Preliminary and incomplete!

THE ROLE OF INSTITUTIONS AND FIRM HETEROGENEITY FOR LABOR MARKET RESILIENCE: CROSS-COUNTRY FIRM-LEVEL EVIDENCE

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Abstract

This paper investigates the role of policies and institutions for aggregate labour market dynamics during the crisis using disaggregate information. The use of disaggregate information is important for two reasons. First, when firms differ in terms of their adjustment technologies, cross-country differences in labour market adjustment may not just stem from differences in institutional settings, but also from differences in the distribution of shocks across firms and the composition of firms across countries. Second, firm-level information may be useful as it is often difficult to isolate the role of a specific policy or institution using the cross-country variation due to the correlation of policies and institutions across settings. Our contribution to the literature is twofold. First, the elasticity of employment to output shocks is estimated using a multi-country firm-level panel. Next, the paper attempts to quantify the role labor market institutions play explaining the heterogeneity in elasticities. We find that (i) provisions with respect to both individual and collective dismissals have a tendency to reduce the output elasticity of employment, while (ii) provisions with respect to individual dismissals appear to increase the sensitivity of earnings-per-worker to output shocks; (iii) the use temporary contracts tend to increase the sensitivity of employment to output shocks; (iv) that more pervasive collective bargaining mitigates the effect of output shocks on employment.

1. Introduction

1. All OECD countries have been severely hit by the global crisis starting in 2008. But the extent to which the decline in aggregate demand translated into lower employment has differed dramatically across countries. 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), much of the decline in employment has been avoided, despite large output shocks in at least some sectors (typically manufacturing and construction). The large variation in the unemployment impact of the crisis across countries raises important questions about the role of policies and institutions. A number of recent studies have sought to analyse the role of policies and institutions for shaping the impact of the economic downturns on labour markets using aggregate data (*e.g.* Bassanini and Duval, 2006; Bassanini, 2011; De Serres and Murtin; 2011 and OECD, 2012) While these studies have provided useful insights about the potential role of structural reforms for the way labour markets adjust in response to shocks, aggregate studies of this kind are likely to leave a considerable part of the cross-country variation unexplained.

2. This paper analyses the role of policies and institutions for aggregate labour market dynamics during the crisis using disaggregate information. The use of disaggregate information is important for two reasons. First, when firms differ in terms of their adjustment technologies, cross-country differences in labour market adjustment may not just stem from differences in institutional settings, but also from differences in the distribution of shocks across firms and the composition of firms across countries. For example, in Germany and Japan, the bulk of the decline in output demand during the crisis was concentrated in manufacturing, whereas the construction sector was hit particularly hard in countries such as the Ireland, Spain and the US. Since firm-specific human capital tends to be less important in construction than in manufacturing, construction firms tend to adjust their labour inputs more quickly in response to falling output demand. As a result, cross-country differences in the distribution of demand shocks may account for some of the observed differences in aggregate labour-market adjustment patterns across counties.[1] Second, the use of disaggregate information may help one to identify the role of policies and institutions for labour market adjustment. Using disaggregate information allows one to identify the role of policies and institutions using the within-country variation rather than the between-country variation in the data. This is useful as it often difficult to isolate the role of a specific policy or institution using the cross-country variation due to the correlation of policies and institutions across settings.

3. The present paper makes three contributions to the literature. First, using comprehensive and comparable firm-level data for 20 OECD countries for the period 1993-2009, we econometrically analyse the responsiveness of employment and earnings-per-worker to output shocks across countries, industries and firm-size groups. Second, using a nationally representative semi-aggregated dataset of output elasticities, employment shares and output shocks by firm size, industry and country, we employ variance decomposition methods 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 ("response heterogeneity") in explaining the cross-country variation in aggregate labour-market outcomes between 2008 and 2009. The share of the cross-country variation that may be attributed to response heterogeneity is interpreted as an upper bound on the potential role of policies and institutions. Third, the role of specific policies and institutions for response heterogeneity is

1 . Similarly, the credit crunch that was associated with the economic downturn may have affected some firms more than others. For example, the credit crunch may have particularly affected firms that rely to an important extent on external financing or firms that differ in their access to credit (which tends to be related to firm size).

analysed. The analysis considers employment protection, the incidence of temporary work and collective wage bargaining. The impact of policies and institutions in the present analysis is identified using the within-country variation that is provided by the presence of firm-size exemptions in the case of employment protection and differences in the incidence of temporary work and collective bargaining agreements across firmsize and industry groups.[2]

4. The remainder of this paper is organized as follows. Section 2 documents stylized facts to further motivate this paper. Section 3 describes the methodology that is used to estimate the responsiveness of employment and earnings-per-worker with respect to output; puts forward a variance decomposition that is used to quantify the relative importance of structure, shock and response heterogeneity for aggregate labour market dynamics during the crisis; and introduces the framework to analyze the role of institutions for the responsiveness of employment and earnings-per-worker to output shocks. Section 4 gives a short description of the data used for the different parts of the analysis. Section 5 presents the results. Section 6 concludes.

2. Stylized facts

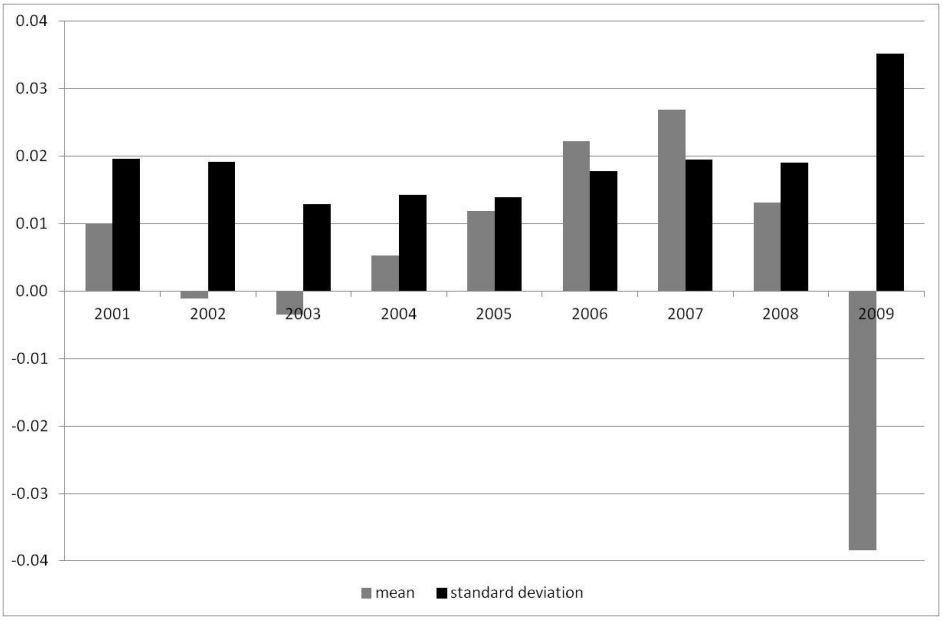
5. The aim of this section is to document two stylized facts that provide the key motivation for this paper by documenting the evolution of aggregate labour market dynamics and provide a first indication of the role of disaggregate information.

6. Aggregate labour market dynamics have evolved very differently across countries during the crisis. Figure 1 shows the evolution of the first two moments of the cross-country distribution of employment growth, the mean and the standard deviation, using a sample of 21 countries. Prior to 2009, the mean and standard deviation of employment growth were positively correlated over time: both dispersion and mean-employment growth decreased in economic downturns and increased in expansions. As a result of the global financial crisis, however, mean employment growth dropped substantially in 2009.[3] More interestingly for the present purposes, the cross-country standard deviation almost doubled between 2008 and 2009. As a result, dispersion in employment growth during the crisis was much higher than at any time during the preceding decade.

2 . Firm size exemptions have been used before to analyse the role of employment protection in specific countries, but not yet in a cross-country context (see Venn, 2010, for details). We are not aware of any previous studies that have looked at the role of collective bargaining coverage and the incidence of temporary work for the adjustment behaviour of firms.

3 . The large mean drop in employment growth is due to negative growth rates all countries except Switzerland and Poland. However, there is a large degree of variation in the extent of the decline: employment levels decreased the most in Estonia (14%), Spain (11%), and the United States (7%), whereas other countries experienced growth rates varying between -1and -6%.

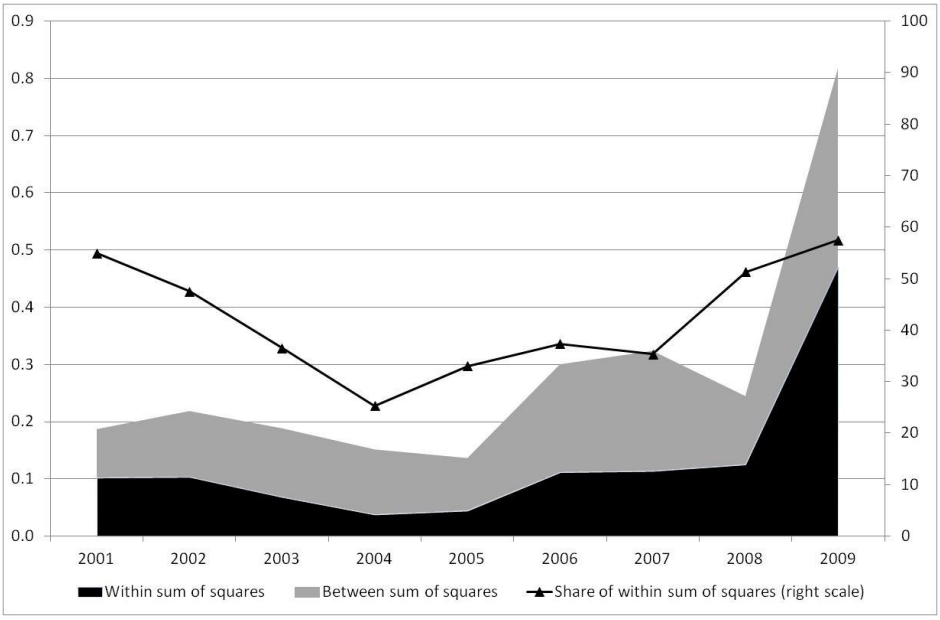
Figure 1. The cross-country distribution of employment growth rates, 2001-2009.



Source: Authors' calculations using STAN.

7. To what extent may disaggregate information help us understand the evolution of aggregate labour market dynamics during the crisis? In order to get a first idea about this, we make use of a semi-aggregated dataset that allows us to decompose the total variation in employment growth across countries, industries and firmsize groups into its components that can be related to the variation across countries and that within countries. The results of this decomposition are presented in Figure 2. It shows that the within and between-country variation in employment growth tend to move together, decreasing during periods of slow economic growth and increasing during boom periods. Both the within and between-country variation increased sharply in 2009. Moreover, the within-country variation accounts for a substantial part of the overall variation and slightly increased during the crisis period to about the total variation in 2009 (see solid line in Figure 2). These observations suggest that, in order to understand what happened to cross-country differences in employment growth during the crisis, it may be helpful to analyze the within-country distribution underlying country-level employment growth rates.

Figure 2. Variance decomposition of the within and between country distribution of employment growth rates. 2001-2009.



Source: STAN, SDBS and own calculations.

3. Methodology

8. The discussion of the methodology proceeds in three steps. First, the estimation in relation to the way firms adjust their labour inputs in response to shocks is discussed. Second, the variance-decomposition method that is used to assess the relative contributions of response, shock, and structure heterogeneity to the cross-country variation in aggregate labour market dynamics during the crisis, is set out. Third, our strategy for identifying the impact of institutions for labour-input adjustment is explained. Throughout the analysis two assumptions are made. Labour market institutions affect firms' responses but not the distribution of shocks or structures.[4] Furthermore, within firm groups, the adjustment technology is assumed to be homogeneous and constant over time.

3.1. Modelling and estimating labour adjustment at the firm level

9. The estimable equation is derived from a simple model of partial adjustment:

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

where l_{it} denotes the log-level of labour input (employment or earnings-per-worker *(can this be also labelled as "labour input"?*) in firm i in year t, y_{it} denotes the log-level of output in firm i in year t, η_i denotes firm-fixed effects and ε_{it} denotes an error term. Both labour inputs and output are expressed in logs.

10. Equation (1) is, in principle, consistent with a variety of structural models. It is consistent with labour demand models which assume that firms do not fully adjust instantaneously because of the

4 . This is a reasonable assumption in the short run. In the long-run, it may be less plausible to assume that the composition of firms is not affected by institutions.

presence of adjustment costs. Firms may partially adjust to changes in optimal employment due to the presence of quadratic adjustment costs at the firm level (Gould, 1968; Hamermesh, 1993).[5] However, at aggregated or semi-aggregated level, equation (1) tends to fit the data well, even in the context of non-convex adjustments at the firm-level (Hamermesh, 1989).[6]

11. The elasticities β are estimated on a cell-by-cell basis to allow variation in the coefficients across cells and countries.[7] The cells are defined by country, industry and firmsize. 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).[8]

3.2. Decomposing cross-country heterogeneity in aggregate labour market outcomes

12. What accounts for the increased dispersion in aggregate employment growth across countries during the crisis documented in Figure 1 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 labour market outcomes 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"). For details on the measurement of these three components, see Section 3.1 for the estimation of labour-demand elasticities and Section 4.

13. In order to be able to assess the importance of these three sources of heterogeneity, we start by defining the growth rate of the labour market outcome of interest of cell g in country k and year t as:

$$(2)\ \Delta e_{gt}^{k} \equiv \beta_{g}^{k} \Delta y_{gt}^{k},$$

where Δe_{gt}^{k} denotes the predicted change in labour market outcome e of cell g in time t in logs, β_{g}^{k} denotes the elasticity of the labour market outcome of interest to output, Δy_{gt}^{k} denotes the change in log output of cell g in time t. Note that the elasticity of the labour market outcome e with respect to output is time-invariant, reflecting the assumption that the adjustment technology of firms is stable over time.

5 . For a recent application, see Lafontaine and Sivadasan (2009).

6 . The smoothing effect of aggregation works also with aggregation through time. Annual data likely is overaggregated in time in the sense the annual frequency at which microeconomic data are usually available does not match the timing of firms' decisions. Consequently, annual employment data may signal smoother adjustment than quarterly or monthly data. Therefore, it is important to emphasize that estimating a linear model using annual firm-level data is not inconsistent with nonlinear adjustment models.

7 In the context of the variance decomposition discussed in Section 3.2, we estimated the labour demand regressions not cell-by-cell but country-by-country level, using additive dummies for industry and sizeclass.

8 . We use difference-GMM with the 3rd to the 5th lags of the labour input and output as instruments.

14. The aggregate growth rate of the labour market outcome of interest can then be written as the weighted-average output growth rates across cells plus the weighted sum of cell-level employment share changes: [9]

$$(3)\ \Delta e_t^k \equiv \sum_{g=1}^{G} \beta_g^k \frac{w_{gt}^k + w_{gt-1}^k}{2} \Delta y_{gt}^k + \sum_{g=1}^{G} \beta_g^k \frac{y_{gt}^k + y_{gt-1}^k}{2} \Delta w_{gt}^k$$

where w_{gt}^k denotes the employment share of cell g in aggregate employment. Using this definition, w_{gt}^k captures heterogeneity in structures, β_g^k captures heterogeneity in responses, and Δy_{gt}^k captures heterogeneity in output shocks. The first term in decomposition (3) quantifies the contribution of cell-level predicted employment growth, whereas the second term shows the effect of reallocation across cells.

15. To get a sense of the role of each source of heterogeneity, the two terms of equation (3) are each split into two components. The first component of each term is assumed to capture the degree of heterogeneity along one of the three dimensions of heterogeneity (*i.e.* response, shock and structure), by rewriting the change in labour input in each cell in terms of the deviation from its cross-country mean along this source of heterogeneity. The second component of each term is given by adding back the change in labour input calculated at the cross-country mean along this source of heterogeneity. More specifically, the contribution of <u>response heterogeneity</u> is given by calculating the deviation of β from its cross-country mean $\bar{\beta}_g$ (with $\bar{\beta}_g = {\sum_{k=1}^{K} \beta_g^k}/{K}$) and the change in labour input evaluated at the cross country-mean of $\bar{\beta}_g$ as follows:

$$(4a)\ \Delta e_t^k = \sum_{g=1}^{G}(\beta - \bar{\beta})v\Delta y + \sum_{g=1}^{G} \bar{\beta} v\Delta y + \sum_{g=1}^{G}(\beta - \bar{\beta})z\Delta w + \sum_{g=1}^{G} \bar{\beta} z\Delta w = \sum(\beta - \bar{\beta})(v\Delta y + z\Delta w) + \beta(v\Delta y + z\Delta w),$$

using $v = \frac{w_{gt} + w_{gt-1}}{2}, z = \frac{y_{gt} + y_{gt-1}}{2}$ and dropping indices g for exposition. The first term after the second equality in (4a) is interpreted as the growth contribution to the labour market outcome of interest that can be attributed to response heterogeneity. To be more accurate, its contribution includes the *combined* effect of response heterogeneity measured by $(\beta - \bar{\beta})$ and the joint distributions of $(v, \Delta y)$ and $(z, \Delta w)$. The second term after the second equality in (4a) shows the contribution of shock and weight changes evaluated at the average response, *i.e.* the change that would arise if there were no response heterogeneity.

16. A similar decomposition is obtained for <u>shock heterogeneity</u>:

$$(4b)\ \Delta e_t^k \equiv \sum \beta v(\Delta y - \overline{\Delta y}) + \sum \beta v\overline{\Delta y} + \sum \beta z(\Delta w - \overline{\Delta w}) + \sum \beta z\overline{\Delta w} = \sum \beta[v(\Delta y - \overline{\Delta y}) + z\Delta w - \Delta w + \beta(v\Delta y + z\Delta w).$$

17. The first term after the second equality in (4b) captures the role of shock heterogeneity, while the second term captures the contribution of response and weight changes evaluated at the average output change. Similar calculations for <u>structure heterogeneity</u> yield:

9. Since group-level changes in employment growth the share of groups in aggregate employment, it is natural to account for the effect of share-changes. This is shown by the second term in equation (3), which separates out the contribution to aggregate growth of cell-level growth rates and changing labour shares. The equation is one application of the Thornquist-approximation of Divisa-index definition of continuous-time growth rates.

(4c) $\Delta e_t^k \equiv \sum \beta(v-\bar{v})\Delta y + \sum \beta\bar{v}\Delta y + \sum \beta(z-\bar{z})\Delta w + \sum \beta\bar{z}\Delta w = \sum \beta[(v-\bar{v})\Delta y + (z-\bar{z})\Delta w] + \beta(v\Delta y + z\Delta w)$.

18. The first term after the second equality in (3c) captures the role of structure heterogeneity, while the second term shows the contribution of shock and response changes evaluated at the average employment shares.

19. Consider equation (4a). If $(\beta-\bar{\beta})$, v and Δy are correlated, then the variance explained by $\sum(\beta-\bar{\beta})(v\Delta y + z\Delta w)$ is attributed not only to response heterogeneity but to the effect of the combined variation in $(\beta-\bar{\beta})$, v and Δy. To fully isolate the role of response heterogeneity in $\sum(\beta-\bar{\beta})(v\Delta y + z\Delta w)$, we first "integrate out" the variation in $v, \Delta y, z$ and Δw. In other words, the term is further decomposed such that $v, \Delta y, z$ and Δw are all set to their respective cross-country averages in each cell:[10]

(5) $\sum(\beta-\bar{\beta})(v\Delta y + z\Delta w) = \sum(\beta-\bar{\beta})(\bar{v}\overline{\Delta y} + \bar{z}\overline{\Delta w}) + \sum(\beta-\bar{\beta})(v-\bar{v})\overline{\Delta y} + \sum(\beta-\beta v\Delta y - \Delta y + \beta - \beta z - z\Delta w + \beta - \beta z\Delta w - \Delta w + \beta - \beta(\Delta w - \Delta w)\Delta y - \Delta y + \beta - \beta z - z(\Delta w - \Delta w)$.

20. The first term after the equality in (5) captures the variation in estimated elasticities when changes in economic structures and shocks are set at their cross-country means in each group. In other words, this term captures the variation in the outcome of interest that is associated with cross-country heterogeneity in responses alone. The remaining terms of equation (5) capture the covariance structure of the variables.

21. In order to decompose the cross-country variance into contributions by the terms given in equations (4a-4c) and (5), we make use of an implication of the definition of variance. Consider equation (4a) and denote the first term as A_k (heterogeneity) and the second term as B_k (average term). Then, the cross-country variance of the left-hand-side of (4a) can be written as:

(6) $\mathrm{var}(\Delta e^k) = \mathrm{var}(A_k + B_k) = \mathrm{var}(A_k) + \mathrm{var}(B_k) + 2\mathrm{cov}(A_k, B_k)$

$= \mathrm{cov}(A_k, \Delta e^k) + \mathrm{cov}(B_k, \Delta e^k)$.

22. Equation (6) allows one to quantify how much of the cross-country variance of employment growth is explained by A_k and B_k separately. If $\mathrm{cov}(A_k, \Delta e^k)$ is large relative to $\mathrm{cov}(B_k, \Delta e^k)$, then most of the cross-country variation employment growth is attributed to the variation in A_k. In other words, heterogeneity at the cell-level is the source of cross-country differences in labour market

[10] To give an example, imagine that countries which tend to have an above average employment sensitivity in some sector, say construction, also tend to have a larger employment share (*v*) and/or a larger output shock (Δy_t) in that sector. For instance, the large fall in aggregate employment in Spain may be combination of an above average shock in construction, an above average responsiveness and an above average employment share to start with. In this case, the contribution of response heterogeneity is likely to be relatively, partly because of the role of interaction effects along these three dimensions. It is therefore also of interest to consider to role of response heterogeneity without taking account of these interaction effects. This boils down to asking what Spain's employment response would have been if *only* its elasticities are larger than average, but its employment weights and the output shocks are fixed at the average level in other countries.

outcomes. If $\text{cov}(B_k, \Delta e^k)$ is large relative to $\text{cov}(A_k, \Delta e^k)$, then heterogeneity at the cell-level plays a smaller role. The interpretation of the terms in equations (4b-4c) is analogous.

23. Applying the result in equation (6) to (4a-4c) and (5) gives two decompositions for each source of heterogeneity: one that isolates the effect of a single source (equation (5)) and one that combines the effect of variables (equations 4a-4c). The difference between the two can serve to illustrate the importance of the covariance between various sources heterogeneity in explaining the cross-country variation. If this difference is large, it shows that using disaggregated data is important not only because it can control for differences in structures and shocks but also for the covariance between them.

3.3. Analyzing the role of institutions

24. This sub-section sets out the methodological framework for identifying the role of labour market policies for way firms their labour inputs in response to shocks. A major challenge when trying to identify the role of policies and institutions is that institutions are typically defined at the country-level and that the cross-country variation in one institution is often correlated to that of other institutions. This makes it difficult to isolate the role of a single institution using cross-country data.[11] Therefore, we focus on within-country variation in labour market institutions. We consider three labour market institutions that may have important implications for the adjustment behavior of firms: employment protection (EP), the incidence of temporary work (TEMP) and collective wage bargaining (CWB).

25. A two-stage approach is adopted to assess the role of institutions for firm-level labour adjustment. In the first stage, the elasticities of employment and earnings-per-worker with respect to output are estimated using firm-level information separately for each country, industry and firm-size cell. The cell structure is defined separately for each set of institutional variables in order to maximise the within-country variation in the data on institutions. In the second stage, the impact of institutions is identified by making use of the within-country variation in the data, whilst controlling for the role of structure and shock heterogeneity. Intuitively, we compare the relationship between labour input elasticities and institutions between firms of type A with that of firms of type B across different countries. The identifying assumption is that the difference in adjustment technologies between firms of different types is identical in the absence of labour market institutions. Consequently, any differences in the relative adjustment technologies across countries may be related to the differential role of institutions across different firm types. By focusing on differences in adjustment technologies across firm types within countries, the analysis takes account of structure and shock heterogeneity that may otherwise obscure cross-country comparisons.

Employment protection and the incidence of temporary work

26. The effect of employment protection is identified using variation generated by exemptions from national settings for specific firmsize-groups (usually small firms, but the threshold differs across countries). Exemptions may be full or partial and relate to individual or collective dismissals (EPR or EPC). In general, one would expect firm-size exemptions with respect to reduce the fixed cost of making adjustments on the extensive margin, *i.e.* number of employees. The impacts of employment

11 For instance, EP may have a stronger effect in a country where the rights of workers are in general more important. The stronger general position of workers may also be reflected in the greater importance of trade unions and collective bargaining agreements.

provisions with respect to individual dismissals, EPR, and those with respect to collective dismissals, EPC, on the elasticities of employment or earnings-per-worker, $\hat{\beta}_{kis}$, are identified as follows:

$$(7)\ \hat{\beta}_{kis} = \alpha_{EPR}EPR_{ks} + \alpha_{EPC}EPC_{ks} + \mu_k + \eta_i + \varepsilon_{kis},$$

where k denotes country, *i* industry, and *s* firmsize. μ_k and η_i control for country- and industry-specific fixed effects. The identification assumption is that firms above and below the threshold differ only in terms of the applicable EP regime and are identical otherwise. To maintain the homogeneity of the sample along dimensions other than EP, only firms with +/- 10 employees around the threshold are used in the estimation sample. Furthermore, only those firms are taken into account whose employment level is either above or below the threshold throughout the whole sample. Data on employment protection are obtained as described in Venn (2009) and documented in more detail in Section 4.3.[12]

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

$$(8)\ \hat{\beta}_{kc} = \alpha_1 TEMP_{kc} + \mu_k + \eta_c + \varepsilon_{kc}$$

where $\hat{\beta}_{kc}$ denotes the first-stage estimates of the employment and earnings-per-worker elasticities by country (k) and industry-firm size cell (c). $TEMP_{kc}$ denotes the incidence of temporary work within a cell. Identification is based on within-country variation through the inclusion of country fixed effects, η_k. Moreover, cell fixed effects η_c are included to control for common elasticity patterns across cells between countries. It is assumed that the remaining variation can entirely be attributed to differences in the cell-level incidence of temporary work. Data on the incidence of temporary work by industry and firm-size cell are obtained from the EU LFS.

Collective bargaining coverage

28. The effect of CWB on the responsiveness of employment and earnings-per worker to output shocks is identified using the variation generated in CWB coverage across cells within countries:

$$(9)\hat{\beta}_{kc} = \alpha_1 CWB_{kc} + \mu_k + \eta_c + \varepsilon_{kc}$$

where CWB_{kc} denotes the incidence of collective wage bargaining in each country-industry-size cell kc. Identification is based on comparing relative differences in adjustment between firms within countries across countries through the inclusion of country-fixed effects and industry times firm-size fixed effects.

29. In a more detailed specification, we allow the impact of CWB coverage on the responsiveness of employment and earnings-per-worker to output shocks to differ according to the

12 . Theoretical models give some background to interpret results of the above regressions. 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, EP may hinder labour adjustment and therefore the efficient re-allocation of resources. Bassanini (XX) provides a good introduction on EPL and its effect on job mobility. The main conclusion is that EPL negatively affects job mobility implying $\hat{\alpha}_{EPR}, \hat{\alpha}_{EPC} < 0$ in equation (7). Hopenhayn-Rogerson (1993), Bertola (1994), and others show the negative effects of EP in theory.

level at which CWB agreements are negotiated and countries with more or less flexible labour market settings, as follows:

$$(10)\ \hat{\beta}_{kc} = (\alpha_1 + \alpha_2 D_{Group\ 1})CWB_{kc}^{firm} + (\alpha_3 + \alpha_4 D_{Group\ 1})CWB_{kc}^{higher} + \mu_k + \eta_c + \varepsilon_{kc}$$

where $\hat{\beta}_{kc}$ denotes the first-stage estimates of the employment and earnings-per-worker elasticities by country (k), industry-firm size-cell (c). The specification distinguishes between CWB agreements negotiated at the firm level (superscript "firm") and those negotiated at the industry or country (superscript "higher"). The specification also allows for differences in the role of bargaining across different groups of countries: a group of countries characterised by flexible labour markets, low levels of CWB coverage and a predominance of firm-level bargaining (Group1: Estonia, Poland and the UK) and a group of countries that have less flexible labour markets, high levels of CWB coverage and a predominance of bargaining at the industry or country levels (Group 2: Belgium, France, Italy and Spain). The main justification for distinguishing between these two groups of countries is that the role of CWB coverage is likely to depend on its broader institutional context. Semi-aggregated data on CWB are obtained from the Structure of Earnings Survey (SES) which identifies the predominant type of wage agreement (covering at least 50% of the employees of the local unit). For more details on the CWB data, see Section 4.3.

30. Theoretical model of collective bargaining tend to focus on structural or equilibrium outcomes rather that the role of bargaining for labour input adjustment. Right-to-manage models postulate that workers bargain over wages and the decision about the level employment is at the firm's discretion (Nickell and Andrews, 1983). As a result of its endogeneity, the equilibrium is Pareto-inefficient and employment is lower than in the neoclassical case without bargaining. Efficient bargaining models assume that unions and firms bargain simultaneously over wages and employment levels, which leads to an efficient outcome where underemployment disappears (McDonald and Solow, 1981). A set of studies investigated the relationship between centralization and labour market outcomes.[13] The majority of frameworks stress the incentives of unions and employers. The basic idea is that wage increases have negative externalities, which are internalized by unions and employers. [14] This behavior of the parties in the bargaining process result in wage restraint in order to save jobs. The extent to which internalization happens depends on the degree of coordination /centralization.[15]

4. Data and implementation

31. This section describes the main data sources used for the analysis. First, a multi-country firm-level dataset, called ORBIS, is used for the estimation of output elasticities. Second, for the purposes of the decomposition exercise discussed in Section 3.2, the make use of a variety of alternative data sources based on administrative information (OECD STAN, National Accounts, SDBS) or labour force surveys. Third, we make use of semi-aggregated information of employment protection, the incidence of temporary work and the coverage rate of collective wage bargaining.

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13 Calmfors (1993) is an example.

14 The literature lists various externalities as examples: consumer price, input price, fiscal, unemployment, investment, envy, efficiency-wage.

15 . A number of recent macroeconomic studies have become interested in the way wages are determined, and more specifically the role of wage rigidities, since conventional search-and-matching models of the labour market systematically underpredict the volatility of employment over the business cycle. Gertler and Trigari (2006) use a model of staggered multi-period wage contracting is used to model frictions.

4.1 Cross-country firm level longitudinal database (ORBIS)

32. For the estimation of output elasticities, we make use of a cross-country, firm-level longitudinal database, called ORBIS. This dataset provides comparable information from balance sheets and income statements for firms across many OECD and non-OECD countries. It is collected by a private company called Bureau van Dijk via national sources.[16] The Statistics Department (STD) of the OECD has carried out extensive consistency checks and cleaning of the data (see Ragoussis and Gonnard, 2012, for details). For the purposes of this project, the OECD/ORBIS dataset was complemented with previous vintages of ORBIS and Amadeus (the "European edition" of ORBIS) to increase the time-horizon of the data. The cleaning procedure developed by the Statistics Department was applied to these earlier datasets and extended to take account of specific issues in relation to the present analysis. For the purposes of the present analysis, we make use of firms in the non-farm, non-financial business sector (2 digit industries from 15 to 74 in NACE Rev 1.1), in 20 OECD countries, for the period 1993 to 2009.

33. Table 1 provides some information on the number of observations with non-missing information for employment and sales or employment, sales and the wage bill that results when taking account of all the selection rules discussed above and the estimation sample that results when implementing a number of additional cleaning rules. The most important cleaning rules that we apply for the specific purposes of this analysis are i) to exclude observations with less than three employees; ii) to exclude firms with less than five observations (not necessarily consecutive); iii) to exclude firms or observations that do not satisfy specific cleaning rules with respect to plausible changes in various variables; iv) to exclude outliers based on the ratio of sales to employment (labour productivity). The greatest loss of observations is due to the application of the first two rules. For more details, see the annex. Of the 20 OECD countries, Austria and the United States could not be included in the estimation of earnings-per-worker elasticities due limited information on the wage bill.

16 . Bureau van Dijk (BvD) is an electronic publishing firm collecting and providing company information and business intelligence. BvD's products range from UK company information to comprehensive global coverage.

Table 1. The number of observations per country and estimation sample

	Raw data, with nonmissing employment and sales	Employment equation sample			Raw data, with nonmissing earnings per worker and sales	Earnings per worker equation sample		
		Total	Smallest cell	Largest cell		Total	Smallest cell	Largest cell
AT*	95,766	15,821	87	6,125	8,643	-	-	-
BE	334,093	199,297	533	66,488	333,696	186,808	530	61,165
DE	751,920	301,071	765	128,329	88,062	24,654	20	7,174
DK	47,267	27,770	117	9,209	45,204	24,034	109	7,466
EE	193,835	76,488	68	39,095	156,854	53,740	41	27,131
ES	3,826,199	1,874,398	1,834	804,956	3,804,147	1,690,616	1,784	716,133
FI	348,238	160,314	193	74,649	333,007	148,181	168	68,382
FR	3,731,112	1,315,958	2,671	555,587	2,875,705	1,213,286	2,602	499,346
GB	415,647	342,794	3,193	117,901	387,501	288,927	2,892	101,783
HU	167,826	3,342	17	877	160,013	2,923	11	797
IT	1,799,317	882,582	864	241,819	1,728,013	821,097	796	222,427
JP	1,316,334	793,330	5,468	261,761	680,111	282,031	1,918	105,581
KR	559,768	232,362	480	77,311	526,431	191,181	174	64,701
NL	43,989	16,253	142	6,352	29,257	7,759	43	2,981
NO	412,995	248,630	155	136,147	400,343	95,742	98	40,737
PL	203,788	113,938	1,254	36,664	148,205	71,593	517	25,731
PT	781,587	11,452	156	3,085	761,775	10,433	126	2,903
SE	1,077,407	455,476	278	236,718	927,112	360,381	183	186,822
SI	65,323	33,597	184	12,043	64,985	31,473	176	11,066
US*	10,975,640	58,516	453	15,019	10	-	-	-
Overall sum	27,148,051	7,163,389	18,912	2,830,135	13,459,064	5,504,859	12,188	2,152,326
Overall mean	1,357,403	358,169	946	141,507	708,372	289,729	641	113,280

Note: Observations are for the years 1993-2009 in the nonfarm, nonfinancial business sector (NACE Rev 1.1 15-74, excluding 41-41 (electricity and water management) and 65-67 (financial services)), for firms with positive employment, sales (turnover in ORBIS) and labor cost per employee. Countries marked with * are excluded from the earnings per worker sample because of the low number of observations. 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, for having at least five observed years in the database. Smallest and largest cells refer to the cells with the least and most number of observations, where the cell structure yields $3 \times 3 = 9$ cells, using three broad sectors (manufacturing, construction and business services) and three size classes based on the average number of employees (less than 20 employees, between 20 and 250 employees, more than 250 employees). See more details on these in the Appendix.

34. For the purposes of the variance decomposition, described in Section 3.2, within-country heterogeneity is captured by stratifying the dataset along two key dimensions: firm size defined in terms of the average number of employees (less than 20 employees, between 20 and 250 employees, more than 250 employees) and industry (construction, manufacturing and business services). While the use of these groups may ignore some differences in labour adjustment across firms within cells, the use of a coarse cell structure makes it easier to highlight the main messages of the descriptive analysis. To get an idea about the range of observations for cells within countries, the minimum and the maximum number of observations are shown in Table 1. Typically, the cells of large construction firms are the ones with the least observations, and the cells of small firms in the business services sector are the ones with the most observations.[17] The cell structure in the institutional analysis was customized in order to the match the within-country variation in the institutional data in the greatest details with that in the estimated output elasticities (see Section 4.3).

[17] For the variance decomposition, the elasticities were estimated on a sample such that in every country, the number of observations were restricted to a maximum of 10,000 firms, by a sample of firms in a stratified way. The sample of 10,000 firms is generated such that the industry and size structure of the sample corresponds to the population structure of those cells. Restricting sample size was necessary for computational reasons.

4.2 Administrative data sources

35. In order to implement the decomposition of the cross-country variation in aggregate labour market dynamics (see Section 3.2), the estimated output elasticities need to be complemented with cell-level information on output shocks (shock heterogeneity) and employment shares (structure heterogeneity). In order to obtain plausible estimates, it is crucial that the information on employment shares and output shares is accurate, *i.e.* allow one to match published aggregate information fairly well. Rather than simply computing semi-aggregated employment shares and output shocks from ORBIS, we rely as much as possible on external data which are consistent with published national accounts and national representative labour force surveys.

36. The employment share by firm size group and industry was calculated as follows. First, industry employment shares industry (manufacturing, construction and services) are taken from OECD STAN, for each country and year. Second, the average employment share by size class within an industry over 2006 and 2007 is calculated from the Structural and Demographic Business Statistics (SDBS).[18] Third, OECD STAN and SDBS shares are combined to yield a complete time series of employment shares for each size class and industry. Thus, we make the implicit assumption that the firm-size distribution within an industry and country is stable over time. Any missing information on cell-level employment was imputed using Labour Force Survey. Figure 3 documents the resulting differences in economic structure in terms of the size and industry composition of firms in 2008.

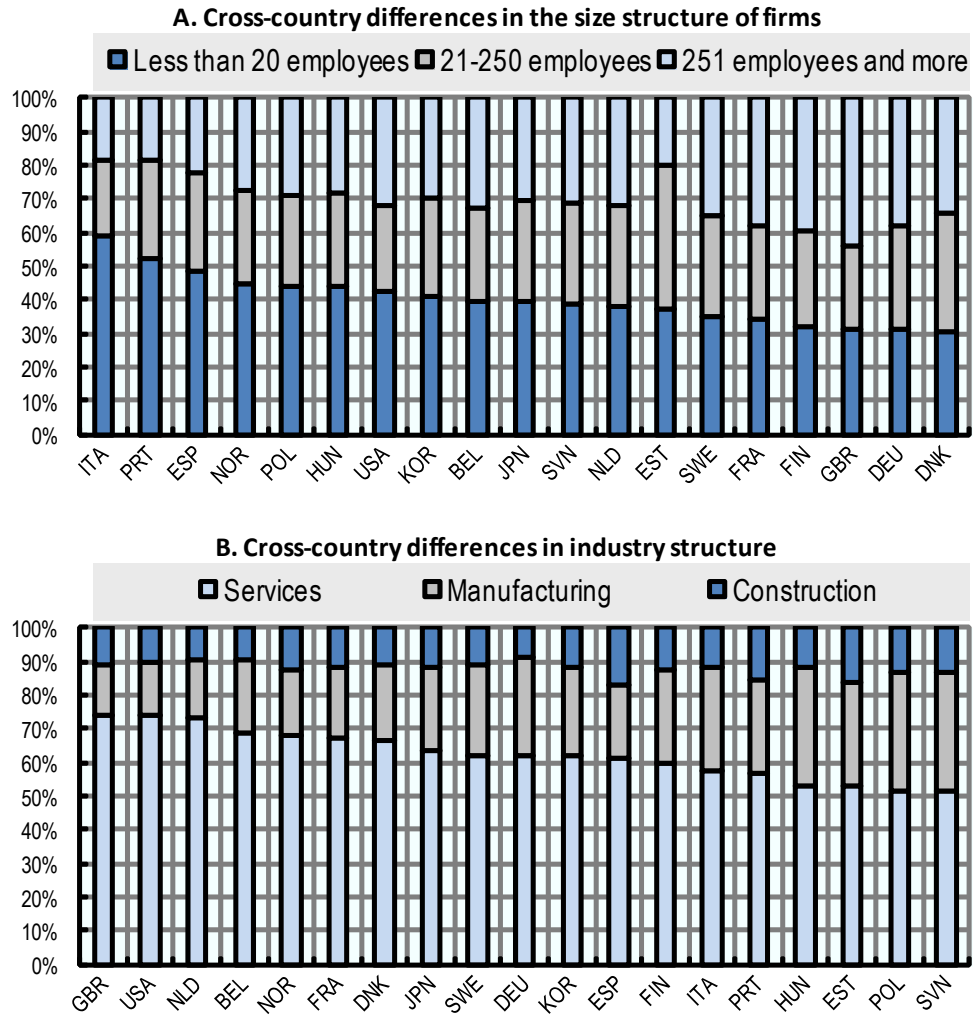
- *Firm size (Panel A).* Small firms with less than 20 employees accounted for over half of the overall level of employment in countries such as Italy and Portugal, whereas small firms accounted for less than one third of employment in Denmark, Finland, Germany and the United Kingdom. By contrast, large firms, defined as firms with more than 250 employees, accounted for less than 20% of employment in Italy and Portugal, while they account for about 40% of employment in Finland, France, Germany and the United Kingdom.

- *Industries (Panel B).* In 2008, construction accounted for more than 15% of employment in Estonia, Portugal and Spain, countries where the aggregate unemployment impact of the crisis tended to be relatively strong, while it accounted for less than 10% in countries such as Belgium, Germany and the Netherlands, countries in which the impact was relatively small. Manufacturing accounted for over one-third of employment in Central and Eastern European countries (CEECs), about 30% in Finland, Germany and Italy, and less than 20% in the Netherlands, Norway, the United Kingdom and the United States. Services accounted for over 70% of employment in the Netherlands, the United Kingdom and the United States, while it accounted for just over one-half of employment in CEECs.

18 . SDBS gives the number of employees per country, year, industry and firm-size class. The years after 2007 are only scarcely available in the NACE Rev 1.1 industry structure, hence we use the average values for the employment shares of different firm size classes in 2005-2007 and apply those for each country, year and broad industry group.

Figure 3. **Cross-country differences in economic structure ("structure heterogeneity")**

Percentage in terms of employees



Source: Authors' calculations based on STAN, LFS and SDBS. Data for the firm size structure, at the industry level, were imputed based on the average of other large developed countries for the US, Japan and Korea, due to their non-standard size-class structure in the SDBS,

37. Cell-level output changes by industry and firmsize 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 evolution of real sales in ORBIS. Third, the growth rates of size classes within an industry were rescaled such that the weighted average growth rate of these size classes equals the industry-level growth rate in STAN.[19] Figure 4 documents differences in output shocks between 2008 and 2009 across size groups, industries and countries.

- *Firm size (Panel A).* In a few countries, including in Germany, Hungary and Sweden, the decline in output was concentrated among large firms. This is consistent with other evidence

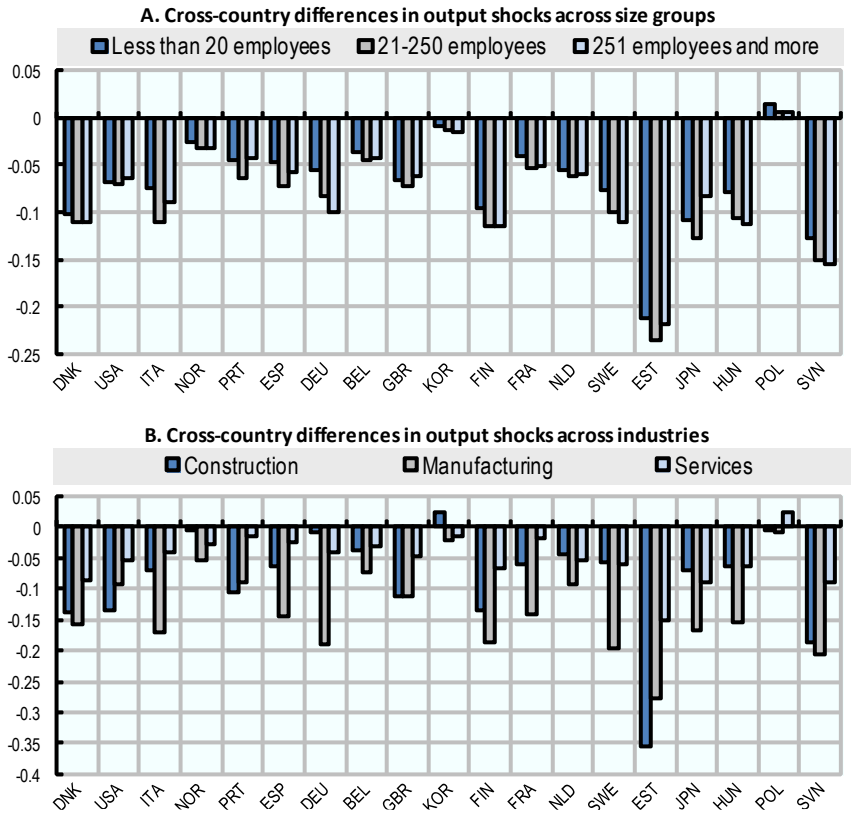
[19] If our assumption that within-cell behaviour can be represented by a homogenous elasticity parameter is correct, then we can capture cell-level output shocks by calculating average sales growth weighted by firms' share in aggregate sales.

for Germany that negative output shocks were concentrated on large exporting firms (Moeller, 2010). In the majority of countries, medium-sized firms were more affected. Small firms were affected the least in the large majority of countries.

- *Industry (Panel B).* In the large majority of countries, manufacturing was most affected by the crisis. Relatively to other sectors, manufacturing was most severely hit in Germany, where output declined by almost 20% in manufacturing, but less than 5% in any of the other sectors. Other countries in which the output decline in manufacturing was at least twice as important as in any of the other sectors include France, Hungary, Italy, Spain and Sweden. In a few countries, the output decline was concentrated in construction, including in Estonia, Portugal and the United States, all countries with an above-average unemployment response to the crisis.

Figure 4. **Differences in output shocks across countries, industries and firmsize groups ("shock heterogeneity")**

Percentage change, 2008-09



Source: Authors' calculations based on ORBIS and STAN.

4.3 Data on labour market institutions

38. The institutional analysis considers both employment protection and collective bargaining coverage. Information on the stringency of employment protection rules with respect to collective and individual dismissals, including information by firm size in countries that apply firm size exemptions, are obtained from Venn (2009). All information relates to 2008. The table provides details on the stringency of employment protection provisions with respect to individual and collective dismissals by

firmsize for all countries that practice firm-size exemptions and are also available in our ORBIS estimation sample. 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. In countries where small firms are exempt from collective dismissal rules the value of EPLC is 0.[20]

Table 2. Countries in the ORBIS sample with firm size exemptions in EPL

Country	Firmsize groups	EPLR	EPLC
Austria	>=20	2.19	3.25
	<20 and >5	2.19	0.00
	<5	1.35	0.00
Belgium	>=20	4.14	4.13
	<20	3.10	0.00
Czech Republic	>=20	5.18	2.13
	<20	4.13	0.00
Denmark	>=20	3.85	3.13
	<20	2.80	0.00
Finland	>=20	4.49	2.38
	<20	3.02	0.00
Germany	>=20	2.85	3.75
	>=10 and <20	2.85	0.00
	<10	0.43	0.00
Hungary	>=20	4.09	2.88
	<20	2.94	0.00
Italy	>=15	3.93	4.88
	<15	2.69	4.88
Korea	>=4	4.87	1.88
	<4	1.56	0.00
Portugal	>=10	4.43	1.88
	<10	3.62	1.88
Spain	>=50	2.38	3.38
	>=25 and <50	2.46	2.13
	<25	3.56	2.13
Switzerland	>=20	1.19	3.88
	<20	1.19	0.00
United States	>=100	0.56	2.88
	<100	0.56	0.00
Slovenia	>=10	2.98	2.88
	<10	2.72	2.88

Note: EPLR denotes the stringency of firing regular workers, and EPLC measures the stringency collective dismissals regulations (EPLC), both available for 2008. The sample to estimate equation (7) includes 6 countries (Belgium, Denmark, Finland, Italy, Spain, Slovenia). Other countries were excluded from the sample when the number of observations in the size class cells in ORBIS was too small to obtain $\hat{\beta}_{kis}$.

20 . This is probably reflects the fact that a firm needs to have a certain critical mass in order to engage in collective dismissals.

39. Data on collective wage bargaining (CWB) are obtained from the Structure of Earnings Survey (SES).[21] SES identifies the predominant type of wage agreement (covering at least 50% of the employees of the local unit). Respondents are required to choose one of the following types of wage barganing: firm-, industry-, country-level, other type or indicate that there is no bargaining at the local unit. CWB_{kc} in equation (8) is computed as the average proportion of firms covered by any of the above types. Therefore, it measures the intensity of collective wage bargaining in general. Table 3 shows average levels of CWB variables in the sample. Each entry corresponds to the average frequency of bargaining type in a country. For instance, the last entry in the first row says that in Belgium, where virtually all firms engage in collective pay agreements, industry- or country-level bargaining is present in 79% of firms. For more details on these indicators, see the Appendix.

Table 3. The incidence and the type of collective wage agreements

Country	Overall	Firm level	Higher level
BE	1.00	0.19	0.81
EE	0.03	0.03	0.00
ES	1.00	0.20	0.79
FR	0.97	0.00	0.96
GB	0.36	0.30	0.05
IT	0.97	0.00	0.97
NL	1.00	0.00	0.00
PL	0.50	0.49	0.01
PT	0.96	0.07	0.68
Total	0.76	0.17	0.53

Note: the numbers for each country and bargaining level (overall, firm-level, higher level) give the average of the CWB intensity across cells by country, where the cell-level intensities are defined by the share of firms taking part in collective wage pay agreements. Overall incidence is defined as the sum of firm-level, higher level, and unspecified. The sample to estimate equation (9) includes 7 countries (Belgium, Estonia, Spain, France, Italy, Poland and the United Kingdom). Other countries were excluded from the sample when the number of observations in the size class cells in ORBIS was too small to obtain $\hat{\beta}_{kc}$.

5. Results

40. This section reports the results from the micro-econometric estimation of output elasticities of employment and earnings-per-worker; presents the results from the variance decomposition; and discusses the findings from the institutional analysis.

5.1 Elasticities of labour market outcomes

41. Figure 5 documents the responsiveness of labour input to output shocks in terms of the elasticity of employment to output and the elasticity of earnings-per-worker to output across countries, industries and firm-size groups.[22]

21 . The European Union *Structure of Earnings Survey*, conducted in 2002 and 2006, is an enterprise survey providing detailed and comparable information on relationships between the level of remuneration, individual characteristics of employees, and their employer. Its website provides aggregated statistics. The current analysis is based on the 2006 vintage of the survey.

22 . These elasticities are estimated separately for each firmsize, industry and country. The elasticities in Figure 5 refer to simple averages across cells. Coefficients on the lagged dependent variable are also

- *Countries* (Panel A). On average across countries, the elasticities of employment and earnings-per-worker are both between 0.1 and 0.15 (shown in the two rightmost columns), 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.[23] 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 CEECs and Japan. The earnings-per-worker elasticity is highest in Hungary, Japan and Poland and lowest in Italy, Portugal and Spain.

- *Industries* (Panel B). 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.[24] 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 concentration of shocks can have important implications for the impact of the crisis on labour markets.

- *Firm-size groups* (Panel B). Differences in the responsiveness of output sensitivity of labour inputs 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 increases in 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).[25] 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 Postel-Vinay and Moscarini (2011), 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.[26]

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of interest but not discussed here as the main purpose is to explain the short-term impact of the crisis on labour markets.

23 . The correlation coefficient is -0.5 and statistically significant.

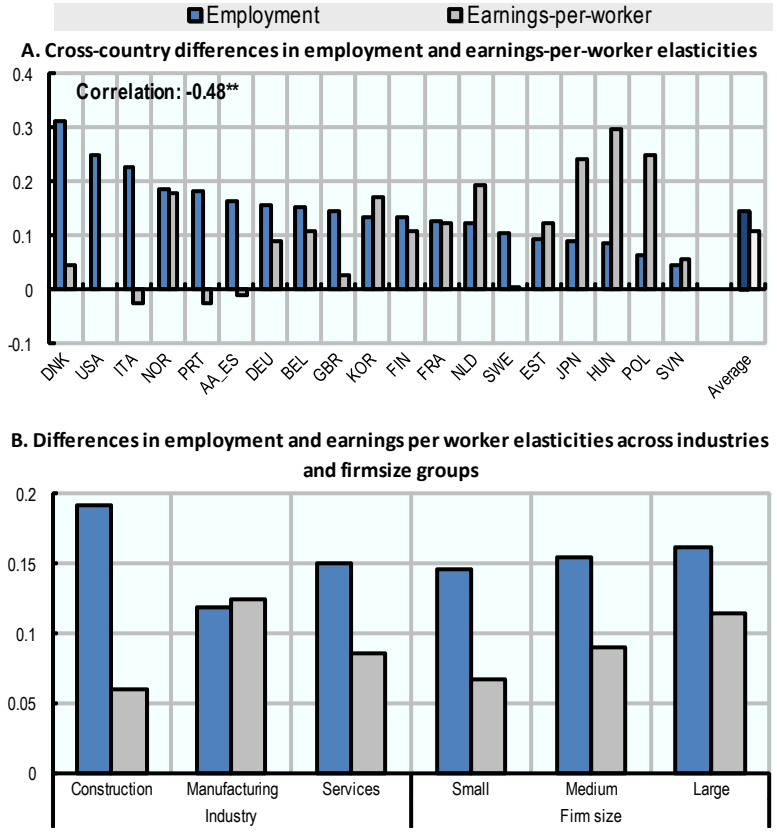
24 . These may reflect differences in production technologies, the skill composition of the workforce or the importance of non-standard contracts.

25 . 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).

26 . 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 Postel-Vinay and Moscarini (2011).

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. This represents an interesting issue for further research.

Figure 5. **Differences in the sensitivity of labour inputs to output shocks across countries, industries and firmsize groups ("response heterogeneity")**



**: Statistically significant at the 5% level.

Source: Authors' calculations based on ORBIS.

5.2 Variance decomposition of aggregate labour market dynamics during the crisis

42. In order to examine the role of structure, shock and response heterogeneity for the way in which labour markets have been impacted by the Great Recession, the cross-country variation in aggregate labour-market dynamics between 2008 and 2009 is decomposed into components that can be attributed to the different sources of heterogeneity (see Section 3.2 for details). 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 the values of the other two at the cross-country average ("without covariances"). 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 sources at their sample values ("with covariances"). Computing the explained variance in this manner gives a measure of explanatory power if we allow for nonzero

covariance among the three sources of heterogeneity. If the three sources of heterogeneity are correlated, computing contributions in this manner should increase the explained variance.[27]

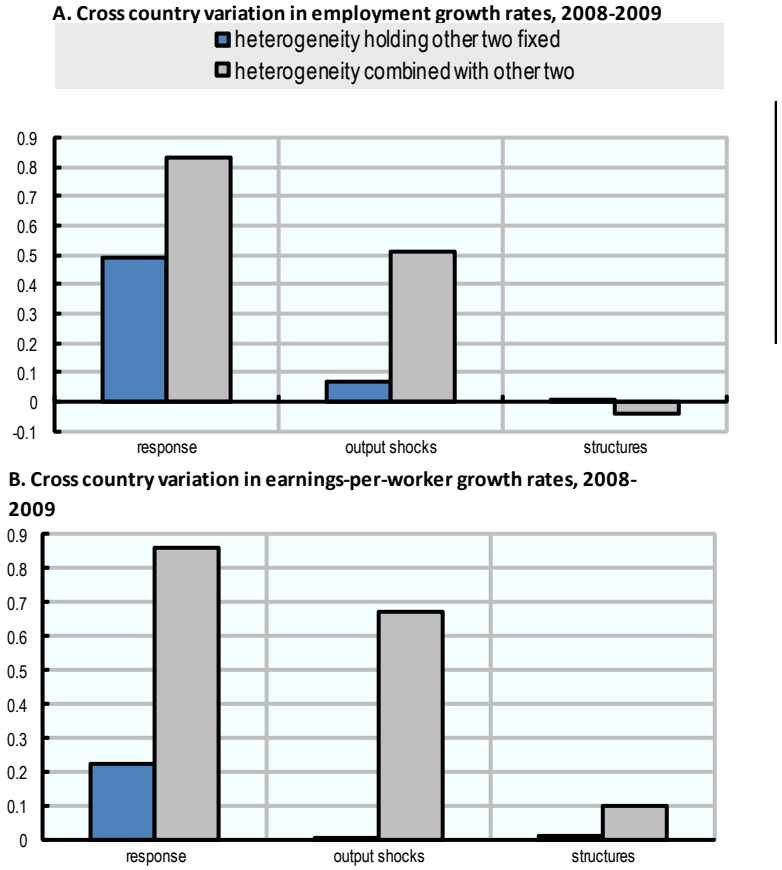
43. The results from the decompositions are presented in Figure 6. Response heterogeneity appears to explain about 50% of the cross-country variation in employment and 20% of the variation in earnings-per-worker when the other variables are kept at their cross-country mean. Considering the sample distributions of employment shares and output shocks, the contribution of response heterogeneity goes up to over 80% of the cross-country variation in both employment and earnings-per-worker changes. This indicates that the covariance between these variables play an important role in shaping cross-country difference in aggregate responses.[28] Repeating the decomposition for shock heterogeneity suggests that this source explains less than 10% of cross-country variation in employment and hardly anything of the variation in earnings-per-worker. After accounting for covariances between output shocks, on the one hand, and employment shares and output responses, on the other, shock heterogeneity explains about 50% of the cross-country variation in employment and almost 70% of earnings-per-worker. The role of structure heterogeneity is negligible irrespective of whether interaction effects are accounted for or not.

44. 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 labour dynamics during the crisis. Second, using disaggregate information can greatly enhance one's ability to explain differences in aggregate labour market dynamics. This is neatly illustrated by the share of the cross-country variance that can be attributed to the role of the covariances across different dimensions of heterogeneity.

27 . The drawback of this measure is that the covariance terms cannot be attributed to a single source of heterogeneity

28 . Note that these interdependencies are captured only by sufficiently disaggregated data.

Figure 6. **Decomposition of cross-country variation in labour input adjustment**



Source: Authors' calculations based on ORBIS, STAN, LFS and SDBS.

5.3 Results of the institutional analysis

Employment protection and the incidence of temporary work

45. The majority of OECD countries exempt small firms from some or all country-wide employment protection requirements (Venn, 2009).[29] The analysis here exploits the resulting within-country variation to examine the role of employment protection provisions with respect to individual and collective dismissals for the responsiveness of labour inputs to output shocks.[30] In order to ensure that the results only relate to exemptions with respect to employment-protection provisions and not other characteristics of labour adjustment that may be related to firm size, the analysis focuses exclusively on firms close to the exemption threshold. The results are reported in Figure 7. They

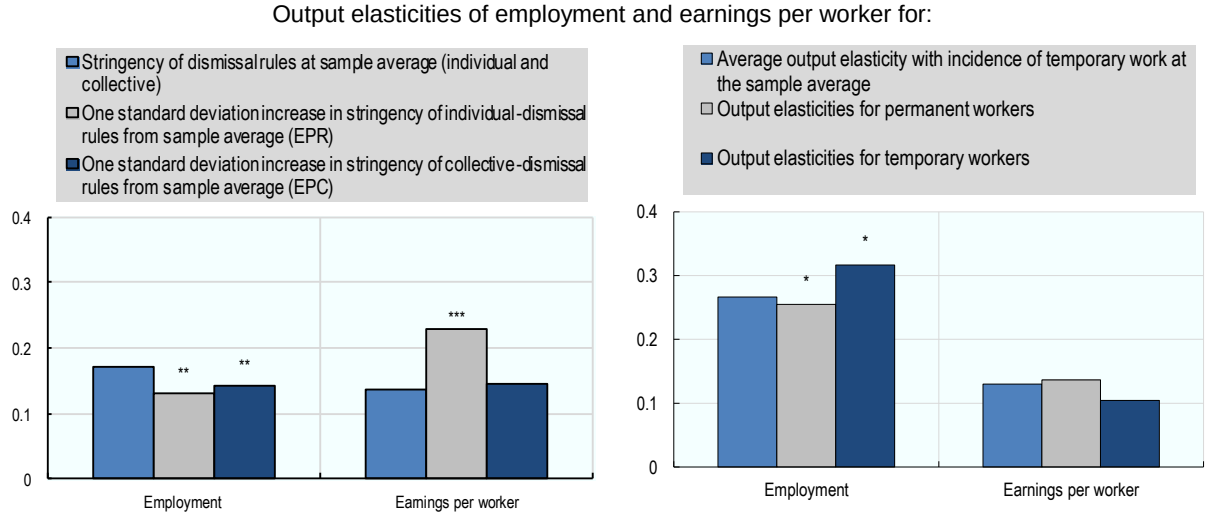
29 . Most commonly, small firms are exempt from additional notification or procedural requirements when undertaking collective dismissals. In addition, several countries reduce or remove severance payments, notice periods or the risk of being accused of unfair dismissal for small firms. A number of countries also apply blanket exemptions (Venn, 2009).

30 . 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, this appears to be the first study to do this on a cross-country basis.

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.

46. Employment protection rules are also likely to have an important impact on the use of temporary contracts. 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, Panel B of Figure 7 analyses the role of the incidence of temporary work for the adjustment behaviour of firms. It shows that, as one would expect, 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 shocks between permanent and temporary workers is not statistically significant.

Figure 7. **The effect of employment protection on the responsiveness of employment and earnings-per-worker to output shocks.**



*, **, ***: statistically significant at the 10%, 5% and 1% level, respectively.

Source: Authors' calculations based on ORBIS and Venn (2009).

Collective bargaining coverage

47. The analysis of the role of collective wage bargaining takes account of both the pervasiveness of collective wage bargaining by looking at the incidence of collective wage agreements across firms within detailed industry and firmsize cells as well as its nature by taking account of the level of centralisation/decentralisation at which collective wage agreements are negotiated. A key

feature of the analysis is that it allows for differences in the role of bargaining across different groups of countries: a group of countries characterised by flexible labour markets, low levels of CWB coverage and a predominance of firm-level bargaining (Group1: Estonia, Poland and the UK) and a group of countries that have less flexible labour markets, high levels of CWB coverage and a predominance of bargaining at the industry or country levels (Group 2: Belgium, France, Italy and Spain). The main justification for distinguishing between these two groups of countries is that the role of CWB coverage is likely to depend on its broader institutional context.[31]

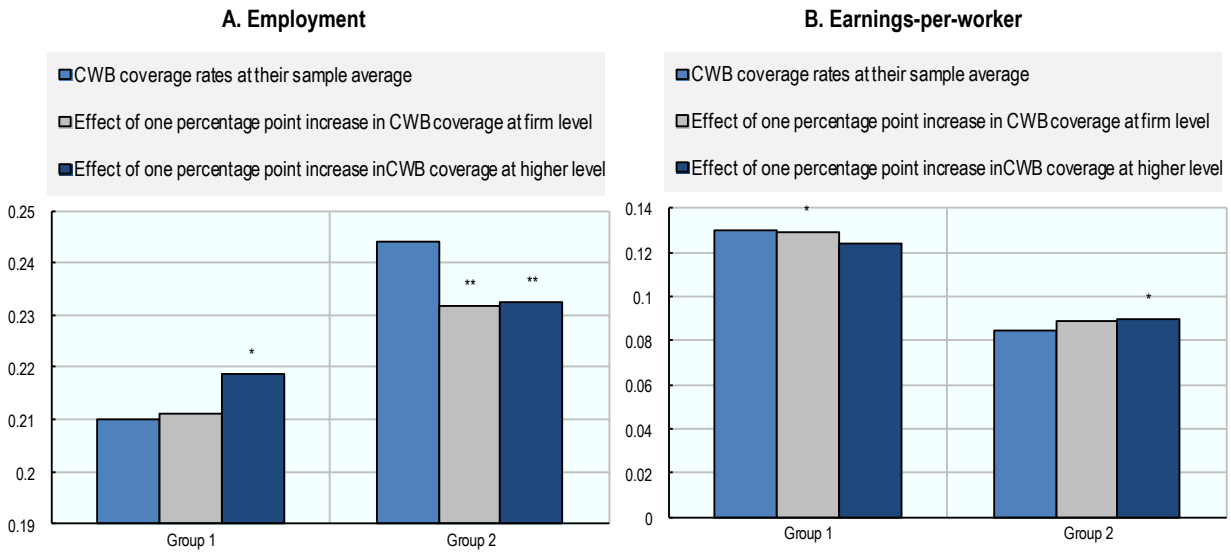
48. Figure 8 compares the average employment and earnings-per worker elasticities that result when the coverage rates of firm and higher-level CWB agreements are set at their sample means with those that result when the coverage rates are increased, one-by-one, by one percentage point from their sample mean. In general, the results suggest that more pervasive collective bargaining mitigates the effect of output shocks on employment in Group 2, but has either no effect or reinforces the impact of output shocks on employment in Group 1. The results with respect to earnings-per-worker are very weak. If anything, the results suggest that CWB coverage increases the responsiveness of earnings-per-worker to shocks in Group 2, while it reduces it in Group 1. However, the effects are small and generally statistically insignificant. The differences in the estimated impact of CWB coverage on the labour input adjustment behaviour of firms across the two groups of countries may indicate that its role depends on the broader institutional environment in which collective bargaining takes place. However, it may also reflect the role of specific features of the bargaining process that are not taken into account in the present analysis.[32] Whether collective bargaining agreements are negotiated at the firm-level or at high-levels of negotiation does not appear to matter in any of the two groups of countries.

31 . In an alternative specification, the role of CWB coverage and how this depends on the mode of collective bargaining was analysed in more detail. This specification explicitly differentiates between the role of coverage and the nature of bargaining (somewhat similar in spirit to the approach taken in the macro analysis). The results of this specification do not suggest much of an independent effect of coverage on average, but provide a weak indication that CWB coverage reduces the sensitivity of employment to output and increases that of earnings per worker when the predominant mode of bargaining is that at the central level.

32 . The results for Group 2 are inconsistent with the predictions from so-called "right-to-manage" models, which suggest that trade unions only care about wages and not about employment, but may be consistent with efficient bargaining models in which trade unions take account of the potentially adverse employment implications of wage bargaining and exercise restraint on wage claims in order to save jobs.

Figure 8. **The effect of collective wage bargaining (CWB) coverage on the responsiveness of employment and earnings-per-worker to output shocks**

Output elasticities by country group[a]



*, **, ***: statistically significant at the 10%, 5% and 1% level, respectively.

a) **Group1**: Estonia, Poland and the UK; **Group 2**: Belgium, France, Italy and Spain.

Source: Authors' calculations based on ORBIS and SES.

6. Concluding remarks

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Appendix

1. Data description

1.1. Sources and construction of international firm-level data

49. The source of the company-level dataset used in the analysis is the ORBIS dataset, collected by the Bureau van Dijk (BvD).[33] 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).[34] 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 X in the main text for the set of countries we use and the number of observations and firms for each.

50. 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.

51. All firms in our analysis have at least three consecutive years of nonmissing 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 A1.

52. 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 sizeclass cell which our outside the interval defined as [p25 – 1.5*iqr, p75 + 1.5*iqr], where p25 and p75 denotes the 25^{th} and 75^{th} percentiles, and iqr is the interquartile range: iqr = p75-p25.

53. 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 utilise enough number of lagged values.

54. The affected number of observation per each country for each of these criteria is available on request.

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33 The ORBIS dataset, which contains countries outside as well as within Europe, is augmented with the Amadeus dataset (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 dataset available at the OECD starts reporting firms mostly only around 1999.

34 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).

Table A1. Criteria for filtering observations

	definition	log changes, controlling for absolute changes as well (in absolute value)[1]	gross growth rates[2]	reversals (in gross growth rates)[3]	log changes at the edges of a firm-spell[4]	
					log changes	difference from lagged log changes
readily available variables						
Employment	-	0.5 log-points, more than 1,000 employees	5	1.5	0.5	0.8
Sales	-	-	6	6	0.7	0.9
Value added	-	-	7	4	0.7	0.9
Labor costs	-	-	6	2	0.6	0.6
Fixed tangible capital	-	-	8	2	-	-
constructed variables						
Earnings per worker	Labour costs / Employment	-	0.8	0.5	-	-
Labour productivity (using sales)	Sales / Employment	-	2	0.7	-	-
Labour productivity (using value added)	Value added / Employment	-	3	1.5	-	-
Capital-labour ratio	Fixed tangible capital / Employment	-	2.5	0.5	-	-

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.

1/ Dropping observations with large absolute changes. An observation is dropped if the absolute value of log changes ($log(X_t)-log(X_{t-1})$) 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.

2/ 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.

3/ 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*.

4/ 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.

1.2. Indicators for labour market institutions: Collective wage bargaining coverage

Table A2. **The incidence of CWB by country, industry and size class**

Country / Sector	Overall	Firm level	Higher level
BE			
BusinessServices	1.000	0.127	0.873
Construction	1.000	0.042	0.958
Manufacturing	1.000	0.249	0.751
Total	1.000	0.206	0.794
CZ			
BusinessServices	0.398	0.345	0.053
Construction	0.807	0.244	0.563
Manufacturing	0.512	0.350	0.162
Total	0.481	0.345	0.136
EE			
BusinessServices	0.104	0.070	0.033
Construction	0.066	0.054	0.012
Manufacturing	0.075	0.061	0.015
Total	0.085	0.064	0.021
ES			
BusinessServices	1.000	0.147	0.838
Construction	1.000	0.066	0.930
Manufacturing	1.000	0.183	0.810
Total	1.000	0.169	0.822
FR			
BusinessServices	0.944	0.007	0.897
Construction	0.974	0.000	0.974
Manufacturing	0.980	0.000	0.980
Total	0.968	0.003	0.951
HU			
BusinessServices	0.256	0.226	0.017
Construction	0.315	0.251	0.035
Manufacturing	0.309	0.255	0.040
Total	0.293	0.246	0.033
IT			
BusinessServices	0.967	0.000	0.967
Construction	0.986	0.000	0.986
Manufacturing	0.980	0.000	0.980
Total	0.975	0.000	0.975
NL			
BusinessServices	1.000	0.000	0.000
Construction	1.000	0.000	0.000
Manufacturing	1.000	0.000	0.000
Total	1.000	0.000	0.000
PL			
BusinessServices	0.500	0.485	0.015
Construction	0.500	0.497	0.003
Manufacturing	0.500	0.493	0.007
Total	0.500	0.490	0.010
PT			
BusinessServices	0.910	0.077	0.537
Construction	0.990	0.000	0.791
Manufacturing	0.963	0.056	0.787
Total	0.946	0.061	0.701
SK			
BusinessServices	0.461	0.373	0.072
Construction	0.495	0.443	0.048
Manufacturing	0.439	0.348	0.061
Total	0.448	0.359	0.064
All countries			
BusinessServices	0.739	0.158	0.442
Construction	0.767	0.143	0.511
Manufacturing	0.748	0.184	0.464
Total	0.745	0.174	0.458

Country / Sizeclass	Overall	Firm level	Higher level
BE			
<50	1.000	0.065	0.935
>=50 and <250	1.000	0.211	0.789
>=250 and <1000	1.000	0.358	0.642
>=1000	1.000	0.176	0.824
Total	1.000	0.206	0.794
CZ			
<50	0.176	0.092	0.084
>=50 and <250	0.551	0.364	0.187
>=250 and <1000	0.729	0.592	0.136
>=1000	0.000	0.000	0.000
Total	0.481	0.345	0.136
EE			
<50	0.011	0.007	0.003
>=50 and <250	0.167	0.126	0.041
>=250 and <1000	0.000	0.000	0.000
>=1000			
Total	0.085	0.064	0.021
ES			
<50	1.000	0.039	0.951
>=50 and <250	1.000	0.148	0.845
>=250 and <1000	1.000	0.363	0.627
>=1000	1.000	0.090	0.899
Total	1.000	0.169	0.822
FR			
<50	0.959	0.000	0.959
>=50 and <250	0.966	0.002	0.955
>=250 and <1000	0.977	0.006	0.939
>=1000			
Total	0.968	0.003	0.951
HU			
<50	0.098	0.077	0.004
>=50 and <250	0.215	0.179	0.023
>=250 and <1000	0.579	0.492	0.073
>=1000	0.000	0.000	0.000
Total	0.293	0.246	0.033
IT			
<50	0.967	0.000	0.967
>=50 and <250	0.957	0.000	0.957
>=250 and <1000	0.993	0.000	0.993
>=1000	0.989	0.000	0.989
Total	0.975	0.000	0.975
NL			
<50	1.000	0.000	0.000
>=50 and <250	1.000	0.000	0.000
>=250 and <1000	1.000	0.000	0.000
>=1000			
Total	1.000	0.000	0.000
PL			
<50	0.500	0.490	0.010
>=50 and <250	0.500	0.494	0.006
>=250 and <1000	0.500	0.487	0.013
>=1000			
Total	0.500	0.490	0.010
PT			
<50	0.955	0.010	0.663
>=50 and <250	0.944	0.022	0.747
>=250 and <1000	0.937	0.168	0.689
>=1000			
Total	0.946	0.061	0.701
SK			
<50	0.122	0.094	0.019
>=50 and <250	0.496	0.385	0.074
>=250 and <1000	0.714	0.587	0.097
>=1000			
Total	0.448	0.359	0.064
All countries			
<50	0.635	0.081	0.435
>=50 and <250	0.729	0.175	0.433
>=250 and <1000	0.850	0.299	0.435
>=1000			
Total	0.745	0.174	0.458

Note: the numbers for each country, industry, size class and bargaining level (overall, firm-level, higher level) give the average of the CWB intensity across cells, where the cell-level intensities are defined by the share of firms taking part in collective wage pay agreements. This share is then averaged across the two waves (2002 and 2006) of the SES survey for each cell. Overall incidence is defined as the sum of firm-level, higher level, and unspecified.