Who are the losers of the labour-market downturn? A scenario analysis for Germany*

Olivier Bargain, Herwig Immervoll, Andreas Peichl , Sebastian Siegloch

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Abstract

Macro-level changes can have substantial effects on the distribution of resources at the household levels. While it is possible to make informal guesses about which groups are likely to be hardest-hit, detailed distributional studies in OECD countries are still largely backward-looking. This paper attempts to provide forward-looking income-distribution scenarios for Germany. It takes as a starting point a very detailed administrative matched employer-employee data to estimate labor demand and predict the effects of output shocks at a very disaggregated level. The predicted employment effects are then linked to household-level micro-data that are commonly used for distributional analysis (GSOEP), in order to model the incidence of rising unemployment and reduced working hours, under alternative scenarios of the adjustment process. The aim is not to provide forecasts but to derive a range of scenarios that can be used for benchmarking the effectiveness of existing income safety nets. We link our result to the current debate on policies aimed at keeping people in employment and limiting the adverse distributional effects of the crisis.

Key Words : Labor demand, Labor Supply, Microsimulation; Work sharing policy; Crisis; Inequality; Poverty.

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*__Acknowledgement:__ Bargain is affiliated to UC Dublin, IZA, the ESRI, the Geary Institute and CHILD. Immervoll is affiliated to the OECD and IZA. Peichl is affiliated to the IZA, the University of Cologne and ISER. Siegloch is affiliated to IZA and the University of Cologne. Usual disclaimers apply.
Correspondence to: Herwig Immervoll, OECD, Herwig.Immervoll@oecd.org

1 Introduction

Macro-economic changes can have substantial effects on the distribution of resources at the individual and household levels. Since the onset of the current economic downturn, concerns about its implications for poverty and distributional outcomes more generally have led to a range of policy initiatives that seek to support job losers and other vulnerable groups (for early comparative summaries of such measures see OECD (2009) and Council of the European Union (2009)). Such concerns follow naturally from the observation that the welfare effects of an economic downturn depend not only on the total size of lost resources but also on how such losses are shared between different people and institutions.

Policy efforts to minimise welfare losses are, however, hampered by how little is known about the likely distribution of changes in market income, or the capacity of existing redistribution systems to soften the negative impact of job and earnings losses. While it is possible to make informed guesses about the groups that are likely to be hardest-hit (e.g. International Labour Organization (2009) or Parrot (2008)), more detailed distributional studies are largely backward-looking and, as such, not directly useful for informing crisis response measures.

This paper attempts to provide forward-looking income-distribution scenarios for Germany. Due to the apparent resilience of the German labour market in the face of sizable and rapid drops in output levels, the German situation is of some general interest (see Figure 1). A first question is whether the reductions in labour demand observed thus far are consistent with firms' production functions, or whether further, perhaps more sizable, adjustments might be expected.

A second question concerns the pattern of labour-demand adjustments in terms of employment levels (extensive margin) and average working hours (intensive margin). To what extent, and under what circumstances, can labour-market institutions that facilitate flexibility of individual working hours soften the negative distributional consequences of deteriorating employment levels? In particular, the generous extensions of the German short-time working scheme have attracted considerable attention both domestically and abroad. By making it less costly to maintain existing employment contracts during a temporary downturn, these measures have provided strong incentives for firms to reduce working hours instead of laying off (and possibly rehiring) workers. It is interesting to ask to what extent working-time adjustments produce more desirable distributional outcomes than layoffs. For instance, are the benefits of partial unemployment benefits and related short-time working policies distributed more or less uniformly, or do they mostly accrue to selected groups of workers – such as those with higher skill levels or relatively secure employment contracts?[1]

To address these questions, we analyse how the demand for labour can be expected to change in response to output shocks in the orders of magnitude that are currently observed. As in other countries, patterns of output adjustments following the onset of the current economic and financial crisis have been highly uneven across sectors and industries in Germany. The manufacturing sector suffered a drop in output of 18 percent, while in the service sector the gross value added actually increased (see table 5). This is likely to drive at least some of the distributional consequences of the labour-market downturn.

To account for this unevenness, we begin with a careful analysis of the demand for labour across different industries. We use detailed administrative firm-level data covering the 12 years preceding the current crisis. This firm-level information is matched with employee data, also from an administrative source, enabling us to estimate models of labour demand for a wide range of different types of workers in each industry. The resulting demand model is used to predict the first-round employment effects of plausible output shocks at a disaggregated level (e.g. by industry, age-group, skill level).

In a second step, we model the incidence of rising unemployment, earnings losses and the associated decline in household income. This is done by applying the predicted employment changes for a large number of different labour-force groups to household-level micro-data commonly used for distributional analysis (the German Socio-Economic Panel, GSOEP). Finally, we apply a tax-benefit model in order to show how effective safety nets are at cushioning the losses experienced by different types of workers and their families. We use two polar cases of the labour-market adjustment process. In one scenario we only allow for changes at the intensive margin (by adjusting hours worked per employee). In the second scenario, we keep average working hours unchanged in order to show the distributional consequences if labour-input is adjusted by changing staff levels through layoffs (extensive margin).

The aim of the paper is not to provide forecasts but to derive a range of scenarios that can be used for benchmarking the effectiveness of existing income safety nets. We link our result to the current debate on policies aimed at keeping people in employment and limiting the adverse distributional effects of the crisis.

The remainder of the paper is structured as follows. Section 2 summarises the observable labour-market effects of the crisis, paying special attention to the German labour-market institutions, in particular the short term working scheme. In section 3, we lay out our empirical approach and present the datasets used. Section 4 we set up and estimate a structural labour demand model to predict the effect of output shocks on different labour

[1] Another important issue, which is beyond the scope of this paper, is whether policies that provide additional security for existing employment contracts inhibit the labour-market dynamism that is necessary for restructuring and a speedy recovery (OECD (2009)).

input. In section 5, we analyse the distributional consequences of the predicted changes in employment on the household level. Section ?? concludes and relates the distributional analysis to policy implications [TO COME].

2 The German Labour Market in the current crisis

In a representative survey of around 8000 German companies in the second quarter of 2009 around 40% of firms indicated that they had been affected by the economic crisis (Heckmann et al. (2009)). More than half of them have embarked on cost-cutting measures to overcome the economic crisis. But layoffs have only occurred in 11% of them and only 12% have either implemented wage reductions or were in the process of negotiating them.

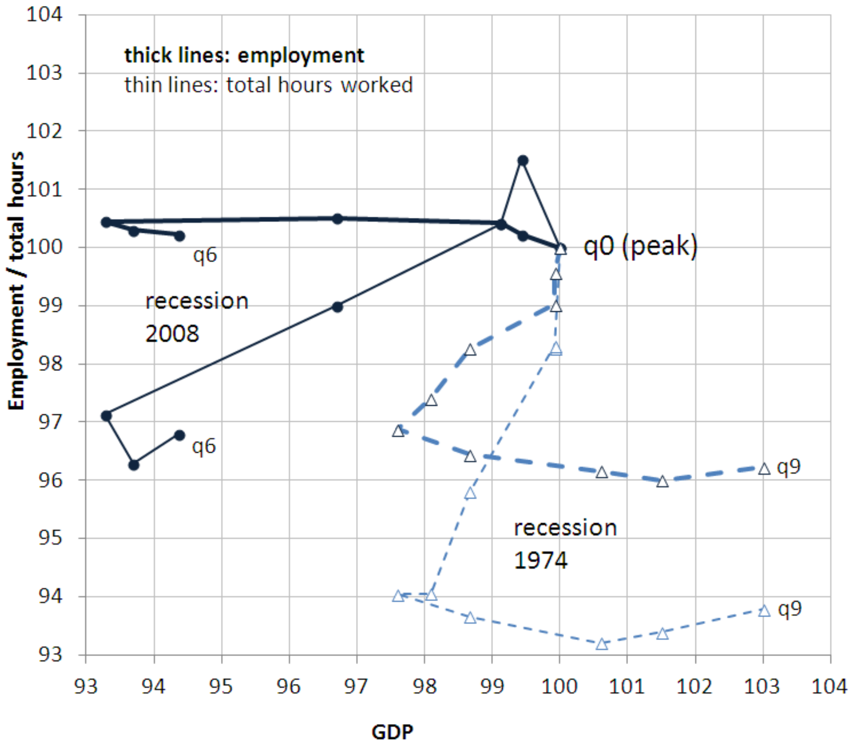
More conventional measures of labour-market performance, summarised in Figure 1, also show that labour-market adjustments to the economic decline have been both muted and unusually slow. Despite a very substantial drop in GDP, overall employment levels have barely changed. The total number of hours did decline significantly, but still much less so than in previous recessions (upper panel of Figure 1). Comparing across countries, it is clear that employment levels, and to a lesser extent working hours, were much less responsive in Germany than elsewhere (lower panel).

Labour market institutions In addition to the depth and specificities of adverse output demand shocks, and firms' ability to absorb deteriorating revenues and profit margins, labour market institutions are likely to play an important role in shaping the labour-market adjustment process that follows. Employment protection legislation (EPL) and working-time arrangements, the collective-bargaining context, as well as discretionary policy responses to an economic downturn affect the ability and the incentives of firms to adjust employment levels, working hours or wages.

Employment protection reduces labour market dynamics by making it more difficult for firms to lay off protected workers and, more controversially, by reduce firms' willingness to hire.[2] All else equal, one would expect a shock on firm profitability to lead to more pronounced employment adjustments in labour markets where statutory employment protection is less stringent. Some evidence for such a relationship is provided by Bassanini & Duval (2006). In the context of the present paper, an interest in EPL can also be motivated by the observation that some of the countries with the smallest employment responses to the downturn, including Germany, belong to the groups with relatively strict EPL measures.

[2] The net effect on unemployment is ambiguous and empirical studies, discussed in OECD (2004) and Venn (2009), provide conflicting results.

Figure 1: Labour-market adjustments during economic downturns
a. Germany, recessions 2008 and 1974



b. Recession 2008: Germany and other OECD countries

Source: OECD National Accounts database and OECD Secretariat calculations based on national and Eurostat labour market statistics. Further details on sources are given in OECD (2010) Notes: q0 is the quarter when GDP peaked and each data point refers to consecutive quarters since then. 1974 data are for West Germany. GDP and employment at peak = 100.

EPL is equally relevant for understanding the distribution of job and earnings losses, notably between those on a regular employment contract and those in other, less protected forms of employment. Across OECD countries, there has been some convergence of the strictness of EPL since 1998 (see also OECD (2004)). This has been mainly driven by a weakening of protection in "high-EPL" countries (Figure 2). However, dismissal protection for those on regular employment contracts has in fact changed only little. Where overall EPL scores did decline, this was mostly a result of measures that tended to liberalise the employment of temporary workers. Germany has been no exception to this general pattern.[3] Over the same 10-year period, the share of temporary employment in Germany has risen more rapidly than in most other OECD countries (from 12.2 percent to 14.6 percent of overall employment).[4]

If firms are unable or unwilling to dismiss workers, they can consider reducing individual working hours as a way of bringing down labour costs in response to lower order volumes. The data shown for Germany in Figure 1 above indicate that working-hours reductions have indeed been a much stronger influence on total working hours than declining employment levels, accounting for some $\frac{3}{4}$ of labour input adjustments in 2009.

The difficulties that many German firms faced in (re-) hiring skilled workers during the most recent economic recovery is one likely driving factor of this response. If a downturn is short-lived and layoff- or rehiring costs are high, then a strategy of labour hoarding, assisted by shorter working hours, can be an efficient response (OECD (2009)). The government-supported short-time working scheme (the *Kurzarbeitergeld* discussed below) has tended to receive most of the attention in this context. Yet, while a substantial part (around 25 percent) of working-time reductions can indeed be attributed to this programme, other factors were more important on aggregate.[5] The biggest reductions, accounting for more than one third of recorded changes in total hours worked, were due to opening clauses in collective agreements which provide for temporary reductions in weekly working hours (and earnings). In addition, working-time accounts or "time banks", as well as substantially reduced overtime account for about 20 percent each.[6]

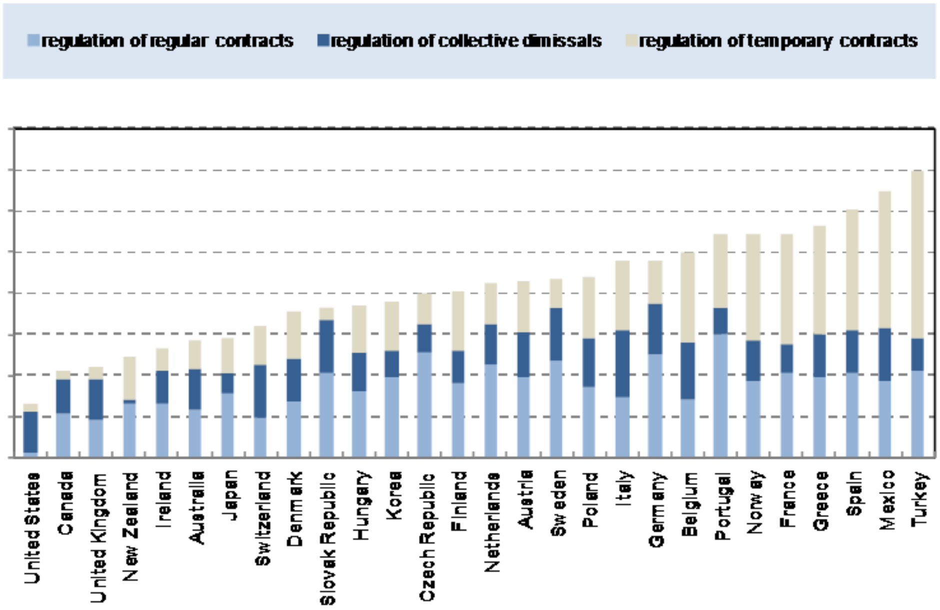
[3] For instance, as part of the "Agenda 2010" initiative of the Schröder Government, temporary workers no longer counted toward the thresholds that determine whether or not small businesses are subject to dismissal protection. More importantly, there has been an easing of rules concerning the conditions under which temporary employment contracts can be offered (TODO insert Ref).

[4] Source: www.oecd.org/els/employment/data.

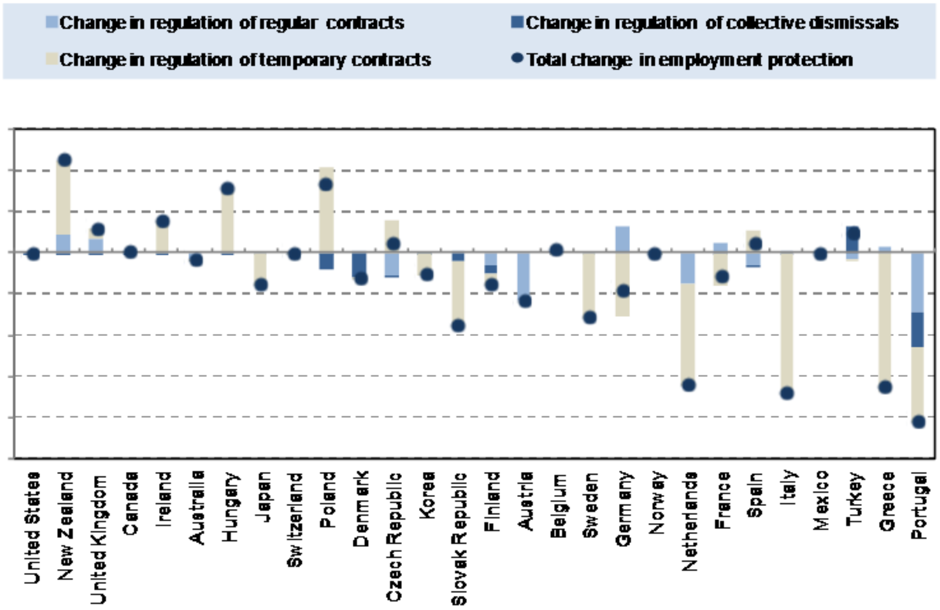
[5] See Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (2009).

[6] Working-time accounts provide additional flexibility by enabling firms to balance actual and contractual working hours over longer periods (and, hence, pay less in overtime premiums). Such accounts have been introduced extensively in recent years. They are especially prevalent in the manufacturing industry, where they now apply to the majority of workers.

Figure 2: Strictness of employment protection
a. 2008



b. Changes 1998-2008



Sources and further details are given in Venn (2009). Notes: Data shown are version 2 of the employment protection summary indicator, which is a weighted average of each of three sub-indicators (scale 0 to 6). For France and Portugal data refer to 2009 instead of 2008.

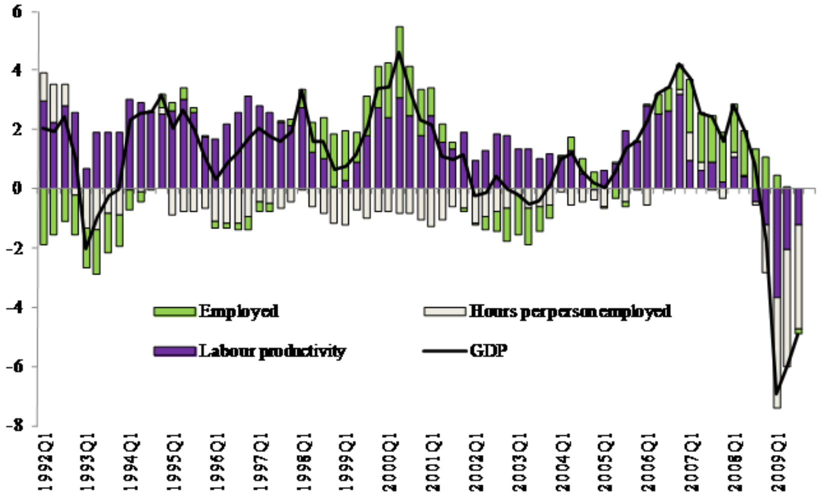
Short term working scheme *Kurzarbeitergeld* existed before the crisis but has been heavily expanded since. Using a simplified procedure, firms qualify if they can demonstrate a temporary and crisis-related drop in output demand. They need to enrol at least one third of workers subject to social security contributions (as of February 2009, subsidies can also be paid to firms who enrol smaller numbers). Working time (gross earnings) of participants must be reduced by a margin of at least 10 percent. The government subsidy consists of replacing 60-67 percent of lost *net* earnings, the same replacement rate as in the unemployment benefit programme. Eligibility to the programme has been extended to a maximum of 24 months. Importantly, participants in the programme continue to accrue social insurance claims based hours worked *plus* up to 80% of hours not worked. Employers have to cover the entire contributions for hours not worked and, depending on the specific circumstances, the government refunds 50 percent or 100 percent of those payments. As German social contribution rates are high, this refund constitutes a significant share of the overall subsidy. Despite the generous subsidies, participation in the programme creates costs for employers.[7] First, labour costs do not decline proportionally with working hours, as some non-wage labour costs continue to apply and sum up to around one fourth to one third of regular (pre-programme) labour costs (Bach & Spitznagel (2009)). Second, agreements between employers and employees may specify worker compensation over and above the subsidies provided by the programme. These costs have implications for programme take-up: they may work as a screening device in the sense that they reduce the number of applications for workers that employers do not intend to keep in the long-term. Employers face, however, no outright penalties for dismissing workers after programme participation.

The discussion has so far focussed on labour-market institutions that directly facilitate or inhibit labour-demand adjustments. In addition, timely wage adjustments can clearly help to reduce the need for reducing staff levels or working hours. If unfavourable economic conditions persist, wage flexibility is a decisive factor for employment levels in the medium term. While union density has been declining in Germany, collective agreements frequently also apply to employees that are not members of the relevant union. Consequently, effective coverage in terms of collectively-agreed wages or working conditions is higher than the share of union members in the workforce would suggest. Unions therefore play a very significant role in determining the degree to which wage concessions can substitute for reduced labour demand. In the recent past, collective agreements tended to become more flexible in Germany, with increasing use of conditional opt-out clauses providing firms with additional flexibility in specific situations, notably unfavour-

[7]Such costs may work as a screening device in the sense that it reduces the number of applications for workers that employers do not intend to keep in the long-term. Unlike in other OECD countries, there are, however, no penalties for dismissing workers after programme participation.

able business conditions. As indicated above, however, such opening clauses often concern working hours and other working conditions rather than basic wages. In any case, statistics showing a strong decrease in productivity (and hence, increasing unit labour costs) do not point towards wage adjustment as the principal short-term response to the downturn (Figure 3).[8] Indeed, recent data on collective wage agreements reached in 2009 show that, in the context of inflation close to zero, employers and unions agreed nominal wage increases ranging mostly between 2 and 4 percent (Collective Agreement Archive (2009)).

Figure 3: Changes in labour productivity, number of people employed and hours per worker



Source: OECD (2010, forthcoming) based on National Accounts database. Note: Growth in real GDP is decomposed into growth in labour productivity, employed and hours worked using the identity gdpv = [gdpv/hrs][hrs/emp][emp] in logarithmic difference, where gdpv is real GDP, hrs is total hours worked by all employed and emp is the total number employed. Data is seasonally adjusted and employment and hours are according to the domestic concept.

Factors that would increase short-term resilience are mostly targeted towards workers with regular employment contracts. There is therefore a distinct possibility that they may exacerbate labour market segmentation between "good" jobs (regular employment contracts) and "bad" jobs (fixed-time contracts, temporary agency work as well as forms of non-standard employment, such as casual, daily or seasonal contracts or so-called "false" self-employment). Compared to previous downturns, both job and income losses might then be more concentrated among temporary workers and other disadvantaged groups. Such a pattern would be one of the factors driving the distributional consequences of the crisis, which we analyse below.

[8]Prior to the current downturn, hourly labour productivity has not fallen since data started being recorded in 1970 (OECD (2010, forthcoming), citing IAB data).

3 Empirical Approach: Overview and Datasets

3.1 Overview of the Method

We assume a "right-to-manage" setting, with employment and hours chosen by the firm. Wages are fixed in the immediate term.[9] To study the short-term effects of a large output shock on employment, earnings and the income distribution, we first illustrate the likely patterns of demand-side adjustments. Instead of relying on estimates from the literature, we derive own labour demand functions using a newly developed labour demand model estimated on matched employer-employee data for Germany.[10] The detailed administrative data allow us to distinguish between groups that are thought to be exposed to different risks of unemployment during a labour-market downturn. In order to provide a suitable basis for the distributional analysis that follows, we derive separate demand functions for 135 groups: 5 industries, 3 education levels, 3 age groups, 3 types of employment contracts.

In a second step, the demand-side model is linked to a household tax benefit model in order to show distributional consequences of the downturn under different scenarios and assumptions about the labour-market adjustment process. We model changes in labour demand allowing for the two relevant margins of adjustments: (1) we only assume adjustments at the intensive margin, that is the working hours change according to the predicted change in labor demand in each of the 135 cells; and (2) the labor demand change affect the workforce only at the extensive margin, i.e. people lose their jobs or, in some cases, enter new employment. Based on the results, we discuss factors that are likely to determine the effectiveness of different policy responses.

3.2 Data

We draw information from two micro-data sources. The demand model is based on the linked employer-employee dataset (LIAB) from the Institute for Employment Research (IAB) in Nuremberg, Germany.[11] For the distributional analysis we use the tax and benefit simulation model of the Institute for the Study of Labor (IZA), which is based on the German Socio Economic Panel (GSOEP), a well-known household survey.[12] Aggregate

[9] In further research, it would be worthwhile to evaluate scenarios, in which wages are allowed to vary. In those cases labor demand and supply iteratively adjust until the labor market equilibrium is achieved (see Peichl & Siegloch (2010a) for a method, how to interact the supply and demand side).

[10] For a detailed presentation of the model, see Peichl & Siegloch (2010b).

[11] For a more detailed description of the data source in the context of the labour demand model, see Peichl & Siegloch (2010b).

[12] For a documentation of the microsimulation model, see Peichl et al. (2010).

data on changes in output (value added) are taken from the German national accounts. Finally, we use detailed aggregate and semi-aggregate labour-market data from the IAB for checking the plausibility of employment changes as predicted by the demand model.

Linked employer-employee data The LIAB combines employee data from the employment statistics of the German Federal Employment Agency (Bundesagentur für Arbeit) with the IAB Establishment Panel, a panel survey at the plant level. The employment statistics come from official records, namely the German employment register, which comprises all employees paying social security taxes or receiving unemployment benefits. The resulting dataset covers about 80 percent of German employees (civil servants, self-employed and family workers are not included in the statistics). Information recorded includes employees' histories on daily wages, age, seniority, schooling, training, occupation, industry and region (Bender et al. (2000)).

The second component of the LIAB is the IAB Establishment Panel, which contains annual information on establishment structures and personnel decisions for the years from 1993 onwards (Alda et al. (2005)). It is a representative stratified random sample drawn from the population of all establishments, covering establishments with at least one social-contributions paying worker. As indicated by the term "establishment", the unit of observation is the individual plant, not the firm, and there can be several plants per company (Kölling (2000)). The panel covers 16 industries. In 1993 the sample comprised 4265 plants, that is 0.27 percent of all plants in Western Germany. The Eastern German subsample was established in 1996. In 2005 the unified sample included 16,280 establishments.

A main purpose of the establishment panel is to provide detailed information of the demand side of the labor market. Therefore, questions on employment levels and changes, and the structure of staff qualification represent a substantial part of the questionnaire (Kölling (2000), p. 295). Further questions are on export, investment or technological status. Information on all these topics is recorded annually. Other types of information, such as on technology, are not provided every year.

The administrative data only contains information on contributions to the statutory pension fund, which are subject to a contributions ceiling. Monthly gross labour income are therefore right censored. We impute the censored wages using a censored regression model provided by the IAB (see Gartner (2005)). We further impute missing information on wages, by taking into account individual characterstics of the worker, especially education, age, employment type, industry and whether she works in a big or a small firm. Moreover, we observe individual characteristics such as skill level, age and employment type (full-time, part-time or marginally employed). As for the establishment part of the dataset, we have information on the industry sector and output of the firm in the previous year. All monetary variables (i.e. wages and output) are expressed in 2008 prices. Finally, we use weights to make the establishment sample representative for the whole population of German firms.

The data from the employee history are linked with the establishment sample year by year using a plant identifier. Individuals working in a plant, which is not part of the establishment panel, are dropped, as are the (few) establishments whose workers could not be identified in the employment statistics. We select the waves from 1996 to 2007, in order to have a sufficient number of Eastern German plants. We treat the dataset as pooled cross-section, resulting in a total of 68,926 establishment-year observations.

Household data For the distributional analysis, we employ the static tax/benefit module of IZAΨMOD, IZA's microsimulation and labour supply model, which is based on the German Socio Economic Panel Study (GSOEP). GSOEP was started in 1984 as a representative cross-section of the adult population living in private households in (Western) Germany. In June 1990 an East German sample was added (see Wagner et al. (2007)). Thanks to oversampling certain groups and refresher samples, the data remain representative of the entire German population with about 25,000 individual respondents in a cross section.

The main purpose of GSOEP is to measure well-being. Next to information on psychological and, more recently, on behavioral dimensions, the principal focus is on household income, which is also the most important input into IZAΨMOD. For the present paper, information drawn from the GSOEP includes labour-market status, gross wage, job type, benefits, industry, working time, household composition, age, education levels and housing costs. We use the 2007 wave. In order to make information consistent with the year of analysis (2008 for our baseline), we using a static ageing technique which allows controlling for changes in global structural variables as well as a differentiated adjustment for different income components.[13]

The static tax benefit module of IZAΨMOD incorporates all important features of the German tax and transfer system (for details, see Peichl et al. (2010)). IZAΨMOD allows us to first convert predicted employment and gross-earnings changes into net income effects at the household level.

[13] Cf. Gupta & Kapur (2000) for an overview of the techniques to modify the data for the use in microsimulation models.

4 Labor Demand Estimation

4.1 A structural demand model

Almost all studies that estimate labor demand depart from the dual approach, that is, assuming a constant output, cost minimization yields the same factor demands as profit maximization (Hamermesh (1993), p. 25). In general, we are faced with a cost function of some form. We apply Shephard's lemma and take the derivate of the cost function with respect to the price of the input factor, i.e. the wage, and get demand functions of each labor input, which can be estimated.

There are several ways of specifying the cost function of the firms. We choose the Generalized Leontief (GL), which belongs to the family of flexible functional forms that do not restrict the substitution elasticities of input factors and are, on that basis, preferred to Cobb-Douglas or CES-functions. Besides the Translog and the Quadratic cost function, GL is the most commonly used flexible functional form.[14].

The GL cost function is a linear second-order approximation to an arbitrary cost function. It goes back to the work of Diewert (1971). In practice, there are numerous different specifications of the firms' cost function depending on the purpose and the context of the study.[15] We take as a starting point a specification by Morrison (1988), but adapt it by allowing for non-constant returns to scale following Park & Kwon (1995). This provides for more flexibility in the change in output, which is important in the context of our study. We further do not include capital in our function, as also done by Diewert & Wales (1987), since we explicitly want to estimate a short-term cost function and assume that capital is fixed in the short-term. Short term costs C are defined as

$$C = Y(\sum_i \sum_j \alpha_{ij} w_i^{0.5} w_j^{0.5} + \sum_i \beta_{iY} w_i Y^{0.5} + \sum_i w_i \beta_{YY} Y) \tag{1}$$

where Y and w_i denote output and the wage of skill group i. The symmetry conditions $\alpha_{ij} = \alpha_{ji}$, $\forall i, j$, are imposed on the coefficients. Constant returns to scale can be imposed by setting $\beta_{iY} = \beta_{YY} = 0$ (see Morrison (1988)).

Differentiating C with respect to wages w_i yields the factor demands X_i. Dividing by

[14] For a textbook presentation of the TL and GL specification, cf. e.g. Berndt (1991). For an overview on the theoretical properties, see Diewert & Wales (1987).

[15] There are especially three issues, which have to be carefully considered, when specifying the functional form of the model. First, the treatment of capital differs depending on the time horizon assumed. Secondly, the inclusion on control variables is closely related to the research questions and, finally, a choice has to be made on the degree of homogeneity in output. Basically, there are two ways: Firstly, assuming linear homogeneity in output, i.e. constant returns to scale (CRS), or, secondly, assuming non-constant returns to scale (NCRS). Peichl & Siegloch (2010a) show how decisions on the those three issues affect the functional form of the firms' costs and the results.

Y gives us the system of input-output ratio R_i which is to be estimated.

$$R_i = \alpha_{ii} + \textstyle\sum_{j\neq i} \alpha_{ij} \left(\frac{w_j}{w_i}\right)^{0.5} + \beta_{iY} Y^{0.5} + \beta_{YY} Y \tag{2}$$

In order to derive wage elasticities of labor demand, the input-output ratios R_i are multiplied with output Y to arrive at the factor demands X_i and X_i is differentiated with respect to w_i and w_j to get own-wage and cross-wage elasticities. The own-wage elasticity conditional on output is

$$\epsilon_{ii} = \frac{\partial X_i}{\partial w_i} \frac{w_i}{X_i} = -0.5Y \frac{\sum_{j\neq i} \alpha_{ij} w_j^{0.5}}{X_i w_i^{0.5}} \tag{3}$$

and the cross-wage elasticity is

$$\epsilon_{ij} = \frac{\partial X_i}{\partial w_j} \frac{w_j}{X_i} = 0.5Y \frac{\alpha_{ij} w_j^{0.5}}{X_i w_i^{0.5}} \tag{4}$$

Since we are especially interested in the comparative-static effect of output shocks, we also have to derive the output elasticity of input demand, a measure, which is less common in the literature. We differentiate X_i with respect to Y, to get $\frac{\partial X_i}{\partial Y} = \alpha_{ii} + \sum_{j\neq i} \alpha_{ij} \left(\frac{w_j}{w_i}\right)^{0.5} + 1.5\beta_{iY} Y^{0.5} + 2\beta_{YY} Y$. Simplifying and rearranging gives us the output elasticity of input demand[16]

$$\epsilon_{iY} = \frac{\partial X_i}{\partial Y} \frac{Y}{X_i} = 1 + \frac{Y(0.5\beta_{iY} Y^{0.5} + \beta_{YY} Y)}{X_i} \tag{5}$$

4.2 Empirical Model and Estimation Method

In order to assess the distributional impact of a downturn in as much detail as possible, we start by defining a large number of different labor demand inputs. We differentiate between three skill/education levels, three age groups and three employment types, which gives us 27 labor demand functions. High-skilled workers hold a university, polytechnical or college degree. Medium-skilled employees have either completed a vocational training or obtained the German highest high school diploma (the *Abitur*). Unskilled workers have neither completed vocational training nor obtained the *Abitur*.[17] Age groups are defined as 15 to 29, 30 to 54 and 55 to 64 years old. We differentiate between full-time workers,

[16] For the calculation of all elasticities we use fitted values following Berndt (1991).

[17] With that specification we follow several studies, such as Steiner & Wagner (1997), Buslei & Steiner (1999), Bellmann et al. (2002), Kölling & Schank (2002) or Addison et al. (2008).

part-timers and the group of irregular employees, defining irregular as being marginally employed under the German Minijob and Midijob programmes.

For the estimation we add disturbance terms ε_i, $i = 1, .., 27$ to each of the input-output ratios (2). The resulting disturbance vector $\varepsilon = \{\varepsilon_1, ..., \varepsilon_{27}\}$ is assumed to be multivariate and normally distributed with mean vector zero and constant covariance matrix Ω (Berndt (1991)). We thus arrive at a system of $n = 27$ equations for each firm.[18]

The system (2) is estimated by using the method of Seemingly Unrelated Regression (SUR) developed by Zellner (1962). Although consistency is not lost when estimating the equations separately with ordinary least squares (OLS), SUR is more efficient. The main advantage of SUR is that error terms can be contemporaneously correlated across regressions. In a first step, SUR uses equation-by-equation OLS to obtain the covariance matrix of the error terms, Ω. Then a generalized least squares (GLS) estimation is performed on the system of equations, conditional on Ω (see Greene (2008)).[19]

4.3 Descriptive statistics

We estimate the 27 input output ratios separately for five industries: (1) manufacturing, (2) construction, (3) trade and traffic, (4) services and (5) the financial sector. The whole public sector is excluded, since civil servants are not observed in the data. Table 1 shows the number of firms-years per industry in the 1996-2007 pooled cross-section. Manufacturing and services are by far the largest groups.

Table 1: Number of firm (establishment) years per industry

Year	Total	Share
Manufacturing	26,278	38.12
Construction	8,153	11.38
Traffic & Trade	12,859	18.66
Services	19,349	28.07
Financial Sector	2,287	3.32
Total	68,926	100

Source: Own calculations using LIAB.

[18] It is possible but not necessary to estimate that system together with the underlying cost function. (Greene (2008), footnote 30 on p. 278). The advantage of including a cost function is that one gets estimates of parameters that do not show up in the cost shares, such as α_0. This is especially useful (and sometimes necessary) when assuming mor complex cost functions. The disadvantage, however, is that we increase the number of restrictions that have to be imposed on the system. In our case, that is why we decided not include the cost function (see below for more on that issue).

[19] As the equation system is considerably large and $\sum_{k=1}^{26} k = 351$ cross-equation restrictions have to be imposed on the wage coefficients so that $\alpha_{ij} = \alpha_{ji}$. In order to make the system not too restrictive we do not impose condition that β_{YY} is constant overall 27 input output ratios as suggested by equations (1) and (2).

Table 2 provides an overview of selected worker characteristics. For every year under consideration we exploit information on at least 2 million workers recorded by the official employment statistics.

Table 2: Worker charactersitics

	2007
Observations	1,972,278
% female	38.80
% foreigner	6.08
% working in East	20.58
Median wage	2928
Skill level	
% high-sk.	20.69
% medium-sk.	66.19
% low-sk.	13.12
Age groups	
% young	9.75
% medium	75.28
% old	14.97
Average age	41.7
Job type	
% fulltime	72.01
% part time	17.36
% irregular	10.64

Source: Own calculations using LIAB. Note: median wage in 2008 prices.

Finally, table 3 provides frequencies and average monthly wages for every cell, based on weighted observations.

4.4 Estimation results

With 27 equations for each industry, we can differentiate between 135 different labour-demand reactions to a given output shock. For each industry, the joint estimation of system (2) employs 351 cross-equation restrictions[20]. For every sector the overall fit of the model is reasonably good (see Appendix). Moreover, almost all coefficients on wage ratios are highly significant[21].

[20] $\alpha_{ij} = \alpha_{ji}$ for all $i, j = 1, ...n$, $i \neq j$ yields $\frac{n(n-1)}{2}$ constraints.
[21] Detailed regression statistics are available upon request.

Table 3: Average number of worker and wages by cell

Dimension	Manu		Constr		TrafTrad		Servic		Finan	
averages	Heads	Wage	Heads	Wage	Heads	Wage	Heads	Wage	Heads	Wage
High sk.	5.27	2320	1.80	1939	2.64	1583	4.13	1715	3.68	2564
Med. sk.	24.79	2179	8.17	2119	10.32	1874	6.46	1651	25.92	2540
Low sk.	8.07	1554	2.11	1403	2.30	1237	1.67	924	2.41	1549
Full-time	32.15	2304	10.05	2243	10.70	2146	7.62	2093	23.47	2921
Part-time	2.15	1404	0.31	1279	1.70	1355	1.76	1314	4.89	1714
Irregular	3.83	437	1.72	481	2.87	387	2.88	360	3.65	567
Old	4.74	2084	1.32	1974	1.90	1751	1.35	1670	3.19	2881
Medium	29.39	2197	8.89	2143	11.45	1858	9.19	1700	24.97	2555
Young	3.99	1084	1.87	1128	1.92	925	1.71	821	3.85	1566
Total	**38.13**	**2066**	**12.08**	**1967**	**15.27**	**1727**	**12.26**	**1574**	**32.01**	**2469**

Source: Own calculations using LIAB. Note: Heads in persons; Wages in 2008 euros per month.

More than 80 percent of our own-wage elasticities as set up by equation (3) are negative as demanded by theory. We consider this satisfactory taking into account the complex substitution pattern we need to assume across the 27 labour inputs. Nevertheless, elasticities for some cells exceed the values reported in the literature by a considerable margin, although we note that direct comparisons are not possible as we differentiate between a much larger number of labour inputs than is commonly done.[22]

To test the theoretical fit of the demand model we employ two criteria proposed by Berndt (1991). First, all predicted input/output ratios should be greater than zero and, second, the condition $\sum_j \mu_{ij}$ should be fulfilled for all i.[23] The adding up condition is indeed met for all input factors and industries and the predictions of the input-output ratios are on average positive for every sector as well. They are, however, not always positive for each single combination of industry / labour input. On average, the predicted input-output ratios fit theory in more than two thirds of the cases. One exception is the financial sector, where only slightly more than half of the predicted ratios are in fact positive. In this sector, the number of oberservation is by far the lowest and output measurement is less straightforward. These factors will need to be investigated further in subsequent versions of this paper.

Table 4 presents output elasticities, following equation (5). For better readability, we present output elasticities averaged across 9 groups, rather than the full 27. All group

[22] As the focus of this paper is not on wage elasticities, we do not report the full results. They are available on request.

[23] There is a third criterion proposed by Berndt that is, in order for C to be quasi-concave in input prices the nxn matrix of the substitution elasticities has to be negative semi-definite at each observation. This check has not been established, yet.

elasticities are positive, as suggested by theory.[24]

Table 4: Output elasticities

Group averages	Manu	Constr	TrafTrad	Servic	Finan	**Total**
High skilled	0.93	0.73	1.16	0.91	1.02	**0.96**
Medium skilled	0.84	0.67	0.69	0.71	0.96	**0.83**
Low skilled	1.20	0.99	0.81	0.86	0.57	**0.99**
Fulltime	0.93	0.73	0.99	0.82	0.95	**0.91**
Parttime	0.83	0.66	0.66	0.69	0.95	**0.82**
Irregular	1.11	1.01	0.81	0.91	0.53	**0.95**
Old	0.84	0.70	0.92	0.69	0.88	**0.83**
Medium	0.41	0.36	0.37	0.38	0.48	**0.42**
Young	0.60	0.73	0.58	0.71	0.35	**0.59**
Total	**0.93**	**0.74**	**0.79**	**0.79**	**0.94**	**0.88**

Source: Own calculations using LIAB. Note: All numbers are averages weighted by the number of workers in the respective cells.

The average output elasticity of labor demand across all cells is 0.88. Labor demand reacts most strongly to an output change in the manufacturing and financial sector, with elasticities of 0.93 and 0.94. The results by education group suggest that, in most industries, medium skilled employees are neither hired as quickly in a boom nor fired as fast in a recession as the two other groups. Demand for older workers varies the most with changes in output, followed by the young. Labor demand for medium-aged tends to be the most robust with respect to output variation. Overall, output elasticities are largest for low-skilled and irregular workers in the manufacturing industry and, perhaps more surprisingly, high-skilled workers in the trade and financial-services sectors.

4.5 Output and employment shocks

In order to predict how a change in output translates into a change in employment given the output elasticities of labor demand presented in table 4, we first need to define the relative output shock by industry. As reference period we choose the overall change in output, which occured between the years 2008 and 2009, as this period corresponds reasonably well to the onset of the most recent downturn, and the associated drop in output. Table 5 shows absolute and relative changes in value added as reported by the German Federal Statistical Office.

Output decreased in all industries but the service sector. Overall, the German economy shrunk by five percent from 2008 to 2009. In particular, the decline in manufacturing

[24] On the cell level there are a few cases with negative output elasticities (12 cells out of 135), suggesting that some of the cells may need to be collapsed.

Table 5: Overall change of value added

Industry	2008	2009	Change (%)
Manufacturing	116.52	95.65	-18
Construction	81.93	81.33	-1
Traffic and Trade	114.25	108.48	-5
Services	108.62	109.69	+1
Financial Services	117.45	115.54	-2

Source: German national accounts, constant prices, chain-linked index (2000=100).

output, a slump of almost 20 percent, is noteworthy.

Multiplying these output changes with output elasticities of labor demand yields relative labour-input reductions for each of the 135 cells. Table 6 summarizes the resulting employment changes by reporting average changes for selected group, and assuming uniform output shocks within industries.

Table 6: Predicted change in total labour input by group

Group averages	Manu	Constr	TrafTrad	Servic	Finan	**Total**
High sk.	-0.17	-0.01	-0.06	0.01	-0.02	**-0.06**
Med. sk.	-0.15	-0.01	-0.03	0.01	-0.02	**-0.06**
Low sk.	-0.22	-0.01	-0.04	0.01	-0.01	**-0.11**
Full-time	-0.17	-0.01	-0.05	0.01	-0.02	**-0.07**
Part-time	-0.15	-0.01	-0.03	0.01	-0.02	**-0.06**
Irregular	-0.20	-0.01	-0.04	0.01	-0.01	**-0.10**
Old	-0.15	-0.01	-0.05	0.01	-0.02	**-0.06**
Medium	-0.07	0.00	-0.02	0.00	-0.01	**-0.03**
Young	-0.11	-0.01	-0.03	0.01	-0.01	**-0.06**
Total	**-0.17**	**-0.01**	**-0.04**	**0.01**	**-0.02**	**-0.07**

Source: Own calculations using LIAB. Note: All numbers are averages weighted by the number of workers in the respective sub-cells.

The predicted reduction of labor demand is 7 percent on aggregate across the industries in our sample. In the manufacturing industry, a large decline in output combined with above-average elasticities results in high layoff-risks. Since available output data have forced us to assume the same output shock for all firms in a given industry, the employment changes for different types of workers within industries mirror the elasticities reported in Table 4. For instance, in the manufacturing sector, low-skilled and irregular workers are the most likely to be affected by jobs or earnings losses. And in most industries, older workers are predicted to face a more substantial decline in job opportunities than younger and middle-aged individuals.

Table 7 compares the predicted average total changes by industry to relevant observed changes in employment quantities over the same period.

Table 7: labour-input adjustments following the 2008-2009 output shock: observed and predicted

Employment Effects	Manu	Constr	TrafTrad	Servic	Finan	Total
Heads (thousands)						
2008	7,667	2,193	10,046	12,140	7,010	39,056
2009	7,457	2,197	10,081	12,379	6,907	39,021
Absolute change	-210	4	35	239	-103	-35
Relative change (in %)	-2.7	0.2	0.4	2.0	-1.5	-0.09
Total hours (millions)						
2008	21,312	2,680	11,505	14,516	8,205	58,218
2009	19,240	2,628	11,267	14,636	7,843	55,614
Absolute change	-2,073	-52	-238	120	-362	-2,605
Relative change (in %)	-9.7	-1.9	-2.1	0.8	-4.4	-4.4
Prediction (in %)	-16.7	-0.7	-3.9	0.8	-1.9	-6.88

Sources: Institute for Employment Research, IAB, and own calculations using LIAB (predictions).

As highlighted in Section 2, employment levels have changed surprisingly little since the beginning of the downturn. In fact, employment fell in only two of the five industries. In contrast, total hours worked did see a substantial drop over a relatively short period of time, with a very large drop of about 10% in total hours in the manufacturing sector.

The comparison with observed changes over a specific period (here 2008-2009) provides an interesting indication of the plausibility of predicted patterns of employment changes. Importantly, however, there is no reason to expect a perfect match. The demand model currently does not incorporate an explicit time horizon and is therefore not predicting employment changes over the first twelve months after an output shock (or any other specific period). In fact, since the model is estimated based on a 12-year pooled cross-section, the resulting coefficients are best interpreted as summarizing employment changes over the short- to medium-term.

Since labour-input adjustments during 2008-2009 were, on aggregate, almost entirely along the intensive margin, total hours worked is the most interesting measure when comparing observed data with model predictions. In terms of the overall pattern of changes in total working hours, and with the exception of the financial sector, the model predictions match the observed year-on-year changes reasonably well. The predictions for the manufacturing and traffic&trade sectors are, however, much bigger than the observed values. The interpretation of this mismatch is that recent labour-input adjustments in these two sectors are significantly less than would be expected from the correlation of output and employment over the 1996-2007 period. Put differently, historical data suggest that the extent of labour hoarding observed in these two industries thus far may not be sustainable and that further adjustments may be expected if output remains at or around current levels.

5 Distributional effects of the crisis

5.1 Cell identification and shock scenarios

We now feed the predicted employment shocks for each cell into the GSOEP, a representative micro dataset, often used for distributional analyses. The first task consists in identifying in the GSOEP data the same cells as defined in the labor demand model. The GSOEP is informationally rich and allows us to differentiating by skill, age, employment group and industry, just as we did in the linked employer-employee data. Only a marginal number of GSOEP cells were found empty – those correspond to very specific situations found over the many years covered by the linked employer-employee data but not representative in the single-year GSOEP wave, and hence are not a matter of concern.

The rest of the procedure consists in imputing the specific employment shocks previously predicted at the cell level. Labour-input adjustments can materialize either as a change in worked hours (e.g., switch from full to part time) or at the extensive margin (hiring or redundancies). To assess the sensitivity of the total distributional impact with respect to the margin of adjustment, we initially suggest two polar scenarios. In the first one, we change the working hours proportionally to the total change in labor demand at the cell level (holding employment levels constant). As highlighted above, this scenario corresponds approximately to the aggregate adjustment pattern observed in Germany since the beginning of the downturn, and is therefore of particular interest (see table 7). The second adjustment scenario consists in changes in employment rates at cell level (holding working hours per employee constant). If the total predicted employment effect for a given cell is $-X\%$, we draw randomly $X\%$ of workers within the GSOEP cell and make them unemployed.[25] In reality, unemployment risks are of course not randomly distributed. However, in the context of our distributional analysis, the draw will have no noticeable impact as cell definitions are already highly disaggregated and cell sizes small. Any non-random modelling attempt would, in any case, run into difficulties as it would have to utilise characteristics (such as age, education) that are similar to the ones used to

[25] Inversely, if a positive shock occurs in a cell, we allow for unemployed persons (including those made redundant in other cells) to be hired in that cell. These persons have to match the age and skill level requirement of the cell and will adopt the working time of that that cell, either part-time, full-time or irregular.

distinguish cells. As shown in the distributional analysis below, these two simple scenarios are sufficient for illustrating a range of interesting effects. We keep for further research some intermediary scenarios based on more realistic combinations of the intensive and extensive margins.

5.2 Distributional results

The distributional analysis is based on GSOEP data before and after the different employment shocks. We denote by "0" the pre-crisis (baseline) situation; by "1" the post-crisis scenario resulting from adjustments along the intensive margin only; and by "2" the post-crisis scenario resulting from extensive-margin adjustments. We look at the distributions of both gross and net incomes in order to capture the cushioning effect of the tax-benefit system. Net incomes are calculated with IZAΨMOD using 2008 (2009) policy parameters for the pre-crisis (post-crisis) situations. It is important to note, however, that the post-crisis scenarios do *not* yet account for benefits paid through the short-time working programme. This is relevant when considering the distributional effects reported for the "intensive" scenario below: they are based on the income changes that working-hours reductions would have produced in the absence of compensating payments through a short-time working scheme.

All income measures account for the incomes brought in by other household members (we use the so-called "modified OECD " equivalence scale to make incomes comparable across households with a different size or composition). Capturing the household context is, of course, a principal reason for performing the distributional analysis on the GSOEP data, rather than the individual-based LIAB. It turns out that accounting for the household context is indeed essential for understanding the distributional results.

Table 8 shows large working-hours changes for workers in the manufacturing industry mirroring the predicted labour-input adjustment in Table 6.[26] Gross earnings closely follow changes in working hours. They are not the same, however, since working hours are shown on an individual basis, whereas incomes are measured on an "equivalised" basis and, hence, also affected by the incomes of other household members. The same is true for the individuals in the "other" category. This large group includes the non-employed as well as those working in industries which we excluded from our establishment sample (agriculture and, much more important, the public sector). For all these individuals, we

[26] Note that, in the "intensive" scenario, the working-hours changes in all industries match the predictions from the demand model almost exactly. This is not self-evident, as the predictions have been applied cell-by-cell from the LIAB data to the GSOEP. The match indicates that GSOEP data provide a representative sample of workers by industry. Working-hours changes shown for the "extensive" scenarios differ slightly. This is due to the way cells were adjusted when making people unemployed (see Section 5.1).

assume that working hours and any earnings remain the same as in the baseline scenario. Incomes shown for this group in Table 8 decrease nonetheless; this is again due to the losses experienced by other household members.

Across industries, low-skill and irregular workers are found to suffer the biggest earnings losses. It is interesting to note that changes in earnings for irregular and part-time workers exceed the average working-hours reductions for these groups. This indicates that they are frequently secondary earners, whose partners may be experiencing even bigger drops in earnings. Young individuals are also seeing large losses on average. Average losses (as well as working-hours reductions) are even larger than for the older age group, despite the earlier finding in Table 6 that older workers are somewhat more likely to face job loss or working-time reductions than young workers. The reason is that older workers are much more likely to be living with a partner whose income partly shields them from a drop in household incomes. Looking at different family types, the most striking result is that single parents are much less strongly affected by lower earnings because relatively few of them are in employment (and because, by definition, they do not have a partner whose job or earnings loss might reduce household resources).

Comparing changes in gross and net income gives some indication of the effectiveness of social safety nets at absorbing some of the income loss. The income of low-skilled workers and working lone parents is likely to be relatively close to the level of minimum-income benefits. Safety-net benefits therefore absorb a large part of their earnings losses on average resulting in large differences between gross and net earnings changes. Reflecting the EUR 400/800 earnings ceilings of the Mini/Midijob programme, the average wages of those in the "irregular" category are even lower than for the low-skilled group (Table 3 above). However, these jobs are especially attractive for second earners and holder of irregular jobs are therefore more likely to have a partner with higher earnings, and, hence, less likely to receive means-tested benefits when losing all or part of their own earnings. Unsurprisingly, the difference between gross and net earnings changes is more pronounced in the "extensive" scenario, as job losers are likely to be entitled to unemployment insurance benefits.

How do these group effects map into changes for different income groups? This is shown in table 9, which presents the same changes of incomes and working hours by decile group (Table 16 in the appendix shows the same information in absolute values). Interestingly, relative net income losses in the "intensive" scenario are very similar from decile three to ten. Perhaps even more strikingly, the lowest two decile groups see the smallest net income changes. Many of the poorest 10 percent were already out of work before the crisis. Those in the second decile group do see much larger gross income losses, but these are partly cushioned by means-tested minimum-income benefits.

Table 8: Relative change in earnings and hours by group (in %)

	Scenario 1: intensive			Scenario 2: extensive		
	Gross1	Net1	Hours1	Gross2	Net2	Hours2
High skilled	-3.1	-2.4	-2.7	-3.9	-2.7	-3.4
Medium skilled	-4.1	-2.7	-4.0	-4.5	-2.7	-4.3
Low skilled	-7.4	-3.5	-7.5	-7.5	-2.8	-7.2
Full-time	-3.8	-2.9	-4.0	-4.4	-3.1	-4.7
Part-time	-3.6	-2.4	-1.7	-4.1	-2.6	-2.2
Irregular	-4.2	-2.7	-1.9	-4.6	-2.2	-2.0
Young	-4.7	-2.9	-4.6	-5.3	-2.8	-5.0
Medium	-4.1	-2.9	-3.9	-4.4	-2.8	-4.1
Old	-2.3	-1.4	-1.6	-3.7	-2.1	-3.8
Manufacturing	-12.9	-9.8	-16.6	-13.1	-8.9	-16.9
Construction	-1.4	-1.0	-0.8	-1.3	-0.9	-0.6
Traffic / Trade	-4.6	-3.3	-4.5	-6.0	-4.0	-5.8
Services	-0.9	-0.6	+1.0	-1.7	-1.1	0.0
Fin. Services	-1.8	-1.4	-1.9	-1.9	-1.4	-1.6
Other	-0.6	-0.5	0.0	-0.3	-0.2	0.0
Single	-3.6	-2.5	-3.9	-3.8	-2.2	-3.9
Childless Couple	-4.0	-2.9	-3.9	-4.7	-3.5	-4.7
Single parents	-1.7	-0.4	-1.9	-1.9	-0.5	-1.8
Couple w/ children	-4.0	-2.8	-4.0	-4.2	-2.3	-3.9
Total	-3.9	-2.6	-3.8	-4.4	-2.7	-4.1

Source: Own calculations using GSOEP and IZAΨMOD. Note: Incomes are equivalized (modified OECD scale), working hours are shown on an individual basis.

Table 9: Relative change in earnings and hours by income decile (in %)

	Scenario 1: intensive			Scenario 2: extensive		
Deciles	Gross1	Net1	Hours1	Gross2	Net2	Hours2
1	-2.2	-0.1	-2.2	+4.5	+0.3	+2.0
2	-4.2	-0.7	-4.1	-3.8	-0.8	-4.0
3	-5.2	-3.1	-3.7	-5.6	-1.7	-4.5
4	-4.0	-2.8	-3.8	-3.6	-1.7	-3.7
5	-4.3	-3.0	-4.4	-4.3	-2.3	-4.1
6	-4.1	-2.8	-3.8	-4.4	-2.6	-4.0
7	-3.7	-2.8	-3.8	-4.8	-3.4	-4.8
8	-4.4	-3.1	-4.3	-6.0	-4.2	-5.8
9	-3.4	-2.6	-3.0	-4.0	-3.1	-3.6
10	-3.5	-2.9	-3.3	-3.9	-3.2	-3.9
Total	-3.9	-2.6	-3.8	-4.4	-2.7	-4.1

Source: Own calculations using GSOEP and IZAΨMOD. Note: Incomes are equivalized (modified OECD scale), working hours are shown on an individual basis. Decile groups are for the our selected sample only (working-age individuals and household members) and are based on the "pre-crisis" baseline.

A different picture emerges if firms implement the predicted labour-input adjustments entirely through layoffs ("extensive" scenario). Gross income losses tend to by more concentrated among higher-income groups. To understand the pattern of gross income changes, and, in particular, the significant increase in the lowest income group, it is important to remember that, given increasing output in one of the sectors (services), the demand for labour is predicted (and also observed) to go up in several of the employee cells. To achieve this increase using only extensive employment adjustments, it is necessary for some unemployed people in these cells to be matched to these new jobs. In the top 9 income groups, some of those losing their jobs find new ones in the expanding industry. But given the magnitudes of job losses in other sectors, most remain without a job, resulting in significant declines in average earnings and hours. This is not the case in the bottom decile group, where a large majority of individuals were without a job before the crisis. The number of job losses in this income group is therefore very limited and even a small number of new job matches can result in a net employment increase. Clearly, this result is in part a result of the "extensive" scenario allowing adjustments only in terms of employment levels. In the context of a severe recession, it is possible, and indeed likely, that firms prefer to increase working time rather than employing new workers. Yet, statistics reported in Table 7 show that employment levels in the service sector saw an increase of 2% (or 239,000) between 2008 and 2009, while the increase in working time over the same period amounted to less than half that.

Table 10: Inequality and poverty measures and relative change

	Net0	Net1	$\not\Delta$	Net2	$\not\Delta$
Gini	0.249	0.249	-0.002	0.257	0.031
GE0	0.100	0.099	-0.011	0.106	0.058
GE1	0.101	0.101	-0.002	0.107	0.059
GE2	0.112	0.113	0.007	0.119	0.064
P9010	3.232	3.165	-0.021	3.398	0.051
FGT0	0.153	0.163	0.065	0.186	0.219
FGT1	0.026	0.026	0.024	0.032	0.237
FGT2	0.006	0.006	0.011	0.008	0.235
FGT0v	0.153	0.141	-0.081	0.165	0.079
Rich	0.057	0.051	-0.097	0.054	-0.047
Richv	0.057	0.057	0.009	0.063	0.115

Source: Own calculations using GSOEP and IZAΨMOD. Note: Measures are based on equivalized disposable incomes (modified OECD scale). The poverty (richness) line is set at 60% (200%) of median income and is either fixed for the baseline or variable for each scenario (indicated with a "v")..

Finally, Table 10 reports a range of global distribution measures as well as relative poverty and richness (affluence) measures. Looking only at the patterns of income changes by decile group reported in the previous table 8 above, one might even suspect that overall inequality could go down. However, the global measures show that this is not the case: while average income losses of upper decile groups exceed those of the bottom groups, there is a sufficient degree of re-ranking to more than compensate the apparent narrowing of income differences between decile groups. An important result is that global inequality measures change hardly at all in the "intensive" scenario while the same amount of total working-hours adjustments in the for of layoffs results in a significant increase of both the Gini and the GE measures. This illustrates that policies that successfully facilitate working-hours adjustments can play an important role in limiting the growth of income disparities during a downturn.

They cannot avoid them, however. The poverty indicators show a very substantial movement of individuals across given income thresholds. Using a constant poverty line, the poverty headcount increases by 7 and 22 percent in the "intensive" and "extensive" scenarios. With a floating line, the effect is much smaller: since median income (and, hence, the poverty threshold) decline more strongly than incomes at the very bottom of the distribution, relative poverty actually declines in the "intensive" scenario. These results underline the importance of evaluating relative poverty measures alongside absolute changes in income levels, especially when assessing the distributional consequences of rapid economic change.

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A Appendix

Equation	Observations	Parameters	RMSE	R-sq	chi2	P
io_hof	1.60E+06	26	2.52E-06	0.0116	51195.66	0.0000
io_mof	1.60E+06	26	3.95E-06	0.0205	37024.03	0.0000
io_uof	1.60E+06	26	1.54E-06	0.085	159865.5	0.0000
io_hop	1.60E+06	26	6.17E-07	0.0037	19736.66	0.0000
io_mop	1.60E+06	26	1.89E-06	0.0146	43075.3	0.0000
io_uop	1.60E+06	26	1.39E-06	0.0037	13554.44	0.0000
io_hoi	1.60E+06	26	2.24E-06	0.0109	11840.69	0.0000
io_moi	1.60E+06	26	3.39E-06	0.0234	35198.76	0.0000
io_uoi	1.60E+06	26	1.36E-06	0.0097	13164.26	0.0000
io_hmf	1.60E+06	26	1.25E-05	0.0008	34599.53	0.0000
io_mmf	1.60E+06	26	2.55E-05	0.024	56360.58	0.0000
io_umf	1.60E+06	26	7.54E-06	0.0255	66050.39	0.0000
io_hmp	1.60E+06	26	2.11E-06	0.0484	83501.29	0.0000
io_mmp	1.60E+06	26	7.08E-06	0.0102	33220.17	0.0000
io_ump	1.60E+06	26	2.38E-06	0.0054	24573.56	0.0000
io_hmi	1.60E+06	26	9.30E-06	0.0086	28375.77	0.0000
io_mmi	1.60E+06	26	8.95E-06	0.0182	15290.63	0.0000
io_umi	1.60E+06	26	3.57E-06	0.0159	32196.06	0.0000
io_hyf	1.60E+06	26	1.88E-06	0.0041	15432.05	0.0000
io_myf	1.60E+06	26	4.44E-06	0.0086	9687.99	0.0000
io_uyf	1.60E+06	26	1.18E-06	0.0085	17428.07	0.0000
io_hyp	1.60E+06	26	7.37E-07	-0.0011	7855.4	0.0000
io_myp	1.60E+06	26	7.41E-07	0.0068	16372.67	0.0000
io_uyp	1.60E+06	26	3.66E-07	0.0132	16195.77	0.0000
io_hyi	1.60E+06	26	3.25E-06	0.0172	32773.03	0.0000
io_myi	1.60E+06	26	3.17E-06	0.0684	114162.7	0.0000
io_uyi	1.60E+06	26	1.18E-05	0.0066	45302.91	0.0000

Table 11: Estimation statistics: manufacturing

Equation	Observations	Parameters	RMSE	R-sq	chi2	P
io_hof	1.20E+06	26	2.46E-06	0.0092	23782.25	0.0000
io_mof	1.20E+06	26	3.01E-05	0.0133	19055.84	0.0000
io_uof	1.20E+06	26	1.47E-06	0.0153	28171.46	0.0000
io_hop	1.20E+06	26	1.85E-07	-0.0527	10370.77	0.0000
io_mop	1.20E+06	26	2.05E-06	0.0066	19285.44	0.0000
io_uop	1.20E+06	26	1.39E-07	-0.0201	7578.78	0.0000
io_hoi	1.20E+06	26	1.97E-06	0.0057	9364.88	0.0000
io_moi	1.20E+06	26	4.17E-06	0.0064	10721.61	0.0000
io_uoi	1.20E+06	26	5.31E-07	0.0269	29819.05	0.0000
io_hmf	1.20E+06	26	1.84E-05	0.0122	33819.63	0.0000
io_mmf	1.20E+06	26	5.26E-05	0.0225	38873.04	0.0000
io_umf	1.20E+06	26	8.55E-06	0.0083	16839.13	0.0000
io_hmp	1.20E+06	26	3.39E-06	0.0134	16035.61	0.0000
io_mmp	1.20E+06	26	6.83E-06	0.0126	26058.4	0.0000
io_ump	1.20E+06	26	3.99E-07	0.0024	3656.89	0.0000
io_hmi	1.20E+06	26	7.73E-06	0.0147	22827.21	0.0000
io_mmi	1.20E+06	26	0.000015	0.0144	26660.4	0.0000
io_umi	1.20E+06	26	2.05E-06	0.0247	29006.43	0.0000
io_hyf	1.20E+06	26	7.91E-06	0.0042	11171.66	0.0000
io_myf	1.20E+06	26	9.60E-06	0.0264	19414.27	0.0000
io_uyf	1.20E+06	26	1.81E-05	-0.0001	10936.24	0.0000
io_hyp	1.20E+06	26	5.68E-08	-0.5402	6059.2	0.0000
io_myp	1.20E+06	26	8.01E-07	0.0036	10496.52	0.0000
io_uyp	1.20E+06	26	6.31E-07	0.0032	6706.33	0.0000
io_hyi	1.20E+06	26	2.60E-06	0.0206	26213.9	0.0000
io_myi	1.20E+06	26	2.74E-06	0.0163	17136.57	0.0000
io_uyi	1.20E+06	26	6.31E-06	0.0302	19559	0.0000

Table 12: Estimation statistics: construction

Equation	Observations	Parameters	RMSE	R-sq	chi2	P
io_hof	2.40E+06	26	1.52E-05	0.0061	138221.6	0.0000
io_mof	2.40E+06	26	1.01E-05	0.0218	82229.44	0.0000
io_uof	2.40E+06	26	2.02E-06	0.013	54675.17	0.0000
io_hop	2.40E+06	26	2.90E-06	0.0011	26151.82	0.0000
io_mop	2.40E+06	26	5.39E-06	0.0217	95327.38	0.0000
io_uop	2.40E+06	26	4.36E-07	-0.0502	18885.42	0.0000
io_hoi	2.40E+06	26	8.77E-06	0.029	67880.39	0.0000
io_moi	2.40E+06	26	8.11E-06	0.0093	31357.26	0.0000
io_uoi	2.40E+06	26	2.63E-06	0.0088	28241.39	0.0000
io_hmf	2.40E+06	26	0.000121	0.0013	87062.19	0.0000
io_mmf	2.40E+06	26	0.000108	0.0028	81731.23	0.0000
io_umf	2.40E+06	26	6.97E-06	0.0561	191411.2	0.0000
io_hmp	2.40E+06	26	4.19E-06	0.0374	119578.5	0.0000
io_mmp	2.40E+06	26	1.02E-05	0.0261	87257.92	0.0000
io_ump	2.40E+06	26	1.89E-06	0.0279	71882.53	0.0000
io_hmi	2.40E+06	26	2.49E-05	0.009	36362.08	0.0000
io_mmi	2.40E+06	26	1.81E-05	0.0199	42034.65	0.0000
io_umi	2.40E+06	26	7.25E-06	0.0105	31875.21	0.0000
io_hyf	2.40E+06	26	1.51E-05	0.0093	50377.51	0.0000
io_myf	2.40E+06	26	8.24E-06	0.0199	75156.27	0.0000
io_uyf	2.40E+06	26	1.22E-06	0.0113	42974.07	0.0000
io_hyp	2.40E+06	26	6.13E-07	0.005	27186.7	0.0000
io_myp	2.40E+06	26	1.69E-06	0.0035	20774.38	0.0000
io_uyp	2.40E+06	26	3.57E-07	-0.0115	21654.3	0.0000
io_hyi	2.40E+06	26	3.96E-06	0.0187	53322.37	0.0000
io_myi	2.40E+06	26	4.20E-06	0.0371	75424.38	0.0000
io_uyi	2.40E+06	26	6.32E-06	0.0329	76702.06	0.0000

Table 13: Estimation statistics: traffic and trade

Equation	Observations	Parameters	RMSE	R-sq	chi2	P
io_hof	3.60E+06	26	5.87E-06	0.0367	227561.2	0.0000
io_mof	3.60E+06	26	6.81E-06	0.0459	300981.6	0.0000
io_uof	3.60E+06	26	4.76E-06	0.0042	92202.33	0.0000
io_hop	3.60E+06	26	5.36E-06	-0.0032	43829.7	0.0000
io_mop	3.60E+06	26	8.15E-06	0.0167	203855.5	0.0000
io_uop	3.60E+06	26	1.64E-06	-0.005	49730.13	0.0000
io_hoi	3.60E+06	26	5.25E-06	0.0131	41102.22	0.0000
io_moi	3.60E+06	26	8.52E-06	0.0013	31033.77	0.0000
io_uoi	3.60E+06	26	2.06E-06	0.0119	41345.89	0.0000
io_hmf	3.60E+06	26	4.47E-05	0.0063	102804.9	0.0000
io_mmf	3.60E+06	26	0.000023	0.0329	201551.2	0.0000
io_umf	3.60E+06	26	9.05E-06	0.0106	116572.9	0.0000
io_hmp	3.60E+06	26	2.18E-05	-0.0026	106828.3	0.0000
io_mmp	3.60E+06	26	2.04E-05	0.0028	147569.7	0.0000
io_ump	3.60E+06	26	4.17E-06	0.0004	97718.17	0.0000
io_hmi	3.60E+06	26	0.000024	0.017	66807.78	0.0000
io_mmi	3.60E+06	26	2.29E-05	0.0279	109315.9	0.0000
io_umi	3.60E+06	26	6.38E-06	0.0451	139106.2	0.0000
io_hyf	3.60E+06	26	4.32E-06	0.0261	131996	0.0000
io_myf	3.60E+06	26	5.52E-06	0.0281	88672.63	0.0000
io_uyf	3.60E+06	26	1.55E-06	0.0062	32739.09	0.0000
io_hyp	3.60E+06	26	1.75E-06	0.0012	15496.78	0.0000
io_myp	3.60E+06	26	2.34E-06	-0.0022	26062.83	0.0000
io_uyp	3.60E+06	26	4.71E-07	-0.004	10091.05	0.0000
io_hyi	3.60E+06	26	8.06E-06	0.0443	145095.8	0.0000
io_myi	3.60E+06	26	7.15E-06	0.046	173310.4	0.0000
io_uyi	3.60E+06	26	9.65E-06	0.0175	77627.83	0.0000

Table 14: Estimation statistics: services

Equation	Observations	Parameters	RMSE	R-sq	chi2	P
io_hof	2.10E+05	26	7.01E-07	0.0374	20334.53	0.0000
io_mof	2.10E+05	26	1.06E-06	0.1262	48333.1	0.0000
io_uof	2.10E+05	26	3.78E-07	0.0427	18237.4	0.0000
io_hop	2.10E+05	26	1.45E-07	0.0131	4160.51	0.0000
io_mop	2.10E+05	26	4.50E-07	-0.0032	6682.97	0.0000
io_uop	2.10E+05	26	9.76E-08	-0.0405	4915.77	0.0000
io_hoi	2.10E+05	26	8.71E-07	0.0686	20430.03	0.0000
io_moi	2.10E+05	26	5.38E-07	0.0513	15090.87	0.0000
io_uoi	2.10E+05	26	3.20E-07	0.0223	4764.12	0.0000
io_hmf	2.10E+05	26	3.29E-06	0.0995	51053.47	0.0000
io_mmf	2.10E+05	26	5.60E-06	0.077	81007.31	0.0000
io_umf	2.10E+05	26	1.90E-07	0.0229	9734.36	0.0000
io_hmp	2.10E+05	26	1.91E-06	0.0387	10386.12	0.0000
io_mmp	2.10E+05	26	1.45E-06	0.06	41105.96	0.0000
io_ump	2.10E+05	26	2.83E-07	-0.0017	6840.47	0.0000
io_hmi	2.10E+05	26	5.19E-06	0.0251	14397.42	0.0000
io_mmi	2.10E+05	26	3.80E-06	0.0158	10543.88	0.0000
io_umi	2.10E+05	26	1.05E-06	0.0188	8701.95	0.0000
io_hyf	2.10E+05	26	3.93E-07	0.0672	19517.23	0.0000
io_myf	2.10E+05	26	1.14E-06	0.062	20818.28	0.0000
io_uyf	2.10E+05	26	2.48E-08	-0.699	3889	0.0000
io_hyp	2.10E+05	26	1.33E-08	-9.7814	3280.7	0.0000
io_myp	2.10E+05	26	5.65E-08	-0.0679	3446.54	0.0000
io_uyp	2.10E+05	26	1.99E-08	-33.2012	5182.81	0.0000
io_hyi	2.10E+05	26	1.36E-06	0.0896	27860.42	0.0000
io_myi	2.10E+05	26	1.19E-06	0.0969	22610.38	0.0000
io_uyi	2.10E+05	26	1.12E-06	0.1257	33411.53	0.0000

Table 15: Estimation statistics: financial services

Table 16: Earnings and hours by income deciles

	Baseline			Scenario 1: intensive			Scenario 2: extensive		
Deciles	Gross0	Net0	Hours0	Gross1	Net1	Hours1	Gross2	Net2	Hours2
1	148	712	6	145	711	5	155	714	6
2	1,342	924	26	1,285	917	25	1,291	917	25
3	2,152	1,111	28	2,041	1,077	27	2,030	1,091	27
4	2,722	1,288	30	2,614	1,252	29	2,624	1,267	29
5	3,015	1,455	34	2,887	1,410	32	2,886	1,421	32
6	3,430	1,619	34	3,289	1,573	33	3,279	1,577	33
7	4,181	1,802	36	4,027	1,752	34	3,979	1,741	34
8	4,750	2,047	35	4,543	1,983	34	4,465	1,961	33
9	6,377	2,419	39	6,162	2,356	37	6,124	2,344	37
10	9,379	3,411	41	9,051	3,313	40	9,014	3,301	40

Source: Own calculations using GSOEP and IZAΨMOD. Note: Incomes per month are equivalized (modified OECD scale), hours are per week.