1945	103	238	66	33	473	443	272	83	34	40		2,899
1946	114	309	123	54	761	1,294	256	114	57	128		,
1947	165	337	155	77	912		453	138	77	184	91	3,181
1948	212	327	126	104	965		405	140	74	215		3,236
1949	222	302	136	71	1,100	1,982	424	153	69	186	71	3,324
1950	181	233	80	60	953	2,172	467	187	29	126	41	3,396
1951	208	293	113	85	1,147	2,489	661	212	38	144	61	3,726
1952	195	308	104	89	1,204		661	220	26	134	48	3,772
1953	189	306	87	78	1,117		746	222	24	115	34	3,756
1954	210	312	88	81	1,159	2,792	830	239	23	109		3,813
1955	237	318	107	96	1,147	3,069	905	255	24	119		3,924
1956	250	362	88	105	1,287	3,250	951	276	23	109	60	3,903
1957	257	366	101	122	1,294		974	269	22	116	66	3,878
1958	219	363	88	121	1,263	3,281	916	250	19	97	43	3,805
1959	202	325	87	135	1,197	3,164	924	240	18	99	41	3,689
1960	208	305	108	146	1,168	3,336	1,019	263	20	105	47	3,503
1961	195	300	110	147	1,159	3,452	1,080	257	32	101	40	3,461
1962	203	309	123	149	1,162	3,551	1,175	270	37	100	41	3,588
1963	225	383	135	150	1,255	3,702	1,290	282	37	98	56	3,507
1964	219	378	134	154	1,299	3,838	1,332	282	39	105	45	3,515
1965	206	375	128	151	1,306	3,708	1,469	269	38	98	42	3,458
1966	200	351	140	140	1,304	3,595	1,611	261	37	98	49	3,280
1967	189	341	145	155	1,364	3,429	1,758	257	40	116	64	3,309
1968	190	376	147	170	1,327	3,487	1,821	258	52	141	67	3,212
1969	180	384	145	185	1,338	3,584	1,854	275	54	153	66	3,008
1970	199	395	147	230	1,432	3,748	2,035	295	60	164	68	2,921
1971	194	358	123	210	1,393	3,711	1,970	266	56	161	61	3,028
1972	204	388	114	203	1,369	3,612	1,925	273	59	149	52	2,589
1973	208	393	125	210	1,451	3,633	2,028	287	62	148	65	2,742
1974	214	392	139	236	1,538	3,620	2,098	280	66	169	71	2,488
1975	197	339	136	236	1,366	3,505	1,731	239	63	175	50	2,650
1976	195	334	129	222	1,415	3,565	1,696	253	73	196	43	2,510
1977	188	381	153	268	1,491	3,542	1,867	255	75	201	48	2,411
1978	191	348	156	248	1,423	3,433	1,789	228	71	205	43	2,365

Annex Table 2 (continued). Sulfur emissions, 1850 to 1999...

Year	Austria	Belgium	Denmark	Finland	France	Germany	Italy	Netherlds.	Norway	Sweden	Switzerl.	UK
1979	208	387	190	278	1,584	3,682	1,933	253	72	219	51	2,343
1980	192	414	226	292	1,606	3,757	1,879	245	69	246	58	2,440
1981	167	356	185	267	1,262	3,721	1,665	232	64	216	54	2,213
1982	158	347	189	242	1,207	3,720	1,425	202	55	186	50	2,107
1983	119	280	161	186	992	3,673	1,232	162	52	153	46	1,937
1984	106	250	153	184	885	3,817	1,057	150	48	148	42	1,856
1985	95	200	172	191	740	3,866	951	129	49	133	38	1,875
1986	86	189	146	166	672	3,821	965	132	46	136	34	1,955
1987	76	184	129	164	665	3,698	1,015	132	37	114	31	1,954
1988	58	177	127	151	610	3,244	982	125	34	112	28	1,920
1989	51	163	99	122	690	3,083	927	102	29	80	25	1,860
1990	46	186	91	130	639	2,661	826	101	26	60	21	1,877
1991	41	167	121	97	695	1,998	770	87	22	48	21	1,784
1992	32	159	94	71	606	1,654	697	86	18	44	19	1,724
1993	30	149	77	62	526	1,473	667	82	18	44	17	1,553
1994	29	127	78	57	495	1,237	636	73	17	41	16	1,333
1995	28	123	74	48	467	997	661	74	17	40	17	1,174
1996	26	120	90	53	457	703	603	68	17	42	15	1,005
1997	25	110	55	50	384	564	538	59	15	26	13	819
1998	23	106	38	45	404	450	520	54	15	25	14	784
1999	21	93	28	44	341	416	462	50	14	32	13	594

Annex Table 2 (continued). Sulfur emissions, 1850 to 1999...

Year	Regulation
1821	Smoke prohibition act. Tried to encourage the prosecution of a public nuisance from smoke.
1845	Railway Clauses Consolidated Act Engines to consume their own smoke.
1847	Improvement Clauses act Reduce factory smoke.
1853	London Act. Penalties against smoke nuisance.
1863	Alkali Act. Regulate alkali trade – condense at least 95% hydrochloric acid gas.
1866 1874	Sanitary Act. <i>Authorities empowered to take action in cases of smoke nuisances.</i> Other noxious gases added to Alkali Act.
1874	Public Health Act
1906	
	Alkali etc. Works Regulation Act
1926	Smoke Abatement Act
1953	Grit came under control of Alkali inspectors. Reduce emissions to 0.5 grains per
	cubic foot and install precipitators.
1955	Environment Act. Became law in 1956. 7 years to re-equip, 10 years later, industry had reduced emissions 74%.
1956	Clean Air Act. "Subject to the provisions of this Act, dark smoke shall not be emitted
	from a chimney of any building, and if, on any day, smoke is so emitted the occupier
	of the building shall be guilty of an offence." Section 1. Dark smoke is one whose
	color is equal to or darker than shade 2 of the Ringlemann Chart – a subjective
	measure. (Manning 1993 chap. 3) Smokeless zones allowed – not instituted until
	<i>1960.</i>
1968	Clean Air Act. Taller chimneys for more dispersement.
1974	Control of Pollution Act. Allows for the making of regulations imposing requirements
	on vehicle fuel regulations could be made for sulfur content of oil in furnaces and
	engines.
1979	Convention on Long Range Transboundary Pollution
1980	Directive 80/779 on limit values for sulfur dioxide and suspended particulates: OJ
	1980 No. L229/30.
	Over a year, the average level of black smoke (or fine particulates) cannot exceed
	eighty micrograms per cubic meter. The level of sulfur dioxide is dependant on
	the concentration of smoke. If there are less than or equal to forty micrograms
	per cubic meter of black smoke, the amount of sulfur dioxide cannot exceed 120
	micrograms per cubic meter. When the amount of smoke exceeds forty
	micrograms per cubic meter, then the top limit of sulfur dioxide is reduced to
	eighty micrograms per cubic meter. Similar standards are set for wintertime (18)
	and peak concentrations (19). (Manning chap. 4)
1985	Helsinki Protocol on Reduction of Sulfur emissions. <i>Reduce by 30% by 1993</i>
1700	compared to 1980 levels (Europa link)
1988	Sofia Protocol on Nitrogen Oxide. <i>Reduce emissions by 1994 compared to 1987</i>
1700	levels. Apply national emissions standards to mobile sources and introduce pollution
	control measures for major stationary sources. (Europa link)
	control measures for major stationary sources. (Europa unit)

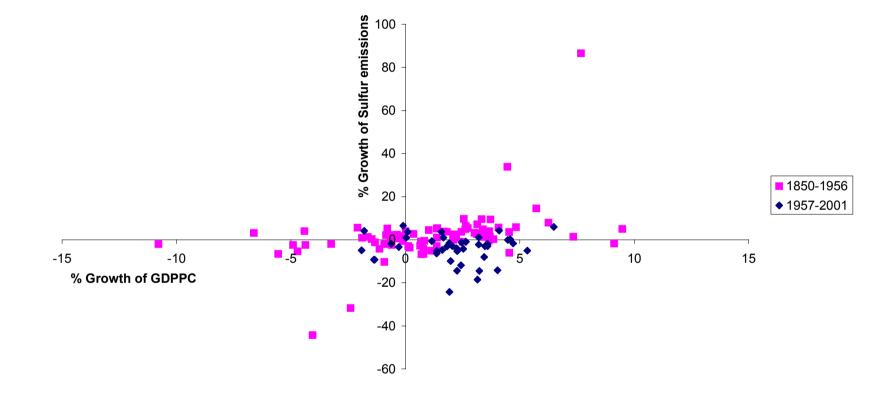
Annex Table 3. Key Dates for Sulfur Relevant Legislation in the UK.

Year	Table 3 (continued). Key Dates for Sulfur Relevant Legislation in the UK. Regulation
<b>Year</b> 1988	EC Directive on large combustion plant.
1900	•
	• Power stations to reduce emissions of Sulfur Dioxide and Nitrogen Oxide.
	• UK to reduce $SO_2$ by 60% of 1980 levels by 2003.
	• NO by 30% of 1980 levels by 1998.
	• UK Stated target of 30% for Sulfur was an 'aim of policy' Manning 1993 chap. 4
1989	Air Quality Standards Regulations (S.I. 1989 No. 317).
	• One year: limit SO <sub>2</sub> to 120 microg/m <sup>3</sup> if smoke less than 40 microg/m <sup>3</sup>
	(median of daily values) 80 microg/ $m^3$ if smoke more than 40.
	• Winter: 180 if smoke less than 60
	(median of winter values) 130 if smoke more than 60
	• Year, peak 350 if smoke less than 150
	• (98 percentile of daily values) 250 if smoke more than 150
	• From Leeson 1995: 229-230: these figures are the same as for Directive 80/779.
	• Other EC directives to go into effect in the Air Quality Standards Regulations are
	82/884/EEC (lead), 85/203/EEC (nitrogen dioxide) and 92/72/EEC (ozone)
1990	Environmental Protection Act. Integrated Pollution control. Regulates statutory
	nuisances i.e. something prejudicial to health or a nuisance at common law. (Handler
	ed. 58)
1990	Large Combustion plant national plan. <i>Reduction targets for SO<sub>2</sub> at 60% of 1980</i> <i>levels by 2003.</i>
1992	Directive 91/441/EEC (see SI 1992 No. 2137). Limits emissions of carbon monoxide,
	hydrocarbons and oxides of nitrogen from new passenger and light goods vehicles.
1993	Directive 93/59/EEC. Limits emissions from new light commercial vehicles and vans
	(see McEldowney and McEldowney page 269 for further directives limiting vehicular
	emissions).
1993	Clean Air Act. Consolidation of 1955 and 1963 Acts.
1993	Stubble burning banned.
1994	Second Protocol on Reduction of Suphur Emissions (Oslo Protocol)
	• W. Europe to reduce 70-80% if 1980 levels
	• <i>E. Europe to reduce to 40-50%</i>
1995	Environment Act (came into practice 1997 NAQA)
1997	National Air Quality Strategy. Standards and Objectives for CO, NO <sub>2</sub> , SO <sub>2</sub> ,
	particulates, ozone, lead, benzene and 1,3- butadene. Guideline and more serious
	alert thresholds. Government adopted the standard of 100ppb at 99.9% compliance.
	(electricity.org)
1999	Gothenburg Protocol. Emissions ceilings for sulfur, NOx, VOC, and ammonia. Sulfur
	should be cut by at least 63%, NOx by 41%, VOC by 40% and ammonia by 17%
	compared to 1990.
	4

Annex Table 3 (continued). Key Dates for Sulfur Relevant Legislation in the UK.

Year	Regulation
1972	Environmental Action Programme
1979	Convention on Long Range Transboundary Pollution
1980	Directive 80/779 on limit values for sulfur dioxide and suspended particulates: OJ
	1980 No. L229/30. Over a year, the average level of black smoke (or fine
	particulates) cannot exceed eighty micrograms per cubic meter. The level of sulfur
	dioxide is dependant on the concentration of smoke. If there are less than or equal to
	forty micrograms per cubic meter of black smoke, the amount of sulfur dioxide
	cannot exceed 120 micrograms per cubic meter. When the amount of smoke exceeds
	forty micrograms per cubic meter, then the top limit of sulfur dioxide is reduced to
	eighty micrograms per cubic meter. Similar standards are set for wintertime and peak concentrations. (Manning chap. 4)
1985	Helsinki Protocol on Reduction of Sulfur emissions. Reduce by 30% by 1993
	compared to 1980 levels (Europa link)
1988	Sofia Protocol on Nitrogen Oxide. Reduce emissions by 1994 compared to 1987
	levels. Apply national emissions standards to mobile sources and introduce pollution
	control measures for major stationary sources. (Europa link)
1988	EC Directive on large combustion plant. Power stations required to reduce emissions
	of sulfur dioxide and nitrogen oxide.
1989	Air Quality Standards Regulations (S.I. 1989 No. 317)
1992	Directive 91/441/EEC (see SI 1992 No. 2137). Limits emissions of carbon monoxide,
	hydrocarbons and oxides of nitrogen from new passenger and light goods vehicles.
1993	Directive 93/59/EEC. Limits emissions from new light commercial vehicles and vans
	(see McEldowney and McEldowney page 269 for further directives limiting vehicular
1004	emissions)
1994	Second Protocol on Reduction of Suphur Emissions (Oslo Protocol)
	• <i>W. Europe to reduce 70-80% if 1980 levels</i>
	• <i>E. Europe to reduce to 40-50%</i>
1999	Gothenburg Protocol. Emissions ceilings for sulphur, NOx, VOC, and ammonia.
	Sulfur should be cut by at least 63%, NOx by 41%, VOC by 40% and ammonia by
1000	17% compared to 1990.
1999	Directive on sulfur dioxide, nitrogen dioxide and oxides of nitrogen, particulate
	matter and lead in ambient air (1999/30/EC)

Figure E1. United Kingdom: Sulfur emissions (1850-1999) and Real GDP per capita (1870-2001), Annual Growth Rates.



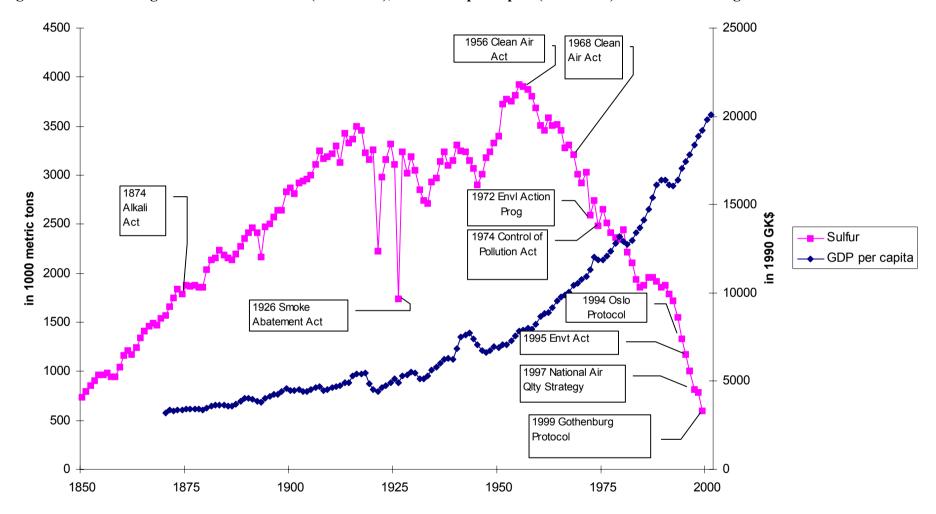


Figure E2. United Kingdom: Sulfur emissions (1850-1999), Real GDP per capita (1870-2001) and Some Air Regulations.

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 (lix) This paper was presented at the ENGIME Workshop on "Mapping Diversity", Leuven, May 16-17, 2002

(lx) This paper was presented at the EuroConference on "Auctions and Market Design: Theory, Evidence and Applications", organised by the Fondazione Eni Enrico Mattei, Milan, September 26-28, 2002

(lxi) This paper was presented at the Eighth Meeting of the Coalition Theory Network organised by the GREQAM, Aix-en-Provence, France, January 24-25, 2003

(lxii) This paper was presented at the ENGIME Workshop on "Communication across Cultures in Multicultural Cities", The Hague, November 7-8, 2002

(lxiii) This paper was presented at the ENGIME Workshop on "Social dynamics and conflicts in multicultural cities", Milan, March 20-21, 2003

(lxiv) This paper was presented at the International Conference on "Theoretical Topics in Ecological Economics", organised by the Abdus Salam International Centre for Theoretical Physics - ICTP, the Beijer International Institute of Ecological Economics, and Fondazione Eni Enrico Mattei – FEEM Trieste, February 10-21, 2003

(lxv) This paper was presented at the EuroConference on "Auctions and Market Design: Theory, Evidence and Applications" organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003

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