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Research Report

Firm's productivity, investment and training: What happened during the recession and how was it affected by the national minimum wage? A report to the low pay commission

IFS Report, No. R76

Provided in Cooperation with:

The Institute for Fiscal Studies (IFS), London

Suggested Citation: Crawford, Claire; Jin, Wenchao; Simpson, Helen (2013) : Firm's productivity, investment and training: What happened during the recession and how was it affected by the national minimum wage? A report to the low pay commission, IFS Report, No. R76, ISBN 9781909463042, Institute for Fiscal Studies (IFS), London, <https://doi.org/10.1920/re.ifs.2013.0076>

This Version is available at:

<https://hdl.handle.net/10419/83507>

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Firms' productivity, investment and training: what happened during the recession and how was it affected by the national minimum wage?

IFS Report R76

Claire Crawford
Wenchao Jin
Helen Simpson

Firms' Productivity, Investment and Training: What Happened During the Recession and How Was It Affected by the National Minimum Wage?

A Report to the Low Pay Commission

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The authors would like to thank the Low Pay Commission for funding this work and James Brennan and Tim Butcher in particular for their help and advice. This report is based on data accessed through the Secure Data Service. The work uses research data sets which may not exactly reproduce National Statistics aggregates. The original data creators, depositors or copyright holders, the funders of the Data Collections (if different) and the UK Data Archive bear no responsibility for any analysis or interpretation in this report.

Published by

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ISBN 978-1-909463-04-2

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Executive Summary

In 2008–09, the UK experienced its deepest recession since the Second World War. One notable feature of this recession was, however, the resilience of employment, which fell by just 2.1% at a time when GDP fell by 6.3%. This suggests that firms may have been trying to weather the recession by holding on to their workers and reducing their hours, rather than making them redundant. Such behaviour is sometimes thought to indicate ‘labour hoarding’.

This report uses business data to document what happened to a variety of indicators of labour hoarding, as well as investment and training, over the course of the 2008–09 recession. In particular, it shows how these patterns vary amongst different types of firms, including by size and coverage of the National Minimum Wage (NMW) (i.e. the proportion of workers who are paid at or below this level).

It builds on the existing evidence in this area by:

- providing more detailed evidence on the types of firms that seem to have hoarded the most labour, as indicated by those that have experienced the greatest falls in labour productivity, hours worked or real wages, that are most likely to have imposed nominal wage freezes or that have seen the biggest increases in the proportion of their workforce working part-time;
- providing new insight into the extent to which these changes occurred *within firms*;
- providing new evidence on the other ways in which firms have responded to the recession – by reducing investment in physical or human capital – and how this varies by type of firm;
- most importantly for the Low Pay Commission, considering how the NMW regime has affected the ways in which firms have chosen (or been able) to respond to the recession.

The main data set we use is the Annual Respondents Database (ARD) – a panel survey that contains detailed information on a range of firm characteristics, including gross value added, employment, labour costs and investment. We combine this with information on training and skills shortages from the National Employer Skills Survey (NESS) and hours and earnings from the Annual Survey of Hours and Earnings (ASHE).

Contrary to much of the existing literature in this area (e.g. Bank of England, 2012; Field and Franklin, 2013), we use fixed effect regressions to examine the drivers of within-firm changes in labour and capital inputs over the course of the recession, and remain agnostic about what explains the aggregate patterns. This decision is at least partly driven by concerns over the changing composition of firms in the ARD over time, which makes it difficult to reproduce aggregate productivity estimates. This approach means that our sample is biased towards larger, higher-productivity survivors (as each firm must appear at least twice to be included in our estimates).

Key results

- We find strong evidence that firms hoarded labour in response to the 2008–09 recession. In particular, we find that real gross value added per employee fell by 6.1% relative to its pre-recession trend, that the proportion of workers working part-time increased by 1.5 percentage points and that the average annual growth in real hourly wages among existing workers fell by 0.6 percentage points.
- This means that the aggregate changes in labour productivity, hours and wages that have been observed by other commentators are not just the result of changes in the composition of firms and workers over time, but also appear to be occurring within firms, thus providing some suggestive evidence that firms are weathering the recession by reducing the hours and/or wages of their existing workforce rather than making them redundant.
- We confirm the evidence from other studies (Bank of England, 2012; Field and Franklin, 2013) that small firms appear to be more likely to hoard labour than larger firms. This seems plausible in a world in which hiring and firing workers is likely to be relatively more costly for small firms.
- By contrast, we find relatively mixed evidence of the extent to which labour hoarding varies according to the coverage of the NMW, with its effect apparently dominated by that of firm size. This suggests that the minimum wage regime is not the driving force behind the differential responses to the recession that we observe across firms.
- In terms of other pre-recession characteristics, we find that labour hoarding is positively correlated with higher profits, higher average labour costs and skill-shortage vacancies (vacancies that are hard to fill because applicants lack required skills, experience or qualifications), but not with generally hard-to-fill vacancies.
- We also find some evidence that, while firms that hoard labour are less likely to train their workforce, conditional on whether they hoard labour, the extent of labour hoarding is positively associated with the provision of training. This seems plausible: if training is costly, then some firms that need to reduce costs may be less likely to undertake training; however, the more underutilised a firm's staff (i.e. the lower their productivity), the more time (and lower opportunity cost) there is to train them.
- We also investigate the extent to which a reduction in contemporaneous labour costs or capital investment can 'explain' the fall in labour productivity that we observe. We find that the fall in real wages is particularly important, 'explaining' around two-thirds of the gap. The direction of causality is unclear, however: firms could be responding to a fall in real wages by keeping on more workers than they otherwise would have done, or substituting labour for capital; or they could be responding to a fall in productivity by

reducing real wages. Nonetheless, this suggests that falling real wages may have been a significant contributor to the better-than-expected performance of employment (and the worse-than-expected performance of labour productivity) during the 2008–09 recession.

- In addition to economising in terms of labour inputs, we find some evidence that firms have reduced their investments in physical and human capital over the course of the recession, and the likelihood of making a profit also appears to have fallen. For example, real investment fell by 14% relative to its pre-recession trend and the likelihood of being in profit fell by 5.7 percentage points. The proportion of employees being trained by their firms also fell sharply between 2007 and 2009.
- We find little systematic evidence that these investments in physical and human capital varied by firm size or NMW coverage over the course of the recession, although there is some evidence that the proportion of employees receiving training fell by significantly more in firms with higher proportions of workers affected by the NMW than in the 25% of firms with the lowest coverage. In the longer term, however, we find some weak suggestive evidence that the introduction of the NMW in 1999 was associated with decreases in investment amongst firms with the highest proportions of low-paid workers, though these findings warrant further exploration using longer-term data sets before drawing firm conclusions.

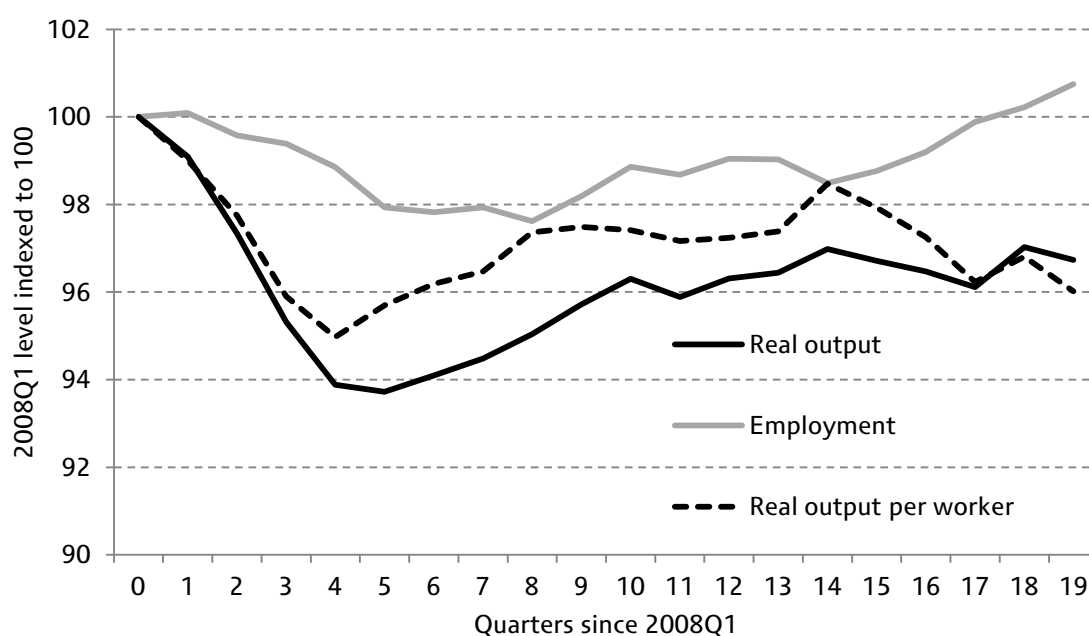
In terms of conclusions for the Low Pay Commission, we find no strong evidence that the minimum wage has hindered the ability of firms to respond to the recession by reducing hours or cutting real wages. If anything, we find that high-coverage firms are more likely to exhibit such labour hoarding behaviour. We have, however, found some weak suggestive evidence that, at least in the longer term, the minimum wage might have reduced investment in firms that were most affected by its introduction. This evidence is based on divergences from a trend, which we are only able to estimate using data from 1997 and 1998; thus we would urge some caution in interpreting these results and recommend undertaking further analysis before reaching a definite conclusion on this issue.

1. Introduction

This report uses micro-level business data to document what happened to labour productivity, investment and training over the course of the 2008–09 recession in the UK. In particular, it shows how these patterns vary amongst different types of firms – including by size and other pre-recession characteristics, such as the number of vacancies and extent of skill shortages, and by coverage of the National Minimum Wage (NMW) (i.e. the proportion of workers who are paid at or below this level).

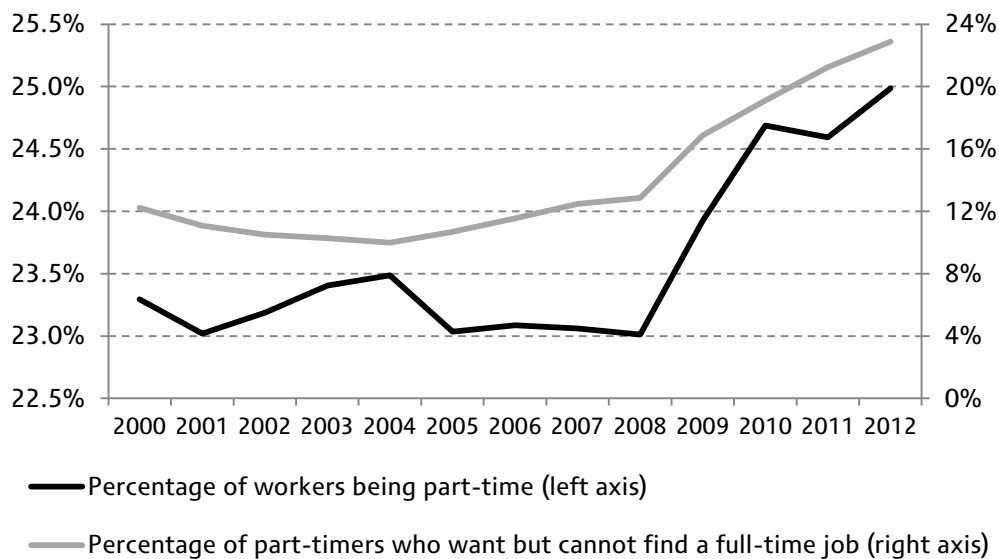
The UK has recently experienced its deepest recession since the Second World War, with real GDP falling by 6.3% between 2008Q1 and 2009Q2. One notable feature of this recession has, however, been the resilience of employment, which fell by just 2.1% over the same period. As a result, labour productivity, as measured by real output per worker, has fallen substantially (see Figure 1.1) across the economy as a whole. This appears to have been at least partly driven by an increase in the proportions of part-time and under-employed workers (see Figure 1.2), and hence a reduction in average hours worked; there has also been a significant increase in the proportions of workers who have a temporary job or are self-employed (Grice, 2012; Patterson, 2012). This provides some suggestive evidence that firms are trying to weather the recession by holding on to their workers and reducing their hours, rather than simply making them redundant. Such behaviour is sometimes thought to indicate that firms are ‘labour hoarding’.

Figure 1.1. Changes to output, jobs and productivity in the UK since 2008



Note: Each of the three series is normalised to 100 at 2008Q1 (quarter 0). Real output is based on ONS series ABMI, which is real GDP seasonally adjusted; employment is based on ONS series MGRZ, which is the total in employment aged 16 and over. Real output per worker equals real output divided by employment.

Figure 1.2. Percentage of workers part-time and percentage of part-time workers who want a full-time job but cannot get one in the UK



Source: Authors' calculations based on data from the Labour Force Survey. We define part-time workers as those working fewer than 30 hours per week.

Conceptually, labour hoarding refers to a situation in which firms continue to employ more labour than 'necessary' when faced with a negative demand shock (such as that experienced during a recession), perhaps because of non-negligible adjustment costs (e.g. Patterson, 2012). Employment protection and redundancy packages can make it costly for firms to fire workers, and firms that have cut their workforce during the downturn may then incur recruitment costs or struggle to fill their vacancies when things start to pick up. Furthermore, firing workers may lead to a loss of both general and firm-specific knowledge, adding to the cost of training new recruits during the recovery. In fact, the loss of specific skills was the main reason cited by UK employers for holding on to more labour than they needed in a recent survey by the Chartered Institute of Personnel and Development (2012). Finally, firms may choose to hoard labour because not firing workers during downturns may create a stable benign relationship between the firm and the workforce, and benefit the firm's reputation as a reliable employer, which could improve long-term productivity.

Of course, it is not straightforward to conceptualise the 'necessary' amount of labour required, let alone measure it. While the recent CIPD survey (Chartered Institute of Personnel and Development, 2012) asked employers about their labour hoarding directly, this type of question is more conducive to a binary response than to a continuous measure, and such information is not generally available in large-scale surveys. This report therefore considers a variety of measures that are thought to be indicative of labour hoarding, including lower average hours per worker, a higher proportion of the workforce working part-time, lower average real wages or a higher probability of experiencing nominal wage freezes, as well as unexpected falls in labour productivity.

We are particularly interested in whether low-paying firms or sectors – specifically, those in which a relatively high proportion of workers are affected by the minimum wage – might be more likely to hoard labour than others. This might be plausible if, for example, the introduction and subsequent increases of the NMW encouraged firms to invest more in the skills (general and firm-specific human capital) of their lowest-paid workers in order to raise productivity in line with the increased (minimum) wage – as suggested by Acemoglu and Pischke (2003) – which might then make them more reluctant to shed this trained labour.

In addition to investigating the relationship between various measures of labour hoarding and the coverage of the NMW, we build on the burgeoning literature in this area (e.g. Bank of England, 2012; Field and Franklin, 2013) by considering how labour hoarding varies with other pre-recession firm characteristics, including firm size (and the interaction between firm size and NMW coverage), profit level, vacancy rates and skill shortages (which Möller (2010) found to be particularly important in Germany).

Of particular interest to us is the extent to which labour hoarding occurs *within firms* (and within different types of firms) rather than in aggregate across the economy as a whole, as the previous literature in this field has considered (e.g. Bank of England, 2012; Field and Franklin, 2013). We examine this by adopting a 'fixed effects' approach – discussed in more detail in Section 2.2 – which enables us to isolate changes in productivity and other indicators of labour hoarding over time within firms.

In order for firms to hoard labour while enduring a negative demand shock, they may not only reduce their labour inputs – by restricting hours or restraining real wages – but may also reduce other expenditures, including investment and training. For example, Benito et al. (2010) demonstrated that business investment fell very sharply between 2008 and 2010, while Carolan et al. (2012) showed that gross fixed capital formation has been falling as a proportion of GDP since 2007; in both cases, these changes have been more dramatic than in previous recessions (Benito et al., 2010; Anagboso, 2012). We therefore additionally consider firms' capital investment and training behaviour during the recession, including how it varies by a variety of pre-recession firm characteristics, such as firm size and coverage of the NMW.

The main contributions of this report are therefore fourfold:

- to provide more detailed evidence on the types of firms that seem to have hoarded the most labour, as indicated by those that have experienced the greatest falls in labour productivity, hours worked or real wages, that are most likely to have imposed nominal wage freezes or that have seen the biggest increases in the proportion of their workforce working part-time;
- to provide new insight into the extent to which these changes occurred *within firms*;

- to provide new evidence on the other ways in which firms have responded to the recession – by reducing investment in physical or human capital – and how this varies by type of firm;
- most importantly for the Low Pay Commission, to consider how the NMW regime has affected the ways in which firms have chosen (or been able) to respond to the recession.

It should be noted that we only have access to data up to the end of 2009; hence this report focuses on what happened during the 2008–09 recession and not the second ‘dip’ in 2011–12.

The report now proceeds as follows. Section 2 describes the data that we use and the methodology that we adopt. Section 3 discusses what happened to various measures of labour hoarding, investment in physical and human capital and firm profits over the course of the 2008–09 recession, while Section 4 provides some descriptive evidence of the longer-term effect of the NMW on firms’ investment decisions. Section 5 concludes.

2. Data and Methodology

2.1 Data

This report makes use of three micro data sets to piece together a picture of how firms' productivity, investment and training have changed over the course of the 2008–09 recession.

- The **Annual Respondents Database (ARD)** is a micro-level business data set from which we calculate our main outcome of interest – labour productivity – as measured by real gross value added per worker for each firm (or reporting unit).¹ The ARD also provides other firm-level characteristics, including investment and labour costs, and enables us to construct a measure of profits. We make use of data from 1997 to 2009. A more detailed discussion of this data set is provided below.
- The **National Employer Skills Survey (NESS)** is a workplace-level data set that contains information about the skills of employees at particular workplaces. The survey has been conducted every two years since 2001, covering around 80,000 workplaces on each occasion (although it is not a panel). Key variables covered include the number of employees by occupation, hard-to-fill vacancies, skill gaps and employees undertaking training. We make use of information from the 2007 and 2009 surveys in this report.
- The **Annual Survey of Hours and Earnings (ASHE)** is a 1% random sample of employees in all industries, covering around 160,000 employees per year. It includes employees whose National Insurance number ends with a particular pair of digits, so the same individuals can be linked over time. It primarily contains information on earnings and hours worked, which is collected from employers, thus making it reasonably reliable. We use this information to calculate the proportion of the workforce who work part-time, as well as average weekly hours and average annual growth in real hourly wages amongst existing employees, using data from 1997 to 2009.

The fact that all three surveys include enterprise identifiers from the Inter-Departmental Business Register means that it is possible, in principle, to link together all three data sets at the enterprise level. In practice, however, the resultant sample sizes are too small to produce robust analysis. For example, only 10% of all workplaces in NESS can be matched to ARD, and there are generally too few employees available in each enterprise in ASHE to produce robust

¹ Reporting unit is the most disaggregated level at which we observe key economic information such as labour cost and investment. This is the level at which businesses choose to respond to the ARD. Most businesses report at a whole-enterprise level. But bigger and more complex enterprises may have multiple reporting units. For example, in 2009, 259 out of 41,559 enterprises (0.6%) in our sample have multiple reporting units. For simplicity, we use the term 'firm' interchangeably with the term 'reporting unit' in this report.

information about employees at the enterprise level (e.g. average wages). Information from NESS and ASHE is therefore summarised at a more aggregate level – specifically, within cells defined by industry, region and firm size² – and merged into ARD at that level. This means that some of our indicators (such as the proportion of the workforce who work part-time) do not relate to an individual firm or enterprise, but rather to firms of a similar size working in the same industry and region.³

Further information about the Annual Respondents Database and sample selection

The Annual Respondents Database is a collection of micro data from business surveys in the UK and contains detailed information on a range of indicators – including gross value added, employment, labour costs and investment – for each firm (or reporting unit) included in the survey. From an administrative perspective, the ARD comprised Annual Business Inquiry-1 (ABI-1, a survey of employment) and Annual Business Inquiry-2 (ABI-2, a survey of financial information) from 1997 to 2008, but in 2009 ABI-1 was replaced by the Business Register and Employment Survey (BRES) and ABI-2 was replaced by the Annual Business Survey (ABS).

Unfortunately, this change to the way in which the surveys were administered, as well as some other methodological changes, significantly affects our key measures of interest. In particular, we use real gross value added (GVA) per employee as our main measure of labour productivity, which is calculated using nominal GVA from ABI-2/ABS, number of employees at a specific point in time from ABI-1/BRES and a two-digit industry-level deflator. Up until 2005, ABI-2 was a subsample of ABI-1, so for all firms for which we observe GVA, we also observe the number of employees (except where there is item non-response). Since 2006, however, the sample date of ABI-1 changed (from December to September), such that ABI-2 was no longer a subsample of ABI-1. As a result, we do not observe the number of employees for substantial proportions of the ARD sample from 2006 to 2008; we must also account for the change in reference date in our analysis.⁴

² Firm size in ASHE is split into three bands: small (less than 50 employees), medium (50–249 employees) and large (250+ employees), but it is only possible to split the NESS sample into two bands: small and medium (less than 250 employees) and large (250+ employees).

³ This is slightly complicated by the fact that a firm may operate across multiple regions. In such cases, we take an employment-weighted average of the information from ASHE and NESS across the firm's different locations, and apply that average information to the firm in our analysis.

⁴ There was a further small change in the question on the number of employees in the firm when ABI-1 was replaced by BRES in 2009, but we do not account for this additional break in our model, as it would mean that we could no longer include a single post-2008 (recessionary) dummy. Any effect that this small change might have on our estimates will therefore be conflated with our estimates of the effects of the recession on our outcomes of interest. We do not anticipate that this effect will bias our results substantially, but this is an untestable assumption.

Table 2.1. Summary statistics of the restricted ARD sample, by year

Year	(1) No. of RUs for which we observe both GVA and no. of employees	(2) No. of RUs that represent entire enterprises	(3) Average no. of employees	(4) Average real GVA per employee (£'000, 2008 prices)	(5) Median real GVA per employee (£'000, 2008 prices)	(6) Average real GVA per employee (2007=100)	(7) Median real GVA per employee (2007=100)
2002	49,327	48,477	7.3	37.0	26.3	95.4	96.7
2003	48,823	47,967	7.2	36.6	26.0	94.2	95.5
2004	48,564	47,694	7.1	40.0	27.2	103.0	99.9
2005	47,555	46,576	7.1	40.8	26.8	105.2	98.4
2006	33,231	32,299	8.6	40.3	27.9	103.9	102.7
2007	26,120	25,124	11.3	38.8	27.2	100.0	100.0
2008	16,218	15,242	19.1	41.9	30.2	107.9	110.8
2009	41,983	41,300	7.1	49.8	25.9	128.5	95.0

Note: In each year, we have excluded the top and bottom 1% of reporting units according to GVA and number of employees. Outcomes in columns 3 to 7 are weighted by the sample design weight '*aweight*'. We only present figures from 2002 onwards because *aweight* is not available from 1997 to 2001. There are around 600 RUs in years 2005 to 2008 whose enterprise identifier is missing. These RUs are not included in column 2, but they are included in all other results.

This problem of missing data is particularly acute in 2006, 2007 and 2008, and among smaller firms. Table 2.1 presents the number of observations in the ARD sample by year. It shows that the number of reporting units (RUs) with non-missing GVA and number of employees is much lower between 2006 and 2008 than in other years; it also shows that the average number of employees per reporting unit is much higher in 2006, 2007 and 2008, reflecting the fact that smaller firms are more likely to have missing number of employees.

More worryingly, the table also suggests that, even after weighting the sample (which should, in theory, make it representative of the population of firms in the UK), average real GVA per employee appears to have increased between 2007 and 2009 (and median real GVA per employee between 2007 and 2008), while the aggregate figures from the Office for National Statistics (ONS) suggest that productivity fell by 4% over the same period.⁵ Moreover, when we split the sample by firm size – into small (less than 50 employees), medium-sized (50–249 employees) and large (250 or more employees) firms – the figures in Table 2.2 suggest that mean and median productivity has fallen in medium-sized and large firms, while it has increased in small firms. This is in sharp contrast to the findings documented in Bank of England (2012) and Field and Franklin (2013), who both found evidence of larger productivity falls amongst smaller firms.⁶

⁵ Calculated using real GDP measured by ONS series ABMI and employment measured by ONS series MGRZ.

⁶ Field and Franklin (2013) found the strongest evidence of a negative relationship between firm size and labour productivity for ICT firms between 2007 and 2008 and for manufacturing firms between 2008 and 2009. The relationship is less strong for other service firms across both years.

Table 2.2. Summary statistics of ARD sample, by year and firm size

Year	Number of reporting units			Mean real GVA per employee (2007=100)			Median real GVA per employee (2007=100)		
	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
2002	28,131	9,971	4,412	95.7	91.3	83.4	97.3	97.7	87.7
2003	27,936	9,935	4,312	94.5	93.4	86.2	95.8	100.7	92.2
2004	27,800	9,658	4,450	103.4	96.1	94.1	100.3	102.2	98.5
2005	27,157	9,399	4,369	105.6	99.9	89.5	98.6	100.3	91.1
2006	17,889	8,027	3,948	104.2	98.1	95.5	102.8	101.1	97.1
2007	12,507	7,067	4,545	100.0	100.0	100.0	100.0	100.0	100.0
2008	6,017	4,120	4,886	108.4	99.7	95.8	111.7	99.9	89.0
2009	26,815	6,601	4,354	129.8	89.9	92.9	95.7	85.1	88.8

Note: In each year, we have excluded the top and bottom 1% of reporting units according to GVA and number of employees. Mean and median real GVA per employee are weighted by the sample design weight '*aweight*'. We only present figures from 2002 onwards because *aweight* is not available from 1997 to 2001. Firms with no employees are excluded here, but are included in the aggregate figures in Table 2.1.

While we would not necessarily expect to be able to match productivity estimates derived from micro and macro data exactly⁷ – not least because we exclude public sector organisations from our analysis because their productivity is notoriously difficult to measure – the sizeable discrepancies that we observe are nonetheless concerning. With this in mind, we instead choose to use fixed effect regressions to examine the drivers of within-firm changes in labour and capital inputs over the course of the recession, and remain agnostic about what explains the aggregate patterns. This approach differs from that taken by Bank of England (2012) and Field and Franklin (2013), whose estimates reflect both within-firm changes and compositional changes reflecting the varying types of firms in the economy over time.

Because we opt to use a fixed effects approach, only reporting units that appear more than once in our sample affect our estimates. (The mean number of appearances is five; the median is four.) The summary statistics for our final sample are shown in Table 2.3. The top panel presents the estimates weighted by the sample design weight (which are comparable to those shown in Table 2.1), while the bottom panel presents the unweighted estimates (which are comparable to the more detailed summary statistics shown in Table 2.5).⁸

As one might expect, both sets of figures show that our sample is biased towards larger firms with higher productivity (as we are conditioning on the fact that firms must survive for at least two periods), as evidenced by the fact that both the

⁷ See Field and Franklin (2013) for further discussion of this issue.

⁸ Because we restrict attention to reporting units that appear at least twice in the survey, the sample is no longer representative of the population of firms in the economy; thus there is little point in using the sample weights. The unweighted figures therefore represent the true comparisons for our later regression analysis, which does not apply the sample design weights either.

average number of employees and real GVA per employee are substantially higher in Table 2.3 than in Table 2.1. It is also clear that restricting our sample to firms that appear at least twice does not overcome all of the challenges associated with composition bias, as the average number of employees is still very substantially higher in 2007 and 2008, while average real GVA per employee increases between 2008 and 2009, when we know that the aggregate figures suggest otherwise. This emphasises the importance of focusing on within-firm changes and not just of restricting our sample.⁹

Table 2.3. Summary statistics for RUs that appear at least twice between 1997 and 2009

	Number of reporting units	Average number of employees	Mean real GVA per employee (£'000, 2008 prices)	Median real GVA per employee (£'000, 2008 prices)
<i>Weighted by sample design weight</i>				
2002	26,842	43.9	38.9	29.4
2003	26,420	45.8	38.1	29.3
2004	26,203	44.9	43.9	30.8
2005	25,322	44.3	41.6	30.1
2006	20,619	46.2	40.6	30.0
2007	17,475	66.3	43.0	31.3
2008	11,568	96.9	39.2	30.2
2009	17,078	42.4	48.8	26.3
<i>Unweighted</i>				
1997	18,269	177.9	48.1	30.7
1998	20,959	144.6	50.1	30.0
1999	23,811	134.1	52.1	29.7
2000	24,261	141.8	54.4	30.1
2001	26,927	139.1	57.9	31.1
2002	26,842	141.1	47.3	31.8
2003	26,420	141.6	48.9	32.4
2004	26,203	146.8	52.0	34.0
2005	25,322	150.7	56.8	33.7
2006	20,619	174.1	52.2	34.5
2007	17,475	234.3	53.2	34.9
2008	11,568	392.1	56.5	35.0
2009	17,078	189.5	75.1	35.5

Note: In each year, we have excluded the top and bottom 1% of reporting units according to GVA and number of employees. In the top panel, average number of employees, and mean and median real GVA per employee, are weighted by the sample design weight '*aweight*'; we only present these figures from 2002 onwards because *aweight* is not available from 1997 to 2001.

⁹ This point is further highlighted by a comparison of the results obtained using ordinary least squares and fixed effects regression analysis applied to the unrestricted and restricted samples in Appendix Table A.1.

Key outcomes and covariates of interest

Table 2.4 outlines our key outcomes and covariates of interest and the data sets from which they are derived/calculated. Table 2.5 summarises these variables before and during the recession.

Table 2.4. Description of key outcomes and covariates of interest

Outcomes	Data source
Indicators of labour hoarding	
Log real GVA (per employee)	Derived from ARD at the RU level
Log real labour cost (per employee)	
Degree of labour hoarding: constructed by running equation 1 in Section 2.2 (without the <i>post08</i> dummy and for years before 2008), predicting labour productivity and calculating the proportional gap between actual and predicted productivity post-recession; positive values indicate labour hoarding	
Binary indicator of labour hoarding: equal to 1 if the degree of labour hoarding variable described above is positive and 0 otherwise	
Percentage of employees working part-time	Derived from ASHE at the industry–region–firm-size level
Average weekly hours among existing employees	
Average annual growth in real hourly wages among existing employees	
Percentage of existing employees facing nominal wage freezes	
Investment and profit	
Log real investment (per employee) measured using net capital expenditure	Derived from ARD at the RU level
Binary indicator for having positive real investment	
Binary indicator for being in profit (or having positive surplus, defined as GVA minus total labour costs)	
Training	
Percentage of employees that have received training from their employer in the last 12 months	Derived from NESS at the industry–region–firm-size level
Key covariates of interest	
Firm size: ^a small (<50 employees); medium (50–249 employees); large (250+ employees)	Derived from ARD at the RU level
Coverage of the NMW: <i>Quartile of long-term coverage:</i> ^b derived from the percentage of employees paid at or below the NMW when it was introduced in 1999	Derived from ASHE at the industry–region–firm-size level

^a Firm size is calculated by averaging across reporting units over the pre-recession period 1997–2007, i.e. it does not vary over time.

^b Defined according to a firm's first appearance in the data since 1999 and not allowed to vary over time.

Table 2.5. Further descriptive statistics for RUs that appear at least twice between 1997 and 2009

	Pre-recession (1997–2007)		Recession (2008–09)	
	Mean	Median	Mean	Median
Indicators of labour hoarding				
Real GVA per employee (£'000, 2008 prices)	52.2	32.0	67.6	35.3
Labour cost per employee (£'000, 2008 prices)	27.3	23.1	35.0	26.4
Binary indicator of labour hoarding			54.7%	
Binary indicator of labour hoarding, conditional on GVA lower than predicted ^a			77.5%	
Degree of labour hoarding			6.0%	3.5%
Degree of labour hoarding, conditional on GVA lower than predicted			38.6%	23.8%
Percentage of employees working part-time	20.9%	17.7%	23.3%	20.9%
Average weekly hours among existing employees	36.8	37.3	35.6	35.9
Average annual growth in real hourly wages among existing employees	5.6%	5.4%	2.1%	2.1%
Percentage of existing employees experiencing nominal wage freezes (wage growth ≤ 0)	26.1%	25.8%	30.3%	29.3%
Investment and profit				
Binary indicator of positive investment	76.3%		72.4%	
Real investment per employee (£'000, 2008 prices)	5.43	1.02	5.11	0.65
Binary indicator of making positive profit	84.3%		73.4%	
Training				
Percentage of employees trained in year before 2007 survey	45.9%	41.0%	49.3%	49.5%
Firm size and coverage of NMW				
Percentage of firms: small	45.3%		33.7%	
Percentage of firms: medium-sized	37.0%		36.2%	
Percentage of firms: large	17.7%		30.1%	
Average coverage of NMW in 1999	2.6%	2.2%	2.2%	1.8%

^a Conditions on actual GVA being lower than predicted in an attempt to capture firms that faced negative demand shocks and were not growing or expanding as quickly as they were before 2008. (It is possible for expanding firms to experience a reduction in productivity per worker – for example, if they are taking on part-time staff or staff with lower-than-average skills – but we would not want to describe these firms as hoarding labour.)

Table 2.5 shows that just over half of the firms in our sample appeared to experience a negative productivity shock during the recession (i.e. could be thought of as hoarding labour); this figure increases to over three-quarters of those whose GVA was lower than anticipated (i.e. amongst firms that were not expanding). The table also shows that, relative to the 10 years leading up to the recession, the proportion of the workforce working part-time increased, average weekly hours fell, average annual growth in real hourly wages fell substantially and the proportion of employees experiencing nominal wage freezes increased during the recession. Our main analysis (presented in Section 3) will investigate

whether these changes also occurred within firms and whether they can be said to differ significantly compared with a linear pre-recession trend.

2.2 Methodology

Our basic regression specification for all of our outcomes of interest is as follows:

$$(1) \quad Y_{it} = \alpha_i + \beta \text{post08} + \gamma \text{year}_t + \delta \text{post06} + u_{it}$$

where Y is our outcome of interest for each reporting unit in each year; α_i are fixed reporting unit effects, designed to capture unobserved firm characteristics that are relevant for our outcomes of interest and are constant over time; post08 is a binary variable equal to 1 if the observation falls in 2008 or 2009 and 0 otherwise (designed to indicate a recession effect); year is a linear time trend (estimated on data from 1997 to 2005);¹⁰ post06 is a binary variable equal to 1 if the observation falls in or after 2006 and 0 otherwise (designed to capture the change in reference period from December to September that occurred in 2006); and u_{it} is an observation-specific error term.

The main coefficient of interest is β , which reflects the average within-firm change in the outcome of interest that occurred in 2008–09 relative to a pre-recession linear time trend, which we interpret as the effect of the recession on our outcome of interest.

To examine which types of firm are more likely to hoard labour (or change their investment or training decisions relative to a pre-recession trend), we take two approaches: first, we run models based on equation 1 separately for each subgroup of interest, such as for small, medium-sized and large firms, or for different quartiles of coverage of the minimum wage; second, we interact the post08 dummy with the firm-level variables of interest, as in equation 2:

$$(2) \quad Y_{it} = \alpha_i + \beta_1 \text{post08} * \text{small}_i + \beta_2 \text{post08} * \text{medium}_i + \beta_3 \text{post08} * \text{large}_i + \gamma \text{year}_t + \delta \text{post06} + u_{it}.$$

In this model, β_1 indicates the effect of the recession on the outcome of interest amongst small firms, β_2 the effect on medium-sized firms and β_3 the effect on large firms. A similar approach is adopted for other covariates of interest, such as the quartile of coverage of the minimum wage.

The key difference between these two approaches is that running the models separately for each subgroup is more flexible, as it allows the pre-recession trends (and the effect of changing the reference date from December to

¹⁰ Our estimates of the effect of the recession on real GVA per worker are robust to the use of a quadratic time trend instead of a linear time trend, but the results for other outcomes are somewhat more variable. This is at least partly because it is more difficult to discern an obvious pre-recession trend for these outcomes (see Appendix Figure A.1). Given that the primary focus of this report is on changes to labour productivity – and that our estimates of the effect of the recession on other labour market outcomes are consistent with what we know from other sources – we are not overly concerned by these discrepancies.

September) to vary by size of firm or coverage of NMW, which – as we will see – sometimes matters for our results.

Section 4 additionally provides some descriptive evidence of the extent to which the introduction of the NMW in 1999 affected firms' longer-term investment decisions. To do so, we follow a similar approach to that outlined above to investigate differences in the effect of the recession by quartile of NMW coverage, except that when we run the models separately by quartile, we add a binary indicator equal to 1 if the observation falls in or after 1999 and 0 otherwise, while when we include all firm types in the same model (in a similar manner to equation 2), we additionally include interactions between quartile of NMW coverage and our post-1999 indicator variable. This analysis is somewhat less robust than that described above, because it relies on estimating how investment changed in 1999 relative to a trend that we are only able to estimate using data from 1997 and 1998 (while the pre-recession trend in the analysis above is estimated on data from 1997 to 2005). We should therefore regard the results of this analysis as indicative only.

3. Productivity, Investment and Training during the Recession

3.1 Labour hoarding

Overall

Table 3.1 reports our estimates of the impact of the recession on labour productivity (as measured by real GVA per employee) and a variety of other indicators of labour hoarding. Column 1 suggests that labour productivity during the recession was 6.1% lower than might have been expected in the reporting units in our sample relative to their historical trend. Column 2 shows that there was a 2.7% reduction in the number of employees per firm and column 3 shows that real labour costs per employee fell by 5.8%. This suggests both that firms may have reduced the size of their workforce and that remaining employees may be working fewer hours or for lower hourly wages or both.¹¹

Table 3.1. Impact of the recession on various indicators of labour hoarding

	(1) Log real GVA per employee	(2) Log no. of employees	(3) Log real labour cost per employee	(4) Proportion of employees working part-time	(5) Average weekly hours among existing employees	(6) Average annual growth in real hourly wages among existing employees	(7) Proportion of existing employees facing nominal pay freezes
Post08	-0.061*** [0.005]	-0.027*** [0.003]	-0.058*** [0.003]	0.015*** [0.001]	-0.300*** [0.012]	-0.006*** [0.001]	0.057*** [0.001]
Post06	-0.028*** [0.005]	0.045*** [0.003]	-0.060*** [0.003]	0.010*** [0.0004]	0.002 [0.011]	0.004*** [0.001]	0.010*** [0.001]
Year	0.019*** [0.001]	0.005*** [0.0004]	0.031*** [0.0003]	-0.0005*** [0.0001]	-0.133*** [0.002]	-0.005*** [0.0001]	-0.002*** [0.0001]
No. of obs.	270,513	279,065	277,875	281,859	263,605	263,545	263,545
No. of RUs	88,355	89,917	89,450	91,107	90,110	90,101	90,101

Note: Based on a sample of reporting units that appear at least twice between 1997 and 2009, excluding the top and bottom 1% of RUs on the basis of GVA and number of employees. The sample size varies due to the extent of missing values for different outcomes. Standard errors are given in square brackets. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

¹¹ There could also have been a change in the composition of the workforce towards part-time or otherwise lower-paid workers.

The remaining columns in the table suggest that both are plausible explanations for the observed reduction. For example, column 4 shows that the proportion of the workforce working part-time has increased by 1.5 percentage points since the start of the recession, while column 5 shows that average hours worked by existing staff have fallen by just over 0.3 hours per week. Similarly, column 6 shows that there has been a small reduction in the average annual growth in real hourly wages amongst existing staff of around 0.6 percentage points (compared with an average year-on-year growth rate of 5.6% over the pre-recession period; see Table 2.5), while column 7 shows that there has been a 5.7 percentage point increase in the proportion of existing employees experiencing nominal pay freezes since the start of the recession.

Overall, these results suggest that the aggregate changes in labour productivity, hours and wages that have been observed by other commentators (e.g. Grice, 2012; Patterson, 2012; Field and Franklin, 2013) are not just the result of changes in the composition of firms and workers over time, but also appear to be occurring within firms. This provides some suggestive evidence that the types of firms that are included in our sample – which, it must be remembered, are biased towards larger, more productive survivors – may be weathering the recession by reducing the hours and/or wages of their existing workforce rather than making them redundant.

By firm size

Bank of England (2012) and Field and Franklin (2013) both investigated the extent to which the aggregate changes in productivity that have been observed in the UK economy vary by size of firm; the former used company accounts information from the Financial Analysis Made Easy (FAME) database, while the latter used similar data to us (i.e. the Annual Respondents Database). Both concluded that productivity had fallen more in small firms than in larger firms over the course of the recession, but neither could distinguish between within-firm and compositional changes as the potential drivers of these differences. We build on their analysis by attempting to identify the extent to which within-firm changes in labour productivity, as well as a range of other indicators of potential labour hoarding, vary by firm size. As described in Section 2, we split our sample into small firms (those with less than 50 employees), medium-sized firms (50–249 employees) and large firms (250 or more employees).

We start by focusing on changes in real GVA per employee. Table 3.2 presents the results obtained by running separate regressions for small, medium-sized and large firms, while column 1 of Table 3.3a presents the results obtained by interacting the *post08* dummy with indicators of firm size. Both sets of results indicate that labour productivity has fallen substantially more in small firms than in large firms over the course of the recession. For example, Table 3.2 suggests that there has been an 11.7% fall in labour productivity among small firms relative to their pre-recession trend, a 5.9% fall for medium-sized firms and only a small reduction (of 2%) for large firms.

Table 3.2. Impact of the recession on real GVA per employee, by firm size

	Small firms (<50 employees)	Medium-sized firms (50–249 employees)	Large firms (≥250 employees)
Post08	–0.117*** [0.011]	–0.059*** [0.008]	–0.020** [0.009]
Post06	–0.044*** [0.009]	–0.034*** [0.007]	0.001 [0.008]
Year	0.021*** [0.001]	0.019*** [0.001]	0.018*** [0.001]
No. of obs.	117,910	99,974	50,667
No. of RUs	51,320	26,681	8,899

Note: Based on samples of reporting units that appear at least twice between 1997 and 2009, excluding the top and bottom 1% of RUs on the basis of GVA and number of employees. Estimates of the effect of the recession on real GVA per employee obtained by running separate regressions for different firm sizes. Firms with zero employees are not included. Standard errors are given in square brackets. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

The differential fall in labour productivity by firm size appears to be driven by changes in both gross value added and employment. For example, column 2 of Table 3.3a confirms that smaller firms experienced slightly larger falls in GVA than larger firms. More strikingly, column 3 suggests that the number of employees actually *increased* (by 2.4%) over the course of the recession (relative to its pre-recession trend) within small firms, while it declined significantly (by nearly 8%) in large firms. Partly as a result of this difference in employment behaviour between smaller and larger firms, smaller firms had substantially greater falls in real labour cost *per head*. The last column in Table 3.3a shows a 10.7% reduction in labour cost per head in small firms compared with a 1.7% fall in large firms. Moreover, the changes to labour cost per head are quite similar to the changes in labour productivity for each band of firm size, suggesting that the two may be closely related. We discuss this relationship further in the context of Tables 3.7 and 3.8 below.

The idea that labour hoarding is being driven by smaller firms is also supported by the higher-level indicators derived from the Annual Survey of Hours and Earnings, and shown in Table 3.3b. For example, we see that small firms have experienced a greater increase in the percentage of their workforce working part-time (2.4 percentage points compared with just 0.1 percentage points for large firms), a larger reduction in average hours worked per week (about 0.6 hours per week compared with less than 0.01 hours), a larger reduction in average annual growth in real wages (0.8% compared with 0.3% for large firms) amongst existing employees, and a larger increase in the proportion of employees experiencing pay freezes (7.8% compared with 2.5% for large firms).

Table 3.3a. Impact of the recession on various indicators of labour hoarding, by firm size

	(1) Log real GVA per employee	(2) Log real GVA	(3) Log number of employees	(4) Log real labour cost per employee
Post08*	-0.120***	-0.098***	0.024***	-0.107***
Small firm	[0.009]	[0.009]	[0.006]	[0.005]
Post08*	-0.065***	-0.078***	-0.018***	-0.061***
Medium firm	[0.008]	[0.008]	[0.005]	[0.005]
Post08*	-0.008	-0.082***	-0.078***	-0.017***
Large firm	[0.008]	[0.009]	[0.005]	[0.005]
Post06	-0.028***	0.016***	0.045***	-0.060***
	[0.005]	[0.005]	[0.003]	[0.003]
Year	0.020***	0.025***	0.005***	0.031***
	[0.001]	[0.001]	[0.0004]	[0.0003]
No. of obs.	268,551	269,833	276,924	275,870
No. of RUs	86,900	87,317	88,341	88,001

Note: Based on a sample of reporting units that appear at least twice between 1997 and 2009, excluding the top and bottom 1% of RUs on the basis of GVA and number of employees. Estimates of the effect of the recession on indicators of labour hoarding obtained by interacting the *post08* indicator with dummy variables for firm size. Firms with zero employees are not included. Standard errors are given in square brackets. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Table 3.3b. Impact of the recession on various indicators of labour hoarding, by firm size

	Proportion of employees working part- time	Average weekly hours among existing employees	Average annual growth in real hourly wages among existing employees	Proportion of existing employees facing pay freezes
Post08*	0.024***	-0.568***	-0.008***	0.078***
Small firm	[0.001]	[0.021]	[0.001]	[0.001]
Post08*	0.019***	-0.342***	-0.008***	0.070***
Medium firm	[0.001]	[0.018]	[0.001]	[0.001]
Post08*	0.001*	-0.005	-0.003***	0.025***
Large firm	[0.001]	[0.019]	[0.001]	[0.001]
Post06	0.010***	0.005	0.005***	0.010***
	[0.0004]	[0.011]	[0.0006]	[0.001]
Year	-0.001***	-0.132***	-0.005***	-0.002***
	[0.0001]	[0.002]	[0.0001]	[0.0001]
No. of obs.	278,202	260,038	259,981	259,981
No. of RUs	88,782	87,812	87,806	87,806

Note: See note to Table 3.3a.

Overall, the evidence presented in this subsection seems to support the findings for the aggregate economy from other studies, namely that small firms appear to be more likely to hoard labour than larger firms. Moreover, this appears to arise at least partly as a result of within-firm changes in labour costs and usage over the course of the recession (at least, this is the case amongst our selected sample of larger firms that survive for a minimum of two periods). This result seems plausible in a world in which hiring and firing workers is likely to be relatively more costly for small firms, as well as in cases where there may be some minimum scale of operation required for a business to be viable.

By coverage of the minimum wage

Previous research commissioned by the Low Pay Commission has found some evidence that the introduction of the minimum wage had a small positive effect on productivity, including amongst low-paying sectors (Galinda-Rueda and Pereira, 2004; Rizov and Croucher, 2011). In this subsection, we investigate whether the changes in labour productivity and other potential indicators of labour hoarding that occurred during the recession varied according to the ‘coverage’ of the minimum wage (i.e. the proportion of workers paid below the NMW) when it was introduced in 1999.

As outlined in Section 2.1, we do not observe the long-term coverage of the minimum wage directly for each firm – and in any case we might be worried about the potential endogeneity of such a measure – so we instead impute the coverage for each firm on the basis of the average coverage amongst firms in the same industry and region, and of the same size, on the basis of ASHE data. We use this information to split the sample of reporting units with non-missing GVA and number of employees into four equally sized groups (quartiles). On average, the coverage of the NMW is relatively low: the thresholds dividing the groups are 1.3%, 3.0% and 3.9%.¹²

As was the case for firm size, we investigate the relationship between NMW coverage and labour hoarding during the recession both by running separate regressions for each quartile (Table 3.4) and by interacting the *post08* dummy with indicators of quartile (Tables 3.5a and 3.5b). In contrast to the results for firm size, however, these approaches provide different pictures of the extent to which the change in labour productivity varies according to the coverage of the NMW: while Table 3.4 suggests that real GVA per head has fallen by more in firms with the lowest proportion of workers affected by the NMW than in firms with the highest proportion of workers affected, the opposite is true for real GVA per head in column 1 of Table 3.5a.

¹² The median is slightly different from that shown in Table 2.5, because that table focuses on our sample (which is restricted to firms that appear at least twice between 1997 and 2009), while these thresholds do not.

Table 3.4. Impact of the recession on real GVA per employee, by long-term coverage of NMW

	Bottom quartile (lowest coverage)	2 nd quartile	3 rd quartile	Top quartile (highest coverage)
Post08	-0.063*** [0.007]	-0.042*** [0.010]	-0.091*** [0.015]	-0.054*** [0.016]
Post06	-0.016** [0.006]	-0.025*** [0.009]	-0.055*** [0.014]	-0.054*** [0.013]
Year	0.023*** [0.001]	0.016*** [0.001]	0.021*** [0.002]	0.013*** [0.002]
No. of obs.	100,796	75,892	45,557	44,986
No. of RUs	25,514	24,430	18,422	18,215

Note: Based on samples of reporting units that appear at least twice between 1997 and 2009, excluding the top and bottom 1% of RUs on the basis of GVA and number of employees. Estimates of the impact of the recession by NMW coverage obtained by running separate regressions for different quartiles of long-term NMW coverage. Standard errors are given in square brackets. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Table 3.5a. Impact of recession on various indicators of labour hoarding, by long-term coverage of NMW

	(1) Log real GVA per employee	(2) Log no. of employees	(3) Log real labour cost per employee
Post08*Lowest quartile	-0.034*** [0.007]	-0.089*** [0.005]	-0.040*** [0.004]
Post08*2 nd quartile	-0.061*** [0.009]	-0.014** [0.006]	-0.066*** [0.005]
Post08*3 rd quartile	-0.105*** [0.012]	0.063*** [0.008]	-0.075*** [0.007]
Post08*Highest quartile	-0.111*** [0.013]	0.054*** [0.008]	-0.085*** [0.008]
Post06	-0.028*** [0.005]	0.044*** [0.003]	-0.059*** [0.003]
Year	0.019*** [0.001]	0.005*** [0.0004]	0.031*** [0.0004]
No. of obs.	267,231	275,734	274,555
No. of RUs	86,581	88,125	87,662

Note: Based on a sample of reporting units that appear at least twice between 1997 and 2009, excluding the top and bottom 1% of RUs on the basis of GVA and number of employees. Estimates of the impact of the recession by NMW coverage obtained by interacting the *post08* indicator with a series of dummy variables indicating quartile of long-term coverage of the NMW. Standard errors are given in square brackets. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Table 3.5b. Impact of recession on various indicators of labour hoarding, by long-term coverage of NMW

	(1) Proportion of employees working part-time	(2) Average weekly hours among existing employees	(3) Average annual growth in real hourly wages among existing employees	(4) Proportion of existing employees facing pay freezes
Post08*	0.016***	-0.268***	-0.010***	0.059***
Lowest quartile	[0.001]	[0.017]	[0.001]	[0.001]
Post08*	0.015***	-0.376***	-0.005***	0.054***
2 nd quartile	[0.001]	[0.020]	[0.001]	[0.001]
Post08*	0.022***	-0.388***	-0.006***	0.064***
3 rd quartile	[0.001]	[0.027]	[0.001]	[0.001]
Post08*	0.002*	-0.097***	0.002*	0.049***
Highest quartile	[0.001]	[0.030]	[0.001]	[0.001]
Post06	0.009***	0.002	0.004***	0.010***
	[0.0004]	[0.011]	[0.001]	[0.001]
Year	-0.0004***	-0.133***	-0.005***	-0.002***
	[0.0001]	[0.002]	[0.0001]	[0.0001]
No. of obs.	278,554	262,050	261,995	261,995
No. of RUs	89,311	88,581	88,572	88,572

Note: See note to Table 3.5a.

It seems likely that the different results produced by these two approaches can be at least partly explained by the fact that we impose the same pre-recession trends across all firm types in Table 3.5, but allow them to differ in Table 3.4. Table 3.4 provides some support for this hypothesis, as it suggests that there is some variation in the estimated year effect (i.e. the pre-recession trend) for firms with different proportions of workers affected by the NMW: in terms of year-on-year productivity increases, it varies from 1.3% for those with the highest proportions of workers affected to 2.3% for those in the bottom quartile of NMW coverage. This is in sharp contrast to the results for firm size (shown in Table 3.2), in which the year effects (and hence the results across the two methods) were very similar for small, medium-sized and large firms.

However, it is also the case that, even once we focus on a particular method, the various outcomes of interest suggest a similarly mixed picture of the relationship between NMW coverage and labour hoarding.¹³ For example, while column 1 of Table 3.5a suggests that firms with the highest proportions of workers affected by the NMW experience the largest drops in productivity (and hence may be regarded as the largest labour hoarders), column 1 of Table 3.5b shows that the

¹³ We present here the results interacting our *post08* indicator with quartile of coverage of the NMW, but this also holds true if we run the results separately by quartile of coverage (and hence allow the pre-recession trends to vary) – see Appendix Table A.2.

proportion of part-time workers hardly rose (relative to the pre-recession trend) in the highest-coverage firms, while it rose by 1.5–2.2% in the other three quartile groups.

Interestingly, while wage growth amongst existing staff appears to have been marginally positive in firms with the highest proportions of low-paid workers, labour cost per head fell significantly in those firms. The two can be reconciled if firms are reducing hours worked by higher-paid staff and replacing them with new lower-paid staff. It is also possible that while workers paid the minimum wage saw their earnings uprated in line with changes to this floor rate, higher-paid workers may have faced pay restraint, thus reducing within-firm wage inequality.

Given the lack of consistency in these estimates – both across estimation methods and across labour hoarding indicators – it seems prudent not to place too much weight on the variation in the extent of labour hoarding according to the coverage of the NMW. In any case, it seems likely that firm size is the more important driver of these differences, as we shall now attempt to demonstrate.

We know that small firms tend to have higher proportions of low-paid workers than larger firms (Dickens, Riley and Wilkinson, 2012), and the numbers of RUs in Table 3.6 show that this translates into higher proportions of smaller firms falling into higher-NMW-coverage groups than of larger firms. This raises the question of whether it is firm size or NMW coverage that is driving these results. Table 3.6 attempts to shed some light on this issue by splitting the sample into 12 subsamples – small, medium-sized and large firms in each of the four quartiles of NMW coverage – and running regressions estimating the impact of the recession on real GVA per worker separately for each subsample.

The table provides evidence of a strong and monotonic negative relationship between firm size and the effect of the recession on labour productivity for each quartile group of NMW coverage: small firms always appear to experience substantially larger falls in labour productivity than larger firms, regardless of the quartile of NMW coverage into which they fall. By contrast, the relationship between NMW coverage and labour productivity by firm size is somewhat less strong, and not always monotonic. This, together with the fact that all small firms – regardless of NMW coverage – experienced a greater fall in labour productivity relative to their pre-recession trend than the overall average of 6.1% (illustrated in Tables 3.1 and 3.2), suggests that firm size is a more powerful predictor of the extent of labour hoarding than NMW coverage.¹⁴

¹⁴ Appendix Table A.3 additionally shows how the change in productivity since 2008 varies for subsamples defined according to firm size and pre-recession profits relative to GVA. It suggests that for small and medium-sized firms, pre-recession profitability is strongly and positively correlated with labour hoarding. We discuss this relationship in more detail below.

Table 3.6. Impact of the recession on real GVA per worker: is it driven by firm size or coverage of the NMW?

		Bottom quartile of NMW coverage	2nd quartile of NMW coverage	3rd quartile of NMW coverage	Top quartile of NMW coverage
Small firms	Post08	-0.176*** [0.025]	-0.082*** [0.018]	-0.137*** [0.021]	-0.091*** [0.023]
	No. of RUs	6,863	14,750	14,679	14,228
Medium- sized firms	Post08	-0.066*** [0.010]	-0.038** [0.017]	-0.077*** [0.029]	-0.033 [0.027]
	No. of RUs	13,507	6,694	2,581	3,206
Large firms	Post08	-0.031*** [0.011]	-0.012 [0.017]	0.017 [0.031]	-0.002 [0.034]
	No. of RUs	4,762	2,628	681	551

Note: Based on samples of reporting units that appear at least twice between 1997 and 2009, excluding the top and bottom 1% of RUs on the basis of GVA and number of employees. Estimates of the impact of recession by firm size and NMW coverage obtained by running separate regressions on samples defined on the basis of firm size and quartile of long-term NMW coverage. Standard errors are given in square brackets. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Overall, the evidence presented in this subsection provides a mixed picture of the extent to which labour hoarding varies by coverage of the NMW. In any case, there is some evidence that firm size is a more important driver of these decisions than long-term coverage of the NMW, thus suggesting that the minimum wage regime is not the driving force behind the differences in the responses to the recession that we observe across firms.

By region and industry

Tables A.4 and A.5 in the appendix illustrate the extent to which labour hoarding varies by region and by industry. Table A.4 shows that London has experienced no decline in labour productivity (as measured by real GVA per employee) relative to its pre-recession trend, despite a 3% reduction in real labour costs per employee and an 11% fall in real investment. By contrast, several regions – including the North West, West Midlands and Yorkshire & the Humber – have experienced labour productivity falls of 10% or more. Table A.5 suggests that there has also been a great deal of variation by industry. For example, firms in the construction, retail, hospitality, arts and real estate industries have experienced the largest declines in productivity, while manufacturing and professional

activities have been relatively less affected. Government services¹⁵ have also experienced greater falls in labour costs and productivity than the aggregate.

Other predictors of labour hoarding

Having examined the effect of the recession on a variety of indicators of labour hoarding overall, and by firm size, long-term NMW coverage, region and industry, we now investigate which firm characteristics and behaviours may be able to explain the extent of labour hoarding undertaken.

We do this in two ways:

- First, we regress our continuous measure of labour hoarding (described in detail in Table 2.4) on industry, region and firm-size dummies, plus a variety of pre-recession and contemporaneous firm characteristics, which we add to the model individually.
- Second, we return to our overall estimates of the impact of the recession on labour productivity (shown in Table 3.1) and examine the extent to which this variation can be explained by changes in investment or the overall cost of labour to the firm.

The idea in both cases is to identify characteristics that are *correlated with* (the extent of) labour hoarding, rather than to estimate the causal impact of these characteristics per se.

Table 3.7 presents the results of the first analysis. The first column presents the estimated correlations for a sample including all values of the dependent variable – i.e. including firms for which actual GVA is higher than expected (which could not legitimately be referred to as labour hoarding) – while the second column restricts attention to those for which actual GVA is below expectation (i.e. firms that may be constrained on the demand side).¹⁶

In terms of pre-recession firm characteristics, Table 3.7 suggests that the degree of labour hoarding is positively correlated with higher profits, higher average labour costs and skill shortages. Moreover, these relationships hold regardless of whether the firm's GVA has shrunk relative to expectation. Once we condition on firms whose GVA was lower than expected during the recession – i.e. firms that might plausibly be thought of as hoarding labour in response to negative shocks – we additionally find that higher investment in physical and human capital is also positively associated with the extent of labour hoarding. In terms of the relationship between pre-recession profits and labour hoarding, higher profits may have put some firms in a better position to keep their workers, which is

¹⁵ SIC2007 sections O, P and Q, excluding central government, local government and public corporations. Remaining firms within this category include private schools and private health-care providers.

¹⁶ The prediction of GVA is based on a model regressing GVA (from 1997 to 2007) on a linear time trend, a *post06* indicator and reporting unit fixed effects.

likely to reduce short-term labour productivity. On the other hand, higher pre-recession profits are correlated with higher productivity before the recession, so there could be some 'regression to the mean' going on as well.

Table 3.7 also shows that labour hoarding is positively associated with reductions in investment, labour costs and profits during the recession. The

Table 3.7. Which firm characteristics explain the variation in labour hoarding?

	Full sample	Conditional on firm's GVA since 2008 being below historical trend
Pre-recession firm characteristics (averaged across all observations before 2008)		
Real log profit (plus a dummy for non-positive pre-recession profits)	0.042*** [0.006]	0.051*** [0.007]
Real log investment (plus a dummy for non-positive pre-recession investment)	-0.003 [0.004]	0.018*** [0.006]
Real labour cost per head	0.121*** [0.015]	0.152*** [0.020]
Workplace characteristics in 2007		
Vacancies as a percentage of workforce size (100=100%)	0.003 [0.002]	0.004 [0.003]
Hard-to-fill vacancies as a percentage of vacancies (100=100%)	0.003* [0.002]	0.003 [0.003]
Skill-shortage vacancies as a percentage of hard-to-fill vacancies (100=100%)	0.004*** [0.001]	0.005** [0.002]
Percentage of employees not fully proficient (100=100%)	0.012*** [0.003]	0.020*** [0.005]
Proportion of employees trained in the past 12 months (1=100%)	-0.022 [0.082]	0.217* [0.117]
Changes in factors during the recession (relative to 2007, 1=100%)		
Proportional change in real investment (conditional on positive investments in 2007 and 2008-09)	-0.025*** [0.005]	-0.018*** [0.006]
Proportional change in real investment per head (conditional on positive investments in 2007 and 2008-09)	-0.049*** [0.006]	-0.045*** [0.006]
Proportional change in real labour cost	-0.379*** [0.039]	-0.171*** [0.054]
Proportional change in real labour cost per head	-0.687*** [0.030]	-0.628*** [0.034]
Proportional change in real profits	-0.129*** [0.009]	-0.071*** [0.012]

Note: Based on a sample of reporting units that appear at least twice between 1997 and 2009, excluding the top and bottom 1% of RUs on the basis of GVA and number of employees. Each covariate is included in a separate regression model (also including dummies for region, industry and firm size). Standard errors are given in square brackets. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Table 3.8. Drivers of the fall in labour productivity experienced during the recession

	(1) Baseline	(1) plus lagged real investment per employee	(1) plus current and lagged real investment per employee	(1) plus lagged real labour cost per employee	(1) plus current and lagged real labour cost per employee	(1) plus current real investment and labour cost per employee
Post08	−0.061*** [0.005]	−0.062*** [0.005]	−0.057*** [0.005]	−0.059*** [0.005]	−0.021*** [0.005]	−0.020*** [0.005]
Post06	−0.028*** [0.005]	−0.029*** [0.005]	−0.028*** [0.005]	−0.026*** [0.005]	0.009** [0.004]	0.008* [0.004]
Year	0.019*** [0.001]	0.019*** [0.001]	0.021*** [0.001]	0.020*** [0.001]	−0.001 [0.001]	0.001 [0.001]
No. of obs.	270,513	270,513	270,513	270,513	270,513	270,513
No. of RUs	88,355	88,355	88,355	88,355	88,355	88,355

Note: Based on a sample of reporting units that appear at least twice between 1997 and 2009, excluding the top and bottom 1% of RUs on the basis of GVA and number of employees. Missing values of the lag measures (e.g. for firms that we do not observe three times in our data) are captured through the inclusion of missing dummy variables, though the results do not materially change if we restrict attention to RUs that we observe at least three times. Standard errors are given in square brackets. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

association between labour hoarding and average labour costs is particularly strong, with our estimate suggesting that a 1% reduction in average labour cost is associated with a 0.69% reduction in real labour productivity relative to the historical trend. This finding is also borne out by the results of our second analysis, shown in Table 3.8.

Column 1 of Table 3.8 replicates the overall results presented in column 1 of Table 3.1, showing that labour productivity was, on average, 6.1% lower during the recession than might have been expected on the basis of a historical trend. The remaining columns go on to illustrate how this estimate changes once we add controls for past (two lags) and contemporaneous measures of investment and labour costs to the model. Columns 2 and 3 – which add lagged and current real investment per employee – indicate that the observed fall in labour productivity cannot be explained by lower capital investment in the last three periods. The addition of lagged real labour cost per employee in the next column also makes little difference. However, once current labour cost per employee is controlled for, as in the penultimate column, our estimate of the effect of the recession on productivity falls to 2.1%. This suggests that a fall in real wages can ‘explain’ around two-thirds of the fall in labour productivity that we observe.¹⁷

¹⁷ These findings remain broadly consistent if we restrict attention to firms that appear at least three times in our data (i.e. for which the lag measures are non-missing) or if we use absolute investment or labour costs rather than investment or labour costs per employee.

In both cases, the direction of causality is unclear: firms could be responding to a fall in real wages by keeping on more workers than they otherwise would have done, or substituting labour for capital; or they could be responding to a fall in productivity by reducing real wages. Nonetheless, both pieces of analysis suggest that falling real wages may have been a significant contributor to the better-than-expected performance of employment (and the worse-than-expected performance of labour productivity) during the 2008–09 recession.

3.2 Investment and profit

This section builds on the analysis of labour hoarding described in the previous section. It investigates what happened to real investment (as measured by net capital expenditure) and the likelihood of making a profit (i.e. having a positive surplus of GVA over labour costs) over the course of the recession, and the extent to which this varied by firm size or NMW coverage. Table 3.9 presents these results for all firms (in columns 1 and 2 respectively), by firm size (columns 3 and 4) and by the coverage of the minimum wage (columns 5 and 6).

Column 1 indicates that investment was, on average, 14% lower during the recession than its pre-recession trend would have suggested, while column 2 indicates that firms were 5.7 percentage points less likely to be in profit. In contrast to the results for labour hoarding (shown in Tables 3.2 and 3.3), column 3 indicates that there appears to be no clear relationship between firm size and the effect of the recession on investment. By contrast, column 4 shows that there is a clear negative relationship between firm size and profits, with large firms 8 percentage points less likely to make a profit in 2008 or 2009 (relative to a pre-recession trend) compared with just a 2.4 percentage point reduction for small firms. This is not the result of bigger firms being more likely to make a profit before the recession and a convergence since then; in fact, large firms were, on average, slightly less likely to make a profit before the recession than smaller ones (although there might be some selection bias if the survival of small firms during the recession depended more on their pre-recession profitability).¹⁸

Column 5 suggests that investment has fallen proportionately more in firms with lower NMW coverage. However, as was the case for the extent of labour hoarding by quartile of NMW coverage, these results differ once we relax the assumption that the linear time trend and 2006 discontinuity are the same across the four coverage groups. In this case, the estimates would suggest that the impact of the recession on investment is the least negative in the lowest-coverage group, the exact opposite of the results in Table 3.9. We therefore conclude that there is no robust evidence of a differential impact of the recession on firm investment by coverage of the NMW. This also holds true for the relationship between NMW coverage and profits during the recession (see column 6 of Table 3.9).

¹⁸ On an unweighted basis, our sample shows that 81% of firms with 250+ employees made profits before the recession, in comparison with 85% among small firms (less than 50 employees) and 84% among medium-sized ones.

Table 3.9. Impact of the recession on firm investment and profits

	(1) Real log investment	(2) Likelihood of being in profit	(3) Real log investment	(4) Likelihood of being in profit	(5) Real log investment	(6) Likelihood of being in profit
Post08	-0.139*** [0.013]	-0.057*** [0.003]				
Post08* Small firm			-0.126*** [0.025]	-0.024*** [0.005]		
Post08* Medium firm			-0.175*** [0.019]	-0.061*** [0.004]		
Post08* Large firm			-0.109*** [0.019]	-0.081*** [0.005]		
Post08*NMW 1 st quartile					-0.171*** [0.018]	-0.054*** [0.004]
Post08*NMW 2 nd quartile					-0.126*** [0.022]	-0.061*** [0.005]
Post08*NMW 3 rd quartile					-0.107*** [0.031]	-0.054*** [0.007]
Post08*NMW 4 th quartile					-0.077** [0.034]	-0.064*** [0.007]
Post06	0.097*** [0.012]	-0.009*** [0.003]	0.098*** [0.012]	-0.008*** [0.003]	0.097*** [0.012]	-0.009*** [0.003]
Year	-0.047*** [0.001]	-0.006*** [0.0003]	-0.047*** [0.001]	-0.006*** [0.0003]	-0.047*** [0.001]	-0.006*** [0.0003]
No. of obs.	214,876	281,985	213,149	278,314	212,210	278,570
No. of RUs	77,592	91,149	76,301	88,813	76,000	89,320

Note: All estimates are based on a sample of reporting units that appear at least twice between 1997 and 2009, excluding the top and bottom 1% of RUs according to GVA and number of employees. The impact of the recession by firm size is estimated by interacting the *post08* indicator with a series of dummy variables for firm size, while the impact of the recession by coverage of the NMW is estimated by interacting the *post08* indicator with a series of dummy variables indicating quartile of coverage of the NMW. Standard errors are given in square brackets. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

Overall, these results suggest that during the 2008–09 recession – at least among our sample of larger, higher-productivity survivors – firms were economising not only in terms of labour inputs (as we saw in Section 3.1), but also in terms of capital inputs. However, we find little evidence that these relationships differ systematically according to either firm size or coverage of the NMW. The likelihood of making a profit also appears to have fallen, more so for larger firms, but there is little difference according to coverage of the NMW.

3.3 Workplace training

This section focuses on what happened to workplace training between 2007 and 2009. Previous research has found some evidence of a positive effect of the NMW on employer-provided training (e.g. Arulampalam, Booth and Bryan, 2004; Booth

and Bryan, 2006), although not all studies agree, including one commissioned by the Low Pay Commission (Dickerson, 2007).

We build on the existing evidence by providing some descriptive information on the way in which employer-provided training over the previous 12 months changes between 2007 and 2009 (i.e. over the course of the 2008–09 recession) and the extent to which this varies according to the long-term and pre-recession coverage of the NMW, as well as a variety of other pre-recession firm characteristics. In this respect, the analysis is most similar to that investigating the characteristics associated with changes in labour productivity over the course of the recession, presented in Table 3.7.

Table 3.10 describes how the percentage of employees receiving training from their employer changes between 2007 and 2009, and how this effect varies by both the long-term (1999) and the immediate pre-recession (2007) coverage of the NMW. In contrast to the previous tables in this report, it presents the effects for firms in the lowest-coverage quartile and then shows how the effects for firms in other quartiles differ from these estimates. This table shows that, on average, a significantly lower proportion of employees working in all firms received training in 2009 than in 2007, but that the effect on those working in the 75% of firms in which the coverage of the NMW was highest (i.e. the second, third and highest quartiles) was significantly larger than the effect on those in the bottom quartile.¹⁹ This is true whether we evaluate the coverage of the NMW in 1999 or

Table 3.10. Changes to the percentage of staff who receive employer-provided training between 2007 and 2009, by coverage of NMW

	NMW coverage in 1999		NMW coverage in 2007	
	Unconditional	Conditional on dummies for industry, region and firm size	Unconditional	Conditional on dummies for industry, region and firm size
Lowest-coverage quartile	-2.944*** [0.087]	-1.424*** [0.461]	-2.532*** [0.092]	-2.807*** [0.472]
2 nd quartile (relative to lowest)	-2.493*** [0.131]	-2.319*** [0.139]	-3.513*** [0.148]	-2.026*** [0.155]
3 rd quartile (relative to lowest)	-2.799*** [0.153]	-1.967*** [0.194]	-2.690*** [0.148]	-1.014*** [0.175]
Highest-coverage quartile (relative to lowest)	-2.544*** [0.170]	-1.294*** [0.225]	-3.611*** [0.174]	-1.320*** [0.248]
No. of obs.	20,373	18,337	18,235	17,870

Note: The sample consists of post-2008 observations only. Standard errors are given in square brackets. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

¹⁹ Remember that the effects for the second, third and highest-coverage quartiles are relative to the lowest-coverage quartile, so the unconditional estimate of the effect of the long-term coverage of the NMW on firms in the second quartile, for example, is $-2.944 - 2.493 = -5.437$ percentage points.

2007, and whether or not we control for industry, region and firm size. For example, while employees in the 25% of firms with the lowest NMW coverage were just over 2.9 percentage points less likely to receive training in 2009 than in 2007 (when we do not condition on any other firm characteristics), the effect was around 5.5 percentage points²⁰ for those in the 25% of firms with the highest NMW coverage.

Table 3.11 extends this exercise by adding controls for a range of pre-recession firm characteristics – in addition to quartile of coverage of the NMW – to the model. It also adds controls for whether the firm engaged in labour hoarding during the recession (and, if so, to what extent) in order to illustrate the relationship between changes to employment and training behaviour. It does so for all firms in the sample (the 'unconditional' estimates) and for just those firms that experienced negative shocks to GVA (i.e. that were not expanding during the recession).

The table shows that there is a strong degree of persistence in the likelihood of providing training, with a large and significant positive relationship between the provision of training in 2007 and 2009 in all specifications. It also appears that firms that invest more in physical capital are also more likely to invest in human capital, with a significant positive relationship between pre-recession investment and training. Intuitively, firms that are experiencing skills shortages – as evidenced by a higher proportion of skilled vacancies and a higher proportion of staff who are not proficient – also tend to train more in 2009.

In terms of the relationship between labour hoarding and training, there is some evidence that firms that hoard labour are less likely to provide training. The first column of Table 3.11 suggests that the proportion of staff trained is 0.34 percentage points lower in firms that hoard labour than in firms that do not. Conditional on whether a firm hoards labour, however, the degree of hoarding is positively associated with the provision of training (the coefficient on the 'degree of labour hoarding' indicator is positive in the last two columns). This seems plausible: if training is costly, then firms that need to reduce costs may be less likely to undertake it; however, conditional on being in that situation, the more underutilised staff are (i.e. the lower their productivity), the more time (and lower opportunity cost) there is to train them.

Overall, this section provides some suggestive evidence that the proportion of employees receiving training fell by more in high-NMW-coverage firms than in low-NMW-coverage firms, and by more in firms that hoarded labour during the recession than in those that did not.

²⁰ $-2.944 - 2.544 = -5.488$ percentage points.

Table 3.11. What other characteristics explain the percentage of staff trained in 2009?

	Unconditional	Conditional on the firm's GVA since 2008 being below its historical trend	Unconditional	Conditional on the firm's GVA since 2008 being below its historical trend	Unconditional	Conditional on the firm's GVA since 2008 being below its historical trend
Whether hoards labour	-0.336*** [0.093]	-0.254* [0.149]			-0.481*** [0.117]	-0.491*** [0.168]
Degree of labour hoarding			-0.035 [0.055]	0.145* [0.076]	0.140* [0.069]	0.261*** [0.085]
Percentage of employees trained in 2007	0.569*** [0.006]	0.579*** [0.009]	0.569*** [0.006]	0.578*** [0.009]	0.569*** [0.006]	0.578*** [0.009]
Log pre-recession average labour cost per employee	0.007 [0.085]	0.221* [0.119]	-0.014 [0.085]	0.178 [0.119]	-0.002 [0.085]	0.197* [0.119]
Log pre-recession average investment	0.123*** [0.032]	0.094** [0.044]	0.125*** [0.032]	0.091** [0.044]	0.124*** [0.032]	0.092** [0.040]
Vacancies as a percentage of workforce size in 2007	0.061*** [0.016]	-0.034 [0.022]	0.060*** [0.016]	-0.034 [0.022]	0.061*** [0.016]	-0.034 [0.022]
Hard-to-fill vacancies as a percentage of vacancies in 2007	-0.278*** [0.020]	-0.265*** [0.027]	-0.278*** [0.020]	-0.262*** [0.027]	-0.278*** [0.020]	-0.264*** [0.027]
Skill-shortage vacancies as a percentage of hard-to-fill vacancies in 2007	0.097*** [0.017]	0.089*** [0.022]	0.097*** [0.017]	0.088*** [0.022]	0.097*** [0.017]	0.088*** [0.022]
Percentage of employees not fully proficient in 2007	0.564*** [0.029]	0.611*** [0.042]	0.564*** [0.029]	0.607*** [0.042]	0.563*** [0.029]	0.608*** [0.042]
Second quartile of 1999 NMW coverage	-1.253*** [0.126]	-1.428*** [0.170]	-1.253*** [0.126]	-1.428*** [0.170]	-1.255*** [0.126]	-1.437*** [0.170]
Third quartile of 1999 NMW coverage	-0.683*** [0.177]	-0.865*** [0.244]	-0.689*** [0.177]	-0.862*** [0.244]	-0.684*** [0.177]	-0.863*** [0.244]
Highest quartile of 1999 NMW coverage	-0.402* [0.208]	-0.037 [0.283]	-0.408** [0.208]	-0.029 [0.283]	-0.400* [0.208]	-0.033 [0.282]
No. of obs.	15,866	8,636	15,866	8,636	15,866	8,636

Note: Regressors also include a constant, average workplace size in 2007, average workplace size in 2009, a dummy for non-positive pre-recession investment, log pre-recession average number of employees, and dummies for industry, region and three bands of firm size. Standard errors are given in square brackets. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

4. The Relationship between Firm Investment and the NMW

While Section 3.2 presented little evidence that the effect of the recession on investment varied systematically according to the long-term bite of the National Minimum Wage, it is plausible that its introduction affected firms' long-term investment decisions. Moreover, these effects have received relatively little attention in the literature to date. Previous research commissioned by the Low Pay Commission – Forth and O'Mahony (2003) and Forth et al. (2009) – has considered a measure of the capital-labour ratio, but not addressed investment directly. Thus, while the main focus of this report is on what happened to capital, labour and profits during the 2008–09 recession, this section provides some descriptive evidence about what has happened to firm investment since the minimum wage was introduced in the UK in 1999.

To do so, we adopt a fixed effects approach very similar to that used in our main analysis looking at what happened to productivity and other outcomes during the recession, except that we add a binary variable equal to 1 if the observation falls in or after 1999 and 0 otherwise. The purpose of this variable is to try to capture the effect of the introduction of the NMW in 1999. To differentiate this from a simple change in trend occurring in 1999, we investigate whether the effects differ by the proportion of workers affected by the NMW (i.e. by quartile of coverage). Table 4.1 presents the estimates from these models for a variety of measures of investment. Because Section 3.2 showed that the time trend in investment might differ across the four groups of NMW coverage, we run the analysis separately by group.

The top panel of the table looks at the binary outcome of whether a firm makes any positive investment. Since 1999, there has been a significant increase in the proportion of firms in our sample making positive investments among the two lower-coverage groups. By contrast, the two higher-coverage groups saw little increase in the likelihood of undertaking positive investment. Estimates of the effect of the recession on all other outcomes reported in the table are also more positive (or less negative) for lower-coverage firms. For example, the second panel shows that firms in the two higher-coverage groups saw a decline of 3–4% in real investment following the introduction of the NMW, while the two lowest-coverage groups saw almost no change. The same pattern is seen in real investment per employee and real investment relative to GVA.

While these results are, on the whole, not statistically significant and should not be regarded as causal, they provide some weak suggestive evidence that the introduction of the minimum wage in 1999 might have been associated with a small reduction in investment amongst firms that were more likely to be affected (i.e. those with the highest coverage). As outlined in Section 2, however, we have relatively little data from which to estimate the trend in investments prior to the introduction of the NMW (and can hence only do so on the basis of changes

Table 4.1. Long-term impact of the NMW on firm investment, and whether it differs during the recession

	Bottom quartile (lowest coverage)	2 nd quartile	3 rd quartile	Top quartile (highest coverage)
Any positive investment				
Post99	0.014*** [0.005]	0.013** [0.006]	0.006 [0.009]	0.007 [0.009]
Post08	0.023*** [0.005]	0.021*** [0.007]	-0.003 [0.011]	0.019* [0.011]
Post06	0.013*** [0.005]	0.023*** [0.006]	0.017* [0.010]	0.001 [0.010]
Year	-0.018*** [0.001]	-0.018*** [0.001]	-0.017*** [0.002]	-0.014*** [0.002]
No. of obs.	103,516	79,469	47,893	47,856
No. of RUs	25,987	25,106	19,193	19,043
Log real investment				
Post99	-0.007 [0.017]	0.008 [0.024]	-0.038 [0.035]	-0.033 [0.038]
Post08	-0.099*** [0.019]	-0.199*** [0.026]	-0.184*** [0.040]	-0.159*** [0.044]
Post06	0.111*** [0.018]	0.086*** [0.024]	0.084** [0.038]	0.047 [0.039]
Year	-0.060*** [0.003]	-0.033*** [0.004]	-0.031*** [0.007]	-0.025*** [0.007]
No. of obs.	85,916	60,200	33,532	32,562
No. of RUs	23,897	21,604	15,379	15,120
Log real investment per employee				
Post99	-0.015 [0.017]	-0.005 [0.024]	-0.024 [0.035]	-0.032 [0.038]
Post08	-0.086*** [0.019]	-0.148*** [0.026]	-0.148*** [0.040]	-0.143*** [0.045]
Post06	0.061*** [0.018]	0.054** [0.024]	0.052 [0.038]	-0.002 [0.039]
Year	-0.057*** [0.003]	-0.054*** [0.004]	-0.062*** [0.006]	-0.052*** [0.007]
No. of obs.	85,723	60,000	33,225	32,369
No. of RUs	23,816	21,504	15,191	15,005
Log real investment relative to GVA				
Post99	-0.015 [0.018]	-0.003 [0.025]	-0.053 [0.037]	-0.025 [0.040]
Post08	-0.025 [0.020]	-0.121*** [0.028]	-0.071* [0.042]	-0.124*** [0.048]
Post06	0.074*** [0.019]	0.048* [0.026]	0.047 [0.040]	0.060 [0.042]
Year	-0.081*** [0.003]	-0.071*** [0.005]	-0.075*** [0.007]	-0.066*** [0.007]
No. of obs.	84,352	58,017	32,816	31,177
No. of RUs	23,623	21,184	15,155	14,687

Note: Standard errors are given in square brackets. *** indicates significance at the 1% level, ** at the 5% level and * at the 10% level.

between 1997 and 1998). We would therefore recommend that this finding is investigated further using longer-term data sets before reaching a firm conclusion on this issue.

5. Summary and Conclusions

This report has adopted a fixed effects approach to examine the drivers of within-firm changes in labour and capital inputs over the course of the 2008–09 recession, as well as to show how these patterns vary amongst different types of firms, notably by firm size and coverage of the National Minimum Wage (NMW).

- We find strong evidence that firms hoarded labour in response to the 2008–09 recession. In particular, we find that real gross value added per employee fell by 6.1% relative to its pre-recession trend, that the proportion of workers working part-time increased by 1.5 percentage points and that the average annual growth in real hourly wages among existing workers fell by 0.6 percentage points.
- This means that the aggregate changes in labour productivity, hours and wages that have been observed by other commentators are not just the result of changes in the composition of firms and workers over time, but also appear to be occurring within firms. This provides some suggestive evidence that firms are weathering the recession by reducing the hours and/or wages of their existing workforce rather than making them redundant.
- We confirm the evidence from other studies (Bank of England, 2012; Field and Franklin, 2013) that small firms appear to be more likely to hoard labour than larger firms. This seems plausible in a world in which hiring and firing workers is likely to be relatively more costly for small firms.
- By contrast, we find relatively mixed evidence of the extent to which labour hoarding varies according to the coverage of the NMW, with its effect apparently dominated by that of firm size. This suggests that the minimum wage regime is not the driving force behind the differential responses to the recession that we observe across firms.
- In terms of other pre-recession characteristics, we find that labour hoarding is positively correlated with higher profits, higher average labour costs and skill-shortage vacancies (vacancies that are hard to fill because applicants lack required skills, experience or qualifications), but not with generally hard-to-fill vacancies.
- We also find some evidence that, while firms that hoard labour are less likely to train their workforce, conditional on whether they hoard labour, the extent of labour hoarding is positively associated with the provision of training. This seems plausible: if training is costly, then some firms that need to reduce costs may be less likely to undertake training; however, the more underutilised a firm's staff (i.e. the lower their productivity), the more time (and lower opportunity cost) there is to train them.
- We also investigate the extent to which a reduction in contemporaneous labour costs or capital investment can 'explain' the fall in labour productivity

that we observe. We find that the fall in real wages is particularly important, 'explaining' around two-thirds of the gap. The direction of causality is unclear, however: firms could be responding to a fall in real wages by keeping on more workers than they otherwise would have done, or substituting labour for capital; or they could be responding to a fall in productivity by reducing real wages. Nonetheless, this suggests that falling real wages may have been a significant contributor to the better-than-expected performance of employment (and the worse-than-expected performance of labour productivity) during the 2008–09 recession.

- In addition to economising in terms of labour inputs, we find some evidence that firms have reduced their investments in physical and human capital over the course of the recession, and the likelihood of making a profit also appears to have fallen. For example, real investment fell by 14% relative to its pre-recession trend and the likelihood of being in profit fell by 5.7 percentage points. The proportion of employees being trained by their firms also fell sharply between 2007 and 2009.
- We find little systematic evidence that these investments in physical and human capital varied by firm size or NMW coverage over the course of the recession, although there is some evidence that the proportion of employees receiving training fell by significantly more in firms with higher proportions of workers affected by the NMW than in the 25% of firms with the lowest coverage. In the longer term, however, we find some weak suggestive evidence that the introduction of the NMW in 1999 was associated with decreases in investment amongst firms with the highest proportions of low-paid workers, though these findings warrant further exploration using longer-term data sets before drawing firm conclusions.

In terms of conclusions for the Low Pay Commission, we find no strong evidence that the minimum wage has hindered the ability of firms to respond to the recession by reducing hours or cutting real wages. If anything, we find that high-coverage firms are more likely to exhibit such labour hoarding behaviour. We have, however, found some weak suggestive evidence that, at least in the longer term, the minimum wage might have reduced investment in firms that were most affected by its introduction. This evidence is based on divergences from a trend, which we are only able to estimate using data from 1997 and 1998; thus we would urge some caution in interpreting these results and recommend undertaking further analysis before reaching a definite conclusion on this issue.

Appendix

Table A.1 reports the basic regressions of labour productivity under fixed effects (FE) and ordinary least squares (OLS), using three different samples. The entire sample (with positive GVA and excluding extreme values, and excluding the public sector) includes 450,477 observations of 268,319 unique reporting units from 1997 to 2009, as seen in the first two columns. Among them, 84,597 RUs appear at least twice and correspond to 266,755 observations in columns 3 and 4. Of these, 20,714 RUs appear at least once before and once after the recession, corresponding to 94,036 observations in the last two columns. Columns 1 and 3 report the same estimates because, under FE, RUs that appear only once do not affect the estimates. The FE estimates show a 6.1 percentage point fall in labour productivity relative to the pre-recession trend. When restricting the sample to observations that appear both before and after 2008, the FE and OLS estimates are similar. The sensitivity of OLS estimates with regard to the sample suggests that compositional shifts over time or panel imbalances are indeed non-negligible.

Table A.1. Impact of the recession on labour productivity: FE versus OLS

	All RUs with non-missing GVA and employee data		All RUs with non-missing GVA and employee data that appear at least twice		All RUs with non-missing GVA and employee data that appear at least once before and once after 2008	
	FE	OLS	FE	OLS	FE	OLS
Post08	-0.061*** [0.005]	0.003 [0.007]	-0.061*** [0.005]	0.047*** [0.008]	-0.060*** [0.006]	-0.060*** [0.010]
Post06	-0.028*** [0.005]	-0.046*** [0.006]	-0.028*** [0.005]	-0.048*** [0.007]	-0.022*** [0.007]	-0.118*** [0.011]
Year	0.019*** [0.001]	0.025*** [0.001]	0.019*** [0.001]	0.023*** [0.001]	0.018*** [0.001]	0.026*** [0.001]
No. of obs.	450,477	450,477	266,755	266,755	94,036	94,036
No. of RUs	268,319		84,597		20,714	

Note: Standard errors are given in square brackets. *** denotes significance at 1%, ** at 5% and * at 10% level.

Figure A.1. Unweighted time trend of ASHE indicators by year, restricted to RUs that appear at least twice over 1997–2009

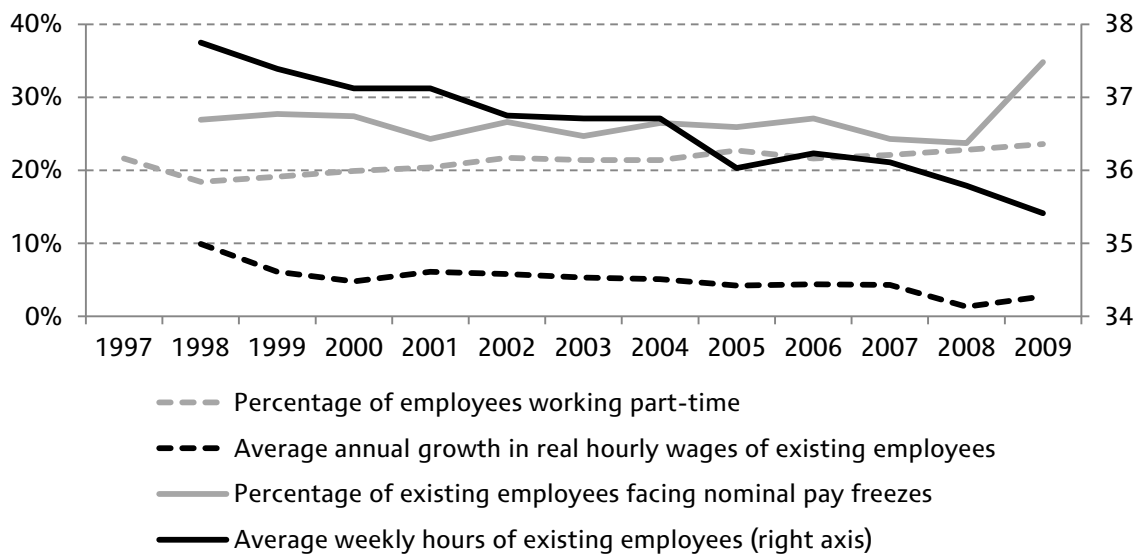


Table A.2. Differential trends by quartiles of NMW coverage

	Lowest quartile of NMW coverage	2nd quartile	3rd quartile	Highest quartile of NMW coverage
Log real GVA	-0.074*** [0.008]	-0.097*** [0.011]	-0.116*** [0.017]	-0.073*** [0.016]
No. of RUs	25,648	24,614	18,891	18,497
Log number of employees	-0.017*** [0.005]	-0.059*** [0.006]	-0.022** [0.010]	-0.027*** [0.010]
No. of RUs	25,833	24,880	18,686	18,726
Any positive surplus	0.046*** [0.005]	-0.057*** [0.006]	-0.077*** [0.008]	-0.077*** [0.009]
No. of RUs	25,985	25,102	19,191	19,042
Log real labour cost per employee	-0.065*** [0.004]	-0.044*** [0.006]	-0.073*** [0.010]	-0.042*** [0.010]
No. of RUs	25,742	24,793	18,491	18,636
Proportion of employees working part-time	0.018*** [0.001]	0.011*** [0.001]	0.015*** [0.001]	0.010*** [0.002]
No. of RUs	25,978	25,104	19,192	19,037
Average weekly hours of existing employees	-0.293*** [0.018]	-0.311*** [0.021]	-0.294*** [0.032]	-0.268*** [0.042]
No. of RUs	25,756	24,937	18,984	18,904
Average annual growth in real wages of existing employees	-0.009*** [0.001]	-0.003*** [0.001]	-0.010*** [0.002]	-0.002 [0.002]
No. of RUs	25,750	24,937	18,983	18,902
Proportion of existing employees facing pay freezes	0.053*** [0.001]	0.051*** [0.001]	0.084*** [0.001]	0.060*** [0.002]
No. of RUs	25,750	24,937	18,983	18,902
Any positive investment	0.019*** [0.005]	0.017** [0.007]	-0.005 [0.010]	0.016 [0.011]
No. of RUs	25,987	25,106	19,193	19,043
Log real investment	-0.096*** [0.019]	-0.201*** [0.025]	-0.173*** [0.039]	-0.149*** [0.043]
No. of RUs	23,897	21,604	15,379	15,120
Log real investment per employee	-0.081*** [0.018]	-0.147*** [0.025]	-0.140*** [0.039]	-0.134*** [0.043]
No. of RUs	23,816	21,504	15,191	15,005
Log real investment relative to GVA	-0.020 [0.019]	-0.119*** [0.027]	-0.055 [0.041]	-0.117** [0.046]
No. of RUs	23,623	21,184	15,155	14,687

Note: Standard errors are given in square brackets. *** denotes significance at 1%, ** at 5% and * at 10% level.

Table A.3. Impact of recession on labour productivity by pre-recession firm size and profitability (profit relative to GVA)

		Bottom quartile of pre-recession profit/GVA	2nd quartile of profitability	3rd quartile of profitability	Top quartile of pre-recession profit/GVA
Small firms	Post08	0.103** [0.041]	-0.035 [0.026]	-0.155*** [0.026]	-0.326*** [0.061]
	No. of RUs	12,628	14,460	15,545	7,839
Medium- sized firms	Post08	0.055** [0.026]	-0.049*** [0.016]	-0.153*** [0.021]	-0.224*** [0.054]
	No. of RUs	8,780	8,835	6,259	2,585
Large firms	Post08	0.054** [0.024]	-0.031* [0.017]	-0.153*** [0.019]	0.003 [0.049]
	No. of RUs	3,234	2,639	1,952	1,029

Note: Standard errors are given in square brackets. *** denotes significance at 1%, ** at 5% and * at 10% level.

Table A.4. Impact of recession by region

	Log GVA per employee	Likelihood of having a positive surplus	Labour cost per employee	Log real investment
East	-0.054*** [0.015]	-0.067*** [0.009]	-0.054*** [0.009]	-0.210*** [0.038]
East Midlands	-0.036** [0.016]	-0.041*** [0.010]	-0.050*** [0.010]	-0.110*** [0.041]
London	-0.006 [0.012]	-0.073*** [0.007]	-0.032*** [0.008]	-0.114*** [0.032]
North East	0.019 [0.022]	-0.049*** [0.013]	-0.007 [0.014]	-0.076 [0.056]
North West	-0.115*** [0.015]	-0.073*** [0.009]	-0.077*** [0.009]	-0.184*** [0.038]
Scotland	-0.043*** [0.012]	-0.026*** [0.007]	-0.061*** [0.007]	-0.101*** [0.030]
South East	-0.049*** [0.012]	-0.062*** [0.007]	-0.049*** [0.007]	-0.131*** [0.031]
South West	-0.099*** [0.016]	-0.058*** [0.010]	-0.077*** [0.010]	-0.114*** [0.040]
Wales	-0.082*** [0.020]	-0.043*** [0.012]	-0.045*** [0.012]	-0.189*** [0.051]
West Midlands	-0.104*** [0.015]	-0.080*** [0.009]	-0.077*** [0.009]	-0.162*** [0.037]
Yorkshire and Humber	-0.111*** [0.016]	-0.055*** [0.010]	-0.089*** [0.001]	-0.192*** [0.040]
Post06	-0.029*** [0.005]	-0.009*** [0.003]	-0.060*** [0.003]	0.097*** [0.011]
Year	0.019*** [0.0006]	-0.006*** [0.0003]	0.031*** [0.0003]	-0.046*** [0.001]
No. of obs.	270,090	281,677	277,438	214,529
No. of RUs	88,333	91,135	89,430	77,559

Table continues on next page

Table A.4 continued

	Proportion of employees working part-time	Average weekly hours of existing employees	Average annual growth in real wages of existing employees	Proportion of existing employees facing nominal pay freezes
East	0.017*** [0.001]	-0.344*** [0.035]	-0.003* [0.001]	0.078*** [0.002]
East Midlands	0.007*** [0.001]	-0.303*** [0.038]	-0.008*** [0.002]	0.078*** [0.002]
London	0.011*** [0.001]	-0.030 [0.029]	0.002 [0.001]	0.050*** [0.001]
North East	0.016*** [0.002]	-0.343*** [0.052]	-0.005** [0.002]	0.059*** [0.002]
North West	0.018*** [0.001]	-0.382*** [0.035]	-0.012*** [0.001]	0.064*** [0.002]
Scotland	0.025*** [0.001]	-0.212*** [0.027]	0.006*** [0.001]	0.041*** [0.001]
South East	0.012*** [0.001]	-0.382*** [0.028]	-0.015*** [0.001]	0.054*** [0.001]
South West	0.011*** [0.001]	-0.336*** [0.037]	-0.012*** [0.002]	0.061*** [0.002]
Wales	0.012*** [0.002]	-0.232*** [0.046]	-0.012*** [0.002]	0.046*** [0.002]
West Midlands	0.017*** [0.001]	-0.577*** [0.034]	-0.010*** [0.001]	0.064*** [0.002]
Yorkshire and Humber	0.016*** [0.001]	-0.377*** [0.037]	-0.010*** [0.001]	0.059*** [0.002]
Post06	0.010*** [0.0004]	0.006 [0.011]	0.004*** [0.0005]	0.010*** [0.0005]
Year	-0.0005*** [0.00005]	-0.133*** [0.002]	-0.005*** [0.00006]	-0.002*** [0.00007]
No. of obs.	281,410	263,156	263,096	263,096
No. of RUs	91,086	90,084	90,075	90,075

Note: Standard errors are given in square brackets. *** denotes significance at 1%, ** at 5% and * at 10% level.

Table A.5. Impact of recession by industry

	Log GVA per employee	Likelihood of having a positive surplus	Labour cost per employee	Log real investment
Agriculture, mining, energy	-0.030 [0.032]	0.014 [0.018]	-0.096*** [0.019]	0.028 [0.077]
Manufacturing	-0.037*** [0.008]	-0.040*** [0.005]	-0.029*** [0.005]	-0.212*** [0.021]
Construction	-0.131*** [0.018]	-0.064*** [0.010]	-0.080*** [0.011]	-0.360*** [0.050]
Wholesale, retail	-0.094*** [0.009]	-0.061*** [0.005]	-0.044*** [0.006]	-0.164*** [0.024]
Transport, storage	-0.068*** [0.020]	-0.083*** [0.012]	-0.071*** [0.012]	-0.030 [0.051]
Hotel, catering	-0.096*** [0.026]	-0.060*** [0.016]	-0.105*** [0.016]	0.013 [0.067]
Information, communication	0.051** [0.022]	-0.059*** [0.013]	0.013 [0.013]	0.051 [0.055]
Finance	-0.144 [0.211]	0.071 [0.118]	0.144 [0.130]	-0.335 [0.493]
Real estate	-0.100*** [0.030]	-0.088*** [0.017]	-0.065*** [0.018]	-0.652*** [0.074]
Professional	-0.001 [0.016]	-0.052*** [0.009]	-0.043*** [0.010]	-0.071* [0.040]
Admin and support services	0.011 [0.016]	-0.098*** [0.010]	-0.004 [0.010]	-0.059 [0.045]
Government services	-0.203*** [0.020]	-0.078*** [0.011]	-0.244*** [0.011]	0.098** [0.043]
Arts	-0.094*** [0.021]	-0.035*** [0.012]	-0.138*** [0.012]	-0.068 [0.052]
Post06	-0.028*** [0.005]	-0.008*** [0.003]	-0.060*** [0.003]	0.098*** [0.012]
Year	0.019*** [0.001]	-0.006*** [0.0003]	0.031*** [0.0003]	-0.046*** [0.001]
No. of obs.	270,513	281,985	277,875	214,876
No. of RUs	88,355	91,149	89,450	77,592

Table continues on next page

Table A.5 continued

	Proportion of employees working part-time	Average weekly hours of existing employees	Average annual growth in real wages of existing employees	Proportion of existing employees facing nominal pay freezes
Agriculture, mining, energy	0.011*** [0.003]	-0.143* [0.074]	-0.013*** [0.003]	0.037*** [0.003]
Manufacturing	0.018*** [0.0008]	-0.463*** [0.0199]	-0.023*** [0.0008]	0.070*** [0.0009]
Construction	0.022*** [0.002]	-0.684*** [0.041]	0.044*** [0.002]	0.091*** [0.002]
Wholesale, retail	0.036*** [0.001]	-0.573*** [0.022]	-0.009*** [0.001]	0.057*** [0.001]
Transport, storage	0.013*** [0.002]	-0.683*** [0.047]	-0.002 [0.002]	0.076*** [0.002]
Hotel, catering	-0.007*** [0.002]	0.0007 [0.061]	0.017*** [0.002]	0.022*** [0.003]
Information, communication	0.010*** [0.002]	-0.189*** [0.051]	-0.018*** [0.002]	0.057*** [0.002]
Finance	0.073*** [0.018]	-0.348 [0.459]	0.015 [0.019]	0.062*** [0.021]
Real estate	0.008*** [0.003]	0.025 [0.068]	0.020*** [0.003]	0.049*** [0.003]
Professional	0.002 [0.001]	0.236*** [0.038]	-0.013*** [0.002]	0.060*** [0.002]
Admin and support services	0.003** [0.002]	0.015 [0.039]	-0.0003 [0.002]	0.060*** [0.002]
Government services	-0.020*** [0.002]	0.574*** [0.042]	0.017*** [0.002]	-0.021*** [0.002]
Arts	-0.004** [0.002]	-0.094** [0.046]	-0.003 [0.002]	0.044*** [0.002]
Post06	0.009*** [0.0004]	0.009 [0.011]	0.004*** [0.0005]	0.010*** [0.0005]
Year	-0.0005*** [0.00005]	-0.132*** [0.002]	-0.005*** [0.00006]	-0.002*** [0.00007]
No. of obs.	281,859	263,605	263,545	263,545
No. of RUs	91,107	90,110	90,101	90,101

Note: The definition of industry here follows SIC2007. Data before 2008 were collected on a SIC2003 basis and converted to SIC2007 by the authors. Standard errors are given in square brackets. *** denotes significance at 1%, ** at 5% and * at 10% level.

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