4 The role of firm heterogeneity in cross-country employment adjustment patterns during the financial crisis

4.1 Introduction

Virtually all advanced economies have been severely hit by the global financial crisis starting in 2008. However, the extent to which the decline in aggregate demand translated into lower employment has differed dramatically across countries (Figure 4.1, and OECD, 2012). In some of them, much of the adjustment in the labour market has been in terms of labour shedding (e.g. Spain and the U.S.). In others, where firms have tended to hoard labour (e.g. Germany, Japan) employment declined less. This large variation in the employment impact of the crisis across countries raises important questions about the role of policies and institutions. Before assessing their role, however, one has to consider the influence of a number of other potential explanations.

In particular, differences in the employment impact of the shock initiated by the crisis can be broken down into three margins: (i) variations in the nature and size of shocks across firm groups; (ii) differences in the economic structures along these firm groups; (iii) and the policy and institutional characteristics of countries, shaping the response of firms within these firm groups. In the paper, firm groups will be investigated along the joint sector- and firm size dimensions. Figure 4.1 illustrates that even though differences in the size of aggregate shocks played an important role, there is also a substantial part of the variation in employment dynamics that is left

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1This chapter has evolved from a project on labour market resilience at the OECD, based on joint work with Alexander Hijzen (OECD) and Zoltan Wolf (OECD at the time of the project, currently at Census Bureau of the United States). Earlier versions have appeared as IZA Discussion Papers No 7399 (May 2013) and OECD Social, Employment and Migration Working Papers No 134 (October 2012). I would like to thank Eric Bartelsman, Andrea Bassanini, Bart Hobijn, Mark Keese, John Martin, Stefano Scarpetta and Ken Swinnerton as well as participants of the CAED 2012 Conference for helpful comments and suggestions.
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Figure 4.1: The relationship between output and employment change (2008-09)

Source: OECD data on labour force survey statistics on total employment and annual real GDP growth.

unexplained. For example, in Germany and Japan, manufacturing industries suffered the most from the slump. In contrast, the construction sector was hit particularly hard in Ireland, Spain and the US, where it had tended to grow rapidly before the crisis as a result of the housing bubble. Since firm-specific human capital tends to be less important in construction than in manufacturing, construction firms may adjust their labour inputs more quickly in response to falling output. In other words, there may be a role for firm heterogeneity in shaping the diverse aggregate responses: cross-country differences in the distribution of output shocks across heterogeneous firms as well as differences in their composition can account for some of the observed differences in aggregate employment.  

Against this background, this chapter investigates the role of policies and institutions for aggregate labour market dynamics during the financial crisis using cross-country longitudinal firm-level data. The advantages of firm-level data are twofold. On the one hand, it allows us to control for firm-heterogeneity, differences in the composition of firms and the distribution of shocks when understanding aggregate dynamics. On the

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2Indeed, it can be shown that during the global financial crisis, labor market outcomes diverged within countries. The increase in within-country dispersion during a downturn is consistent with previous work on uncertainty by Bloom (2009) and provides a first indication that using disaggregate data instead of aggregate data can add to understanding aggregate labor market dynamics.
other hand, we can use within-country variation as well as across country variation to identify the impact of institutions. The use of within-country variation for identifying the impact of policies and institutions is useful since it is able to focus on and exploit the specific mechanism via which they exert their impact across firms, hence lending more credibility to identification. Controlling for all relevant drivers of policies and employment dynamics is difficult to do at the macroeconomic level (e.g. Belot and van Ours, 2004).

More specifically, this chapter makes the three contributions. First, using comprehensive and internationally comparable firm-level data for 20 OECD countries for the period 1993-2009, it estimates the responsiveness of employment and earnings per worker to output shocks across countries, industries and firm-size groups. Second, using a semi-aggregated data set of estimated output elasticities, employment shares and output shocks by the same breakdown, it employs a variance decomposition to assess the relative contribution of cross-country differences in economic structure (“structure heterogeneity”); the distribution of output shocks across different types of firms (“shock heterogeneity”); and the responsiveness of labour inputs to output shocks (“heterogeneity in elasticities”) in explaining the cross-country variation in aggregate employment growth during the crisis. Assuming labour market institutions affect elasticities but not output shocks or economic structures, the variance explained by heterogeneity in elasticities can be interpreted as an upper bound on the effect of institutions. Third, it investigates the role of employment protection legislation using both the within-country as well as the cross-country variation arising from firm-size exemptions and assesses the implications of our findings for aggregate labour market dynamics during the crisis.

Given the focus on the immediate, short-run response following the crisis, we maintain two assumptions throughout the analysis. First, labour market institutions affect the adjustment of firms to output shocks, but not the distribution of output shocks across different groups of firms. Of course, the distribution of shocks can also be endogenous in the long run, but that is beyond the scope of this paper. Further, the employment composition along sector and firm-size classes can also be influenced by policies institutions. However, it turns out that cross-country differences in these compositions play only a minor role in explaining cross-country differences during the crisis. For our purposes, therefore, the potential role of institutions through changing employment structures is negligible. Second, the adjustment technology is assumed to be homogeneous and constant over time for each firm group. Our assumption of the stability of labour market response to shocks is also supported by a recent study by Ball et al. (2013) where they show that even during the recent crisis and in most countries, Okun’s law coefficients did not change substantially. Moreover, they also show that differences across countries in terms of their responsiveness are much more important than the variation of responses over time, hinting at the role of labour market institutions which tend to be change only slowly and gradually over time.
us to use our micro-economic estimates for making inferences about aggregate labour market dynamics in the short run.

The main findings of the chapter are as follows. First, there is considerable heterogeneity in the way firms adjust their labour inputs to output shocks. This gives rise to systematic differences in the adjustment patterns of firms in different countries, industries and size groups. Consequently, taking account of firm heterogeneity is potentially important for explaining aggregate employment dynamics. Second, policies and institutions explain a significant part of the aggregate employment response to the crisis. This finding is based on our decomposition which suggests that heterogeneity in output elasticities – i.e. systematic differences in the adjustment behaviour of firms – accounts for as much as 40% of the cross-country variation in aggregate employment growth during the period 2008-2009. Third, strict employment protection (EPL) has a significant dampening impact on employment adjustment to output changes at the firm level. However, differences in EPL account only for a small part of the overall cross-country variation in aggregate employment growth during the crisis.

The chapter contributes to different branches of the existing literature. First, the analysis fits the line of papers about the role of market institutions for labor market outcomes. This includes macro studies which exploit the variation across many countries (Nickell and Layard, 1999; Blanchard and Wolfers, 2000; Bassanini and Duval, 2009) as well as micro studies which seek to identify the impact of employment protection using the within-country variation in production technologies across industries (Bassanini et al., 2009; Cingano et al., 2010). Lafontaine and Sivadasan (2009) falls somewhere in between in the sense that it uses plant-level data for a single multinational firm across more than 40 countries, but exploits the cross-country variation to assess the role of labour market rigidities for employment adjustment. Second, it relates to the literature that assesses aggregate implications of the way firms adjust to shocks at the micro level (Caballero et al., 1997; Davis et al., 2012). While those studies emphasize the importance of non-linearities in adjustment technologies for aggregate dynamics, the present study focuses on the role of heterogeneity in adjustment technologies. Third, it provides another evidence on the role of EPL as reducing employment response as in Bertola (1990).

5A number of recent papers (European Central Bank, 2012; Hobijn and Sahin, 2013) also investigate the cross-country patterns in employment during the crisis, using data on vacancies and unemployment and focusing on policies affecting labour market matching.

6Put differently, our analysis follows microeconomic studies in that the elasticities are estimated using firm-level data. However, we deviate from those studies in that data is collected in a comprehensive manner from a multitude of countries. Our approach is related to macroeconomic studies in that one of the objectives is to explain cross-country variation in employment growth. However, it is different in that we do it by making use of within-country variation.
4.2 Characterising labour adjustment at the firm level

The remainder of the chapter is organized as follows. Section 4.2 characterises the labour input adjustment behaviour of firms at the micro level using a multi-country firm-level panel data set (Orbis). Section 4.3 sets out the decomposition analysis to get a first idea of the role of policies and institutions for aggregate employment dynamics during the crisis and discusses the results. Analyse the role of policies. Section 4.4 presents the methodology to identify the impact of employment protection using firm-size exemptions and discusses the results, while Section 4.5 discusses the aggregate implications. The final section concludes.

4.2 Characterising labour adjustment at the firm level

This section lays out the approach to estimate the responsiveness of labour inputs to output shocks, provides a brief description of the data and discusses the results.

4.2.1 Estimation methodology

We take a simple reduced form dynamic labour adjustment equation as the basis for obtaining estimates of output elasticities of the extensive margin (number of employees) and of the intensive margin (earnings per worker)

\[ l_{it} = \gamma l_{it-1} + \beta y_{it} + \eta_i + \varepsilon_{it}, \] (4.1)

where \( l_{it} \) denotes the labour input variable of interest in firm \( i \) in year \( t \), \( y_{it} \) denotes output (measured by turnover) in firm \( i \) in year \( t \), \( \eta_i \) denotes firm-fixed effects and \( \varepsilon_{it} \) denotes an error term. Both the labour input variable and output are expressed in logs. Given the focus of the present analysis on short-run adjustment, especially over the crisis, the analysis will focus on the short-term output elasticities, i.e. differences in the estimates of the \( \beta \)-s.\(^7\)

We consider two aspects of the labour input: its quantity (employment) and price (earnings per worker). The focus on earnings per worker in addition to employment is motivated by our aim to account for different margins of labour input adjustment. Macroeconomic evidence shows that in countries such as Spain and the United States, labour market adjustment related to the crisis has overwhelmingly taken the form of labour shedding (external margin). In countries such Germany and Japan, where firms have tended to hoard labour and reduce working hours (internal margin) much

\(^7\)Note that the long run elasticities \( \beta/(1 - \gamma) \) are primarily driven by technological factors such as productivity growth and the general trend in capital-labour substitution, whereas our current aim is to assess the role of policies in shaping the short-run response to the crisis.
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of the decline in employment has been avoided. Turning to the role of adjustment through wages, macroeconomic evidence with respect to real hourly wages is less reliable due to the role of composition effects.\(^8\) Nevertheless, there is suggestive evidence that real wage adjustments have been relatively important in Central and Eastern European countries (OECD, 2012). As our available measures do not allow differentiating between changes in working time and real wages, the analysis focuses on earnings per worker instead and labels it as the "adjustment on the intensive margin".

Equation 4.1 is a reduced form, in the sense that it leaves out many determinants of labour demand and does not explicitly model adjustment costs. For our purposes of identifying differences in responsiveness across countries and firm types, however, it is compatible with a variety structural models. For example, it is consistent with labour demand models which assume that firms do not fully adjust instantaneously because of the presence of quadratic adjustment costs (Gould, 1968; Hamermesh, 1993), and also provides a valid approximation when adjustment costs have a more complex structure (e.g. non-convex) due to the smoothing effect of aggregation across firms and over time.\(^9\)

Equation 4.1 is estimated by country * industry * firm size class groups (or cells) to allow for variation in the coefficients across each of these dimensions. To control for the endogeneity of output and lagged labour inputs, we apply a generalized method of moments estimator described in Arellano and Bond (1991). We use difference-GMM with the 3rd to the 5th lags of the labour input and output as instruments. These lags were chosen for computational feasibility, such that the lagged instrument levels have sufficient explanatory power while maintaining orthogonality. As the estimates are carried out cell-by-cell and including year fixed effects, cell-level time-varying factors are controlled for.

The estimated output elasticities are used as inputs for the variance decomposition and the analysis of institutions. In order to ensure that the estimated output elasticities are reasonable, we make use of the following rules. First, we disregard any output elasticities that do not satisfy the restriction \(0 < \hat{\beta} < 1\) as these are considered to be implausible. Second, we disregard any output elasticities if (i) the number of instruments \((j)\) is large relative to the sample size \((N)\) and (ii) Hansen’s test of over-

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8Namely, the fact that less efficient workers with lower wages are more likely to be dismissed during a downturn increases average wages.

9Annual data is likely to be “overaggregated” in time, meaning it does not match the timing of firm decisions. Consequently, annual employment data may signal smoother adjustment than quarterly or monthly data. Therefore, estimating a linear model using annual firm-level data is not inconsistent with underlying models that specify non-linear adjustment costs (Hamermesh, 1993). Indeed, the simulation results by Lafontaine and Sivadasan (2009) confirm that the relationship between the underlying friction and the estimated \(\beta\) and \(\gamma\) coefficients in a reduced form regression such as equation 4.1 is preserved under various types of adjustment costs.
identifying restrictions rejects the null of the orthogonality of the instrument matrix and estimated errors. An estimate is considered to be acceptable if (i) $j/N < 0.3$ and (ii) Hansen’s test does not reject at the 5% level.\footnote{The literature does not provide tests or even a rule of thumb to see whether the number of instruments is ‘too’ large relative to sample size. Increasing $j/N$ filters less $\beta_{cjs}$-observations and therefore leads to a larger sample size in the second stage (the institutional analysis) However, it also increases the probability that observations are noisier.}

### 4.2.2 Cross-country firm-level longitudinal data

We estimate output elasticities using previous vintages of the cross-country, firm-level longitudinal database (Orbis) that is used in Chapter 3.\footnote{The Statistics Department of the OECD has carried out extensive consistency checks and cleaning of the data (see Ragoussis and Gonnard, 2012, for details). This cleaning procedure was applied and extended to take account of specific issues in relation to the present analysis and are described in more detail below and in Appendix 4.A.1. In addition, we complemented the OECD-Orbis data set with previous vintages of Orbis and Amadeus (the “European edition” of Orbis) to increase the time-horizon of the data back in time.}

We make use of firms in the non-farm, non-financial business sector in 20 OECD countries for the period 1993 to 2009. Our “raw” sample for the analysis of employment adjustment was obtained after suppressing all observations with non-positive information on sales and employment. Similarly, our raw sample for the analysis of earnings per worker was obtained after suppressing all observations with non-positive information on sales, employment and earnings per workers. We further cleaned the two raw samples by applying a variety of cleaning rules (see Section 4.A.1 in the Appendix). Table A.2 of the Appendix provides information on the number of observations before and after applying these additional cleaning rules to the employment and earnings-per-worker samples. Of the 20 OECD countries, Austria and the United States had to be suppressed from the earnings-per-worker sample due the lack of comprehensive information on the wage bill. The final sample for employment and earnings-per-worker results in 7.1 million and 5.5 million firm-year observations, respectively. For more details, see Section 4.A.1 in the Appendix.

For the present purposes as well as the the variance decomposition in Section 4.3 within-country heterogeneity is captured by stratifying the data set along two dimensions: firm size and industry. Firm size is defined in terms of the average number of employees: less than 20 employees; between 20 and 250 employees; more than 250 employees. Industries are grouped into construction, manufacturing and business services. While the use of a limited number of groups may lead to ignore some differences in labour adjustment across firms, the use of a coarse cell structure makes it easier to highlight the main messages of the descriptive analysis and also allows enough observations within
each cell to estimate output elasticities using equation 4.1.\textsuperscript{12}

### 4.2.3 Output elasticities of employment and earnings per worker

Figure 4.2 describes the estimated responsiveness of labour input to output shocks.\textsuperscript{13} On average, across countries, the short-term elasticities of employment and earnings-per-worker are both between 0.1 and 0.15, with the sensitivity of employment to output shocks being slightly larger than that of earnings-per-worker. This suggests that, at least in terms of the cross-country averages, contemporaneous adjustments on the extensive (employment) and intensive margins (average hours worked and wages) to output shocks account both for a substantial part of total labour-cost adjustment. However, there appears to be considerable heterogeneity in the cross-country distribution of elasticities, with a strong negative correlation between the output elasticities of employment and earnings per worker (the pairwise correlation is -0.5 and statistically significant) This implies that firms that adjust more on the employment margin tend to adjust less on the earnings-per-worker margin. The elasticity of employment with respect to output is highest in countries such as Denmark and the United States, while it is lowest in Central and Eastern European Countries (CEECs) and Japan. The earnings-per-worker elasticity is highest in Hungary, Japan and Poland and lowest in Italy, Portugal and Spain. The former results echo earlier findings on the flexible US and Danish labour markets, while the latter findings are broadly in line with those of the Wage Dynamics Network of the European Central Bank, showing that real wages in the CEECs are generally more flexible than in more developed EU countries (Babeck et al., 2010; Rusinova et al., 2015).

The cross-country averages of elasticities for each industry show that the responsiveness of employment to output is highest in construction and lowest in manufacturing, while the responsiveness of earnings-per-worker is highest in manufacturing and lowest in construction. The differences in elasticities are quantitatively large, with the employment (earnings-per-worker) elasticity in construction being about twice as large (small) as that in manufacturing. These may reflect differences in production technologies, the skill composition of the workforce or the importance of non-standard contracts. The large differences across sectors in the responsiveness of labour inputs to output shocks imply that cross-country differences in industrial structure and the sectoral concentra-

\textsuperscript{12}The cell structure used in Section 4.4 is adjusted to match the sizeclass dimensions of EPL driven by firm size exemptions.

\textsuperscript{13}These elasticities are estimated separately for each firm size, industry and country. In Figure 4.2, unweighted averages are shown as we do not want the relative size of cells to affect the picture. Coefficients on the lagged dependent variable are also of interest but not discussed here as the main purpose is to explain the short-term impact of the crisis on labour markets.
tion of shocks can have important implications for the impact of the crisis on labour markets.

Differences in the responsiveness of labour inputs to output shocks across size groups are less pronounced than those across industries, but are of particular interest as they do not appear to conform well to the perceived wisdom at first sight. According to the figure, the responsiveness of both employment and earnings-per-worker to output shocks increases with firm size. This suggests that the sensitivity of the wage bill also increases with firm size. Traditionally, however, employment in small firms has been considered to be more sensitive to output shocks than employment in large firms, because the former were thought to find it more difficult to hoard labour during periods of weak product demand due to financial constraints (Sharpe, 1994). This argument implies that the sensitivity of both employment and earnings-per worker to output should decline with firm size. However, the traditional view that small firms hoard less during a downturn has recently been challenged by Moscarini and Postel-Vinay (2012) who suggest that large firms may have weaker incentives to retain workers during a downturn since they tend to be more productive and offer higher wages and, as a result, find it easier to recruit new workers during a recovery. This argument is, in principle, consistent with the positive relationship between the sensitivity of employment and firm size, but does not explain the positive relationship between earnings-per-worker and firm size.

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\[14\] Small firms tend to have shorter credit histories, to be subject to higher levels of idiosyncratic risk and are less likely to have adequate collateral (Gertler and Gilchrist, 1994).

\[15\] Descriptive statistics based on firm-level data for a large number of European countries in OECD (2010) are also at odds with the traditional view and consistent with the evidence in Moscarini and Postel-Vinay (2012).
Figure 4.2: The elasticity of employment and earnings per worker with respect to output

Estimated output elasticities across countries, industries and firm size groups

Notes: unweighted averages over cells by country (panel A) and over countries by cells (panel B). *, **, ***: statistically significant at the 10%, 5% and 1% level, respectively. n.a.: Not available.
4.3 The role of policies and institutions: A first pass

4.3.1 Decomposing cross-country heterogeneity in aggregate employment growth

What accounts for the increased dispersion in aggregate employment growth across countries during the global financial crisis, and what is the potential role of policies and institutions? We take a first pass at these questions by decomposing the cross-country variation in aggregate employment growth into the respective contributions of three sources of heterogeneity: cross-country differences in economic structure (“structure heterogeneity”); the distribution of output shocks across different types of firms (“shock heterogeneity”); and the responsiveness of labour inputs to output shocks (“response heterogeneity”).

We start by defining the predicted aggregate growth rate of log employment, $\Delta l_c$ in country $c$ as the weighted average predicted employment growth rates $\Delta l$ over industry and firm size cells $c$:

$$
\Delta l_c = \sum_{s=1}^{S} \sum_{j=1}^{J} w_{cjs} \left( \beta_{cjs} \Delta y_{cjs} \right) / \Delta l_{cjs}
$$

where $w_{cjs}$ denotes the employment share of size class $s$ and industry $j$ in country $c$ aggregate employment in the base period, $\beta_{cjs}$ the elasticity of employment with respect to output in size class $s$, industry $j$ and country $c$, $y_{cjs}$ log output and $\Delta$ the first difference operator. Note that elasticities are estimated, using equation 4.1, rather than directly observed, but for ease of exposition, we write $\beta$ instead of $\hat{\beta}$. Time indices are dropped for expositional convenience. Note that the elasticities, obtained by estimating equation 4.1 for each firm group, are assumed to be time-invariant.

To quantify the role of each source of heterogeneity, we decompose equation 4.2 into two components:

$$
\Delta l_c = \sum_{g=1}^{G} w_{cg} \left( \beta_{cg} - \bar{\beta}_g \right) \Delta y_{cg} + \sum_{g=1}^{G} w_{cg} \bar{\beta}_g \Delta y_{cg},
$$

where we introduce index $g$ for the group of firms defined by size class and industry (thus $G$ denotes thus the total number of size class and industry combinations) and cross-country average response heterogeneity in a firm group is given $\bar{\beta}_g = \frac{1}{C} \sum_{c=1}^{C} \beta_{cg}$. The first component $A_c$ captures the degree of heterogeneity in responses or elasticities
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The second component \( B_c \) of 4.3 shows the predicted aggregate employment change that would arise if there were no response heterogeneity, i.e. when output changes and employment shares evaluated at the average response \( \bar{\beta}_g \).

Coming back to the first term, \( A_c \), in equation 4.3, it is important to realize that it includes the combined effect of response heterogeneity measured by \( \beta_{cg} - \bar{\beta}_g \) and the joint distributions of \( w_{cg} \) and \( \Delta y_{cg} \). As such, if \( \beta - \bar{\beta}, w \) and \( \Delta y \) are correlated, then the contribution of heterogeneity, term \( A_c \), stems not only from heterogeneity in the \( \beta \)-s, but also from the combined variation in \( \beta - \bar{\beta}, w \) and \( \Delta y \). We will refer to this term in the results section (Section 4.3.3) as “the contribution of response heterogeneity with interaction effects”.

To fully isolate the role of response heterogeneity, we consider another measure as well, without interaction effects. We do so by decomposing \( A_c \) into a term where employment shares and output shocks are set to their respective cross-country averages in each group, and into other terms that capture the covariance structure of the variables:

\[
A_c = \sum_{g=1}^{G} w_{cg} \left( \beta_{cg} - \bar{\beta}_g \right) \Delta y_{cg} + \sum_{g=1}^{G} \bar{w}_g \left( \beta_{cg} - \bar{\beta}_g \right) \overline{\Delta y}_g + \sum_{g=1}^{G} \left( w_{cg} - \bar{w}_g \right) \left( \beta_{cg} - \bar{\beta}_g \right) \Delta y_{cg} + \sum_{g=1}^{G} \left( \bar{w}_g - \bar{\beta}_g \right) \left( \Delta y_{cg} - \overline{\Delta y}_g \right),
\]

where \( \overline{\Delta y}_g = \frac{1}{C} \sum_{c=1}^{C} \Delta y_{cg} \) and \( \bar{w}_g = \frac{1}{C} \sum_{c=1}^{C} w_{cg} \) are the cross-country means of output growth and employment share in cell or firm group \( g \). The first term on the right side of 4.4, \( A'_c \), captures that part of employment growth which is associated with heterogeneity in responses alone. We refer to this part as the “contribution without interaction effects”.

On the potential importance of the remaining terms \( A_c - A'_c \), i.e. the interaction effects, consider the following example. Suppose that countries with high (above-average) employment sensitivity \( \beta_{cg} \) in a given group of firms, say small construction firms, also tend to have a larger employment share \( w_{cg} \) and/or experience a larger output shock \( \Delta y_{cg} \) in that group. For instance, the large fall in aggregate employment in Spain may be a combination of a large output shock hitting small construction firms,

\[\text{\footnotesize{More precisely, it gives the weighted average deviation of elasticities from their group-specific cross-country averages.}}\]
4.3 The role of policies and institutions: A first pass

a large employment response to the shock and relatively high employment share of those firms. In this case, the contribution of response heterogeneity is likely to be relatively large, partly because of the role of interaction effects along these three dimensions. This is the motivation to consider the role of response heterogeneity without taking account of these interaction effects. This essentially boils down to a question such as, for instance, what Spain’s employment response would have been when employment weights and the output shocks are at the average level of other countries.

How to implement a variance decomposition in this setting? In order to calculate the contribution of each source of heterogeneity to the cross-country variation in employment growth, we make use of an implication of the definition of variance. Consider again equation 4.3. The cross-country variance of the left-hand-side of it can be written as:

\[
\text{var} \left( \Delta l_c \right) = \text{var}(A_c + B_c) = \text{var}(A_c) + \text{var}(B_c) + 2\text{cov}(A_c, B_c) \\
= \text{cov}(A_c, \Delta l_c) + \text{cov}(B_c, \Delta l_c).
\]

Equation 4.5 allows one to quantify how much of the cross-country variance of employment growth is explained by \( A_c \) and \( B_c \) separately. If \( \text{cov}(A_c, \Delta l_c) \) is large relative \( \text{var}(\Delta l_c) \), then most of the cross-country variation in employment growth is attributed to cross-country heterogeneity of responses and their interactions with structures and shocks. Thus we will focus on the ratios

**Role of response heterogeneity with interactions:**

\[
\frac{\text{cov}(A_c, \Delta l_c)}{\text{var}(\Delta l_c)}
\]

**Role of response heterogeneity without interactions:**

\[
\frac{\text{cov}(A'_c, \Delta l_c)}{\text{var}(\Delta l_c)}
\]

which represent the share of cross-country variation in employment growth due to response heterogeneity with and without interaction effects.

Analogously to the steps we described above for response heterogeneity, which uses deviations from the cross-country means in elasticities \( \beta_{cg} - \bar{\beta}_g \), we calculate the role of the two other sources of heterogeneity as well: output shocks and employment structure. They use deviations from cross-country means in output shocks and employment shares also with and without interaction effects.

---

17 Using the definition of the covariance, and if \( Z = X + Y \), we have that (i) \( \sigma_Z^2 = \sigma_X^2 + \sigma_Y^2 + 2\sigma_{XY} \) and (ii) \( \sigma_{ZX} = \sigma_X^2 + \sigma_{XY} \) and (iii) \( \sigma_{ZY} = \sigma_Y^2 + \sigma_{XY} \). Then (i)-(iii) imply \( \sigma_Z^2 = \sigma_{ZX} + \sigma_{ZY} \).
4.3.2 Additional data from administrative data sources

In order to implement the decomposition of the cross-country variation in aggregate employment growth, the estimated output elasticities in Section 4.2 need to be complemented with cell-level information on output shocks (shock heterogeneity) and employment shares (structure heterogeneity). To ensure that our decomposition is consistent with official aggregate information, we rely as much as possible on external data which are consistent with published national accounts and nationally representative labour force surveys.

The measures of structure heterogeneity are constructed by combining two data sources. First, information on the employment shares of manufacturing, construction and services by country and year are obtained from OECD STAN. Second, since OECD STAN does not provide any information by firm size, we multiply the employment shares by industry by time-invariant employment shares of firm-size groups within industries obtained from the Structural and Demographic Business Statistics (SDBS).\(^{18}\)

Cell-level output changes by industry and firm size are measured as follows. First, changes in real output by industry, country and year are obtained from OECD STAN. Second, cell-level output changes are calculated using the year-on-year evolution of real sales in Orbis. Third, the growth rates of size classes within an industry, calculated from Orbis, are rescaled such that the weighted-average growth rate of these size classes equals the industry-level growth rate observed in STAN.\(^{19}\)

The data on employment shares (structure heterogeneity) and output changes (shock heterogeneity) are summarised in Table 4.1.

---

\(^{18}\)While the SDBS, in principle, provides information on employment and the number of firms by country, year, industry and firm-size class, this information is typically missing from 2008 onward. We, therefore, use the average values of the employment shares in 2006-2007 and assume these are constant over time. Any missing information in STAN on cell-level employment was imputed using chained labour force surveys.

\(^{19}\)Cell-level output growth rates are rescaled as follows:

\[ \Delta y_{cjt} \doteq \Delta y_{cjt}^{ORBIS} \frac{\Delta y_{cjt}^{STAN}}{\Delta y_{cjt}^{ORBIS}}, \]

where \(\Delta y_{cjt}^{STAN}\) and \(\Delta y_{cjt}^{ORBIS}\) denote output growth rates in country \(c\), industry \(j\) and year \(t\) from STAN and Orbis, respectively. Cell-level output growth rates \(\Delta y_{cjt}^{ORBIS}\) are calculated as sales weighted average output growth rates across firms within a cell.
4.3 The role of policies and institutions: A first pass

Table 4.1: Cross-country differences in economic structure and the distribution of output shocks

Panel A: Economic structure ("structure heterogeneity")

<table>
<thead>
<tr>
<th>Firm size group</th>
<th>Belgium</th>
<th>Denmark</th>
<th>Estonia</th>
<th>Finland</th>
<th>France</th>
<th>Germany</th>
<th>Hungary</th>
<th>Italy</th>
<th>Japan</th>
<th>Korea</th>
<th>Netherlands</th>
<th>Norway</th>
<th>Poland</th>
<th>Portugal</th>
<th>Slovenia</th>
<th>Spain</th>
<th>Sweden</th>
<th>United Kingdom</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 20 employees</td>
<td>39.7</td>
<td>30.1</td>
<td>37.2</td>
<td>32.0</td>
<td>34.2</td>
<td>31.4</td>
<td>43.7</td>
<td>58.7</td>
<td>39.4</td>
<td>41.1</td>
<td>38.2</td>
<td>44.7</td>
<td>43.6</td>
<td>51.9</td>
<td>38.0</td>
<td>48.3</td>
<td>34.3</td>
<td>31.4</td>
<td>42.4</td>
</tr>
<tr>
<td>21-250 employees</td>
<td>27.5</td>
<td>35.8</td>
<td>42.7</td>
<td>28.3</td>
<td>27.9</td>
<td>30.7</td>
<td>27.9</td>
<td>22.7</td>
<td>29.9</td>
<td>28.8</td>
<td>29.8</td>
<td>27.9</td>
<td>27.4</td>
<td>29.8</td>
<td>30.5</td>
<td>28.4</td>
<td>31.0</td>
<td>24.4</td>
<td>25.8</td>
</tr>
<tr>
<td>251 employees and more</td>
<td>32.8</td>
<td>34.1</td>
<td>20.1</td>
<td>39.7</td>
<td>37.8</td>
<td>38.0</td>
<td>28.5</td>
<td>18.6</td>
<td>30.7</td>
<td>30.1</td>
<td>32.0</td>
<td>27.4</td>
<td>29.0</td>
<td>18.3</td>
<td>31.6</td>
<td>22.2</td>
<td>35.7</td>
<td>44.2</td>
<td>31.8</td>
</tr>
<tr>
<td>Industry</td>
<td>Construction</td>
<td>9.7</td>
<td>11.3</td>
<td>18.3</td>
<td>12.5</td>
<td>11.9</td>
<td>8.6</td>
<td>12.1</td>
<td>12.0</td>
<td>12.2</td>
<td>11.8</td>
<td>13.0</td>
<td>12.5</td>
<td>16.7</td>
<td>13.1</td>
<td>10.9</td>
<td>11.0</td>
<td>11.4</td>
<td>10.7</td>
</tr>
<tr>
<td></td>
<td>Manufacturing</td>
<td>22.1</td>
<td>23.0</td>
<td>31.1</td>
<td>29.1</td>
<td>21.3</td>
<td>29.0</td>
<td>35.6</td>
<td>31.0</td>
<td>25.3</td>
<td>26.4</td>
<td>20.0</td>
<td>36.1</td>
<td>28.0</td>
<td>36.6</td>
<td>22.6</td>
<td>27.9</td>
<td>15.9</td>
<td>16.8</td>
</tr>
<tr>
<td></td>
<td>Services</td>
<td>68.2</td>
<td>62.7</td>
<td>10.6</td>
<td>58.4</td>
<td>66.8</td>
<td>61.6</td>
<td>52.3</td>
<td>57.0</td>
<td>62.5</td>
<td>61.7</td>
<td>73.0</td>
<td>51.4</td>
<td>55.3</td>
<td>90.3</td>
<td>58.5</td>
<td>61.3</td>
<td>72.7</td>
<td>72.5</td>
</tr>
</tbody>
</table>

Note: In the non-farm, non-financial business sector.

Panel B: Output shocks ("shock heterogeneity")

<table>
<thead>
<tr>
<th>Firm size group</th>
<th>Belgium</th>
<th>Denmark</th>
<th>Estonia</th>
<th>Finland</th>
<th>France</th>
<th>Germany</th>
<th>Hungary</th>
<th>Italy</th>
<th>Japan</th>
<th>Korea</th>
<th>Netherlands</th>
<th>Norway</th>
<th>Poland</th>
<th>Portugal</th>
<th>Slovenia</th>
<th>Spain</th>
<th>Sweden</th>
<th>United Kingdom</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 20 employees</td>
<td>-3.6</td>
<td>-10.2</td>
<td>-21.2</td>
<td>-9.6</td>
<td>-4.1</td>
<td>-5.6</td>
<td>-7.9</td>
<td>-7.4</td>
<td>-10.9</td>
<td>-0.9</td>
<td>-5.6</td>
<td>-2.6</td>
<td>1.4</td>
<td>-4.4</td>
<td>-12.7</td>
<td>-4.6</td>
<td>-7.7</td>
<td>-6.5</td>
<td>-6.8</td>
</tr>
<tr>
<td>21-250 employees</td>
<td>-4.4</td>
<td>-11.0</td>
<td>-23.6</td>
<td>-11.6</td>
<td>-5.4</td>
<td>-8.3</td>
<td>-10.5</td>
<td>-11.0</td>
<td>-12.7</td>
<td>-1.3</td>
<td>-6.1</td>
<td>-3.1</td>
<td>0.5</td>
<td>-6.3</td>
<td>-15.2</td>
<td>-7.2</td>
<td>-9.9</td>
<td>-7.2</td>
<td>-7.1</td>
</tr>
<tr>
<td>251 employees and more</td>
<td>-4.4</td>
<td>-11.0</td>
<td>-23.6</td>
<td>-11.6</td>
<td>-5.4</td>
<td>-8.3</td>
<td>-10.5</td>
<td>-11.0</td>
<td>-12.7</td>
<td>-1.3</td>
<td>-6.1</td>
<td>-3.1</td>
<td>0.5</td>
<td>-6.3</td>
<td>-15.2</td>
<td>-7.2</td>
<td>-9.9</td>
<td>-7.2</td>
<td>-7.1</td>
</tr>
<tr>
<td>Industry</td>
<td>Construction</td>
<td>-3.6</td>
<td>-12.7</td>
<td>-35.4</td>
<td>-13.6</td>
<td>-5.9</td>
<td>0.9</td>
<td>-6.5</td>
<td>-7.0</td>
<td>-8.9</td>
<td>-4.3</td>
<td>-0.5</td>
<td>-10.6</td>
<td>-18.8</td>
<td>-6.4</td>
<td>-5.6</td>
<td>-11.3</td>
<td>-13.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manufacturing</td>
<td>-7.5</td>
<td>-15.4</td>
<td>-27.7</td>
<td>-18.8</td>
<td>-14.1</td>
<td>-18.9</td>
<td>-15.4</td>
<td>-17.2</td>
<td>-16.9</td>
<td>-9.2</td>
<td>-5.2</td>
<td>-9.1</td>
<td>-20.6</td>
<td>-14.4</td>
<td>-19.8</td>
<td>-11.3</td>
<td>-9.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Services</td>
<td>-3.1</td>
<td>-8.6</td>
<td>-15.1</td>
<td>-6.6</td>
<td>-1.7</td>
<td>-3.9</td>
<td>-6.4</td>
<td>-4.2</td>
<td>-8.9</td>
<td>-5.3</td>
<td>-2.7</td>
<td>2.4</td>
<td>-1.4</td>
<td>-8.8</td>
<td>-2.3</td>
<td>-5.9</td>
<td>-4.8</td>
<td>-5.3</td>
</tr>
</tbody>
</table>

Note: In the non-farm, non-financial business sector.

It is worth pointing out some interesting findings from there. First, Spain and Portugal had above average construction sectors, while, together with Italy, had also a lot of employment concentrated in small firms. Second, output declines tended to be largest in the manufacturing sector, except Spain, Portugal, the UK and the US where
it was concentrated in construction. Third, Estonia was especially hard hit in each of the sectors.

4.3.3 Variance decomposition of aggregate employment growth during the global financial crisis

In order to examine the role of structure, shock and response heterogeneity for aggregate employment growth during the global financial crisis, the cross-country variation in aggregate employment growth between 2008 and 2009 is decomposed into components that are assumed to capture different sources of heterogeneity. The contribution of each source of heterogeneity to the cross-country variance is calculated in two ways. First, for each source of heterogeneity, we switch off the two other sources of heterogeneity by setting their values to the cross-country average (equation 4.4) This is labelled “contribution without interaction effects” in Figure 4.3. Computing the explained variance in this manner gives a measure of the explanatory power of a single source. Second, for each source of heterogeneity, we leave the other two at the actual values (equation 4.3) Computing the explained variance in this manner gives a measure of explanatory power when each source of heterogeneity is evaluated at the actual distribution. If heterogeneity is correlated along these dimensions, computing contributions in this manner should increase the explained variance. This is labelled “contribution with interaction effects”.

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4.3 The role of policies and institutions: A first pass

**Figure 4.3:** Decomposing cross-country variation in labour market adjustment in the crisis

*Contributions to cross-country variance in employment growth rates, 2008-09*

![Graph showing contributions to cross-country variance](image)

Notes: Calculations based on Orbis, STAN, LFS and SDBS. Contributions with interaction effects comprise the variance coming from changing the specific factor only (e.g. response heterogeneity) plus its covariance with the other two factors (shock and structure heterogeneity). For details, see Section 4.3.1 and in particular equation 4.4, which separates the variance coming from the terms with and without interactions effects across the three factors.

The results from the decompositions are presented in Figure 4.3. Response heterogeneity explains 38% of the cross-country variation in employment growth when the other variables are kept at their cross-country mean. Considering the sample distributions of employment shares and output shocks, the contribution of response heterogeneity goes up slightly to 42% of the cross-country variation. Repeating the decomposition for shock heterogeneity suggests that this source explains 46% of the cross-country variation in employment growth. After accounting for the covariances between output shocks, on the one hand, and employment shares and output responses, on the other, shock heterogeneity explains about 59% of the cross-country variation in employment growth. The role of structure heterogeneity is negligible without accounting for interaction effects but increases to 14% after accounting for such effects.

The results provide two key insights. First, the relative importance of response heterogeneity suggests that differences in policies and institutions across countries account for a potentially large part of the cross-country variation in aggregate employment growth during the crisis. Second, using disaggregate information can indeed explain part of differences in aggregate labour market dynamics, as illustrated by the share of the cross-country variance that can be attributed to the role of interactions.
Chapter 4 The role of firm heterogeneity on the employment effects of the crisis

4.4 Analyzing the role of employment protection

One challenge when trying to identify the role of policies and institutions is that institutions are typically defined at the country-level and are correlated with each other across countries (Bassanini, 2010; Belot and van Ours, 2004). For instance, employment protection legislation tends to be stronger in countries where other employees have other means of protection as well, in the form of trade unions, more generous unemployment benefits, etc. This makes it difficult to isolate the role of a single institution using cross-country data unless all institutional effects are effectively accounted for in the regression analysis. One way to get around this problem is to focus on the available within-country variation of a given institution as this is less likely to be correlated across institutions. We consider two important labour market institutions that may have important implications for the adjustment behavior of firms, and which have data availabilities allowing us to utilize within-country as well as cross-country variation: employment protection provisions by exploiting firm-size exemptions and the role of temporary work by considering its incidence across firm types.

The institutional analysis uses the cell-by-cell estimates of the output elasticities $\hat{\beta}_{cg}$ of employment and earnings per workers based on equation 4.1 as the dependent, left-hand side variable. The impact of the institution of interest is identified by relating the within-country variation in output elasticities to the within-country variation, or more precisely, by comparing the variation in these two variables across firm types within countries and comparing them across countries. In this sense, our estimation can be considered a generalized difference-in-difference approach that controls for both country and cell-specific fixed effects.

Formally, the empirical model to identify the role of institutions can be represented

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20 In fact, if institution $X_1$ is correlated with institution $X_2$ in a country, and within-country variation is available, then the role of $X_2$ can be controlled for and therefore the least squares estimate of the effect of $X_1$ on the left-hand side variable can be identified. However, if $X_1$ is defined such that its variation is uncorrelated with $X_2$ by definition, there is no need to include $X_2$ in a regression measuring the effect of $X_1$. This is the case for the first institution: we make use of firm-size exemptions in the case of EPL. The role of temporary work is gauged using incidence measures across firm groups within countries.

21 Note that the cell structure is defined separately for each institutional variable in order to ensure that the within-country variation in the estimated output elasticities matches that of the institutional variable of interest. For instance, if an institution is available by a different size class or industry breakdown than our baseline classification, then we adjust the classification to match that of the institutions, and re-run the first stage regressions to obtain output elasticities $\hat{\beta}_{cg}$s.

22 The “first” difference is defined by within-country deviations in elasticities and institutional variables. The “second” difference is given by the difference in these differences across countries. Comparing the differences gives a measure of the effect of institutions. Our approach may be considered a generalized DiD approach in the sense that we focus on continuous rather than binary variables (i.e. institutions like EPL are measured on a continuous scale).
4.4 Analyzing the role of employment protection

in generic form as follows:

\[
\hat{\beta}_{cg} = \alpha INST_{cg} + \mu_c + \eta_g + \varepsilon_{cg},
\]

where \(\hat{\beta}_{cg}\) denotes the first stage estimates of the employment and earnings-per-worker elasticities by firm group \(g\) and country \(c\), \(INST_{cg}\) is the institutional variable of interest, and \(\mu_c\) and \(\eta_g\) are group- and country specific fixed effects, respectively. Country-specific fixed effects are important as they control for omitted labour market institutions, while group-specific fixed effects control for systematic differences in production technologies and their potential implications for labour adjustment. The coefficient \(\alpha\) is our parameter of interest. It captures the effect of institutions on responsiveness under the identifying assumption that the variation in the elasticities after conditioning on cell and country fixed effects can be attributed to institutions.\(^{23}\)

4.4.1 Employment protection legislation (EPL)

The effect of EPL is identified using variation generated by exemptions from national regulations (Venn, 2009). Exemptions usually apply to small firms but the exemption threshold may differ across countries.\(^{24}\) Exemptions may be full or partial and relate to individual or collective dismissals, denoted by \(EPR_{cs}\) and \(EPC_{cs}\), respectively.\(^{25}\) In general, the effect of more stringent regulations is expected to reduce employment responsiveness by increasing the costs of adjustment. Consequently, one would also expect firm size exemptions, i.e. looser employment protection for small firms, to reduce the fixed cost of adjusting the number of employees. This leads to stronger adjustment, i.e. larger \(\beta\) elasticities, resulting in a negative coefficient \(\alpha < 0\) in equation.\(^{26}\) The identification assumption is that firms above and below the size-threshold differ only in terms of the applicable EPL-regime and are identical otherwise. If this assumption holds, any measured differences between the elasticities each side of the threshold can

\(^{23}\)To account for the fact that the dependent variable is generated by a “first stage” regression (equation 4.1) the second-stage regressions use robust standard errors. We also ran the second stage regressions with using the standard errors of the first stage as weights, which did not affect the results.

\(^{24}\)A number of previous country studies have exploited the firm-size exemptions to study the economic implications of employment protection provisions (see Venn, 2010, and references therein). However, to the best of our knowledge, ours is the first study which does this on a cross-country basis.

\(^{25}\)The stringency of EPL does not vary across industries, but only across countries and size classes. Therefore \(EPR\) and \(EPC\) are indexed only by country \(c\) and size class \(s\).

\(^{26}\)Theoretical models give some background to interpret results of the regressions below. For instance, Pissarides (2001) suggests that firing restrictions may be rationalized in the presence of market imperfections, which prevent workers from insuring against the risk of dismissal. On the other hand, EPL may hinder labour adjustment and therefore the efficient re-allocation of resources.
be attributed to EPL. To maintain the homogeneity of the sample along dimensions other than EPL, only those firms are taken into account whose employment level is either above or below the threshold throughout the entire sample period which is used for measuring output elasticities.

One potential concern with identifying the role of EPL from firm-size exemptions is that its estimated impact may be biased because it captures the independent or autonomous effect of firm size. For example, employment in small firms has traditionally been considered more sensitive to output shocks than employment in large firms due to the role of credit constraint, leading to a biased estimate of the impact of EPL on the responsiveness of employment to output shocks away from zero. However, more recent evidence by Moscarini and Postel-Vinay (2012) as well as the results in Section 4.1 of this chapter show that the employment elasticity, if anything, increases with firm size, suggesting that the bias may go in the other direction.

We control for the independent effect of firm size in two complementary ways. First, we include firm-size dummies which capture any common effects of firm size across countries. This is done either by assuming that the independent effect of firm size does not depend on the level of threshold or by allowing for heterogeneous firm-size effects for each threshold. In the first, more restrictive setting, it is sufficient to include a single dummy that equals one for observations above the threshold and is zero otherwise. This dummy is denoted by $v$ below. In the second setting, a separate firm-size dummy is included for each threshold. These are denoted by $v_s$.

The second way of controlling for independent firm size effects is by including “control” countries that do not provide firm size exemptions in their EPL. The inclusion of control countries is important as it may otherwise not be possible to disentangle independent firm-size effects that are common across countries from threshold effects (particularly when using the restricted model that assumes a common threshold effect across different thresholds).

Formally, the empirical model used to identify the impact of EPL on output elasticities is described as follows:

$$\hat{\beta}_{cjs} = \alpha_{EPR}\text{EPR}_cs + \alpha_{EPC}EPC_{cs} \eta_j + \mu + v_s + \varepsilon_{cjs},$$

(4.7)

where $\mu$ denotes a set of country dummies, $\eta_j$ a set of industry dummies, and $v_s$ a set of size dummies, which allow for threshold-specific size effects. In the restricted version of the model where there is assumed to be a common threshold effect, the size dummy $v_s$ is replaced by $v$ and the interpretation is effectively a uniform above vs. below threshold difference, irrespective of the exact value of the threshold (e.g. 10 or 15 employees, etc.) The coefficients $\alpha_{EPR}$ and $\alpha_{EPC}$ measure the average effect of EPL,
4.4 Analyzing the role of employment protection

conditional on size and country-fixed effects.27

A second potential concern is that firms may systematically sort around the EPL threshold, depending on their adjustment technologies. In particular, firms that have higher output elasticities of employment are more affected by the presence of EPL. The reason is that it increases the fixed costs of adjusting the number of employees, thus hurts more those types of firms who would have more flexible adjustment in the absence of EPL. This provides incentives for firms to choose a small size which will make them exempt from EPL. This type of selection is likely to raise the average output elasticity of employment below the threshold relative to those above the threshold, only by changing the pool of firms below the threshold. It may lead to a downward bias (away from zero) in the estimated impact of EPL on the employment elasticity.

In order to check whether the selection problem is serious in our case, we looked for signs of bumping or heaping in the firm size distribution. If this is important in practice, then observations should congregate below the thresholds, and/or we should observe spikes in the distribution of firm size. In contrast, the size distributions do not show unusual bunching at the thresholds (see Section 4.B in the Appendix). 28

4.4.1.1 The incidence of temporary work

The effect of temporary work on responsiveness can, in principle, be investigated by using another component of the EPL index which refers to provisions with respect to temporary contracts (Venn, 2009). However, because of particular concerns over the enforcement of these provisions, we prefer to focus on the incidence of temporary work instead (Bassanini et al., 2010). The main reason why enforcement issues are of particular concern in the context of temporary contracts is that incentives for enforcement are weak since workers and firms often share a mutual interest in non-enforcement. As

27While equation 4.7 provides the intuition, in practice, we also include the interaction of the size-class dummy with an indicator for being above or below the threshold. The reason for this is that in order to have a sufficient number of observations in each cell for the estimation of the elasticities, we use “overlapping cells”. This means that a firm can be in the “above” group for the sample around the threshold at 10 employees, but in the “below” group for the sample around the threshold at 20 employees. Then the size-class dummy selects which threshold we are focusing on, and the above dummy selects whether the firm is above or below the particular threshold. For the control countries, where no EPL exemptions exist, we define above and below samples for each possible threshold. For the treatment countries, where EPL exemptions exist, we only define above and below samples with respect to the actual threshold.

28Spain, Slovenia, Italy and Portugal, show no major discontinuities in their employment distribution around the thresholds. For a number of other countries, there are spikes in the distributions at every 5 or 10 employees, possibly linked to some rounding in reporting. We attempted to carry out formal tests for breaks in the distribution around the threshold (following McCrary, 2008), but the discrete nature of the employment distribution makes it difficult to obtain reliable results. The recent results by Hijzen et al. (2013) lend support to our case, however, as their tests fails to find a break at the threshold using a continuous (full time equivalent) measure of employment levels for Italy.
a result, it has sometimes been difficult to establish a negative relationship between the incidence of temporary work and the stringency of employment protection provisions with respect to temporary contracts. Bassanini et al. (2010) provide empirical evidence that shows that this is indeed related to the problem of enforcement. Hence, instead of using information based on the legislation, we focus on the actual use of temporary work, by measuring its incidence across countries and firm groups. Of course, it is not a policy variable but is closely influenced by the regulatory environment related to temporary contracts, among other factors. However, by including country fixed effects and relying on within-country variation at least eliminates the concern of other, omitted institutions driving the results. Also, the inclusion of sector and firm size fixed effects ensures that general differences in the prevalence of temporary work along these dimensions are controlled for.

The effect of temporary work on the responsiveness of employment and earnings per worker to output shocks is identified using the following model:

\[
\hat{\beta}_{cjs} = \alpha_{\text{temp}} TEMP_{cjs} + \mu_c + \eta_j + v_s + \varepsilon_{cjs}
\]  

(4.8)

where \(\hat{\beta}_{cjs}\), \(\mu_c\), \(\eta_j\) and \(v_s\) are as before. \(TEMP\) denotes the incidence of temporary work within a cell, measured on a scale of \([0,1]\), by the ratio of temporary workers to total workers in a cell.

### 4.4.2 Data on labour market institutions

The institutional analysis considers employment protection and the incidence of temporary work. Information on the stringency of employment-protection rules with respect to collective and individual dismissals are obtained from the OECD database on EPL described in Venn (2009). Table A.3 of the Appendix provides details on the stringency of employment protection provisions for countries that practice firm-size exemptions or are included in our estimation sample as control countries. Exemptions in relation to individual dismissals (EPR) are partial in all countries in the sample, indicating that workers of small firms are subject to more flexible rules than larger firms. This generally reflects shorter or no notice periods, different procedural requirements or lower levels of severance pay. The other sub-component of EPL which we include in the analysis refers to collective dismissals rules (EPC). In countries where small firms are exempt from collective dismissal rules, the value of EPC is 0.\(^\text{29}\)

Data on the incidence of temporary work by industry and firm-size cell are obtained.

\(^\text{29}\)This reflects the fact that a firm needs to have a certain critical mass to engage in collective dismissals.
from the European Labour Force Survey.

### 4.4.3 Results of the institutional analysis

This section presents evidence on the effect of labour market regulations on the responsiveness to shocks. As a first plausibility check on our estimated elasticities and their relationship with labour market institutions, we present the relationship between employment protection and labour market flexibility using only cross-country variation. Then we move on to present our main results which use micro-level elasticities and within-country variation in employment protection, followed by suggestive evidence on the role of temporary work.

#### 4.4.3.1 The role of employment protection using cross-country variation

Figure 4.4 shows a scatter plot of the regular component of the EPL index ($EPLR$) and the estimated employment elasticities of output shocks (the median $\beta$ -s across firm groups, for each country) The relationship is negative (and significant at 5%) as

**Figure 4.4: Cross-country relationship between employment protection and employment adjustment**

Note: Employment responsiveness to shocks are measured as the median values of the firm-level GMM estimates of elasticities $\beta$ across firm groups (cells) based on equation 4.1. See more on firm-level estimation in Section 4.2.1. Employment protection of permanent workers is the median value of the first subindex of the EPL measure (Venn, 2009) over the years 1998-2009.

Source: Venn, 2009 and calculations based on Orbis.
expected: more stringent employment protection, by increasing the costs of adjustment, generally leads to smaller adjustment to output shocks. Although this finding is in line with economic intuition and earlier evidence (Bassanini and Duval, 2009; OECD, 2012) it meant to be only an illustrative exercise, since no additional controls are included. As we argued in the introduction, the most important controls would be further institutional and policy variables, which can affect both labour market flexibility and usually tend to be related to the stringency of employment protection. To focus only on employment protection and filter out the impact of other policies and institutions, the next subsection exploits within-country variation of the EPL index.

4.4.3.2 The role of employment protection using within-country variation

This part of the analysis of employment protection exploits the within-country variation that results from firm-size exemptions. In order to ensure that the results only relate to exemptions with respect to employment-protection provisions and not the independent effect of firm size the analysis control for common firm-size effects across countries and, in addition, includes countries without firm-size exemptions as controls (see Section 4.4 for details) The results for employment are reported in Table 4.2.

Table 4.2: The effect of EPL of responsiveness on the responsiveness of employment and earnings per worker

<table>
<thead>
<tr>
<th></th>
<th>A. Employment</th>
<th>B. Earnings per worker</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Dismissal for regular workers</td>
<td>-0.031</td>
<td>-0.045 ***</td>
</tr>
<tr>
<td></td>
<td>(-1.55)</td>
<td>(-2.47)</td>
</tr>
<tr>
<td>Collective dismissals</td>
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<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(-1.26)</td>
<td>(0.74)</td>
</tr>
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<td>Size effect</td>
<td>-0.030 ***</td>
<td>n.a.*</td>
</tr>
<tr>
<td></td>
<td>(-3.71)</td>
<td>(4.99)</td>
</tr>
<tr>
<td>Flexible size effect</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of observations</td>
<td>346</td>
<td>346</td>
</tr>
</tbody>
</table>

Notes: Column 1 shows results with constant size effects (equation 4.7 with a uniform for above-below effects, in Section 4.4) Column 2 shows results for flexible size effects (equation 4.7 with a firm-size dependent \( \alpha_s \)) All specifications include a full set of country and industry fixed effects. *, **, ***: statistically significant at the 10%, 5% and 1% level, respectively. t statistics in parentheses *There is no uniform size effect to reported in columns A (2) and B (2) as the impact is allowed to flexibly vary with the thresholds. For details, see Section 4.4.

The results suggest a negative relationship between the stringency of individual dismissal regulations for regular workers and the responsiveness of employment to output shocks. As shown by the first row of Panel A, a unit-increase in the index of EPL is associated with 3-5 percentage point decrease in the employment elasticity, similar
4.4 Analyzing the role of employment protection

to the magnitude obtained using cross-country variation (Figure 4.4) On the other hand, the stringency of collective dismissals does not seem to be significantly related to employment elasticities in our sample. There is evidence of independent size effects around the threshold: the coefficient of $v$ is statistically significant at 5% when we assume a uniform above-below effect (columns 1 and 3) as well as when we allow it to vary with the thresholds (not shown in table).

The responsiveness of earnings per worker to output shocks appears to be positively associated with the stringency of individual-dismissal provisions (4.2, Panel B) The relationship seems to be robust across specifications and even stronger than for employment adjustment. Again, there is evidence of positive size effects around the threshold: the coefficient of $v$ is positive and statistically significant.

The results of specification (4.7) are visualized in Figure 4.5. They indicate that provisions with respect to both individual and collective dismissals have a tendency to reduce the output elasticity of employment, while provisions with respect to individual dismissals appear to increase the sensitivity of earnings per worker to output shocks. Moreover, the effects of individual dismissal provisions appear to be large. A one standard-deviation increase in the stringency of individual dismissal provisions, which corresponds to an increase in the level from Denmark to Belgium, would result in a 4 percentage-point reduction in the responsiveness of employment to output shocks and a 10 percentage-point increase in the responsiveness of earnings-per-worker to output shocks. These results suggest that more stringent employment-protection provisions for regular employees induce firms to adjust less on the extensive and more on the intensive margin.

4.4.3.3 The role of the incidence of temporary work

Employment protection rules are also likely to have an important impact on the use of temporary contracts (Blanchard and Landier, 2002; Boeri, 2011). Employment protection provisions with respect to regular contracts increase incentives to make use of temporary contracts, while employment protection provisions with respect to temporary contracts regulate their use. In order to capture the impact of employment protection on the adjustment behaviour of firms that comes about through its impact on the incidence of temporary work, Figure 4.6 analyses the role of the incidence of temporary work for the adjustment behaviour of firms. It confirms expectations that the employment sensitivity of temporary workers with respect to output shocks is substantially higher than that of regular workers. There is some indication that the increased sensitivity of employment reduces the sensitivity of earnings per worker in response to shocks. However, the difference in the sensitivity of earnings per worker to
Chapter 4  The role of firm heterogeneity on the employment effects of the crisis

**Figure 4.5:** The effect of employment protection on output elasticities

*Output elasticities of employment and earnings per worker, with EPR and EPC at average values and with high values*

- Stringency of dismissal rules at sample average (individual and collective)
- One standard-deviation increase in stringency of individual-dismissal rules from sample average (EPR)
- One standard-deviation increase in stringency of collective-dismissal rules from sample average (EPC)

Notes: **, ***: statistically significant at the 5% and 1% level, respectively. For details, see Section 4.4.

shocks between permanent and temporary workers is not statistically significant.
4.5 Aggregate implications

**Figure 4.6:** The effect of the incidence of temporary work on output elasticities

*Output elasticities of employment and earnings per worker, with temporary work incidence at average values and with high values*

![Graph showing the effect of temporary work incidence on output elasticities.]

Notes: Calculations based on Orbis. For details, see Section 4.4. **, ***: statistically significant at the 5% and 1% level, respectively. Output elasticities for permanent and temporary workers denote the average of predicted values of regression 4.8 when setting the incidence of temporary work to one and to zero.

4.5 Aggregate implications

What does the evidence above suggest about the importance of a specific policy or institution in explaining the cross-country variation of employment growth during the crisis? In order to answer this question, we check how much the dispersion of cross-country employment growth is affected by setting the employment protection index referring to individual dismissals of regular workers (EPR) to the cross-country average. More specifically, we calculate the dispersion of the implied country-level employment growth rates between 2008 and 2009 across countries:

\[
\sigma(\Delta l_t) = \sqrt{\frac{1}{N_c - 1} \sum_{c=1}^{C} (\Delta l_{ct} - \overline{\Delta l_t})^2},
\]

where \( N_c \) is the number of countries and \( \overline{\Delta l_t} \) is the average of the predicted aggregate employment change across countries. The implied country-level employment changes are calculated according to the formula in equation 4.2 in the Section 4.3.1, which uses estimated cell-level employment elasticities \( \hat{\beta}_{cg} \), actual output changes \( \Delta y_{cg} \) and actual...
employment shares $w_{cg}$ in country $c$ and firm group $g$. We repeat that formula here, with time subscripts omitted, and emphasize that estimated $\beta$-s are now treated as a function of the components of EPL, as obtained in the 2nd stage regressions (equation 4.7):

$$ \Delta l_c = \sum_{g=1}^{G} w_{cg} (\beta_{cg} \Delta y_{cg}) $$

(4.9)

The standard deviation of the predicted employment changes across countries $\sigma(\Delta l)$ is 0.9% in 2009. Using the estimated coefficient of $EPR$ on the output elasticity of employment from Panel B of Table 4.2 (-0.47) we calculate the predicted elasticities after setting EPR to its cross-country mean:

$$ \tilde{\beta}_{cg} = \tilde{\beta} - 0.47 \times (EPR_{cg} - \bar{EPR}_{cg}) $$

and use these elasticities in equation 4.9:

$$ \Delta l_c = \sum_{g=1}^{G} w_{cg} (\tilde{\beta}_{cg} \Delta y_{cg}) $$

(4.10)

The resulting cross-country standard deviation is 0.8%, only slightly smaller than the standard deviation based on actual levels in EPR.

Thus, this simple back-of-the-envelope calculation indicates that differences in the regular worker component of EPL alone are unlikely to be a major cause for the dispersion in aggregate employment dynamics during the initial phase of the global financial crisis. In future work, further institutions like tax systems the nature of collective bargaining, could be looked at in order to explain a larger part in the variation of labour adjustment across countries.\(^{30}\)

### 4.6 Concluding remarks

This chapter investigates the role of policies and institutions for aggregate labour market dynamics during the global financial crisis using firm-level data. It makes the case that using micro-level information can be important for understanding macro-economic outcomes in the context of firm heterogeneity and provides new evidence on the role of labour market institutions for the adjustment behaviour of firms.

\(^{30}\)Alternatively, our assumption that output elasticities are constant over time may not be valid during the crises. Perhaps the perceived persistence of the shocks, or other types of shocks (e.g. financial) and changing labour market policies (regulation of short-term work) can also play a role.
4.6 Concluding remarks

The use of firm-level data is important if firms are heterogeneous in their labour input adjustment technologies. In this case, cross-country differences in aggregate labour market dynamics may not just stem from cross-country differences in average labour input technologies - here assumed to be largely due to differences in institutional settings -, but also from differences in the distribution of shocks across firms within countries and the composition of firms across countries. Descriptive evidence based on a variance decomposition suggests that this may indeed be important in practice. Thus, using disaggregate information not only enhances one’s ability when adjustment technologies are non-linear as emphasized in previous related work, but also when firms are heterogeneous in terms of their adjustment technologies.

Firm-level data may also help to shed more light on the role of labour market institutions for the way firms adjust in response to shocks. In contrast to much of the previous literature on the role of labour market institutions the present study does this by exploiting the within-country variation in institutions rather than the cross-country variation. The main advantage of doing so is that the within-country variation allows us to better estimate the effect of a single institutional variable. Moreover, using disaggregate data also allows controlling for different sources of heterogeneity. Estimates from aggregate studies may be misleading to the extent that cross-country differences in labour market adjustment results, in part, from differences in composition of firms or the distribution of business conditions across firms.

This analysis shows that labour market institutions account employment protection provisions for regular workers have a tendency to shift the burden of adjustment from the extensive margin (employment) to the intensive margin (working time and wages) while the incidence of temporary tends to have the opposite effects. However, back-of-the-envelope calculations on the effects of EPL for regular workers suggest that they are unlikely to account for a substantial part of the cross-country variation in aggregate employment dynamics during the initial phase of the global financial crisis. Hence, exploring the role of other labour market institutions as well is an important area of future research.
Appendix 4.A  Data description

4.A.1  Sources and construction of international firm-level data

The source of the company-level data set used in the analysis is the Orbis data set, collected by the Bureau van Dijk (BvD). The database is a collection of accounts, mostly at annual frequency, derived from companies’ balance sheets and income statements. As such, it is a longitudinal database providing rich variation across countries, industries and firm size, and with a time span of seventeen years (1993-2009). The version we can access contains data from 43 countries (primarily OECD member countries and those who participate in the Enhanced Engagement of the OECD) though not all of them can be used in the analysis. Eventually 21 countries were included in the sample, for which there is a large enough number of firms and the appropriate set of variables for our purposes. See Table A.2 in the Section 4.2.2 of the main text for the set of countries we use and the number of observations and firms for each.

---

31 The Orbis data set, which contains countries outside as well as within Europe, is augmented with the Amadeus data set (also collected by the BvD). This was needed primarily to include more firm-year observations in the 1990’s, as the vintage of the Orbis data set available at the OECD starts reporting firms mostly only around 1999.

32 The Statistics Department (STD) and at the Directorate of Employment, Labour and Social Affairs (ELS) of the OECD have carried out extensive consistency checks and cleaning of the data. Among others, the role of consolidated accounts, differing accounting years have been addressed. See more details on this by the OECD STD (Ragoussis and Gonnard, 2011)
4.A Data description

Table A.1: Criteria for filtering observations

<table>
<thead>
<tr>
<th></th>
<th>Definition</th>
<th>Log changes, controlling for absolute changes as well (in absolute value)</th>
<th>Gross growth rates&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Reversals (in gross growth rates)&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Log changes at the edges of a firm-spell&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Log changes</th>
<th>Difference from lagged log changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Readily available variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>-</td>
<td>0.5 log points, more than 1 000 employees</td>
<td>5</td>
<td>1.5</td>
<td>0.5</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Sales</td>
<td>-</td>
<td></td>
<td>6</td>
<td>6</td>
<td>0.7</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Value added</td>
<td>-</td>
<td></td>
<td>7</td>
<td>4</td>
<td>0.7</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Labor costs</td>
<td>-</td>
<td></td>
<td>6</td>
<td>2</td>
<td>0.6</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>Fixed tangible capital</td>
<td>-</td>
<td></td>
<td>8</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>B Constructed variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earnings per worker</td>
<td>Labour costs / Employment</td>
<td>-</td>
<td>0.8</td>
<td>0.5</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Labour productivity (using sales)</td>
<td>Sales / Employment</td>
<td>-</td>
<td>2</td>
<td>0.7</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Labour productivity (using value added)</td>
<td>Value added / Employment</td>
<td>-</td>
<td>3</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Capital-labour ratio</td>
<td>Fixed tangible capital / Employment</td>
<td>-</td>
<td>2.5</td>
<td>0.5</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Note: observations are dropped from the database if any of the criteria (columns) for any variable (rows) is not fulfilled. For example, the first entry in column four corresponds to the following rule: an observation is dropped if the yearly growth rate in employment grows by a factor of 5 or drops by 80%. This rule is equivalent to keeping all observations which satisfy the following rule: $1.2 < E_t / E_{t-1} < 5$. The relative magnitude of the intervals across variables are based on an assessment of the relative standard deviation of the variables.

a) Dropping observations with large absolute changes. An observation is dropped if the absolute value of log changes $|\log(X_t / X_{t-1})|$ is larger than values in the respective cells of the table, and also the absolute value of changes in levels are larger than the value in the cell.

b) Dropping observations with large growth rates. An observation is dropped if $X_t / X_{t-1}$ is larger than the cell value or smaller than the inverse of the cell value.

c) Dropping observations with volatile growth rates (reversals) An observation is dropped if $X_t / X_{t-1}$ is above the cell value in time $t$ and is below the inverse of the cell value in time $t + 1$.

d) Dropping observations with volatile growth rates (lagged growth) An observation is dropped if the absolute value of log changes is larger than the elements in the first sub-column and the difference with the lagged change is larger than the elements in the second sub-column.
**Table A.2:** The number of observations in the raw and estimation samples by country

<table>
<thead>
<tr>
<th>Country</th>
<th>Raw data, with nonmissing employment and sales</th>
<th>Raw data, with nonmissing earnings per worker and sales</th>
<th>Estimation sample (employment equation)</th>
<th>Estimation sample (earnings per worker eq.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria*</td>
<td>95,766</td>
<td>15,821</td>
<td>8,643</td>
<td>0</td>
</tr>
<tr>
<td>Belgium</td>
<td>334,093</td>
<td>199,297</td>
<td>333,696</td>
<td>186,808</td>
</tr>
<tr>
<td>Denmark</td>
<td>47,267</td>
<td>27,770</td>
<td>45,204</td>
<td>24,034</td>
</tr>
<tr>
<td>Estonia</td>
<td>193,835</td>
<td>76,488</td>
<td>156,854</td>
<td>53,740</td>
</tr>
<tr>
<td>Finland</td>
<td>348,238</td>
<td>160,314</td>
<td>333,007</td>
<td>148,181</td>
</tr>
<tr>
<td>France</td>
<td>3,731,112</td>
<td>1,315,958</td>
<td>2,875,705</td>
<td>1,213,286</td>
</tr>
<tr>
<td>Germany</td>
<td>751,920</td>
<td>301,071</td>
<td>88,062</td>
<td>24,654</td>
</tr>
<tr>
<td>Hungary</td>
<td>167,826</td>
<td>3,342</td>
<td>160,103</td>
<td>2,923</td>
</tr>
<tr>
<td>Italy</td>
<td>1,799,317</td>
<td>882,582</td>
<td>1,728,013</td>
<td>821,097</td>
</tr>
<tr>
<td>Japan</td>
<td>1,316,334</td>
<td>793,330</td>
<td>680,111</td>
<td>282,031</td>
</tr>
<tr>
<td>Korea</td>
<td>559,768</td>
<td>232,362</td>
<td>526,431</td>
<td>191,181</td>
</tr>
<tr>
<td>Netherlands</td>
<td>43,989</td>
<td>16,253</td>
<td>29,257</td>
<td>7,759</td>
</tr>
<tr>
<td>Norway</td>
<td>412,995</td>
<td>248,630</td>
<td>400,343</td>
<td>95,742</td>
</tr>
<tr>
<td>Poland</td>
<td>203,788</td>
<td>113,938</td>
<td>148,205</td>
<td>71,593</td>
</tr>
<tr>
<td>Portugal</td>
<td>781,587</td>
<td>11,452</td>
<td>761,775</td>
<td>10,433</td>
</tr>
<tr>
<td>Slovenia</td>
<td>65,323</td>
<td>33,597</td>
<td>64,985</td>
<td>31,473</td>
</tr>
<tr>
<td>Spain</td>
<td>3,826,199</td>
<td>1,874,398</td>
<td>3,804,147</td>
<td>1,690,616</td>
</tr>
<tr>
<td>Sweden</td>
<td>1,077,407</td>
<td>455,476</td>
<td>927,112</td>
<td>360,381</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>415,647</td>
<td>342,794</td>
<td>387,501</td>
<td>288,927</td>
</tr>
<tr>
<td>United States*</td>
<td>10,975,640</td>
<td>58,516</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Overall sum</td>
<td>27,148,051</td>
<td>7,163,389</td>
<td>13,459,064</td>
<td>5,504,859</td>
</tr>
<tr>
<td>Overall mean</td>
<td>1,357,403</td>
<td>358,169</td>
<td>708,372</td>
<td>289,729</td>
</tr>
</tbody>
</table>

Notes: non-farm, non-financial business sector, 1993-2009. The raw sample for the employment (earnings per worker) analysis corresponds to observations with strictly positive values for sales, employment (and earnings per worker). The raw data is different from the estimation sample due to restrictions on minimum firm size (at least 3 employees) basic cleaning and outlier-filtering, and most importantly, concentrating on firms with at least five valid observations. Smallest and largest cells refer to the cells with the least and largest number of observations, considering nine cells based on three broad sectors (manufacturing, construction and business services) and three firm size classes (less than 20 employees, between 20 and 250 employees, more than 250 employees). Countries marked with * are excluded from the earnings per worker sample because of the low number of observations. For more details, see Section 4.A.1 in the Appendix and Section 4.2.2.

Our main variable of interest is employment (EMPLOYEES in Orbis) sales or turnover (OPERATING_REV_TURNOVER) as a proxy for output and labour costs (COSTS_EMPLOYEES). Earnings per worker is defined as labour costs divided by
employment.

All firms in our analysis have at least three consecutive years of non-missing and positive data without implausibly large longitudinal changes. Specifically, as they are likely to be data errors, we filter out observations in any of the conditions are met in Table A.1. The main filtering rules were: i) to exclude observations with less than three employees; ii) to exclude firms with less than three consecutive observations and less than five observations in total (not necessarily consecutive); iii) to exclude observations with implausibly large changes in employment, sales or earnings per worker and iv) to exclude outliers based on sales per worker (i.e. labour productivity).

We also apply outlier filtering based on the distribution of sales over employment and earnings per worker: we apply the Chebyshev method and filter out observations in each country, industry and size class cell which our outside the interval defined as \([p_{25}-1.5 \times iqr, p_{75}+1.5 \times iqr]\), where \(p_{25}\) and \(p_{75}\) denotes the 25th and 75th percentiles, and \(iqr\) is the interquartile range: \(iqr = p_{75} - p_{25}\).

After dropping observations which do not pass these filters, we require that each firm has at least five observations in order to ensure that the GMM type estimation can utilize enough number of lagged values. The affected number of observation per each country for each of these criteria is available on request.

### 4.A.2 Employment protection index with firm size exemptions

Table A.3 presents the degree of employment protection, pertaining to regular, permanent workers (EPL R) and collective dismissals (EPL C) for firms below and above the size thresholds, for countries where such size exemptions of applying employment protection are present. The data is taken from Venn (2009)
Table A.3: Employment protection and firm-size exemptions

Stringency of employment-protection provisions for regular workers and collective dismissals

<table>
<thead>
<tr>
<th>Firm size groups</th>
<th>EPLR</th>
<th>EPLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 5 employees</td>
<td>1.35</td>
<td>0.00</td>
</tr>
<tr>
<td>5-19 employees</td>
<td>2.19</td>
<td>0.00</td>
</tr>
<tr>
<td>20 employees and more</td>
<td>2.19</td>
<td>3.25</td>
</tr>
<tr>
<td>Belgium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 20 employees</td>
<td>3.10</td>
<td>0.00</td>
</tr>
<tr>
<td>20 employees and more</td>
<td>4.14</td>
<td>4.13</td>
</tr>
<tr>
<td>Denmark</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 20 employees</td>
<td>2.80</td>
<td>0.00</td>
</tr>
<tr>
<td>20 employees and more</td>
<td>3.85</td>
<td>3.13</td>
</tr>
<tr>
<td>Finland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 20 employees</td>
<td>3.02</td>
<td>0.00</td>
</tr>
<tr>
<td>20 employees and more</td>
<td>4.49</td>
<td>2.38</td>
</tr>
<tr>
<td>France</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>2.60</td>
<td>2.13</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 10 employees</td>
<td>0.43</td>
<td>0.00</td>
</tr>
<tr>
<td>10-19 employees</td>
<td>2.85</td>
<td>0.00</td>
</tr>
<tr>
<td>20 employees and more</td>
<td>2.85</td>
<td>3.75</td>
</tr>
<tr>
<td>Hungary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 20 employees</td>
<td>2.94</td>
<td>0.00</td>
</tr>
<tr>
<td>20 employees and more</td>
<td>4.09</td>
<td>2.88</td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 15 employees</td>
<td>1.36</td>
<td>4.88</td>
</tr>
<tr>
<td>15 employees and more</td>
<td>1.76</td>
<td>4.88</td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>2.05</td>
<td>1.50</td>
</tr>
<tr>
<td>Korea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>2.29</td>
<td>1.88</td>
</tr>
<tr>
<td>Norway</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>2.20</td>
<td>2.88</td>
</tr>
<tr>
<td>Poland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>2.01</td>
<td>3.63</td>
</tr>
<tr>
<td>Portugal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 10 employees</td>
<td>3.18</td>
<td>1.88</td>
</tr>
<tr>
<td>10 employees and more</td>
<td>3.51</td>
<td>1.88</td>
</tr>
<tr>
<td>Slovenia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 10 employees</td>
<td>2.72</td>
<td>2.88</td>
</tr>
<tr>
<td>10 employees and more</td>
<td>2.98</td>
<td>2.88</td>
</tr>
<tr>
<td>Spain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 25 employees</td>
<td>2.26</td>
<td>2.13</td>
</tr>
<tr>
<td>25-49 employees</td>
<td>2.46</td>
<td>2.13</td>
</tr>
<tr>
<td>50 employees and more</td>
<td>2.38</td>
<td>3.38</td>
</tr>
<tr>
<td>United Kingdom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>1.17</td>
<td>2.88</td>
</tr>
<tr>
<td>United States</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 100 employees</td>
<td>0.56</td>
<td>0.00</td>
</tr>
<tr>
<td>100 employees and more</td>
<td>0.56</td>
<td>2.88</td>
</tr>
</tbody>
</table>

Notes: EPL R denotes the stringency of firing regular workers, and EPL C measures the stringency of collective dismissals regulations in 2008. - : Not applicable. Source: Venn (2009)

Appendix 4.B Firm size distributions by employment thresholds for firm-size exemptions

Below we show the employment distribution of firms for those countries where employment protection legislation exempts small firms from the most stringent regulations. The threshold below firms are considered exempt vary by country, but 4 groups can be identified, with thresholds at employment levels of 10, 15, 20 and 25. The US, with the threshold at 100 employees, is omitted because the stringency of the more important, regular worker component (EPR) of the EPL index is the same below and
above the threshold, and the employment histogram is very irregular around such high employment levels due to low density of firms at such, relatively high employment level.

**Figure B.1:** Firm size distributions by employment thresholds for firm-size exemptions

- **(a) Slovenia** (employment threshold: 10)
- **(b) Italy, Portugal** (employment threshold: 15)
- **(c) Austria, Belgium, Denmark, Finland, Germany, Hungary** (employment threshold: 20)
- **(d) Spain** (employment threshold: 25)

Notes: horizontal axis denotes employment (E) the columns indicate the densities of the firms size (measured by employment) distribution by country-groups, grouped by the employment protection thresholds below which exemptions apply. Vertical lines indicate the country-group specific threshold levels (10, 15, 20 and 25)