Wage Flexibility and the Great Recession: The Response of the Irish Labour Market

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Abstract

Despite the importance of wage rigidity in macroeconomic models, no consensus has emerged in the empirical literature on the extent of wage rigidity. Previous attempts to measure wage rigidity have been hampered by small samples and measurement error. Moreover, results relating to earlier periods may not be relevant in the context of the large macroeconomic shocks that have hit many countries in recent years. In this paper we examine nominal wage flexibility in Ireland both in the build up to, and during the Great Recession, using tax return data that are free of reporting error and cover the entire population of workers. The Irish case is particularly interesting because it has been one of the countries most affected by the crisis. We find a substantial degree of downward wage flexibility in Ireland in the pre-crisis period. Furthermore, we observe a significant change in wage dynamics since the crisis began; the proportion of workers receiving wage cuts more than trebled, rising from 17% in 2006 to 56% at the height of the crisis. Given the large number of workers receiving pay cuts it seems unlikely that wage rigidity played an important role in unemployment dynamics in Ireland over this period.

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1. Introduction

The issue of whether wages are rigid or flexible is one that has been central to macroeconomics for many years.[1] However, many attempts to establish the extent of wage rigidity empirically have been hampered by small samples or measurement error. Moreover, results relating to earlier periods may not be relevant in the context of the large macroeconomic shocks that have hit many countries in recent years. In this paper we examine nominal wage flexibility in Ireland both in the build up to, and during the Great Recession, using tax return data that are free of reporting errors and cover the entire population of workers.

The Irish economy provides an interesting setting for examining the flexibility of wages. After a period of very rapid growth from 1994 to 2007, when the average annual GDP growth rate was over 7%, the economy collapsed and the average growth rate over 2008-2011 was -1.75%. This is reflected in the unemployment rate, which was relatively stable at 4%-5% for most of the early 2000s, rose to 12% in 2009 and continued to rise further to 14.6% in 2011. Inflation averaged 2.5% in the period from 1994 to 2011 but was negative in 2009 (-4.5%) and 2010 (-1%). Given these substantial changes in the macroeconomic environment, and the general flexibility of the Irish labour market (Andranik, 2008), it is useful to examine the extent to which wages responded during this period. In a recent address to the 2014 Annual Central Bank Symposium, ECB President Mario Draghi attributes the recent diverging performances of the Irish and Spanish labour markets in part to the fact that " Ireland entered the crisis with a relatively flexible labour market …[In addition] in Ireland, downward wage adjustment began already in the fourth quarter of 2008 and proceeded more

[1] For a discussion of the role of wage flexibility in alternative economic models see Gali (2012).

quickly [than Spain].” These conclusions are based on measures of aggregate wage changes for all workers, public and private sector combined.

In this paper we look at nominal wage changes over the pre-crisis and crisis periods using individual panel data. We find a significant degree of downward wage flexibility in the pre-crisis period, supporting the view that the Irish labour market is a flexible one. We also observe a significant response in wage change behaviour since the crisis began; the proportion of workers receiving earnings cuts more than trebled during the crisis. In addition, estimates of wage rigidity, which were already low before the crisis, fell further at the onset of the crisis, when unemployment was increasing dramatically. Given these findings, it seems unlikely that nominal wage rigidity played an important role in explaining Irish unemployment dynamics during the crisis.

The remainder of the paper is as follows. Section 2 summarizes previous work relating to wage flexibility. Section 3 gives a brief overview of the Irish policy response to the crisis. Section 4 describes the datasets used in the analysis. Section 5 reports the main results of the paper, based on tax return data, while Section 6 reports some supplemental analyses carried out using the EU Survey of Income and Living Conditions (EU-SILC) data. Section 7 provides estimates of the degree of wage rigidity in Ireland. Section 8 concludes.

2. Literature Review

There is a substantial body of research that uses microdata to examine the extent of wage flexibility. However, as of yet no general consensus has emerged. McLaughlin (1994) analysed Panel Study of Income Dynamics (PSID) data and concluded that wages in the US were flexible; 17% of household heads who did not change employers faced nominal wage cuts annually. However, these results have been challenged by a number of authors who

argue that the extent of wage cuts in these data may be exaggerated by measurement error. Altonji and Devereux (2000) using both firm level personnel files and household survey data conclude that nominal wage cuts are rare once one accounts for measurement error. More recently Barattieri et al. (2014), using Survey of Income and Program Participation (SIPP) data and an alternative strategy to identify measurement error, reach a similar conclusion.

For the UK, Smith (2000) uses the 1991-1996 British Household Panel Survey (BHPS) to examine wage rigidity. Her initial results indicate that 9% of job stayers experienced a zero nominal wage change from year to year, and that 23% experienced nominal wage reductions. To examine the consequences of measurement error, she uses the fact that the BHPS records whether respondents consulted their payslips when answering the wage question. In contrast to the results of Altonji and Devereux (2000) and Barattieri et al. (2014), she finds that measurement error in household surveys leads to an understatement of the extent of wage flexibility. The proportion of workers reporting no wage change falls from 9% to 6% when the sample is restricted to those who consult their payslip, a pattern she attributes to rounding error.

Evidence of wage changes for other countries is more limited. Dickens et al. (2007) report the results of the International Wage Flexibility Project, which analyses individual earnings in 16 countries. They find that on average 8% of workers receive nominal wage freezes, and in many countries wage cuts are rare. Ireland is unusual in that there is a lower incidence of wage freezes, and almost as many wage cuts are reported as would be if the wage cut distribution were symmetric. They argue that the data used for their Irish analysis, the European Community Household Panel (ECHP), may explain the unusual Irish results as

it contains fewer observations and more reporting errors than the datasets available for other countries.[2]

Recently researchers have begun to examine wage adjustment in the Great Recession. Blundell et al. (2014) examine payroll data from the National Employment Survey (NES) for the UK and find that the number of workers experiencing wage freezes increased from approximately 5% in 1990 to 12% in 2011. However, they find a significant degree of downward wage flexibility; throughout the 1990s and 2000s, almost 20% of stayers report a nominal wage cut. Elsby et al. (2014) also analyse UK NES data and similarly find that nominal wage cuts are frequent.

For the US, Elsby et al. (2014) use Current Population Survey (CPS) data to analyse wage changes from 1979-2011. They report several key features of the wage adjustment process in the US. First, there is always a significant spike at zero in the wage change distribution – between 6% and 20% of workers report exactly the same nominal wage in both years. Secondly, there is always a non-trivial fraction of workers (between 10% and 20%) who report nominal wage reductions. Thirdly, while the zero spike increased during the Great Recession, the increase was not substantial. They consider the implications of these features of the wage change distribution and suggest that the high unemployment observed in recent years would have been nearly as high in a world with completely flexible wages.

Much of the research on Ireland in recent years has used firm-level rather than individual-level data to examine the extent of downward wage rigidity. Du Caju et al. (2013) analyse a 2007/2008 survey of European firms and find that only 2% report having cut wages over the previous five years; the figure for Ireland was just 1%. Using the same data, Babecký et al.

[2] The ECHP has also been used by Knoppik and Beissinger (2009) to develop a more formal model of wage rigidity.

(2010) report that 10% of firms froze base wages, with a corresponding figure for Ireland of 9%. Walsh (2012) uses the Earnings, Hours and Employment Costs Survey (EHECS) to examine wage changes during the recession and finds that 23% of establishments report cuts in average hourly earnings between 2008 and 2009, rising to 31% between 2009 and 2010.

3. Irish Policy Response to the Crisis

As noted earlier, Ireland was one of the countries worst affected by the Great Recession, with output falling by over 10% in real terms between 2008 and 2010. The effects of the global recession felt elsewhere were compounded in Ireland by the bursting of a property bubble and the subsequent collapse of output and employment in construction-related sectors. Because bank lending was so highly concentrated in construction, Irish banks experienced huge losses and the government decided to guarantee all bank liabilities in 2008. However, continued falling tax revenue and exposure to bank liabilities resulted in the government deficit going from almost zero in 2008 to 13.9% in 2010 and a remarkable 30.8% in 2011, when banking losses crystallized. As a result, yields in Irish bonds reached unsustainable levels in 2010, and the government sought and accepted a rescue package from the EU, ECB and IMF.

The crisis resulted in the government undertaking a severe programme of austerity measures, combining tax increases and expenditure cuts. As part of the expenditure cuts, the government set out to cut payroll costs in the public sector substantially by reducing staff and directly cutting pay. Pay rates in the public sector were initially reduced via a Pension Levy introduced in 2009 ranging from 5% to 10.5%. Further pay cuts of 5% to 10% were implemented in 2010.[3] In addition, there were increases in hours worked, the reduction or elimination of overtime rates, and lower pay scales for new entrants into professions such as

[3] A third round of public sector pay cuts was implemented in 2013, but these cuts lie outside the period covered by our data.

teaching. However, it should be noted that automatic annual pay increases continued to be paid to some public sector workers until 2013, when they were delayed. The government also abandoned the national wage setting process that had been in place since 1987, in which unions and participating employers bargained at a national level over wage increases.[4]

The immediate aim of these measures was to reduce the government deficit. A longer-term aim was to effect an internal devaluation; as a member of the euro area, only cuts in labour and other costs could reduce real exchange rates. For example, there was an expectation that the public sector wage cuts would have a demonstration effect on the private sector, and so contribute to the desired internal devaluation. However, aggregate data indicate stability in the wages of private sector workers since the onset of the crisis (Barrett and McGuinness, 2012; Bergin et al. 2012). This would suggest that Ireland has been unable to achieve the necessary internal devaluation through private sector wage reductions, perhaps indicating a substantial degree of wage rigidity. However, as acknowledged by the authors, aggregate data suffer from a number of drawbacks. First it is difficult to control for compositional changes in the workforce that have taken place during the crisis; if workers who have lost their jobs differ from those who continue to be employed then basing average wages only on the population of workers will be misleading. Secondly even if the aggregate wage change is relatively small this may be hiding substantial differences in wage adjustments across individuals. By following the earnings of individuals over time we address both these issues.

[4] The national pay agreements were always rigidly adhered to by public sector and semi-state employers. However, for private sector employers, adherence was effectively voluntary and by the time of our sample period, the agreements appear not to have been widely applied.

4. Data

Two datasets are used in the paper. Our main analysis is based on data taken from the Job Churn (JC) dataset, which is a longitudinal administrative dataset covering the years 2005-2011 that has been compiled by the Central Statistics Office (CSO). These data combine three elements. Data on annual income and weeks worked are provided by the tax authorities in respect of every worker who was an employee during that year. Information on workers' age, sex and social welfare class are provided by the Department of Social Welfare. Finally, data on the sector in which each firm operates and the enterprise's ownership structure come from the CSO's Central Business Register. Anonymised worker and firm identifiers are included in the dataset to allow longitudinal analysis.

There are several significant advantages to using the JC data to examine changes in earnings over time. Firstly, because they are administrative data, based on tax returns, they are largely free from measurement error; it is a criminal offence to misreport workers' earnings in these returns. Secondly, the data comprise the entire population of employees in Ireland and so the number of observations is large enough to allow very detailed analysis of earnings changes; there are up to three million employment records in any year. Thirdly, since employers are obliged to file these returns for every worker, problems associated with non-response and attrition are absent from the data. Finally, the data cover the period from 2005 to 2011, allowing us to compare earnings dynamics before and during the crisis.

The earnings variable provided in the JC data also has significant advantages. Earnings are defined as annual 'reckonable' income for the calendar year;[5] this is gross income from all sources including bonuses and taxable benefits-in-kind, after pension

[5] One complication that arises from the use of an annual earnings measure is that the number of pay days can vary for weekly paid workers because of the structure of the calendar. For instance workers who are paid weekly would have received 53 pay cheques in 2010 if paid on Fridays but only 52 in 2009 or 2011 – resulting in a recorded earnings rise of 1.9% between 2009 and 2010 and a cut of 1.9% between 2010 and 2011 for workers whose weekly earnings were unchanged. We take account of this in our analysis where possible.

contributions, which are not taxable, have been deducted. The fact that irregular earnings are included is important because firms can adjust labour costs through these components as well as basic pay; for evidence on the widespread use of adjustments to non-core pay in 2007-2008, see Du Caju et al. (2012) and Dias et al. (2013). In addition, firms can react to labour market shocks by changing hours of work, so we believe that data on earnings are the most appropriate for capturing the flexibility firms have in adjusting costs. The fact that the income measure is net of pension contributions allows us to take into account the Public Sector Pension Levy, mentioned in Section 3 above. Since this levy reduces earnings and entails no compensating increase in pension entitlements, it has the same effect as a reduction in gross pay, but it does not register as such in household surveys that record gross earnings.

While it may be of interest to decompose earnings changes into core pay, non-core pay and pension contributions, the JC data contain no information that would allow this decomposition. For this reason, we supplement our primary analysis by using the Irish component of the EU-SILC for the years 2004-2011. In Ireland, EU-SILC data is collected using a dedicated survey of about 5,000 households, who are interviewed annually.

In the EU-SILC data, we use two pay variables – annual income and hourly wages. In contrast to the JC data, annual income includes pension contributions but excludes overtime and bonus payments. Thus, comparing annual earnings in these two datasets allows us to consider the role of these components in earnings dynamics. The hourly wage variable is calculated based on income received in the last pay cheque and hours worked. A comparison of the annual and hourly wage variables in the EU-SILC allows us to consider the role of hours worked in explaining earnings changes.

All income variables in the EU-SILC were subject to careful cleaning by the CSO, using administrative and other sources. In addition, respondents were encouraged to check

their payslips and whether they did or not was recorded. For these reasons, reporting error is likely to be less important in the EU-SILC than in the ECHP used by Dickens et al. (2007) and Knoppik and Beissinger (2009).

For both JC and EU-SILC datasets, we focus on job stayers, those who remain with the same employer in successive years.[6] In the JC data, job stayers may have changed roles even if they did not change employer, whereas in the EU-SILC data, job stayers exclude those who have been promoted. In addition, for both datasets we restrict our samples to employees who had worked for the full year in each pair of years. In the JC data, we also exclude all workers who had multiple jobs, while in the EU-SILC data we restrict our sample to those who consulted pay slips in order to minimize measurement error. As noted earlier, there are no hours data available in the JC data and so for ease of comparison, we include both part-time and full-time workers in the EU-SILC sample.

Because of the different wage-setting mechanisms that pertain in the public and private sectors, we supplement our overall analysis with separate examinations of these sectors. While there is no public sector identifier in the JC data, the enterprise's NACE code and its ownership structure can be combined to give a good indication of which sector an individual works in. When defining public sector workers, we omit workers in commercial state enterprises to the extent possible.

After imposing these restrictions, we have between 700,000 and 800,000 observations in the JC data, and between 300 and 800 in the EU-SILC data.

[6] Summary statistics on the proportion of workers in the JC data who are job stayers are given in Table A1 of the Appendix.

5. Main Results: Analysis Using Administrative Job Churn Data

We begin our analysis by looking at the relationship between average earnings and unemployment. Figure 1 plots real average annual earnings in 2006 prices against the unemployment rate over our sample period. The correlation between real earnings and unemployment over this period is -0.8. Given the short data period, the results are merely suggestive but nevertheless offer support for the procyclicality of real wages in Ireland.

To analyze wage dynamics in more detail, we exploit the longitudinal nature of the JC data and look at annual nominal earnings changes for individuals for each pair of years between 2005 and 2011. Following Ziliak et al. (2011), we calculate percentage earnings changes using the arc percent change method. The key advantage of this method is that it is symmetric in gains and losses.

Table 1 presents descriptive statistics of the annual earnings changes from 2005/06 to 2010/11. Column 2 shows the median percentage earnings change for each pair of years. The growth in earnings in the pre-crisis period is evident in the numbers reported for 2005-2008, with median annual growth rates of between 4.5% and 6.1%. The impact of the crisis is clearly observed in the later period, with *negative* median wage changes of about 1% in 2008/09 and 2009/10. These wage changes are consistent with the relatively small changes in average earnings reported by Barrett and McGuinness (2012).

However, as noted earlier, aggregate measures may hide important differences across individuals. Columns 3-5 report the percentage of workers receiving an earnings freeze, an earnings cut and an earnings rise; as is common in the literature, we classify a change of less than 0.1% as an earnings freeze. These data reveal substantial flexibility. Similar to Blundell et al. (2014) for the UK and Elsby et al. (2014) for the US and the UK, we find that a non-trivial fraction of Irish workers report nominal earnings reductions in each year. In the pre-

crisis period, the percentage of workers experiencing earnings cuts ranges from 17% to 23%. In contrast to the US and the UK, this proportion increased substantially during the crisis, reaching a high of 55% in 2009/10, compared to 23.6% in the UK and 37% in the US.

Although these results illustrate significant wage reductions in response to the crisis, it is worth noting that the percentage experiencing earnings increases remains above 40% throughout the period. This compares to a figure of over 60% reported for the UK by Blundell et al. (2014).

Turning to wage freezes, the percentage of workers whose earnings did not change from year to year was less than 3% in the pre-crisis period and rose to 6.8% in 2010/11. Elsby et al. (2014) report that the percentage of nominal wage freezes in the UK over the period 2005-2011 ranges from 1.7% to 7.4%, findings that are similar to ours. However, for the US they find that the proportion of wage freezes is substantially larger, ranging from 17.6% to 19.5% for hourly paid workers and from 9.4% to 14.9% for non-hourly paid workers.

To look at these earnings changes in more detail, Figure 2 shows the histograms of annual nominal earnings changes in each of the years. We include two lines on each graph – a solid line at zero, indicating a nominal earnings freeze and a dashed line at the inflation rate for that year, corresponding to a real earnings freeze. In each year we observe a spike in the nominal earnings change distribution at zero, as discussed earlier. In addition to the spike at nominal zero, we also observe a spike near the inflation rate in the pre-crisis period. As we will see later in the paper, this spike applies only to public sector workers, and is likely to reflect national pay agreements, which targeted the expected inflation rate and were strictly adhered to in this sector until 2008.[7] The shift to the left of the wage change distribution

[7] There are also notable spikes at roughly -2% and +2% in the later years; this reflects the distribution of pay days for weekly paid workers and the complication this causes for annual pay discussed in Footnote 5.

during the crisis is also evident from the graphs, as is the increase in mass to the left of the median in 2008/09 and 2009/10.

Given the relatively small number of freezes in the Irish wage change distribution and the very large number of workers receiving earnings cuts during the recession, it seems unlikely that nominal wage rigidity played an important role in explaining Irish unemployment dynamics during the crisis.

As well as the incidence of pay cuts and pay rises, it is also useful to examine the magnitude of these changes. These are reported in Table 2. Column 2 (3) shows the size of the median earnings cut (increase) for those receiving cuts (increases) over the period. Surprisingly, with the exception of 2010/11, the magnitude of pay cuts was relatively constant, while there was a slight decline in the magnitude of pay increases.

A major focus of policy discussion during the crisis centred on the relative wage adjustments in the public and private sectors. Table 3 presents earnings changes separately for these two sectors. Looking at the pre-crisis years, we see that earnings dynamics were similar in the two; between 15% and 25% experienced earnings cuts[8] and between 71% and 85% experienced earnings increases. As discussed earlier, a key government response to the crisis involved the imposition of a series of direct pay cuts in the public sector. Table 3 shows that 59% of public sector workers experienced an earnings cut in the 2008/09 period, increasing to 81% in 2009/10.[9] Furthermore the magnitude of the cuts was substantial; the median earnings change was a cut of 6% in 2009/10. Although there were no legislated pay

[8] The prevalence of earnings decreases in the pre-crisis period is somewhat surprising, particularly in the public sector, where announced pay changes were all positive. The JC data allows us to examine the frequency of earnings cuts by NACE sector for evidence of a pattern that might be explained by hours variability. In results not reported here, we see that even pre-crisis, earnings cuts were widespread in all areas of the public sector and did not seem to vary substantially by gender. The EU-SILC data includes variables that allow us to explore this issue further, so we postpone more detailed discussion of these explanations until later

[9] Recall that annual increments continued to be paid to some public sector workers throughout our period.

cuts in 2010/11, 36% of public sector workers experienced a reduction in annual earnings in that year.

Table 3 also reveals a significant response to the crisis for private sector workers. The percentage experiencing earnings decreases rose from 25% in 2007/08 to 50% in 2008/09. The figures for 2009/10 and 2010/11 fell slightly, but remained high. In each year of the crisis, the median earnings change in the private sector was approximately zero. However, this aggregate figure masks the heterogeneity of earnings responses to the crisis in the private sector.

The histograms reported in Figures 3 and 4 for public and private sector workers respectively show these earnings dynamics in more detail. Looking at Figure 3, we see marked differences in the public sector earnings change distributions before and after the crisis. In the pre-crisis period, there is a spike at roughly the inflation rate, coinciding with the settlements in the national wage agreements that were in operation in this period; this spike disappears during the crisis – during which time the national wage agreements were abandoned – and there is a clear shift to the left of the earnings change distribution for public sector workers. In addition, a strong spike at zero emerges for public sector workers in 2010/11. The histograms for private sector workers are, for the most part, in keeping with the discussion for all workers; there is a persistent spike at zero that increases dramatically during the crisis, combined with a substantial increase in the proportion of workers experiencing earnings cuts at the height of the crisis. However, the spike at the inflation rate in the pre-crisis period is absent in the private sector graphs, which is consistent with the anecdotal evidence that private sector employers did not adhere to national wage agreements.

The very large number of observations in the JC data permits a more detailed breakdown of the earnings changes, classifying workers by broad industrial sector. We begin

by looking at the incidence of year-on-year earnings cuts, increases and freezes. The results are given in Figure 5. As similar patterns were evident in each of the pre-crisis year pairs, we only present the graph for 2005/06, which shows that pay rises dominate in every sector; approximately 80% of workers in each sector receive earnings increases. The figures for the crisis period reveal an increase in the incidence of earnings cuts in all sectors. However, sectoral differences are apparent. The impact of the crisis on the Construction sector is evident in all three years, while in later years earnings decreases were widespread in Public Administration & Education, in Health and in Utilities (gas, electricity and water).

The year-on-year earnings changes presented so far do not allow us to examine cumulative pay changes for a given individual. For example, it is possible that workers whose earnings have been cut in one year have had those pay cuts reversed in subsequent years, resulting in small cumulative pay changes over several years. To address this issue, we examine median cumulative pay changes separately for the pre-crisis and crisis periods by industrial sector. The results are given in Figure 6. Looking at the pre-crisis period we see substantial pay growth in 2005-2008 for all workers, with a median of 16.5%. In contrast, the median cumulative pay change from 2008-2011 was -2%, indicating that pay cuts were not reversed. However, Figure 6 also indicates significant variation across sectors, with pre-crisis cumulative increases for job stayers ranging from a median of 13.5% in Construction to 22.5% in Finance & Insurance. During the crisis, the median pay change was negative in most sectors, with Construction being the hardest hit, with a median cumulative earnings change of -10%. It is notable that the Finance & Insurance sector, which experienced the biggest increase in median pay in the pre-crisis period, has been one of the least affected during the crisis. This finding echoes that of Bell and Van Reenan (2014) for the UK.

6. Further Analysis using EU-SILC Data

As noted earlier, changes in annual reckonable income may reflect changes in hours worked, in non-core pay or in pension contributions, as well as changes in the rates of pay. To examine these issues in more detail, we use the EU-SILC survey data. In this dataset, the annual earnings variable excludes non-core pay and includes pension contributions. The data also include an hourly wage variable. To minimize measurement error, we consider subsamples of workers who consulted their payslips before answering the earnings question.[10] This payslip information is only available from 2006.

We begin by comparing the dynamics for annual JC and EU-SILC earnings. Table 4 shows the results from the EU-SILC, alongside the results from the JC reproduced from Table 1. Looking first at the median changes, we see that with the exception of 2008/09, both datasets give very similar aggregate results. In both datasets, earnings growth falls from about 6% in 2006/07 to about 4.5% in 2007/08, is negative in 2009/10 and small and positive in 2010/11. The only difference between the two series arises in 2008/09, where the median rise in earnings in the EU-SILC data was 5%, compared to a fall of 0.6% in the JC data. This difference is explained by the Public Sector Pension Levy introduced in 2009 discussed earlier. The trends in the percentages receiving earnings freezes, cuts or increases are also similar across the two datasets. Both datasets show a rise in the percentage receiving earnings cuts and a fall in the percentage receiving earnings increases during the crisis. The similarity of the two sets of results – apart from the 2009 pension levy – suggests that changes to non-core pay and discretionary pension contributions were not important determinants of earnings dynamics.

[10] We have also looked at the full sample and the key findings are similar.

It has been well documented (e.g. Walsh, 2012) that firms in Ireland responded to the crisis in part by adjusting hours of work, which would be reflected in changes in annual earnings with no corresponding change in hourly pay. Since the EU-SILC provides information on hours worked, it allows us to examine dynamics in hourly pay. The results are given in Table 5; to allow comparison, we reproduce the EU-SILC results on annual earnings from Table 4 in the first five columns. The major features of wage dynamics reported earlier for annual earnings using both the JC and EU-SILC data are still evident when we use hourly pay. The percentage of workers receiving a cut in hourly pay increases from below 25% in 2006/07 to about 48% in 2009/10, as the labour market reacted significantly to the crisis. The most notable difference between the two series is the fact that in all years, a higher percentage of workers report a pay freeze when using hourly pay as opposed to annual pay. Furthermore, this difference increases substantially during the crisis period, supporting the view that firms responded to the crisis by adjusting hours as well as base pay. Nevertheless, the percentage of workers receiving pay freezes when hourly wages are used is still relatively low in the years immediately following the onset of the crisis.

7. Measurement of Wage Rigidity

So far, we have examined the proportion of freezes and cuts in the wage change distribution as indicators of wage flexibility. In this final section of the paper we turn to the construction of a measure of wage rigidity, which attempts to identify the proportion of desired cuts that are prevented from occurring. Many measures of rigidity have been proposed.[11] These include the 'skewness location approach' (McLaughlin, 1994), the 'histogram location approach' (Kahn, 1997) and the 'symmetry approach' (Card and Hyslop, 1997; Montes and Ehrlich, 2013). These alternatives identify wage rigidity either through shifts in the location

[11] For a summary of many of these measures see Beissinger and Knoppik (2001).

of wage change histograms, or by assumptions on the form of the counterfactual distribution that would be observed in the absence of rigidity. However, all of these measures require that the highest wage change affected by rigidity is smaller than the median of the counterfactual distribution. The economic crisis in Ireland was so severe that in a number of years the median observed pay change was negative, thus violating this requirement.[12] Furthermore the limited variation in the location of the wage change histogram in our data poses a problem for location-based approaches.

Dickens et al. (2007) propose a simple measure of downward nominal wage rigidity that is not dependent on wage change medians being positive or on large variation in the location of the distribution. This measure is based on the assumption that everyone who had a nominal freeze would have had a wage cut in the absence of wage rigidity. The measure is defined simply as the ratio of the proportion of workers receiving freezes to the proportion receiving either cuts or freezes. This measure provides a consistent measure of wage rigidity provided all desired wage cuts that are not enacted are recorded as wage freezes and that wage rigidity does not affect firms wishing to offer pay increases.

In Dickens et al.'s cross country comparison, the average degree of downward rigidity is 28%. Their average for Ireland for the period 1993 to 2001 is 4%, the lowest of all countries covered, but as noted earlier, they express reservations about the Irish data. We calculate this measure using the JC data[13] and the results are reported in Table 6. Rigidity was 16%-18% in the pre-crisis period. Although these figures are substantially higher than

[12] Yet another approach is the earnings function approach (Altonji and Devereux, 2000, Barwell and Schweitizer, 2007, Bauer et al., 2007 and Devicienti et al., 2007). This approach relies on parametric assumptions for identification.

[13] When calculating the rigidity measure we take account of the fact that the different numbers of pays days across years may result in some freezes being recorded as increases or decreases. In particular we use the observed frequency of workers in small bins either side of -1.9% and +1.9% to impute the predicted frequency in the affected bin. The difference between the observed and predicted frequencies is added to the pay freezes in Table 1when calculating the rigidity measure.

those reported by Dickens et al. for Ireland, they are still low relative to many of the other countries reported in their analysis. Our estimates are similar to their results for the U.K. and only slightly higher than those for Denmark, France and Belgium, which are the three most flexible countries in their analysis after Ireland.

At the onset of the crisis, measured downward rigidity fell substantially to 10.1% in 2008/09 before rising again to 21.3% by 2010/11. The finding that wage rigidity fell with the onset of the crisis is consistent with previous work that found that cyclical downturns relax nominal wage rigidity (Beissinger and Knoppik, 2001). The predominant explanation for downward wage rigidity is that employers avoid reducing wages because of the effect on morale. Bewley (1999) examined wage rigidity in the US during the recession of 1991-1992, and found that managers used wage cuts only in circumstances where the firm faced serious problems. Since the economic crisis in Ireland caused serious problems for many firms, it is plausible that downward nominal wage rigidity would be lessened in these years. In addition, Gordon (1996), in his comment on Akerlof et al.'s paper on the impact of wage rigidity in a low-inflation environment, suggests that nominal wage reductions would no longer be seen as unfair. The fact that inflation dropped and then turned negative during the crisis might also explain the fall in downward nominal wage rigidity.

However, our findings for the latter part of the crisis suggest that this reduction in rigidity may not be permanent. By the end of our sample period, at which time Ireland was still experiencing significant economic difficulties, estimated rigidity had returned to its pre-crisis level. Since the Dickens et al. (2007) measure is identified from the spike at zero in the wage change distribution, it is useful to consider the source of the spike in 2010/11 in more detail. One possibility is that firms in Ireland found pay cuts difficult to implement after two consecutive years of cuts, in which case the increased spike comes from the left-hand side of

the wage change distribution. An alternative possibility is that the proportion of freezes is rising because firms who would otherwise give pay *rises* are reluctant to do so because wage rigidity would prevent reversals of these rises in subsequent years (Elsby, 2009). In this case, the increased spike comes from the right-hand side of the distribution. We use the distributions of earnings changes for 2008/09 and 2010/11, shown in Figure 7, to assess these explanations. Comparing the two distributions, it is apparent that the right side of the distribution is similar in both years and that the increase in rigidity in 2010/11 is being drawn largely from the left side of the distribution, with some counterfactual wage cuts being swept up to zero. There is little evidence that the increased spike in the last year of our analysis is been driven by postponed pay rises as opposed to postponed pay cuts.

8. Conclusions

A large body of macroeconomic research emphasizes the role of wage rigidity in accounting for unemployment. However, attempts to measure wage flexibility have been hindered by small samples and measurement error in earnings data. In this paper we examine nominal wage flexibility in Ireland before and since the start of the Great Recession. Our primary analysis uses tax return data that are free from reporting errors and cover the entire population of workers. We supplement the analysis of these administrative data with an analysis of survey data that allow us to examine earnings dynamics in more detail

We find a significant degree of downward flexibility in both annual earnings and hourly wages in the pre-crisis period. We also observe a marked change in wage dynamics; the proportion of workers receiving earnings cuts more than trebled so that at the height of the crisis, over half of all workers were experiencing earnings decreases. In addition, we find that measured wage rigidity was low initially and fell substantially at the onset of the crisis.

Although results based on wage changes at the aggregate level suggest that wages did not respond to the crisis in Ireland, our results highlight the potential deficiencies of using aggregate data to assess the behaviour of labour markets over the business cycle. Focusing on individual wage changes, we show that wages responded dramatically to changing economic conditions. This suggests that downward wage rigidity has not been a key driver of high unemployment in Ireland.

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Table 1: Annual Earnings Dynamics, Job Churn Data, All Job Stayers

Year	Median Change	% Freezes	% Cuts	% Rises
2005/2006	0.060	2.5	17.2	80.4
2006/2007	0.061	2.5	17.6	79.9
2007/2008	0.045	2.8	22.9	74.2
2008/2009	-0.006	3.3	52.7	44.0
2009/2010	-0.011	4.4	55.2	40.3
2010/2011	0.006	6.8	39.3	53.9

Table 2: Sizes of Pay Cuts (Rises) for those Receiving Cuts (Rises)

Year	Median Cut	Median Rise
2005/2006	-0.050	0.078
2006/2007	-0.051	0.079
2007/2008	-0.053	0.066
2008/2009	-0.060	0.046
2009/2010	-0.060	0.051
2010/2011	-0.037	0.044

Table 3: Annual Earnings Dynamics, Job Churn Data, Job Stayers, Public and Private Sectors

Year	All				Public Sector				Private Sector			
	Median Change	% Freezes	% Cuts	% Rises	Median Change	% Freezes	% Cuts	% Rises	Median Change	% Freezes	% Cuts	% Rises
2005/ 2006	0.060	2.5	17.2	80.4	0.063	0.6	14.8	84.6	0.058	3.4	18.3	78.2
2006/ 2007	0.061	2.5	17.6	79.9	0.067	0.6	13.6	85.8	0.058	3.4	18.9	77.7
2007/ 2008	0.045	2.8	22.9	74.2	0.050	0.7	18.5	80.8	0.042	3.9	24.9	71.3
2008/ 2009	-0.006	3.3	52.7	44.0	-0.015	1.4	59.3	39.3	-0.002	4.3	50.4	45.3
2009/ 2010	-0.011	4.4	55.2	40.3	-0.060	1.2	81.0	17.8	0	5.7	46.4	47.9
2010/ 2011	0.006	6.8	39.3	53.9	0.010	4.8	36.4	58.8	0.004	7.8	39.9	52.2

Table 4: Annual Earnings Dynamics, EU-SILC and Job Churn Data, All Job Stayers

Year	Nominal Annual Earnings EU-SILC (Payslips available)					Nominal Annual Earnings Job Churn (Taken from Table 1)			
	N	Median Change	% Freezes	% Cuts	% Rises	Median Change	% Freezes	% Cuts	% Rises
2006-2007	326	0.060	2.8	22.1	75.2	0.061	2.5	17.6	79.9
2007-2008	757	0.044	1.7	28.0	70.3	0.045	2.8	22.9	74.2
2008-2009	638	0.047	0.6	35.9	63.5	-0.006	3.3	52.7	44.0
2009-2010	604	-0.018	0.5	55.8	43.7	-0.011	4.4	55.2	40.3
2010-2011	412	0.010	3.9	40.6	56.1	0.006	6.8	39.3	53.9

Table 5: Annual Earnings and Hourly Wage Dynamics, EU-SILC, All Job Stayers with Pay Slips Available

Year	Nominal Annual Earnings (Taken from Table 4)					Nominal Hourly Wages				
	N	Median Change	% Freezes	% Cuts	% Rises	N	Median Change	% Freezes	% Cuts	% Rises
2006-2007	326	0.060	2.8	22.1	75.2	326	0.054	3.7	24.8	71.5
2007-2008	757	0.044	1.7	28.0	70.3	757	0.049	3.4	27.1	69.5
2008-2009	638	0.047	0.6	35.9	63.5	638	0.027	6.7	32.9	60.3
2009-2010	604	-0.018	0.5	55.8	43.7	604	0	9.6	49.0	41.4
2010-2011	412	0.010	3.9	40.6	56.1	412	0	13.8	40.5	45.6

Table 6: Time Pattern of Wage Rigidity

	% of Wage Cuts Prevented by Rigidity
2005/06	18.1
2006/07	17.3
2007/08	16.4
2008/09	10.1
2009/10	12.1
2010/11	21.3

Figure 1: Average Job Stayers' Real Annual Earnings and Unemployment Rate 2006-2011

Figure 2: Earnings Dynamics, Job Churn Data, All Job Stayers

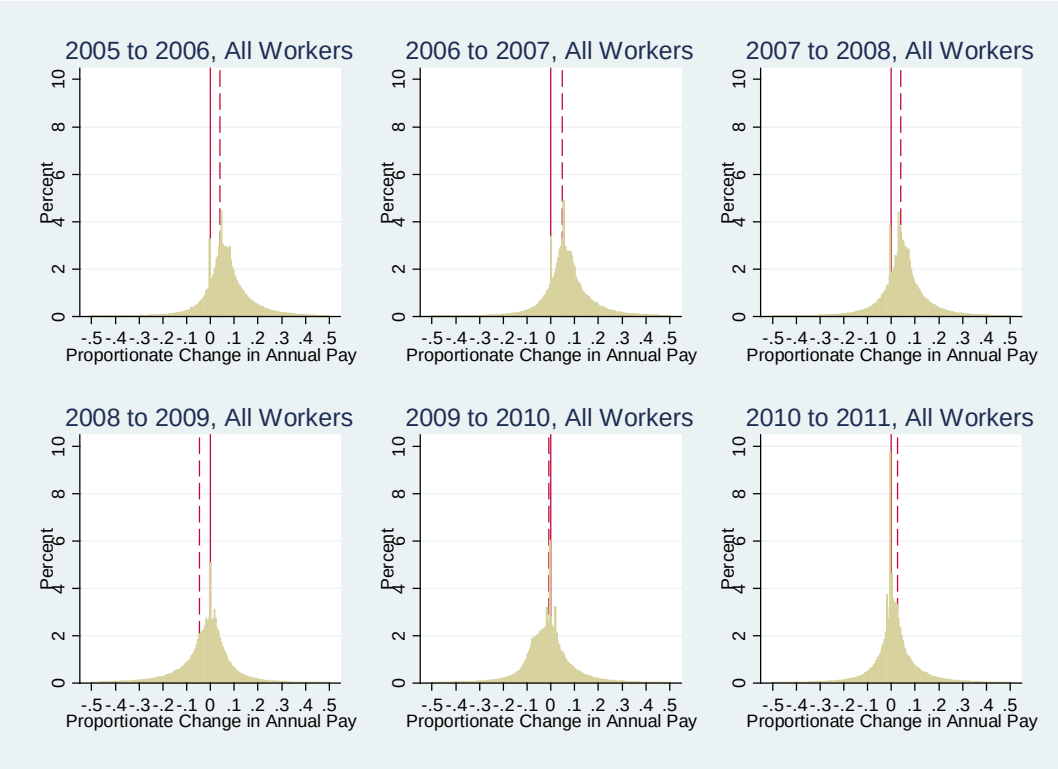


Figure 3: Earnings Dynamics, Job Churn Data, Public Sector Job Stayers

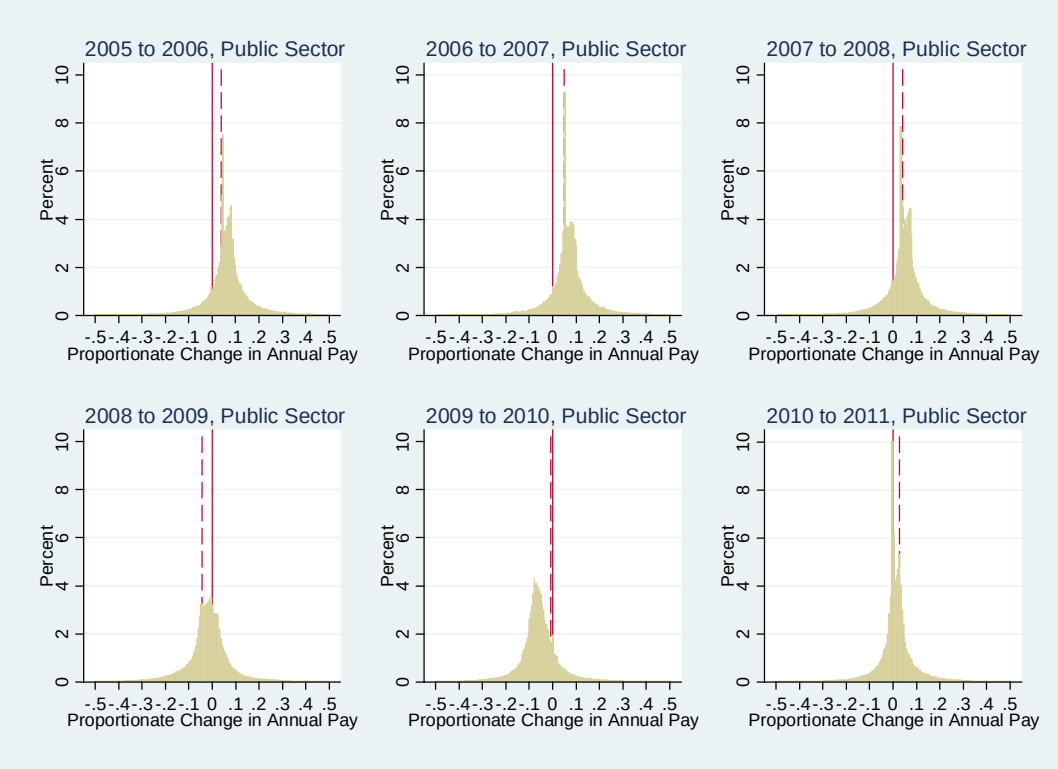


Figure 4: Earnings Dynamics, Job Churn Data, Private Sector Job Stayers

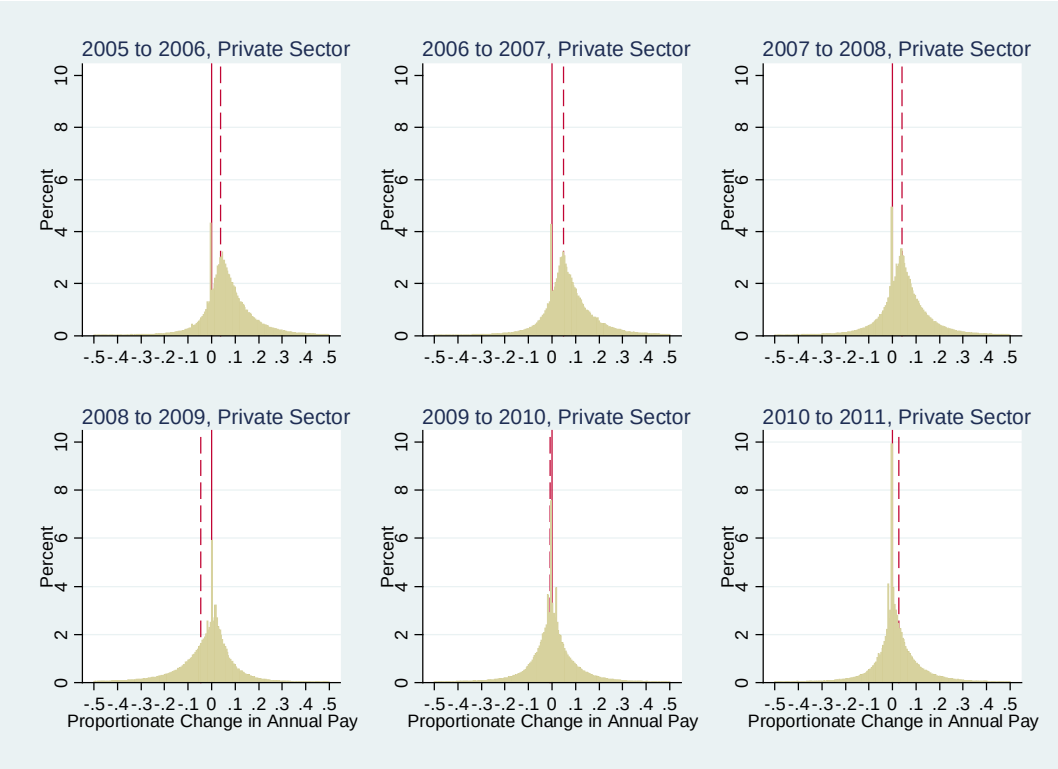


Figure 5: Incidence of Pay Changes by NACE Sector

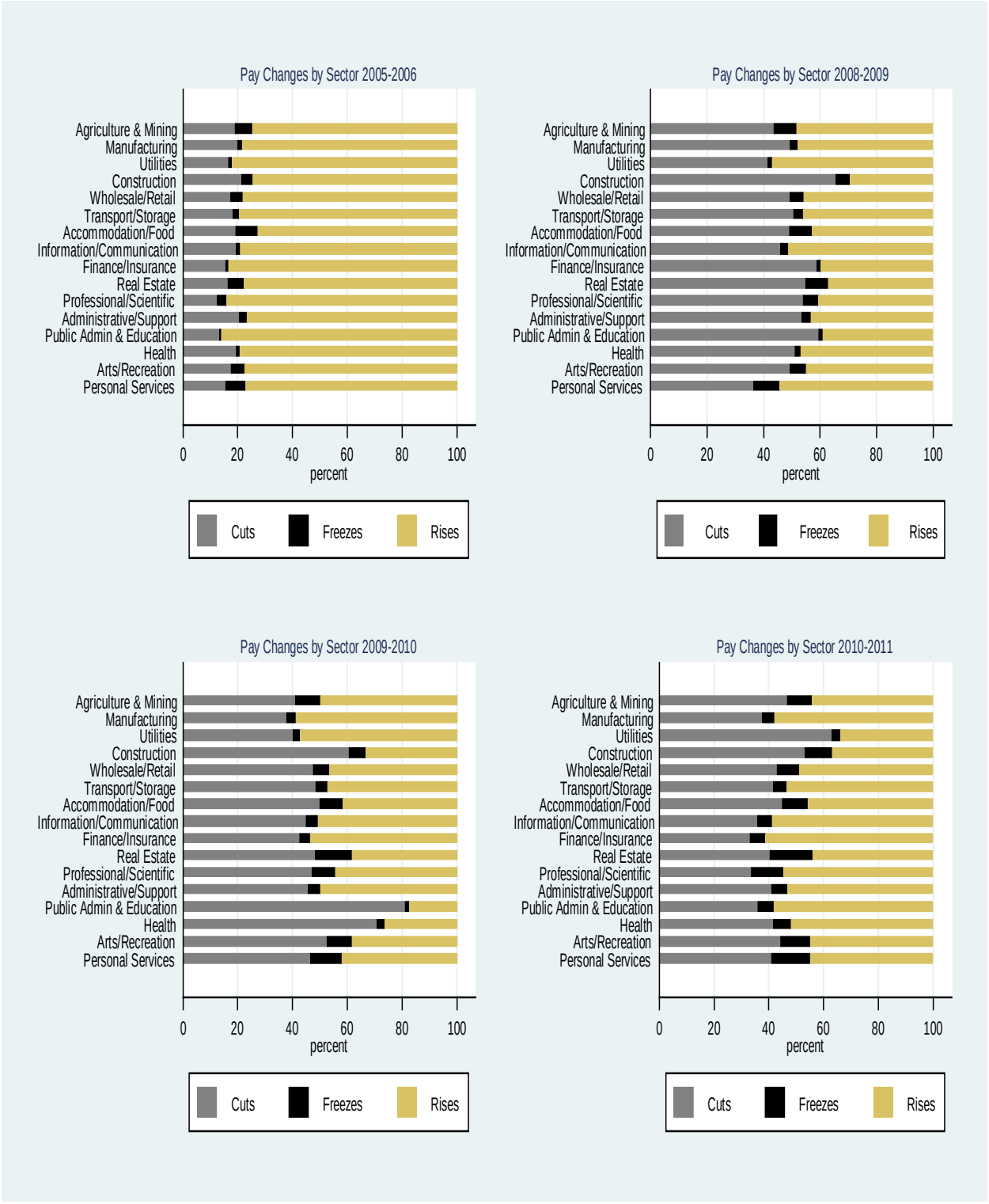


Figure 6: Cumulative Pay Changes 2005-2008 and 2008-2011 by NACE Sector

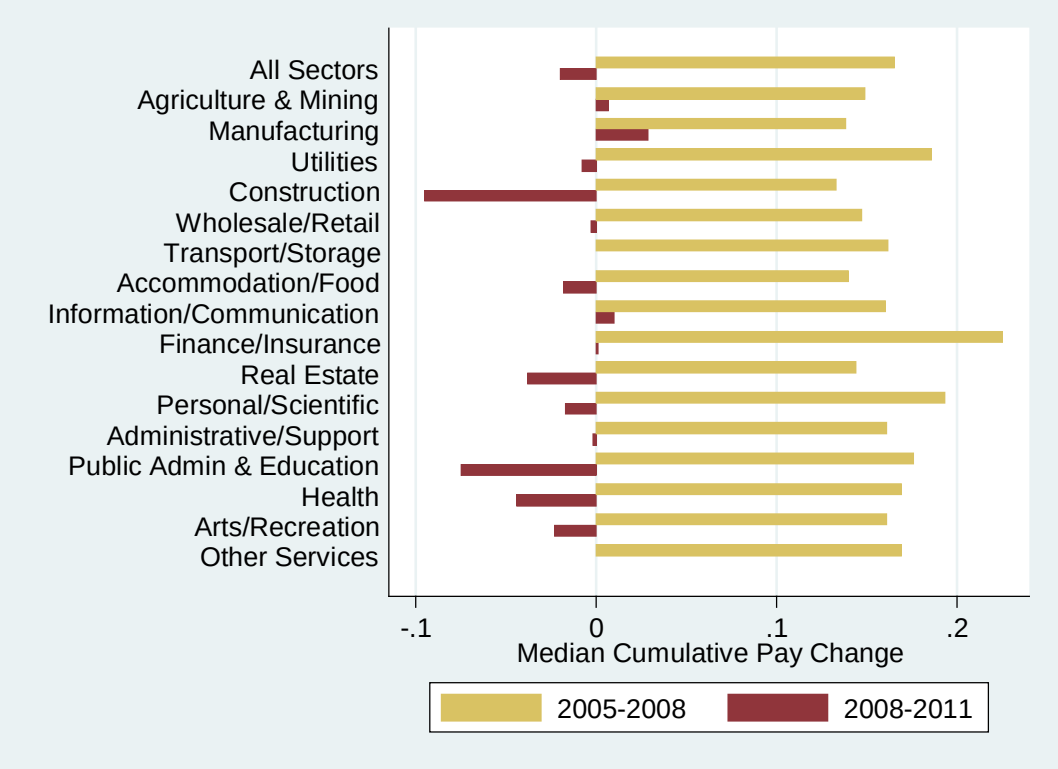
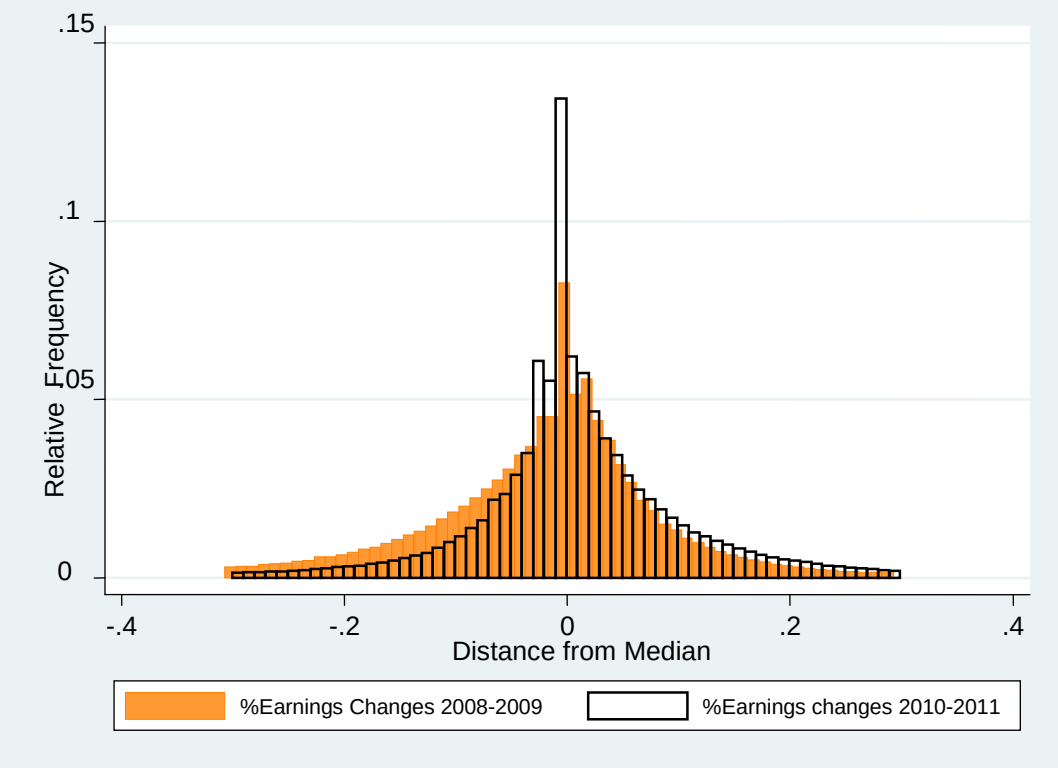


Figure 7: Distribution of Nominal Wage Changes 2008-2009 and 2010-2011



Appendix

Table A1: Proportion of Workers who are Job Stayers by Sector and Year

NACE Sector	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Agriculture/Mining	0.351	0.347	0.347	0.304	0.338	0.363
Manufacturing	0.449	0.434	0.446	0.421	0.479	0.507
Utilities	0.602	0.592	0.563	0.572	0.603	0.596
Construction	0.192	0.177	0.157	0.138	0.153	0.174
Wholesale/Retail	0.289	0.295	0.304	0.322	0.409	0.410
Transport/Storage	0.468	0.423	0.445	0.455	0.483	0.507
Accommodation/Food	0.144	0.135	0.141	0.164	0.191	0.195
Information/Communication	0.442	0.439	0.445	0.457	0.500	0.491
Finance/Insurance	0.518	0.484	0.560	0.614	0.647	0.561
Real Estate	0.336	0.309	0.298	0.296	0.337	0.373
Professional/Scientific	0.386	0.374	0.369	0.363	0.399	0.385
Admin/Support	0.171	0.161	0.152	0.183	0.222	0.244
Public Admin and Education	0.651	0.664	0.665	0.652	0.493	0.625
Health	0.465	0.477	0.503	0.518	0.547	0.528
Arts/Recreation	0.259	0.257	0.261	0.284	0.314	0.314
Other Services	0.330	0.304	0.308	0.314	0.344	0.342
All	**0.360**	**0.358**	**0.365**	**0.377**	**0.408**	**0.434**