ECONOMETRIC MODELLING OF PAY SETTLEMENTS AND EARNINGS BY INDUSTRY 1977-2010.

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Executive summary

The aim of this project is to describe how the recession and the National Minimum Wage affected pay settlements in the UK over the period 1977-2011. The recent recession was the first since the introduction of the National Minimum Wage (NMW) so the Low Pay Commission (LPC) faces new problems determining the NMW when earnings and GDP growth in the economy are sluggish or negative. This research explicitly exploits the information available over the whole 1977-2011 period, which relates to the recessions of the early 1980s and 1990s and the most recent recession of 2008/9, to provide general insights into the relationship between pay settlements and economic forces in times of recession.

The first task of the project was to extend the data collected for the previous report (Dolton et al 2011) up to the latest available, August 2011. Using data from Incomes Data Services (IDS) and Industrial Relations Services (IRS, now XpertHR) combined with data derived from the Labour Force Survey (LFS) and the Annual Survey of Hours and Earnings (Ashe). This yields data for the period 1977-2011. These data were then augmented with aggregate annual data from the Office for National Statistics (ONS) on a number of economic variables that act as controls in our econometric modelling. We were finally able to analyse a consistent annual and quarterly data set by industry for the years 1977-2010 for 14 and 28 industrial groups based on the Standard Industrial Classification (SIC).

The second major task of this project was to explore rigorously the appropriate econometric modelling of the data. Due to time limitations in our previous report we were only able to provide a brief descriptive summary of the available data. In this project we were able to study the most appropriate estimation strategy for the panel data which took account of the main dynamic relationships in the data. We did this by a modified Panel Instrumental Variable estimation method. This econometric estimation strategy provided a fundamental insight into the dynamic relationships between the variables and hence provided us with more confidence in our findings.

The period covered by the data spans three different types of wage control – wage councils controlling wages for a subset of workers, no controls and the national minimum wage for all workers. The evidence is mixed but it can be argued that any association of wage councils

with high settlements and the national minimum wage with low settlements is due to the fact that these periods are, respectively, periods of high and low inflation. However, in the preferred estimates using first differences and the most detailed dataset, neither the wage council years nor the national minimum wage years appear different from the others, probably because these estimates account better for the overall level of inflation.

The macroeconomic variables have a strong and consistent effect on settlements. Settlements increase with inflation and decrease with the rate of unemployment. The business cycle also positively affects settlements in some specifications estimated through the growth in GDP.

The main empirical results from this project which modify the conclusions of our previous report are:

- The effect of the NMW on wage settlements is not significantly different from zero.
- The driving force of settlement levels is the past level of settlements. This finding demonstrates the importance of the dynamic modelling of the settlements process.
- In our more detailed estimated models based on quarterly data there is a negative effect of unemployment on wage settlements. (This finding is less evident in the annual data.) This is consistent with the vast literature on the Phillips Curve.
- Counter to earlier findings the effect of growth on pay settlements is not counterintuitive and appears to be zero when the dynamic structure of the data is taken into account.
- That there is a clear positive effect of price inflation on wage settlements. This result is unsurprising given the importance of inflation in current and previous time periods in wage negotiations.

These findings were subjected to a number of robustness checks including different estimation methods, levels of industrial disaggregation; and definitions of recession. The dynamic structure of key variables is examined although the analysis is restricted to using one settlement series.

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1. INTRODUCTION

The aim of this project is to describe how the recession and the National Minimum Wage (NMW) have affected pay settlements in the UK over the period 1977-2011. This is relevant to the Low Pay Commission (LPC) in the circumstances of the recent recession. The introduction of the NMW in 1999 was followed until 2008 by a period of sustained economic growth and steady economic expansion. In this context, it is unclear how a recession should affect the level of the NMW or its subsequent effects in the labour market. Previously, the revision of the NMW was concerned with how much the NMW should rise given relatively buoyant labour market conditions and an expanding economy. Since 2008 through to the present time of writing (2011) the position has changed to determining the NMW when real earnings and income growth in the economy are falling. The 2008/9 recession is the first since the introduction of the National Minimum Wage, so the (LPC) faces new problems in determining the National Minimum Wage (NMW) when earnings and GDP growth in the economy are sluggish or negative. This research explicitly uses the information available over the whole period 1977-2010 which relates to the recessions of the early 1980s and 1990s as well as the most recent recession of 2008/9 to provide general insights into the relationship between pay settlements and economic forces in times of recession.

This research investigates the course of pay settlements in previous recession periods by collating all available aggregate and micro level data on pay settlements, earnings increases, and all the relevant information on the most important control variables. Hence the first task of the project was to extend the data collected for the previous report (Dolton et al 2011) by adding in data up to August 2011 from Incomes Data Services (IDS) and Industrial Relations Services (IRS, now XpertHR), combined with data derived from the Labour Force Survey (LFS) and the Annual Survey of Hours and Earnings (Ashe), yielding data for the period 1977-2011. These data were then augmented with aggregate annual data from the Office for National Statistics (ONS) on a number of economic variables that act as controls in our

econometric modelling. We were finally able to analyse a consistent annual data set by industry for the years 1977-2010 for 14 and 28 industrial groups based on the Standard Industrial Classification (SIC).

The second major task of this project was to explore rigorously the appropriate econometric modelling of the data. Due to time limitations in our previous report we were only able to provide a brief descriptive summary of the available data. The central problem for research into the effects of the NMW is to econometrically identify what outcomes have been affected by the level or rate of change of the NMW. In this project we were able to study the most appropriate estimation strategy for the panel data which took account of the main dynamic relationships in the data. We did this by a modified Panel Instrumental Variable estimation method. This econometric estimation strategy provided a fundamental insight into the dynamic relationships between the variables and hence provided us with more confidence in our findings.

A major problem for an analysis of the effect of the NMW, with and without a recessionary context, is that we have only had one major recession during the lifetime of the NMW. Hence, to be more generally able to clarify the effect of recessions, one must seek data which relates to the earlier periods of recessionary years, e.g. 1980, 1981 and 1991. This we are able to do with our settlement data collected from our previous LPC project.

The period covered by the data spans three different types of wage control: wage councils controlling wages for a subset of workers; no controls; and the national minimum wage for all workers. The evidence is not unambiguous, but it can be argued that any association of wage councils with high settlements and the national minimum wage with low settlements is due to the fact that these periods are, respectively, periods of high and low inflation. Nevertheless, in the preferred estimates using first differences and the most detailed dataset, neither the wage council years nor the national minimum years appear different from the others probably because these estimates account better for the overall level of inflation.

We find that the main macroeconomic variables of inflation, unemployment and economic growth have a strong and consistent effect on settlements. Settlements increase with inflation and decrease with the rate of unemployment. The business cycle also positively affects settlements in some specifications through the growth in GDP.

Clearly the setting of the NMW must relate, in a consistent way, to how earnings and pay settlements are changing over time. Following the introduction of the NMW in 1999 the economy was never in recession until the recent recession which began in 2008. A recession is often characterised by declining real earnings in certain sectors and nominal pay settlements may be very low, zero or even negative. The challenge facing the LPC is to steer a reasonable course when adjusting the NMW having full regard to the current recessionary circumstances. This project presents evidence which will be integral to understanding how the recession could affect the NMW.

2. ECONOMIC BACKGROUND AND LITERATURE REVIEW.

The most recent paper to model pay settlements in the UK was by Brown et al (2004)[1]. This paper sought to investigate whether there was any evidence of downward nominal wage rigidity in the UK. This has also been a major concern in the US literature (see Card and Hyslop 1997, McLoughlin 1994 and Altonji and Devereux 2000). Not surprisingly, the question is of major interest to policy makers and macroeconomists who seek to understand how to make labour markets flexible and adaptable to modern macroeconomic shocks and pressures. Given the current economic recession this question has taken on a new importance as many countries seek to painfully adjust to lower real wages. In a world where nominal wages have largely been inflexibly downwards, there is justifiable concern as to how any economy is going to be able to adapt to recession.

There is an older tradition of modelling pay settlements and earnings (Gregory et al 1985, 1987) and, indeed, the difference in them. The difference in average earnings rises and pay settlements is known as 'wage drift' or 'pay drift' and modelling the determinants of pay settlements and earnings rises must be heavily influenced by the analysis of pay drift. The analysis of pay drift must be of central concern if one is to explain the process by which earnings change. Of necessity, the forces which condition pay drift must also condition pay settlements. Phelps Brown (1962) categorises these forces as:

i) Rising hourly earnings of pieceworkers in the course of the general improvement of organisation and methods.
ii) Action initiated by employers to attract and retain scarce labour.

[1] There are also other UK papers addressing the same issue – see Smith (2000)

iii) The pressing of claims by particular workers or groups at points where management is likely to prefer a limited rise in labour costs to a loss of output.

Hence the forces which drive pay settlements are: productivity changes; the state of the labour market; the extent and effectiveness of trade union activity; and bargaining with management. As far as possible these forces will be examined. Various papers (including Ordine 1996) have modelled these factors by using data which capture these processes. Following this literature, the measurement of these determinants will require data on, respectively, productivity, unemployment, trade union density and working days lost. These are all available for the UK on either a yearly, quarterly or monthly basis.

3. DEFINING A RECESSION

Since the theme of this report is the study of settlements and earnings growth in the context of an economic recession, we need to define exactly what we mean by a recession. The formal accepted definition of a recession is 2 quarters of consecutive negative real GDP growth. This definition is clear and unambiguous in the context of quarterly data but leaves us with a difficulty when we work with yearly data. We therefore explored three possible definitions of a recession for yearly data:

i) The year contains at least 2 consecutive quarters of negative (real) GDP growth.

ii) The year contains any 2 two quarters (not necessarily consecutive) of negative growth.

iii) The year has negative growth on average over all 4 quarters.

We explored the use of GDP growth directly, both instead of the recessionary indicators defined above and in conjunction with them. Finally, we examined the possibility that characterising a recession by any of the methods above was unnecessary in the sense that it was easier to simply define a ‘year’ effect for each year that was categorised as a recession. This involved including separate dummy variables for the years 1980, 1981, 1991, 2008 and 2009.

We found that the different possible definitions of a ‘recession’ as a discrete variable were unimportant and did not change the nature of our conclusions – hence the results we report in

Tables 2-5 present various estimated equations where we use only real GDP growth to explicitly measure the recession although the rate of unemployment also changes over the business cycle.

4. DATA COLLECTION AND DERIVATION

Data Sources

The main task of the project was to collect and organise all the relevant data relating to earnings and settlements as far back as possible. Data on earnings are abundant. Data on pay settlements are more difficult to obtain but we discuss the sources below. Our goal was to produce the most comprehensive dataset possible on settlements by pooling data from different sources and then to provide the first systematic description of these data. Our analysis focuses on describing the underlying pattern of pay settlements and earnings during periods of regular growth and also in times of recession, and how they both change during the latter and also as a result of changes in the NMW. Since there have not been many recessions over the last 20-40 years, the formal identification of these effects requires a fairly long time series and panel data analysis.

IRS (XpertHR), IDS and CBI all contributed their settlements data. These sources were pooled and a consistent series produced from 1977 to 2010[2] for 14 and 28 sectors[3] on an annual and a quarterly basis. The key macroeconomic indicators were the adult unemployment rate, real GDP and the all items Retail Prices Index (RPI) available from the ONS website.[4] Additional data were derived by industry from official data sources such the Annual Survey of Hours and Earnings (ASHE). The data appendix discusses the data in more detail but a brief outline is necessary here. The data sources used in this project were:

Unemployment, GDP Growth and the RPI

These data were collected from ONS national sources.

***Earnings*:**

Labour Force Survey (LFS) and Annual Survey of Hours and Earnings (ASHE).[5]

Settlements:

[2] There is some data for 2011 but this is incomplete and is not employed in the estimates given in this report.
[3] We can identify 2 more SIC groups (for households as employers and extra-territorial organisations) but the sample sizes are extremely small and we omit them from our analysis.
[4] The GDP and RPI figures were converted to growth rates.
[5] The data are collated separately for each industry (SIC) group but future work might investigate whether alternative indices such as the average earnings index could be used.

Aggregated settlement data were collected and collated from IRS and IDS and the Confederation of British Industry (CBI). Raw settlement data were available from IDS and IRS.

Using the data from IDS, the CBI and IRS it was possible to develop a series on pay settlements from 1977 to 2010 for 14 and 28 sectors[6] on a yearly and a quarterly basis. The former were average (mean) pay settlement levels for each industry averaged over 12 calendar months and the latter were averaged (mean) pay settlement for each industry averaged over each quarter.

Research methods and sampling

Methodology

We seek to describe:

a) The evolution of pay settlements series over the period 1977-2010 which covers recessions in the early eighties and nineties as well as the recent past. LPC (2006) cited evidence suggests that the low paid are less affected than the rest of the economy in times of recession. This is examined and quantified.

b) The determination of pay settlements and earnings and their distribution by sector over time. We were able to calculate sector/occupational pay settlement and earnings data for 28 sectors over the period from 1977-2010 using the IDS, CBI and IRS exclusively.

This analysis controls for the fraction of workers by industry and year who are male, who work full time and who work in the public sector.

5. SUMMARIZING AND CHARTING THE DATA

The data set collected on wage settlements is large and complex. As an initial guide to its characteristics, we provide a series of plots in Figures 1-4 that illustrate its variability at any given point in time and its evolution over time.

Insert Figure 1

The estimates below examine the relationship between the rate of increase in settlements and measures of recession, the presence of wage controls and other variables. Figure 1 explores

[6] We can identify 2 more SIC groups (for households as employers and extra-territorial organisations) but the sample sizes are extremely small and we omit them from our analysis.

the relationship in the annual data between whole economy average pay settlements, GDP growth and inflation. The main pattern in the time series is the high rates of inflation, earnings and settlements in the late 1970s and early 1980s compared to the period after 1991. It shows the timing of the recessions as measured by the rate of GDP growth, which clearly turns negative in 1979-1981, 1991 and 2008-2009. Exactly when the recession started in terms of which month or quarter is open to question. We discussed this in the previous section and note here that the exact definition of which year the UK is in recession does not make any material difference to our results.

Two immediate patterns are discernable from this data. Firstly, in the recessions of 1980/81 and 1991, when GDP growth was clearly negative, we see a clear spike in the level of inflation – reaching 18% in 1980 and 10% in 1991. This is then followed by a spike in the level of earnings growth a year later. The second pattern is rather more subtle, namely that the level of pay settlements seems to reach a peak a year before the level of inflation does. A possible driving force behind the change in the inflation rate is labour costs with a lag and, if pay settlements are high in year t, then this will translate into higher labour costs in the subsequent year.

The data clearly illustrate the change in the structure of pay settlements and inflation over time. Inflation and pay settlements were high in the first 15 years and much lower and less volatile in the last 19 years. Settlements were well above 5% per annum until 1992 and below 3½% thereafter. They ranged from 5.7% (1987) to 15.4% (1979) in the first period but only between 2.2% and 3.2% from 1993-2008 before falling to their lowest level (0.8%) in 2010. The 3 recessions (1980-81, 1991 and 2008/9) appear clearly, although the 2009 decline in GDP is noticeably severe.[7] The relative stability in the settlements and inflation data is matched by a period of fairly constant GDP growth rates from 1992-2007. These patterns in the data have some consequences for our estimates. Wage Councils operated when inflation was relatively high and correspondingly appear to be associated with large pay settlements. The NMW was in place when inflation rates were modest by comparison and about the same as the period with no wage controls. Settlements were on average 5.3% per annum over the whole period but 8.2% during the wage council years and 2.7% during the years of the NMW. The recessionary years in the early part of the period for which we have data are

[7] GDP in 2010 was still 3.6% lower than its value in 2007. This contrasts with the 1980/81 recession where the 1982 GDP figure was 1.1% lower than the 1979 one. Further GDP growth recovered strongly in 1983 but has stalled in 2011.

periods of high inflation with high rates of settlements. This is due to the exceptionally high settlements in 1980 (15.4%) and 1981 (8.6%) and, to a lesser extent, 1991 (6.0%). 2008 experienced about average settlements (2.9%) albeit with a modest fall in GDP. It was only in 2009 that low settlements (1.4%) were directly coupled with a recession, in this case with the most severe reported decrease in GDP (-4.9%).

Insert Figure 2

Figure 2 plots the quarterly data for the same variables as Figure 1 from 1977 through to the second quarter of 2011.[8] It confirms the main features observed in the annual data of an initial period of relatively high and fluctuating settlements followed by a period of relative stability with a notable downturn in settlements at the end of the data period. The main potential advantages of the quarterly data are to increase the number of observations and potential variation, and to pinpoint changes in the key indicators such as GPD growth. For example, there are several instances of quarters of negative GDP growth that occurred during years when the economy expanded. Indeed, the exact timing of a recession is clearer. More precisely the periods of negative growth were 1980q2 to 19981q4, 1991q1 to 1992q3 and 2008q1 to 2010q1 where growth is measured as quarter on quarter growth. Not surprisingly the quarterly series is slightly more volatile that the annual series which has been averaged or smoothed out.

Insert Figure 3

Insert Figure 4

Figure 3 graphs settlements over time for the whole economy and for each of the 14 SICs in the annual data. Figure 4 repeats the exercise for the quarterly data. The settlements in each industry track the series for the whole economy but there is, nonetheless, considerable inter-industry variation in the pattern of settlements over time that we shall exploit in our panel modelling of the data.

Stated simply our goal is to explain the pattern of pay settlements variation over this time period to establish the basic patterns of correlation between settlements, inflation, unemployment and growth in and out of recessionary periods.

Casual inspection of the data suggests the likelihood that these data series may not be stationary and there may be possible structural breaks at the recessionary time periods. The

[8] Given the large number of observations, we omit the individual data points.

underlying patterns of these series suggest that the level of settlements could be positively or negatively correlated with GDP growth depending on time lags, and positively related to contemporaneous price inflation. We will seek to establish the evidence for these basic patterns in the data in the next section and provide an examination of the basic dynamics of these series.

6. MODELLING SETTLEMENTS DATA

Specification

We investigate a simple model in which pay settlements depend on economic activity and the rate of inflation, where economic activity is measured by the growth in real GDP[9] and the rate of unemployment. When the economy is expanding, GDP growth is high and unemployment rates low and this leads to higher pay settlements. Conversely when GDP growth is low and unemployment rates high, pay settlements are low. Pay settlements depend on inflation rates because inflation determines the purchasing power of any pay settlement. In at least one important respect - a pay increase is more affordable when inflation is 'high' than when it is 'low', since in times of higher inflation, cost increases can be passed on to consumers more easily in terms of higher product prices. Similarly workers will want a higher pay increase when inflation is 'high' than when it is 'low'. In practice, actual and previous inflation are viewed as indicators of future inflationary expectations. Recessions are defined in terms of GDP growth, so the GDP growth variable provides a direct measure of the impact of recessions on settlements, although the rate of unemployment has a long history as an indicator of excess demand in the labour market. A second issue of concern is the effect of wage controls on settlements. This is captured by two dummy variables; the first covers the period when the wage councils were in operation and the second the period when national minimum wages were set.[10] The model is completed by a number of industry characteristics (the proportions of men, full time workers and public sector workers in the workforce) that vary over time.

Since one theme of this report is the study of settlements in the context of an economic recession, we consider more explicit definitions of recession. The formal definition is 2 quarters of consecutive negative GDP growth. This does not translate easily into a definition suitable for annual data and we simply define a recessionary year as one in which annual

[9] Henceforth when we refer to GDP growth we always mean real GDP growth and will not continue to use the word 'real'.

[10] These periods are 1977-1992 and 2000-2010 with a separate dummy variable for 1999.

GDP is negative.[11] This identifies 1980, 1981, 1991, 2008 and 2009 as recessionary years[12] and some results described below use dummy variables based on these years to investigate the potential effect of recessions in more detail.

A Panel Model

The basic model we consider for the annual data has the form:

$$y_{it} = \alpha y_{i,t-1} + \boldsymbol{x}_{it}'\beta + \varepsilon_{it} \qquad i=1,..,N,\ t=1,..,T$$

The dependent variable, y, is the growth in pay given by the settlements data, $\boldsymbol{x}$ a vector of exogenous regressors (such as GDP growth and the NMW indicator) and ε a random error. The data varies over industry indexed by i and time indexed by t. We present OLS estimates of this model with and without the lagged dependent variable based on the assumption that ε is independently and identically distributed with mean zero and a constant variance ($\varepsilon_{it} \sim \text{iid}(0, \sigma_\varepsilon^2)$). We allow for one industry to differ from another by including an industry specific fixed effect (μ_i) in the error term.

$$\varepsilon_{it} = \mu_i + \upsilon_{it}$$

where $\mu_i \sim \text{iid}(0, \sigma_\mu^2)$ is independent of $\upsilon_{it} \sim \text{iid}(0, \sigma_\upsilon^2)$.

The fixed effects estimator is typically used to estimate one way error components model when the fixed effect is potentially correlated with one or more regressors. This is probably true in the present case because settlements and their lagged values are likely to vary systematically across industries. However, it is well known following the work of Nickell (1981) that the fixed effects estimator is biased in moderately sized samples. Indeed Judson and Owen (1996, 1999) argue that these biases can persist in reasonably large samples. Instead, in common with much of the literature, we follow Anderson and Hsiao (1981) who suggest instrumental variable (IV) estimation of the first differenced equation

$$y_{it} - y_{it-1} = \alpha(y_{i,t-1} - y_{i,t-2}) + (\boldsymbol{x}_{it} - \boldsymbol{x}_{i,t-1}')\beta + \upsilon_{it} - \upsilon_{i,t-1} \qquad i=1,..,N,\ t=3,..,T\ .$$

The lagged value of the 'pure' error term ($\upsilon_{i,t-1}$) is necessarily correlated with the lagged value of pay settlements ($y_{i,t-1}$) which motivates the use of an IV procedure. We use the 2nd and 3rd lagged (levels) values of pay settlements, of y i.e. ($y_{i,t-2}$ and $y_{i,t-3}$) as suitable

[11] In an earlier study we found that the results were not sensitive to alternative definitions such as a year that contained 2 periods of negative growth.

[12] GDP grew by 0.8% from 1989 to1990 but experienced negative growth in the last two quarters. We treat it as a non-recessionary year in the annual data. Similarly there was a modest growth in GDP of just over 1% during 2010. Although there was one quarter when GDP fell, 2010 does not count as a recessionary year.

instruments. These are correlated with ($y_{i,t-1}$ - $y_{i,t-2}$) and there is evidence that they should perform better as instruments when taken in levels rather than first differences (e.g. ($y_{i,t-2}$ - $y_{i,t-3}$)).[13] The use of these instruments simplifies the estimation compared to the approach of Arellano and Bond (1991) which, in practice, is designed for short panels and is difficult to implement with long panels such as that used here because of the plethora of potential instruments.

7. RESULTS FOR SETTLEMENTS DATA

Annual Data

Measuring the effect of the recession

Table 1 illustrates the effects of different measures of recession on settlements and the effects of the early 'high' inflation years.[14] We also use it to discuss the interpretation of the estimated coefficients. It uses the pooled annual data for 14 SICs and reports OLS estimates. The results listed in column (a) are for a baseline specification where changes in GDP growth and unemployment capture the business cycle. A percentage point rise (fall) in GDP growth has no significant immediate impact on settlements, but significantly increases (decreases) settlements by 0.4 percentage points after a year. The long run impact when both GDP growth and its lagged value have increased is the sum of the coefficients. Using the average GDP growth figures for recessionary and non-recessionary years (2.9% and -1.9% per annum), settlements would fall by 1.8 percentage points because of the difference in average GDP growth. Changes in the unemployment rate have a larger, but still insignificant, positive impact effect (on contemporaneous unemployment) and a larger and significant negative effect (on lagged unemployment). Taking the sum of these effects, if the rate of unemployment rises by one percentage point, after a year, settlements decrease by 0.4 percentage points. The rate of inflation has a large contemporaneous and significant impact on settlements and small negative insignificant impact one year later. Our estimates suggest that a one percentage point increase in the rate of inflation in any given year, would, on

[13] We estimate 4 specifications of this first difference equation (for annual and quarterly data using 14 SICs and 28 SICs). Each IV is separately significant in the reduced form equation with a minimum t-value of 8 and the F-statistic for their joint significance easily rejects the hypothesis of weak instruments. The standard Hausman-Wu test statistic for endogeneity rejects its null that the OLS estimates of the first difference equation are the same as the corresponding IV estimates for all sets of estimates with a maximum p-value of 0.0000.

[14] The reader should note that (in common with other papers in this literature) all inflation and pay settlement data used are in nominal terms – therefore we are performing all calculations based on changes in nominal money values and not changes in real values of inflation or pay settlements.

average, increase settlements by 0.4 percentage points. The details of these effects differ across the specifications considered but, as expected, settlements increase with GDP growth and inflation and decrease with unemployment in the long run.

Insert Table 1

Columns (b) and (d) show what happens when, respectively, a single dummy and individual year dummies measure recessions. Recessionary years are associated with significantly higher settlements either when taken together or individually with noticeably higher settlements in 1980. This reflects the distortions introduced by the early years of high inflation. Columns (c) and (e) investigate this issue by reporting estimates for the period 1981-2010 only which demonstrate that the paradoxical effect of recessions on settlements is due the high inflation in the early years. These preliminary specifications suggest that the business cycle regressors (GDP growth and the unemployment rate) capture the main effects of recessions on settlements and that there is little empirical evidence for the inclusion of the single dummy and multiple year dummies for recessions.[15] We clearly also have to be aware of the potential for the early recession to distort the results.

Examining the results as a whole, the NMW was associated with low settlements when all the data is included and on balance no effect when the early data is omitted. By contrast, the wage councils were associated with high settlements, probably again because they operated when inflation was relatively high. The remaining control variables for the fractions of the workforce who were male, public sector workers and full-time workers added little to the explanatory power of the model. This suggests that industry compositional effects play virtually no role in the determination of pay settlements. These models are, therefore, driven by changes in the key economic aggregate variables that affect settlements in the same way across different industries. These results could well be predicated on modelling industry fixed effects as most of the characteristics of industries do not change much over time. This is also reassuring for the potential role of unobserved heterogeneity by industry which, it may be suggested, could be fairly minor in terms of how it changes over time.

Panel estimation (14 SICs)

Table 2 explores the structure of the model in more detail by incorporating lagged settlements and industry fixed effects. The columns refer to the estimation technique - OLS to pooled data, OLS applied to first differences (FD) or instrumental variables applied to first

[15] Similar results are obtained when individual year dummies are added to the model.

differences (FD, IV) - and to the data period. Columns (a) and (b) report our baseline specifications including and excluding the pre 1981 data. Column (c) displays results where first differences have been used to eliminate industry fixed effects. The remaining columns include lagged settlements as a regressor showing in turn estimates using OLS and Instrumental Variable First Differences. The instruments used for lagged settlements are the second and third order lagged values of settlements. ($Sett_{t-2}$ and $Sett_{t-3}$ are the IVs for $Sett_{t-1}$-$Sett_{t-2}$ in the first difference equation.) The use of these techniques necessarily changes the samples used. Lagging the settlement variable or taking first differences automatically loses the first period observations in a panel and any observations involving a missing lagged value.[16] Estimation by IV imposes a further loss of data, thus effectively estimating the model for post 1980 data.[17] In view of how different our data are in the early high inflation period of 1977-1981 we attempted to assess the sensitivity of our estimates by considering separate estimated models for the period post 1981. By also reporting estimates for the restricted period 1981-2010 using first differences and lagged settlements we examine the robustness of our findings to the inclusion or exclusion of a unusual period of extremely high inflation which took place over 30 years ago and which may not be so relevant to today's economy.

Insert Table 2

There is no compelling evidence that the NMW has had any systematic impact on settlements. Its strong negative and significant effect in the baseline specification disappears when the data period is restricted (in column b) and when industry fixed effects (column c) are taken into account. It is insignificant in all the specifications including lagged settlements. By contrast, there is evidence that the years when wage councils operated were years of higher settlements, although the size of the impact varies across the models from small and insignificant (0.2 - FD with IV), through moderate and highly significant (0.7 - FD) to large and highly significant (1.8/2.3 - OLS).

The previous value of settlements has a robust effect and it is positive as expected in the OLS and first difference with IV results. We now compare the results for first differences without lagged settlements (column c), OLS with lagged settlements (column d), and first differences

[16] For example, there are no settlement data for 'Mining and quarrying' in 1983. This affects the lagged value for 1984 and the differences for 1982-83 and 1983-84.

[17] The use of the third lag to define the IV for lagged settlements in conjunction with first differencing effectively means that we lose data for 1977-80 for most SICs and 1978-81 for 2 SICs. The holes in the post 1980 settlement data lead to the omission of more observations.

with lagged settlements and IV (column e). The impact and lagged effects of GDP growth vary across these models but the sum of these effects is similar (0.144, 0.188 and 0.166) suggesting that GDP growth is positively associated with settlements. Of course the full long run impact requires the imposition of the condition that settlements do not change over time, so the long run impact of GDP growth is given respectively by 0.144, 0.259 and 0.323.[18] These figures suggest a more modest effect of GDP growth on settlements. Using the largest figure, a percentage point rise (fall) in GDP growth eventually increases (decreases) settlements by a bit more than 0.3 percentage points. As discussed earlier a fall in GDP growth has an immediate countercyclical positive effect on settlements which is followed a year later by a larger, negative shock to settlements.

The effects of adult unemployment appear sensitive to the specification. The expected negative impact appears in the first difference results, but the inclusion of lagged settlements leads to approximately offsetting negative immediate and positive lagged effects in the OLS specification[19] and no significant impact in the first difference with IV estimates. Given the strength of the lagged settlement effect, we conclude that, whatever the short run dynamics, it is not conclusive that, in the annual data, changes in the unemployment rate have a long run impact on settlements. The effects of inflation also appear sensitive to the specification. The inclusion of lagged settlements appears to remove any lagged inflation effect in the OLS estimates but still leaves a noticeable short run impact of a change in the inflation rate and more substantial long run effect. By contrast, there is no significant difference in the impact and lagged effects of inflation in the first differences with IV results. There is an immediate positive effect of a rise in inflation which is offset one period later, but whatever the short run dynamics there is no long term effect of a change in inflation.

Panel estimation (28 SICs)

These results illustrate the importance of a careful consideration of the role of simple dynamics in our estimation and the value of quarterly data. If we refer only to the annual data results and ignore the more frequently observed quarterly data then it would appear that the NMW period has a systematic, significant effect on settlements across all the specifications. But it seems that the sign depends on the estimation technique, which may be an unsatisfactory state of affairs. In this context, however, we would place more emphasis on the

[18] These are given by: (0.259-0.071)/(1-0.273) and 0.166/(1-0.486).
[19] The difference is not significant.

quarterly results reported in Table 4 and Table 5 in which the NMW effect is essentially zero when the simple dynamic model with lagged settlements is estimated.

Considering the effect of wage councils there is again evidence that the years when they operated were years of higher settlements. However, its impact ranges, even within the first difference estimates, from small, negative and insignificant (-0.1 - FD with IV) to positive and highly significant (0.6 - FD) as before.

Insert Table 3

The main determinants of settlements in the 14 SICs results were lagged pay settlements and the macroeconomic indicators. The data for 28 SICs generate qualitatively similar results for these variables, although earlier ambiguities about the overall importance of the unemployment rate are resolved. In our preferred specification, an increase in lagged settlements increases current settlements by a slightly larger amount with 28 SICs but the differences from the previous results are small. As discussed earlier, a fall in GDP growth has an immediate countercyclical positive effect on settlements which is followed a year later by a larger, negative shock to pay settlements. There is an immediate positive effect of a rise in inflation on pay settlements which is offset one period later, although the precise effects again differ across the FD estimates. The effects of adult unemployment are again sensitive to the specification but the expected negative impact appears in the first difference results. An increase in the rate of unemployment leads to a significant decrease in settlements after one year in the first difference results, but immediately with the first difference instrumental variable estimates. Interestingly the total effect on the long run value of pay settlements of an increase in the rate of unemployment is actually slightly larger using the first difference instrumental variable estimates.[20]

Quarterly Data

Table 4 and Table 5 report the estimates for the quarterly data. As before, columns (a), (b) and (c) present results for the baseline specification estimated, respectively, by OLS including and excluding 1977-80 and by first differences. Columns (d) and (e) report the results obtained from applying instrumental variable methods to the first difference estimating equation that includes lagged settlements. The results in columns (d) and (e) employ the 1981-2010 data and the whole data set, respectively. The results for the quarterly

[20] (-0.365+0.152)/(1-0.566)=-0.491. A 1 percentage point increase in the unemployment rate decreases settlements by about 0.5 percentage points. The corresponding figure for the FD estimates is 0.4 percentage points.

data do not appear to be as sensitive as the annual ones to high inflation in the early years for which data are available. The estimates for the preferred first differences with IV are qualitatively very similar for the whole period and the restricted period and this is the case irrespective of whether we employ the 14 or 28 SIC data. The main advantage of using these data is the increased sample size; there are potentially four times as many observations (though this increase in numbers is not fully realised because there are several quarter and SIC combinations with no settlements data in most years).[21]

Insert Table 4

Insert Table 5

The most striking feature of the quarterly results is that the unemployment rate now appears to capture the business cycle effect. Lagged GDP growth has a significant positive effect in the FD equation for 14 SICs. This effect disappears in the 1981-2010 results when IV is used and lagged settlements are included and remains only borderline significant (with a p-value of 0.07) in the corresponding IV results for the whole period. However, we find no evidence at all of a significant positive impact for GDP growth in the 28 SICs data. By contrast the unemployment rate has a consistently significant negative total effect in both sets of results although the lag structure differs between the 14 and 28 SIC data. Using 14 SICs, changes in the rate of unemployment have significant impact after one period in the first difference estimates and an insignificant effect in the current period. By contrast, using 28 SICs, changes in the rate of unemployment have significant impact in the current period in the first difference estimates and a possibly significant effect after one period. Inflation remains a significant determinant of settlements predominately, although not exclusively, with a lag. There is some evidence in these results that pay settlements were running at a higher rate in industries with higher proportions of public sector workers.[22] The estimates of the effects of the two periods of wage control are both insignificant in the first difference estimates; there is no systematic difference in pay settlements between the years covered by wage councils, the years covered by the national minimum wage and the remaining years. We noted earlier that

[21] The missing values for settlements imply that the first differenced and lagged values of settlements are also missing but the pattern of the missing data makes it difficult to predict its effect on the samples used in the different specifications. Some of sample sizes may appear odd. For instance, the FD estimator for the 1977-2010 data for 14 SICs uses 1275 observations but the OLS estimator for 1981-2010 actually uses more (1299) because the FD estimator employs fewer observations in each year, for example, 28 observations compared with 35 in 1984.

[22] The regressor shows the fraction of the industry working in the public sector. The relatively large estimate should interpreted with care as a one unit increase in the regressor would correspond to an industry moving from totally private to totally public.

the higher level of disaggregation in the quarterly data appears to eliminate the effect of high inflation in the early period and this would be consistent with the hypothesis that the wage council and national minimum wage dummies were measuring differences in the average rate of settlements.

8. ROBUSTNESS CHECKS

Our estimation so far has also been subject to extensive robustness checks. Specifically we have:

- Estimated all our models with OLS, and Fixed Effects with and without Year Fixed effects, and controlling for the fraction of workers in the SIC grouping who are in the public sector, who are male, and who are part time workers.
- Estimated our models at both the 14 and 28 SIC industrial levels and this has not made any substantive difference to our conclusions.
- Explored the basic dynamic structure of our key regressors – specifically the rate of price inflation, the level of unemployment and the level of economic growth. We find that the model always generates significant effects with a one year lag.
- Variously explored different definitions of what constitutes a recession when measured either as a dummy variable or the level of real GDP growth. These changes have not made any substantive difference to our conclusions.

9. ECONOMETRIC CHALLENGES.

As observed by simply plotting the data in Figures 1 to 4 the basic data under investigation are not stationary and may contain clear structural breaks – particularly at the key points of interest – namely the recession years. We had previously only estimated the annual models with the 14 and 28 SICs (Dolton et al 2010) . In this report we updated the data to 2010 estimated the models using the quarterly data and extended our analysis to a simple dynamic model of settlements which used the lagged value of settlements as a regressor but allowed for this to be endogenous by using an IV strategy.

The estimation following this data creation provides a basic summary of the patterns of correlation in the key variables of interest. There is clear potential to investigate these problems with the quarterly data as one is then dealing with 132 time series observations for each variable.

Further modelling would consider a number of econometric issues such as:

- further investigation of the importance of lagged independent variables, and potential endogenous regressors
- the correction of serial autocorrelation problems, and an investigation of stationarity problems,
- the exploration of the possibilities of structural breaks in the data,
- the consideration of how estimation of panel data models could be extended for weighted data based on means of settlements from different size samples
- the exploitation of the potentially Seemingly Unrelated structure of the SIC composition effects are all beyond the scope of the present enquiry
- the investigation of heterogeneous behaviour across the sectors in th panel.

These issues merit detailed investigation but this would require extensive estimation and modelling which will be the subject of a future research.

10. IMPLICATIONS FOR THE NATIONAL MINIMUM WAGE.

Summarising the regression results with specific reference to the NMW suggests – controlling for other macroeconomic variations – that the NMW has no consistently significant estimated effects on pay settlements.

It should be remembered that these regression results represent simple statistical associations between contemporaneous variables. Although in various specifications we have included one period yearly lags we have not fully studied the possibility of more complex dynamic inter-relationships. For example, the effect of the NMW on pay settlements is not significant for some specifications nor have we examined the time series properties of the models in detail. Further, the NMW dummy variable probably merely measures the difference between the pre and post 1999 periods after controlling for the other variables in the model. It might, for example, capture differences in economic policies of governments before and after this point in time. Taken at face value, for the most part, these results are logical and consistent in the sense that one would not necessarily expect the NMW to exert upward pressure on the level of pay settlements for the majority of workers who are not affected by its level. This is

supported by LPC research showing few spill-over effects of the NMW higher up pay structures (by Stewart reported in LPC 2009). In conclusion the LPC can be cautiously optimistic that the level and uprating of the NMW has had relatively few spill-over effects on industry level wage settlements.

11. CONCLUSIONS

The main estimation results from this project are:

- There is evidence that the effect of the NMW on pay settlements is not significantly different from zero. Earlier work by the authors based on a descriptive analysis of the data did not have this conclusion.
- The driving force on pay settlement levels is the past level of settlements. This finding demonstrates the importance of the dynamic modelling of the settlements process.
- In our more detailed quarterly data estimated there is a negative effect of unemployment on pay settlements. (This finding is less evident in the annual data.) This is consistent with the extant literature on the Phillips Curve.
- In contrast to earlier findings the effect of GDP growth on pay settlements is not counterintuitive and appears to be zero when the dynamic structure of the data is taken into account.
- That there is a clear positive effect of price inflation on pay settlements. This result is unsurprising given the importance of inflation in current and previous time periods in wage negotiations.

Table 1: Settlements - Effect of Different Recession Measures, 14 SICs, OLS Pooled Annual Data

	a	b	c	d	e
	All Data	All Data	1981-2010	All Data	1981-2010
	b/se	b/se	b/se	b/se	b/se
Recession dummy		1.195**	-0.152		
		(0.47)	(0.27)		
Rec. dummy lag		0.131	-0.343		
		(0.49)	(0.28)		
1980 Dummy				7.189***	-
				(0.77)	-
1981 Dummy				2.112***	0.605
				(0.64)	(0.43)
1991 Dummy				0.455	0.372
				(0.58)	(0.33)
2008 Dummy				1.814***	-0.409
				(0.57)	(0.34)
2009 Dummy				4.758***	0.795
				(0.93)	(0.60)
GDP growth	0.007	0.197*	-0.107*	0.666***	0.000
	(0.07)	(0.11)	(0.06)	(0.13)	(0.08)
GDP growth lag	0.375***	0.327***	0.202***	0.068	0.254***
	(0.06)	(0.09)	(0.05)	(0.06)	(0.04)
Unemp. rate	0.353*	0.312	-0.440***	0.223	-0.334**
	(0.21)	(0.22)	(0.16)	(0.22)	(0.15)
Unemp rate lag	-0.711***	-0.746***	0.437**	-0.976***	0.306*
	(0.24)	(0.26)	(0.17)	(0.25)	(0.18)
Inflation	0.502***	0.491***	0.285***	0.270***	0.328***
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)
Inflation lag	-0.076	-0.112**	0.237***	-0.124**	0.176***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Male	0.978	0.968	0.530	0.815	0.503
	(0.75)	(0.75)	(0.42)	(0.68)	(0.42)
Public	-0.082	-0.070	0.198	-0.120	0.189
	(0.24)	(0.24)	(0.14)	(0.22)	(0.14)
Full-time	-0.807	-0.774	-0.396	-0.580	-0.369
	(1.13)	(1.12)	(0.61)	(1.02)	(0.60)
NMW Dummy	-1.327***	-1.543***	0.435*	-2.388***	0.330
	(0.40)	(0.42)	(0.24)	(0.42)	(0.27)
Wage C. Dummy	2.972***	3.220***	2.287***	4.542***	2.295***
	(0.34)	(0.36)	(0.20)	(0.37)	(0.23)
Constant	4.144***	4.423***	0.846	6.997***	0.697
	(1.08)	(1.08)	(0.60)	(1.07)	(0.65)
R-squared	0.792	0.794	0.856	0.829	0.859
N	466	466	415	466	415

Coefficients with standard errors in parenthesis. Asterisks show significance level (* p<0.10, ** p<0.05, *** p<0.01)

Table 2: Settlements – Panel Estimation, Annual Data, 14 SICs

	a	b	c	d	e
	OLS	OLS 1981-2010	FD 1981-2010	OLS 1981-2010	FD, IV 1981-2010
	b/se	b/se	b/se	b/se	b/se
Settlements lag				0.273***	0.486***
				(0.04)	(0.10)
GDP growth	0.007	-0.058	-0.191***	-0.071*	-0.197***
	(0.07)	(0.04)	(0.05)	(0.04)	(0.06)
GDP growth lag	0.375***	0.249***	0.335***	0.259***	0.363***
	(0.06)	(0.04)	(0.05)	(0.03)	(0.06)
Unemp. rate	0.353*	-0.354**	-0.072	-0.350***	-0.200
	(0.21)	(0.14)	(0.16)	(0.13)	(0.19)
Unemp. rate lag	-0.711***	0.331**	-0.411**	0.343**	-0.076
	(0.24)	(0.15)	(0.17)	(0.14)	(0.20)
Inflation	0.502***	0.298***	0.442***	0.250***	0.361***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.06)
Inflation lag	-0.076	0.207***	-0.152***	0.047	-0.337***
	(0.05)	(0.04)	(0.04)	(0.04)	(0.07)
Male	0.978	0.516	-0.728	0.418	3.356
	(0.75)	(0.42)	(5.15)	(0.40)	(5.88)
Public	-0.082	0.199	1.192	0.159	1.009
	(0.24)	(0.14)	(1.10)	(0.13)	(1.24)
Full-time	-0.807	-0.377	5.752	-0.282	9.960
	(1.13)	(0.60)	(5.72)	(0.57)	(6.68)
NMW Dummy	-1.327***	0.310	-0.773	0.276	-0.934
	(0.40)	(0.22)	(0.49)	(0.20)	(0.57)
Wage C. Dummy	2.972***	2.290***	0.689*	1.831***	0.232
	(0.34)	(0.19)	(0.35)	(0.19)	(0.41)
Constant	4.144***	0.844		0.523	
	(1.08)	(0.59)		(0.56)	
R-squared	0.792	0.856	0.629	0.873	-
N	466	415	409	409	386

Coefficient with standard error in parenthesis. Asterisks show significance level. * p<0.10, ** p<0.05, *** p<0.01.

Table 3: Settlements - Panel Estimation, Annual Data, 28 SICs

	a	b	c	d	e
	OLS	OLS 1981-2010	FD 1981-2010	OLS 1981-2010	FD, IV 1981-2010
	b/se	b/se	b/se	b/se	b/se
Settlements lag				0.293***	0.566***
				(0.03)	(0.09)
GDP growth	0.047	-0.085***	-0.178***	-0.082***	-0.156***
	(0.05)	(0.03)	(0.04)	(0.03)	(0.04)
GDP growth lag	0.385***	0.277***	0.335***	0.265***	0.317***
	(0.04)	(0.03)	(0.03)	(0.02)	(0.04)
Unemp. rate	0.325**	-0.381***	-0.169	-0.394***	-0.365***
	(0.15)	(0.10)	(0.11)	(0.09)	(0.13)
Unemp. rate lag	-0.616***	0.439***	-0.231**	0.457***	0.152
	(0.17)	(0.11)	(0.12)	(0.10)	(0.14)
Inflation rate	0.560***	0.324***	0.414***	0.261***	0.295***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Infl. lag	-0.086**	0.198***	-0.111***	0.051*	-0.265***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.05)
Male	1.065**	0.746**	-4.469	0.553**	-0.460
	(0.53)	(0.29)	(3.37)	(0.27)	(3.97)
Public	0.119	0.322***	1.234	0.223**	1.097
	(0.19)	(0.11)	(0.95)	(0.10)	(1.10)
Full-time	-1.401*	-0.893*	7.913**	-0.606	10.673**
	(0.85)	(0.46)	(3.99)	(0.43)	(4.70)
NMW Dummy	-1.216***	0.378**	-0.768**	0.390***	-0.849**
	(0.28)	(0.15)	(0.35)	(0.14)	(0.41)
Wage C. Dummy	2.516***	1.921***	0.418*	1.488***	-0.098
	(0.24)	(0.14)	(0.24)	(0.13)	(0.29)
Constant	3.744***	0.452		0.047	
	(0.79)	(0.44)		(0.41)	
R-squared	0.815	0.864	0.662	0.883	0.406
N	821	732	726	726	689

Coefficient with standard error in parenthesis. Asterisks show significance level (* p<0.10, ** p<0.05, *** p<0.01)

Table 4: Settlements - Panel Estimation, Quarterly Data, 14 SICs

	a	b	c	d	e
	OLS	OLS 1981-2010	FD	FD IV 1981-2010	FD IV
	b/se	b/se	b/se	b/se	b/se
Sett. lag				0.109**	0.113*
				(0.05)	(0.06)
GDP growth	0.023	-0.122	0.027	0.045	-0.042
	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)
GDP growth lag	0.033	-0.037	0.235***	0.069	0.149*
	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)
Unemp. rate	-0.885***	-1.225***	-0.241	0.029	-0.101
	(0.29)	(0.22)	(0.33)	(0.26)	(0.32)
Unemp. % lag	0.217	0.648***	-0.679**	-0.698***	-0.671**
	(0.30)	(0.22)	(0.33)	(0.25)	(0.32)
Inflation	0.266***	0.092*	-0.037	-0.019	0.090
	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)
Infl. lag	0.118**	0.261***	0.244***	0.141***	0.223***
	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)
Male	0.626	0.436	-1.172	-4.421	-2.029
	(0.50)	(0.38)	(12.20)	(8.81)	(11.35)
Public	0.177	0.335***	4.328**	4.692***	4.985**
	(0.16)	(0.13)	(2.13)	(1.53)	(2.00)
Full-time	-0.629	-0.455	2.140	-2.653	2.654
	(0.72)	(0.53)	(11.31)	(8.18)	(10.61)
NMW Dummy	-1.651***	-1.417***	0.484	0.295	0.393
	(0.18)	(0.13)	(0.64)	(0.45)	(0.59)
Wage C. Dummy	3.698***	3.525***	0.672	0.455	0.492
	(0.18)	(0.13)	(0.67)	(0.48)	(0.62)
Constant	8.138***	7.355***			
	(0.51)	(0.39)			
R-squared	0.698	0.660			
N	1402	1299	1275	1112	1169

Coefficient with standard error in parenthesis. Quarterly dummies included. Asterisks show significance level (* p<0.10, ** p<0.05, *** p<0.01)

Table 5: Settlements- Panel Estimation, Quarterly Data, 28 SICs

	a	b	c	d	e
	OLS	OLS 1981-2010	FD	FD IV 1981-2010	FD IV
	b/se	b/se	b/se	b/se	b/se
Sett. lag				0.198***	0.175***
				(0.04)	(0.05)
GDP growth	0.096*	-0.166***	0.087	0.038	-0.005
	(0.06)	(0.05)	(0.05)	(0.05)	(0.06)
GDP growth lag	-0.038	-0.026	0.070	0.043	0.046
	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)
Unemp. rate	-1.220***	-1.574***	-0.592***	-0.474**	-0.607***
	(0.19)	(0.15)	(0.23)	(0.19)	(0.22)
Unemp. % lag	0.570***	1.043***	-0.413*	-0.345*	-0.256
	(0.20)	(0.15)	(0.23)	(0.19)	(0.23)
Inflation	0.286***	0.129***	0.018	0.020	0.080**
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)
Infl. lag	0.106***	0.212***	0.134***	0.069*	0.115***
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)
Male	0.358	0.272	-9.496	-5.836	-5.097
	(0.35)	(0.25)	(7.08)	(5.69)	(6.91)
Public	0.167	0.287***	2.201	3.452**	2.213
	(0.13)	(0.10)	(1.84)	(1.47)	(1.78)
Full-time	-0.457	-0.247	8.079	2.809	7.738
	(0.54)	(0.38)	(7.80)	(6.25)	(7.60)
NMW Dummy	-1.692***	-1.396***	0.102	0.005	0.049
	(0.13)	(0.09)	(0.46)	(0.36)	(0.44)
Wage C. Dummy	3.567***	3.425***	0.678	0.442	0.433
	(0.12)	(0.09)	(0.47)	(0.37)	(0.45)
Constant	7.964***	6.950***			
	(0.39)	(0.29)			
R-squared	0.740	0.706			
N	2656	2442	2476	2186	2304

Coefficient with standard error in parenthesis. Quarterly dummies included. Asterisks show significance level (* p<0.10, ** p<0.05, *** p<0.01)

Figure 1: Settlements (whole economy), Inflation and GDP Growth

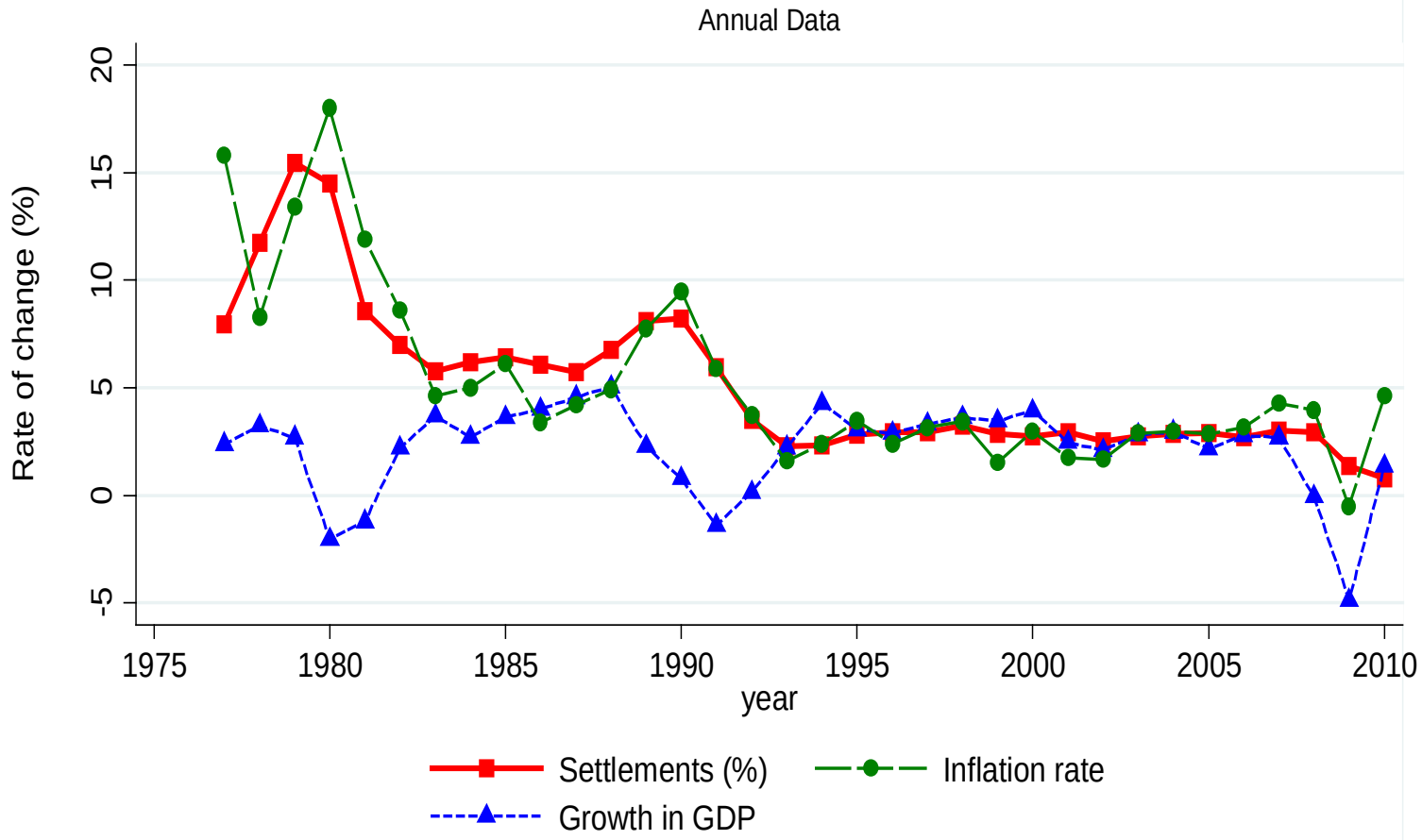


Figure 2: Settlements (whole economy), Inflation and GDP Growth

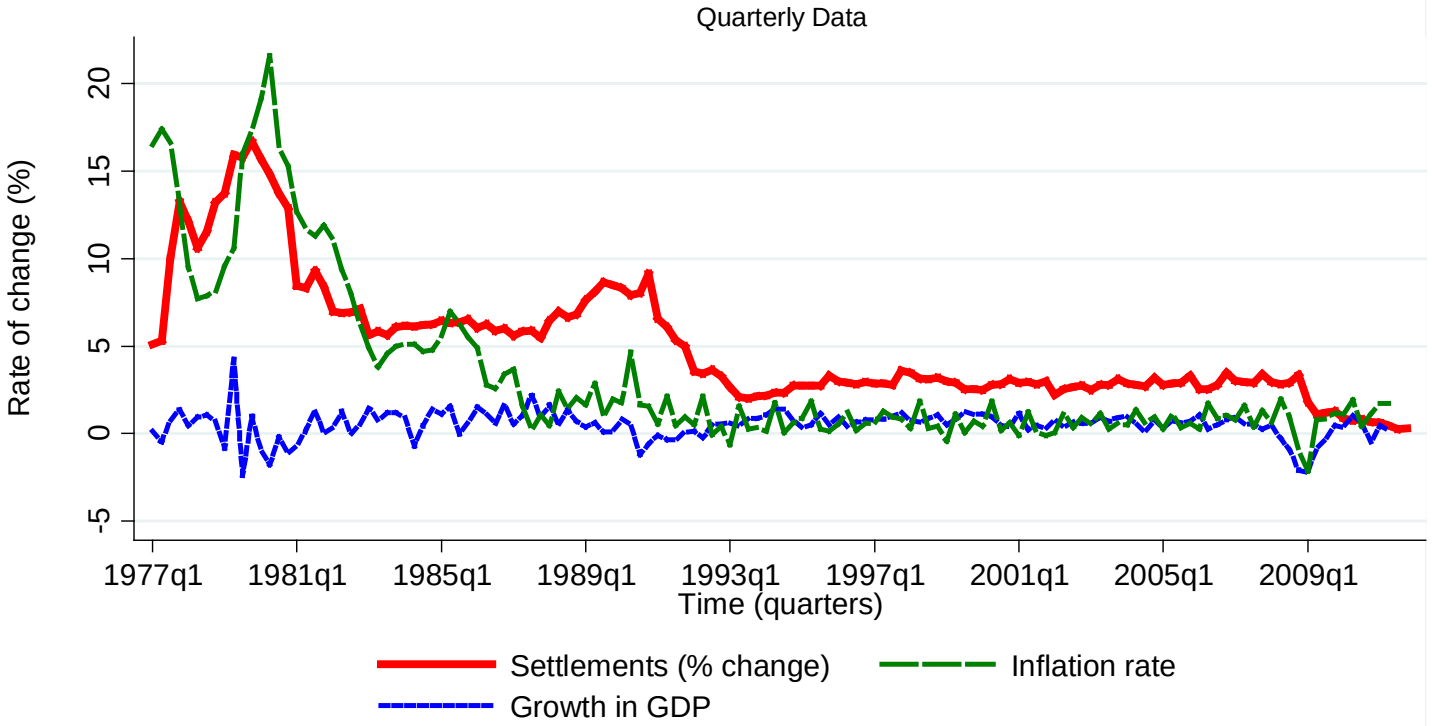


Figure 3: Settlements (by SIC and Whole Economy)

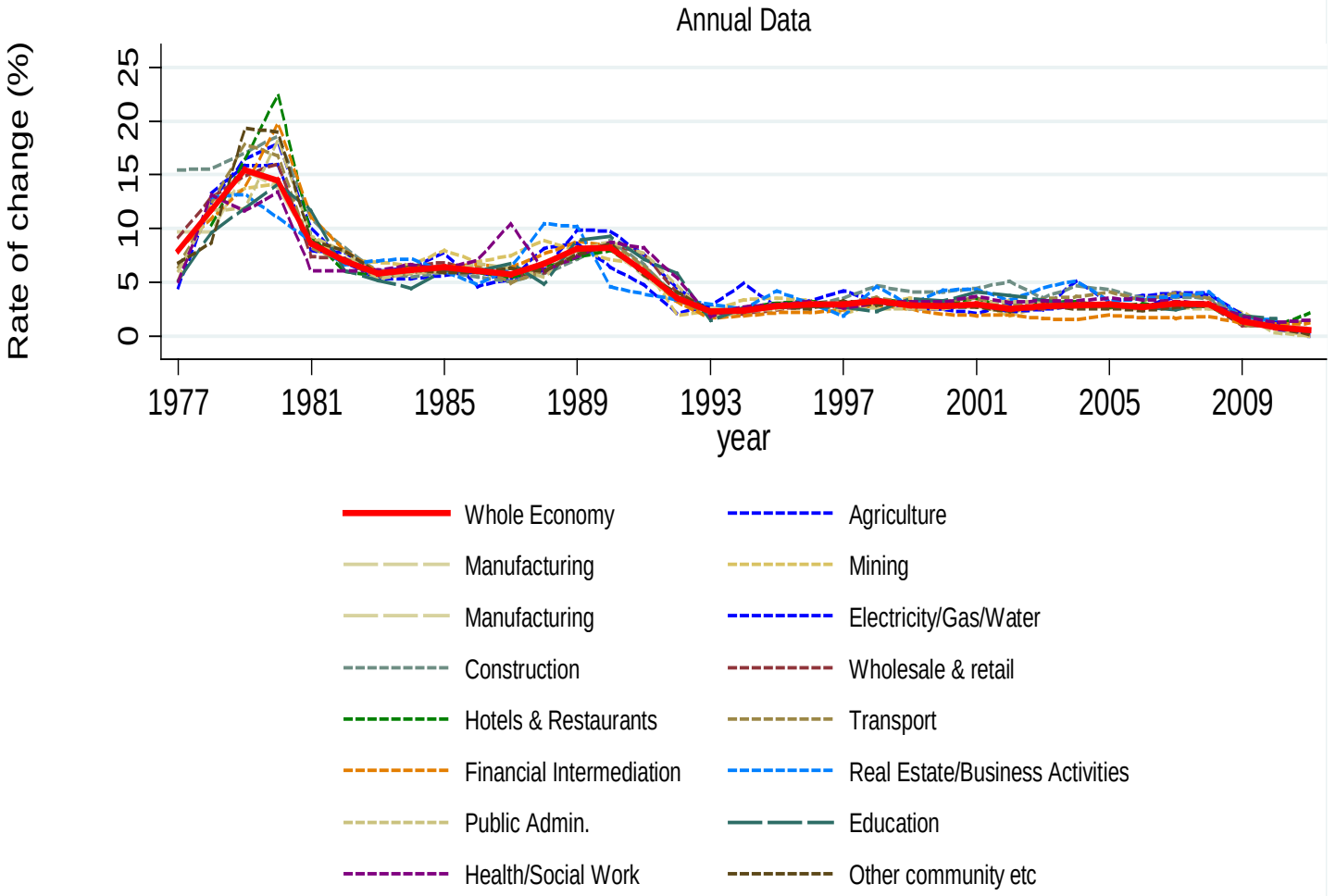
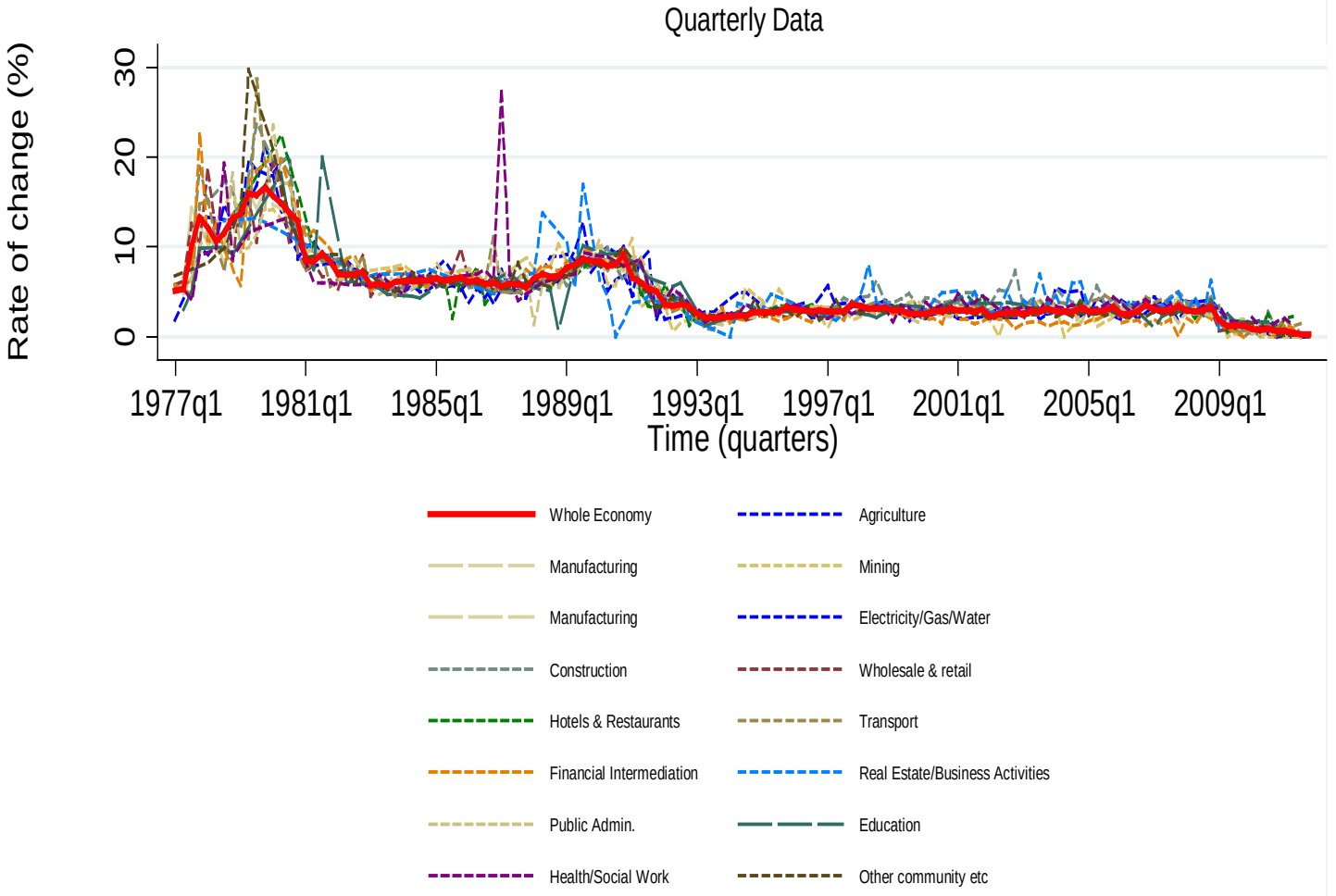


Figure 4: Settlements (by SICs and Whole Economy)



DATA APPENDIX

1. Data of Settlements

1.1 Data Sources

Raw micro settlement data at firm level is available from Incomes Data Services (IDS), Industrial Relations Services (IRS) and CBI Pay Settlements Survey. It is extracted to perform a microeconomic analysis of the distribution of pay settlements, and is used to construct aggregate data of pay settlements over time and across industries.

IDS pay settlements data 1977-2010

An electronic database of pay settlements 1994-2010 is provided by IDS and includes key variables such as the percentage increase in pay settlements, company names, subsectors, number of employees, and effective date of settlements. The historical data prior to 1994 is manually inputted and added to the electronic database from the quarterly reviews (for 1979-1993 data) and the monthly summaries (for 1977-1978 data) published in the IDS Pay Reports (No. 248 to 659).

In cleaning data we carefully check the changes in company names over time so as to obtain a consistent database and map the company names to specific subsectors. The final data has 33,587 observations of pay settlements.

IRS pay settlements data 1984-2009

The IRS data relates to minimum and maximum increase in settlements, industries, number of employees, and date of settlements. We take the average of minimum and maximum increases in settlements to calculate the increase rate of settlements. This data is available for 16 industry groups from 1984 to 2009, with 29,623 observations.

CBI Pay Settlements Survey 1979-1992

From the CBI pay settlements data we extract variables including increase in settlements, industries, number of employees, and date of settlements, and obtain 32,648 observations of pay settlements.

1.2 Reconciled Index of Industries

The main problem when we combine the above three data sets is that they are based on different classifications of industries. The IDS data is classified as 64 subsectors, and in IRS data there are 17 sectors. CBI data defines industries based on SIC 1968. To reconcile different definitions of industry groups we use SIC 1992/2003[23] as a benchmark. Sectors in the IRS data are broadly mapped to SIC 1992/2003. In a similar way we define the industry groups in the IDS data based on the information on subsectors; in addition, we refer to the individual company names to double check which specific group a company belongs to. For CBI data we have to map SIC 1968 to SIC 1992/2003 based on RLAB's works on mapping different SICs.[24] With the industries converted to a consistent classification, we have a data set of 16 industries, with manufacturing industries as one sector. To facilitate a more detailed analysis by industry, we construct a second version of SICS by replacing the manufacturing industry with 14 individual manufacturing sectors, again based on SIC 1992/2003. Details of the two versions of SICs are shown in Table 1. Tables 2 and 3 show how we map the sectors in IDS and IRS to SIC 1992/2003, respectively.

[23] Source: UK Standard Industrial Classification of Economic Activities UK SIC(92)
http://www.statistics.gov.uk/methods_quality/sic/contents.asp

[24] Sources:
http://rlab.lse.ac.uk/data/reference/docs/SIC80_to_SIC92.xls and http://rlab.lse.ac.uk/data/reference/docs/SIC68_to_SIC80.xls

1.3 Aggregate Panel Data of Pay Settlements

Having got the micro data we are able to construct a panel data on pay settlements from 1977 to 2011 for 16 or 30 sectors. The time dimension of the panel data runs either by year from 1977 to 2011, or by quarter from the first quarter in 1975 to the second quarter in 2011. With the two classifications of industries, we have four versions of panel data sets: by year and by 16 sectors, by quarter and by 16 sectors, by year and by 30 sectors, and by quarter and by 30 sectors.

2. Data of Earnings

2.1 Data Sources

The earnings data is constructed from New Earnings Survey (NES) and Annual Survey of Hours and Earnings (ASHE). Key variables include hourly earnings including overtime, hourly earnings excluding overtime, gross weekly pay and working hours.

2.2 Reconciled Index of Industries

As in the data of settlements, there are different definitions of industries over time in the earnings data. Specifically, raw data is defined on SIC 1968 from 1975 to 1981, SIC 1980 from 1982 to 1992, and SIC 1992 from 1996 to 2009. To solve the problem we reconcile the data by mapping SIC 1968 and SIC 1980 to SIC 1992.

2.3 Aggregate Panel Data of Earnings

The micro data of earnings is aggregated to panel data by time and by sectors, in the same format as the settlements data.

3. Other Data

Other key aggregate data are mainly extracted from statistical publications. The main data sources are ONS statistics and Department of Employment Gazettes. Key variables include productivity, working days lost, trade union density, average earnings index, (long term) unemployment and (long term) employment. See the data dictionary for more details.

Table 1. Definition of Industries

16 SICs		30 SICs	
1	Agriculture, hunting, forestry and fishing	1	Agriculture, hunting and forestry
2	Mining and quarrying	2	Fishing
3	Manufacturing	3	Mining and quarrying
4	Electricity, gas and water supply	04-17	Different Manufacturing industries
5	Construction	18	Electricity, gas and water supply
6	Wholesale and retail etc.	19	Construction
7	Hotels and restaurants	20	Wholesale and retail etc.
8	Transport, storage and communication	21	Hotels and restaurants
9	Financial intermediation	22	Transport, storage and communication
10	Real estate, renting and business activities	23	Financial intermediation
11	Public administration and defence; compulsory social security	24	Real estate, renting and business activities
12	Education	25	Public administration and defence; compulsory social security
13	Health and social work	26	Education
14	Other community, social and personal service activities	27	Health and social work
15	Private households with employed persons	28	Other community, social and personal service activities
16	Extra-territorial organisations and bodies	29	Private households with employed persons
		30	Extra-territorial organisations and bodies

Table 2. Subsectors in IDS and SIC 1992/2003

Subsector in IDS	**SIC 1992/2003**	
Advocacy	N	Health and social work
Agriculture & forestry	A	Agriculture, hunting and forestry
Animal welfare	*Mapped to SIC 1992/2003 based on individual company names*	
Business services	K	Real estate, renting and business activities
Call centres	K	Real estate, renting and business activities
Care services & housing	N	Health and social work
Catering	H	Hotels and restaurants
Central government	L	Public administration and defence; compulsory social security
Chemicals, pharmaceuticals & oil	DG	Manufacture of chemicals, chemical products and man-made fibres
Cleaning	K	Real estate, renting and business activities
Construction	F	Construction
Culture	O	Other community, social and personal service activities
Domestic services	O	Other community, social and personal service activities
Education	M	Education
Employment services	N	Health and social work
Energy & water	E	Electricity, gas and water supply
Engineering services	DL	Manufacture of electrical and optical equipment
Engineering: Aerospace & defence	DM	Manufacture of transport equipment
Engineering: Electronics	DL	Manufacture of electrical and optical equipment
Engineering: General	DN	Manufacturing not elsewhere classified
Engineering: Rail infrastructure	DM	Manufacture of transport equipment
Engineering: Shipbuilding	DM	Manufacture of transport equipment
Engineering: Vehicles & components	DM	Manufacture of transport equipment
Environment	O	Other community, social and personal service activities
Fast food, pubs & restaurants	H	Hotels and restaurants
Financial services	J	Financial intermediation
Fire & police	L	Public administration and defence; compulsory social security
Food, drink & tobacco	DA	Manufacture of food products, beverages and tobacco
Glass, pottery & ceramics	DI	Manufacture of other non-metallic mineral products
Health	N	Health and social work
Helplines, advice, counselling	N	Health and social work
Hotels	H	Hotels and restaurants
IT	I	Transport, storage and communication
Leisure	*Mapped to SIC 1992/2003 based on individual company names*	
Local government	L	Public administration and defence; compulsory social security

Media	I	Transport, storage and communication
Mining & quarrying	C	Mining and quarrying
NGOs	O	Other community, social and personal service activities
Nurseries	N	Health and social work
Other manufacturing	DN	Manufacturing not elsewhere classified
Other membership, research & regulatory	O	Other community, social and personal service activities
Other nurseries, housing & welfare	N	Health and social work
Paper & packaging	DE	Manufacture of pulp, paper and paper products; publishing and printing
Pharmaceutical services	O	Other community, social and personal service activities
Plant hire	F	Construction
Post office	I	Transport, storage and communication
Professional services	O	Other community, social and personal service activities
Property	L	Public administration and defence; compulsory social security
Public sector	L	Public administration and defence; compulsory social security
Recreation	O	Other community, social and personal service activities
Research councils/institutes & research funds	O	Other community, social and personal service activities
Retail	G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
Security	*Mapped to SIC 1992/2003 based on individual company names*	
Telecommunications	I	Transport, storage and communication
Textiles, clothing & footwear	DB	Manufacture of textiles and textile products
Timber & furniture	DD	Manufacture of wood and wood products
Trade unions & professional associations	O	Other community, social and personal service activities
Transport: Air	I	Transport, storage and communication
Transport: Buses	I	Transport, storage and communication
Transport: Rail	I	Transport, storage and communication
Transport: Road & distribution	I	Transport, storage and communication
Transport: Shipping & ports	I	Transport, storage and communication
Waste management	O	Other community, social and personal service activities
Wholesale	G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods

Table 3. IRS Industries and SIC 1992/2003

IRS Industries	**SIC 1992/2003**	
Agriculture, hunting and forestry	A	Agriculture, hunting and forestry
Chemicals & pharmaceuticals	DG	Manufacturing
Construction	F	Construction
Electricity, gas and water	E	Electricity, gas and water supply
Engineering and metals	DJ	Manufacturing
Finance	J	Financial intermediation
Food, drink and tobacco	DA	Manufacturing
General manufacturing (including bricks, cement, ceramics, glass, timber product	DN	Manufacturing
General services (including radio and television, security etc)	O	Other community, social and personal service activities
Hotels and catering	H	Hotels and restaurants
Mining and quarrying	C	Mining and quarrying
Not for profit	O	Other community, social and personal service activities
Paper and printing	DE	Manufacturing
Public services	L	Public administration and defence; compulsory social security
Retail and wholesale	G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
Textiles	DB	Manufacturing
Transport and communication	I	Transport, storage and communication

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