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# The Importance of Two-Sided Heterogeneity for the Cyclicalities of Labour Market Dynamics

Ronald Bachmann\*      Peggy Bechara †

October 2018

## Abstract

Using administrative data on individual workers' employment history and firms, we investigate the cyclicalities of worker flows on the German labour market. Focusing on heterogeneities on both sides of the labour market, we find that small firms hire much more workers from unemployment than large firms, and that they do so at the very beginning of an economic expansion. Later on in the expansion, overall hirings more frequently result from direct job-to-job transitions to larger firms. Transitions from unemployment to employment at large firms are generally found to be more (pro-)cyclical. However, this stylised fact disappears when the composition of the workforce is controlled for.

**JEL codes:** J63, J64, J21, E24

**Keywords:** worker flows, accessions, hirings, separations, business cycle, job-to-job, employer-to-employer.

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# 1 Introduction

The analysis of the cyclical dynamics of the labour market has been a very active field of research for the last two decades.<sup>1</sup> Interest in this issue has been further increased by the debate about the relative importance of the inflows and outflows of unemployment in this context (Darby, Haltiwanger, and Plant, 1986, and Shimer, 2012). While a consensus seems to emerge that both inflows into and outflows from unemployment have some role to play (Elsby, Michaels, and Solon, 2009, and Fujita and Ramey, 2009), important questions remain unanswered. One crucial question, raised by Elsby, Michaels, and Solon (2009), is “why job-loss-induced inflows to unemployment increase at the beginning of a recession and why outflows do not increase enough to keep unemployment duration from rising.”

An obvious suspect in this context is the heterogeneity of workers and firms. While this issue has been separately analysed in various studies (e.g. Bachmann and Sinning, 2016; Davis, Faberman, and Haltiwanger, 2013; Haltiwanger, Hyatt, and McEntarfer, 2018), the interaction of heterogeneous agents on both sides of the labour market over the business cycle is a process which is still not completely understood, although interest in this topic has grown rapidly in recent years (see Eeckhout, 2018, for an overview). For example, Moscarini and Postel-Vinay (2008) argue that, on the US labour market, specific phases of the business cycle see different types of firms hiring different types of workers, which leads to specific labour market transitions and wage dynamics. In particular, in the early phase of an economic expansion, small firms hire mainly from the ranks of the unemployed, a process which results in relatively low wages. In later phases of an economic expansion, hirings from larger firms predominate. With the pool of unemployed workers having shrunk considerably, this entails more direct job-to-job transitions from small to large firms, and higher wages (see Moscarini and Postel-Vinay, forthcoming, and Haltiwanger, Hyatt, Kahn, and McEntarfer, 2018, for evidence from the US). The importance of heterogeneity on both sides of the labour market is also stressed by Bagger and Lentz (forthcoming), who attribute 51% of wage variation on the Danish labour market to worker heterogeneity, 11% to firm heterogeneity, 15% to sorting, and the remainder to frictions.

Our analysis aims at providing empirical evidence on the cyclical dynamics of the German labour market, with a particular focus on both the hiring and firing behaviour of establishments belonging to different size classes, and the heterogeneity of workers. We do so by using a very rich administrative micro data set spanning more than three decades of workers’ employment history and providing information on dependent-status, social security employment as well as information on the corresponding establishments for West Germany. This data set makes it possible to analyze the role of heterogeneity on both sides of the West German labour market over the business cycle. Furthermore, the data set makes it possible to precisely measure job-to-job transitions, an issue that the

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<sup>1</sup>Analyses of the dynamics of the German labour market are contained in, e.g. Schmidt (2000), Fitzenberger and Garloff (2007), and Bachmann (2005).

literature on the US labour market has struggled with to an extent (Moscarini and Postel-Vinay, forthcoming).

We are thus able to provide a set of stylized facts on this topic, and to conduct a rigorous econometric analysis controlling for both observed and unobserved heterogeneities on both sides of the labour market. In this context, we focus on ex-post heterogeneity (employed/unemployed) on the worker side, but also take into account the general role of composition effects with respect to observable and unobservable factors.<sup>2</sup> In particular, we establish five facts:

1. Large establishments hire mainly from employment (via job-to-job transitions) and nonparticipation, much less so from unemployment. For small establishments, the share of new hires originating from unemployment is much higher. Similar patterns can be observed for the destination states after a job separation.
2. Employment-to-employment transitions are procyclical, and employment-to-unemployment transitions are countercyclical.
3. In recessions, unemployment supplies relatively more workers to establishments of all sizes.
4. Hires out of unemployment appear to be more cyclically sensitive at large establishments than at small establishments.
5. The greater cyclicity of the transitions from unemployment to employment by large establishments seems to be largely due to composition effects.

These facts contribute to the literature on the importance of heterogeneities for the dynamics of worker flows by providing new insights, and by complementing the international picture with evidence from the German labour market. In particular, Fact 1 is related to the findings by Eriksson and Lagerström (2006) who show that, on the Swedish labour market, unemployed job applicants face a lower probability to get contacted by a firm than otherwise identical employed applicants. They argue that this is so because firms view employment status as an important signal for productivity. Nagypál (2006) provides another theoretical argument for why firms might prefer hiring employed, rather than unemployed, workers. Workers arriving from unemployment are less likely to end up in a job they are happy with than employed job searchers. Therefore, previously unemployed workers are more likely to engage in job-shopping and to leave an employment relationship for a more appealing job. Given that hiring workers involves fixed costs, firms can economize on these costs by hiring employed workers. As for separations, Frederiksen and Westergaard-Nielsen (2007) analyse the effects of individual and workplace characteristics, as well as of the business cycle, on individual job separations and the associated destination states in the

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<sup>2</sup>See Abowd and Kramarz (1999) for an analysis of the determinants of worker flows between different labour market states by accounting for various individual and firm characteristics, which were shown to play an important role.

Danish private sector. They find that there is large heterogeneity both within and between destination states.

Fact 2 confirms evidence about the procyclicality of employment-to-employment flows (Fallick and Fleischman, 2004, Nagypál, 2008, and Bjelland, Fallick, Haltiwanger, and McEntarfer, 2011) and the countercyclicality of unemployment-to-employment transitions (Elsby, Michaels, and Solon, 2009), which were also found for some European economies by Burda and Wyplosz (1994). Fact 4 confirms the evidence for hirings provided by Moscarini and Postel-Vinay (2012) for the US economy as well as for Denmark, France, and Brazil, and qualifies it for separations.

Finally, Fact 5 provides new econometric evidence on the importance of labour market heterogeneities for the cyclicity of labour market dynamics. This is in line with findings for the Austrian and for the US labour market by Alvarez, Borovičková, and Shimer (2016) and Bachmann and Sinning (2016), respectively, that composition effects on the worker side play an important role for the exit rate out of unemployment.

Our findings, and especially Facts 3-5, have important implications for the way we think about labour market dynamics, and thus for economic modelling, which are discussed in Section 5.

The plan of the paper is as follows. The next section describes the data set used in our analysis. The third section summarizes the descriptive empirical evidence, focussing on the importance of labour market heterogeneities in steady state, on the cyclicity of aggregate labour market flows, and on labour market heterogeneities and the business cycle. Section 4 presents an econometric analysis of the cyclicity of these dynamics in order to analyse the role of composition effects in this context. In Section 5, we summarize the empirical evidence and discuss the implications for the theoretical modelling of labour market cyclicity. The last section concludes the analysis.

## 2 Data and Concepts

The main data source for our analysis is the Sample of Integrated Labour Market Biographies (SIAB) for the time period 1975-2014, which is provided by the Institute for Employment Research (IAB). The SIAB is a 2% random sample of the Integrated Employment Biographies (IEB), which contains the labour market history of all individuals in Germany that are employed subject to social security contributions, marginal part-time employed, receiving benefits according to the German Social Code III or II, officially registered as job-seeking at the German Federal Employment Agency or participating in programs of active labour market policies. Civil servants and self-employed workers are not included in the data.<sup>3</sup> The information on labour market states is exact to the

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<sup>3</sup>The exclusion of civil servants should not influence our estimation results, as these individuals exhibit quite stable employment relationships largely unaffected by cyclical variations. By contrast, excluding self-employed workers might be relevant for our findings. Constant and Zimmermann (2004) show that transitions out of self-employment are not affected by

day.<sup>4</sup>

The SIAB provides information on workers' employment status, age, gender, occupation and education as well as limited information on firm characteristics (economic sector, establishment size). This data set is representative for all dependent-status workers, and contains information on all employment and unemployment spells of the workers covered. Given the relatively long time span of the data set, we are able to observe two full business cycles. From this sample, we exclude observations in East Germany, apprentices, trainees, homeworkers, part-time workers, and individuals older than 65.<sup>5</sup> This results in a sample with 10 million individual observations.

The SIAB is representative regarding employment but not regarding unemployment, since only those unemployed who are entitled to transfer payments are covered. In our data, we can derive three labour market states at each point in time: employment (E) covered by social security, unemployment (U), if the worker is receiving transfer payments, and non-participation (N).<sup>6</sup> Non-participants are those individuals not recorded in the data sets. Therefore, this state includes those workers out of the labour market, as well as workers not covered by social security legislation, e.g. civil servants and self-employed workers. Because of the way the data are collected, both firms' reports of a new employee and individuals' notifications of moving into or out of unemployment are not exactly consistent with the actual change of labour market state. For example, workers might report to the unemployment office only a few days after having been laid off. The latter potential measurement error is taken into account in the following way: If the time lag between two employment or unemployment notifications does not exceed 30 days, it is defined as a direct transition between the two states recorded. We count it as an intervening spell of non-participation if the time interval between the two records is larger than 30 days. The descriptive statistics of the data set as used in the econometric analysis are in Table 7.

Since the data set used contains daily information on the employment and unemployment history of every individual in the sample, it is possible to calculate worker flows taking into account every change of labour market state that occurs within a given time period. We are thus able to compute the flows

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the business cycle, while transitions into self-employment are highly procyclical. However, Caliendo and Uhlenhoff (2008) investigate yearly transition rates and find that only 3% of all non-employed workers and only 1% of all wage-employed workers enter the state of self-employment, implying that transitions into and out of this state only plays a minor role for our analyses.

<sup>4</sup>A detailed description of the Sample of Integrated Labour Market Biographies is given by Antoni, Ganzer, and vom Berge (2016).

<sup>5</sup>Excluding part-time workers from our sample and treating them as non-participants artificially increases our transitions into and out of non-participation. However, as the SIAB data only distinguish between two categories of part-time employment and the number of working hours can be relatively low, we decided to focus on core full-time workers. Including part-time workers into the analysis leaves the results qualitatively unchanged.

<sup>6</sup>In the SIAB data, the record on unemployment benefit recipients are unreliably measured before 1980. As we can therefore not use the worker flows to and from unemployment for the time period 1975-1979, we start our analysis in 1980.

between employment, unemployment and non-participation, as well as direct job-to-job transitions (EE flows) using the establishment identification number, which implies that our notion of a job is establishment-based. In addition to EE flows, our analysis focuses on the flows from employment to unemployment and to non-participation (EU and EN, respectively), and from unemployment and from non-participation to employment (UE and NE, respectively). We define as separation flows all flows emanating from employment,  $S_t = EE_t^{sep} + EU_t + EN_t$ , and as accession flows all flows going to employment,  $A_t = EE_t^{acc} + UE_t + NE_t$ ; the stock of employment is the number of individuals employed at the reference date June 30th in year  $t$ .

Note that our definition of establishment size classes is based on the size establishments display on June 30th of the contemporaneous year rather than the previous year. Since the SIAB data are individual-based and not establishment-based data, small establishments are less likely to be observed for two consecutive periods than large establishments. This implies that using the establishment size of the previous year would result in a selected sample, where small establishments are underrepresented.

### 3 Labour Market Dynamics in Germany: Descriptive Evidence

In this section, we derive some stylized facts concerning the dynamics of worker flows in the West German labour market. In doing so, we present steady-state results, both for the aggregate labour market and for flows related to different firm size classes, as well as the cyclical features of aggregate workers flows and of firm size-specific worker flows.

We first focus on the stylized facts about worker flows for different establishment size classes that are invariant over the cycle and can thus be regarded as steady-state results. Table 1 reports the yearly averages of the worker flow rates for the time period 1980-2013 for establishments of different sizes.<sup>7</sup> Establishment size appears to be strongly correlated with worker flows. In particular, there is a general tendency of hiring flows and separation flows to decline with the establishment size. The finding of higher fluctuations in smaller establishments is consistent with other research (Davis and Haltiwanger, 1999, and Lane, Stevens, and Burgess, 1996). As pointed out in the introduction, firms are likely to have preferences over the previous labour market state of their new hires (cf. Eriksson and Lagerström, 2006, and Nagypál, 2006). Firms are likely to prefer hiring employed workers because unemployment may be perceived as a negative signal. Furthermore, the expected duration of a new job is higher for previously employed job seekers because the match is likely to be a better fit than if the worker had been previously unemployed.

<sup>7</sup>As employer-to-employer accessions and employer-to-employer separations are symmetric in the aggregated sample and only slightly differ when the sample is disaggregated by firm size category, we focus on job-to-job hirings in the following.



In order to investigate the consequences of these preferences, we analyse the origin of new hires for different establishment size classes. Looking at all the establishments considered, 29.6% of new hires come from employment, 20.7% come from unemployment, and 49.7% from non-participation (cf. Table 2). The hiring source depends strongly on the size of the establishment. Small establishments hire roughly equal proportions of their new workers from employment and unemployment (27.0% and 25.3%, respectively). With growing establishment size, however, the proportion of hires from employment increases at the expense of hirings from unemployment. Very large establishments hire 30.4% of their new workers from employment, but only 10.6% from unemployment. The larger job-to-job flows to large establishments could be explained by the fact that transitions out of an old job to a larger establishment generally lead to greater wage gains than moving to an equally-sized or smaller firm (Figure 4). Thus, to the extent that firms prefer hiring employed workers, large firms are able to compete more successfully for employed job seekers in the labour market.

An examination of the distribution of destination states that follow a job separation leads to very similar results (Table 2). Considering all establishments, 29.4% of the separations result in a new employment relationship, 23.3% in unemployment, and 47.3% end in nonparticipation. When we split up the establishments into different size classes, we can observe strong size-specific variations in the distribution of separation destinations. In particular, for small establishments we find an equal proportion of the separations to lead to a new employment and to unemployment (28.1%). In contrast to this, separations from very large establishments are followed by employment in 26.1% of cases, and only 16.3% are followed by an unemployment spell. The main difference is thus that many workers in large establishments exit to nonparticipation. There are two potential reasons for this: First, workers in large establishments are on average older and therefore more likely to retire than workers leaving small establishments; second, large establishments tend to employ a higher share of low-skilled workers who have a higher probability to switch between employment and nonparticipation than medium- and high-skilled workers; third there may be more flows into self-employment and public service from large establishments - unfortunately, we cannot investigate the latter hypothesis with our data set. The preceding analysis leads us to state

**Fact 1** *Large establishments hire mainly from employment (via job-to-job transitions) and nonparticipation, much less so from unemployment. For small establishments the share of new hires originating from unemployment is much higher.*

Turning to the cyclical features of aggregate worker flows, we display the evolution of the accession and separation rates for the time period 1980-2013 in Figure 1, with shaded areas indicating times of recession. The accession rate is clearly procyclical, as is the separation rate, but to a lesser extent than the accession rate. This implies a reduction of the aggregate employment level during recessions. These findings are in line with Bachmann (2005) who points

out that during recessions, a decline in the hiring activity can be observed.

In order to further investigate this matter, we split up the accession flows into EE flows, UE flows and NE flows.<sup>8</sup> As one can see in Figure 2, job-to-job transitions show a clearly procyclical pattern, as do transitions from non-participation to employment. However, the flow from unemployment to employment, being not as volatile as the other two worker flows, rises much earlier and drops during periods of economic recovery. These observations indicate that the outflow from unemployment dominates during recessions and during the beginning of expansions, while job-to-job transitions are the most important source of accessions in the mature phase of expansions. From this, we can infer

**Fact 2** *Employment-to-employment transitions are procyclical, and unemployment-to-employment transitions are countercyclical.*

The three worker flows making up separations, namely the EE flows, EU flows and EN flows, are displayed in the second panel of Figure 2. It becomes apparent that direct job-to-job flows and the flows from employment to non-participation are procyclical, while the flow from employment to unemployment increases during recessions and decreases in periods of economic recovery. This means that we can observe a shift from employment-to-unemployment transitions to job-to-job transitions in the mature phase of the economic expansion.

We now turn to the question whether the cyclical features presented in the previous section vary between firms that differ in size. In order to do so, we first compute the share of a specific worker flow  $F$  in total hirings  $H$  for establishments of a specific size, i.e. the fraction  $F_{st}/H_{st}$ , with  $s$  being the establishment size class and  $t$  the year under investigation. The results are depicted in Figure 3. As in Table 2, it again becomes obvious that for larger establishments, job-to-job transitions play a crucial role, whereas the outflow from unemployment makes up only a small part of hirings. For small establishments, however, hirings out of employment outweigh hirings out of unemployment in the mature phase of an economic expansion, while the opposite is the case during recessions and the early phase of the economic upturn. Moreover, the results show that the hiring share from employment is procyclical for all establishments, while the opposite is true for the hiring share from unemployment. This leads to

**Fact 3** *In recessions, unemployment supplies relatively more workers to establishments of all sizes.*

## 4 Econometric Analysis

The descriptive analysis indicated that two-sided heterogeneity plays an important role for the cyclicity of labour market dynamics. We now want to analyse

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<sup>8</sup>Note that we define these transitions as inflows into employment. This implies that for example our calculation of the UE transition rate (UE flows divided by E) differs from other research papers such as Jung and Kuhn (2014), Nordmeier (2014) and H. Gartner and Rothe (2012) who define the UE rate as outflow rate out of unemployment (UE flows divided by U). We choose the inflows definition because we focus on the accession rate to establishments.

this issue econometrically in order to find out whether composition effects play a role in this context. For example, the increase in job-to-job transitions to large establishments during the mature phase of an economic upswing may be equally spread across all workers, which means that composition effects are not important. Alternatively, large firms may be hiring more workers of a particular type in this situation, which could be related to certain observable characteristics (e.g. skills) or certain unobservable characteristics (“high-turnover” vs. “low-turnover” workers). As both are taken into account in our empirical analysis, we obtain a composition-adjusted effect of output growth on transition probabilities, which can be viewed as the effect on the probability of transition *within worker type*.

In order to investigate the determinants of worker flows, we estimate a logit model

$$Pr[y_{it} = 1|x_{it}, \beta, \alpha_i] = \Lambda(\alpha_i + x'_{it}\beta), \quad (1)$$

where  $\Lambda(\cdot)$  is the logistic cdf with  $\lambda(z) = e^z/(1 + e^z)$ . As dependent variables, we consider separations (i.e. the probability of an employed person to separate from his employer), as well as their components (i) transitions from employment to unemployment, and (ii) transitions from employment to another job; furthermore, we estimate the hiring transitions from unemployment to employment, and direct job-to-job-transitions. In particular, the logit model for separations specifies the probability whether or not an individual leaves the establishment between  $t$  and  $t + 1$ , implying that only currently employed workers are at risk of separating. The logit models for the accession flows specify what happened to individuals between  $t - 1$  and  $t$  for all employees employed at time  $t$ .

These probabilities are explained by observable person characteristics  $x_{it}$  (age, skill level, duration of previous employment, duration of previous unemployment) observable firm characteristics  $f_{et}$  (industry), and unobservable worker characteristics as described above.<sup>9</sup> The vector  $GDP_t$ , our measure of the business cycle, contains contemporaneous and lagged GDP growth (lags 1 to 4) and captures the dynamic structure of the labour market process under investigation. In order to analyse the size-specific variations in the cyclical timing of hirings and separations, we estimate the model for large and small firms separately.<sup>10</sup>

In order to explicitly take into account unobserved worker characteristics, we estimate two specifications, a random effects model and a fixed effects model (conditional logit).<sup>11</sup> The random effects model eliminates the individual-specific effect  $\alpha_i$  by integrating over a specified distribution of this effect, which is taken to be a random variable. In our application, this model has the advantage that it allows estimation over all individuals in the sample, i.e. also

<sup>9</sup>As a robustness test, we included the mean wage of the establishment as an explanatory variable. This leaves the results below virtually unchanged. The fixed-effects specification only includes the time-varying characteristics.

<sup>10</sup>Large establishments are defined as those employing more than 100 workers. Trying alternative definitions, we find very similar estimation results.

<sup>11</sup>As a robustness test, we also estimated semi-parametric duration models. This yielded results very similar to the random effects model.

those that never make a transition. However, the random effects estimators are inconsistent if fixed effects are present which are correlated with the regressors. For this reasons, we also estimate a fixed effects model. Qualitatively, i.e. with respect to firm-size specific differences, the two models yield very similar results.

The estimation results for the separation probability of an existing job match are displayed in Table 3.<sup>12</sup> It becomes apparent that the specifications differ quite strongly, which indicates that composition effects play an important role for separations. In addition, the coefficients obtained from the random effects specification show that - irrespective of the establishment size - the probability of separation significantly declines with increasing employment duration.

Regarding the cyclical behaviour, the coefficients on GDP do not show a very clear pattern. The contemporaneous correlation with GDP is negative, and more strongly so for small firms. However, it turns positive in the random effects and fixed effects specifications, again indicating the importance of composition effects. For lagged values of GDP, we observe a mixed picture for both the raw correlation and the coefficients from the regressions with various explanatory variables. We therefore explore this issue further below.

For the transitions from employment to employment (EE), the estimation results generally indicate a procyclical pattern for both small and large establishments for all specifications (Table 4), which is in line with expectations. Looking at the difference between small and large establishments, we see that this cyclical effect is more pronounced for the latter when looking at correlations. However, the picture is much less clear when looking at the fixed effect coefficients.

As becomes apparent in Table 5, the counter-cyclicity of the transitions from employment to unemployment is confirmed for both small and large establishments, as well as the random and the fixed effects specifications. Furthermore, the cyclical sensitivity of employment-to-unemployment transitions in small firms seems to be larger than in large firms in both the random and the fixed effects specification.

Looking at the hiring flows in more detail, the results for direct employer-to-employer transitions treated as an accession flow are very similar to EE separation flows (Table 4).<sup>13</sup> Regarding the transitions from unemployment to employment (Table 6), the coefficients of the GDP variables show a contemporaneously procyclical pattern for both small and large establishments. This implies that initially, as the economy goes into recession, hirings out of unemployment decline. Interestingly, for small establishments, the correlation of the transition rate with GDP turns negative for GDP lagged by 2 and 4 quarters (the coefficient on the 3-quarter-lag is insignificant). We interpret this as a sign

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<sup>12</sup>In this table, as in all the other tables, the fixed effects specification yields coefficients on GDP that are larger than in the random effects specification. As random effects regressions performed on the reduced fixed-effects sample show, this is purely due to the sample selection that goes along with the use of the conditional logit estimator.

<sup>13</sup>They are therefore not reported but are available from the authors.

that small establishments start hiring out of unemployment already during a recession. For large establishments, on the other hand, this phenomenon can only be observed later and with much smaller coefficients.

We now want to summarize our estimation results, focusing on the dynamic response of the different worker flows to innovations in GDP. Furthermore, in order to gauge the importance of composition effects, we contrast the dynamic implications of our estimation results with the dynamics which can be obtained from the correlations between GDP growth and the transitions under investigation. While the estimation results can be used to obtain dynamic responses which are adjusted for composition effects, the correlation-based results lead to the overall dynamic response, which contains both composition and “behavioural” effects.

First, it is useful to note that the fixed effects logit estimator yields the effect of each observable variable on the log-odds ratio

$$\log \left[ \frac{\Pr(h_{it} = 1 | x_{it}, \lambda_i)}{1 - \Pr(h_{it} = 1 | x_{it}, \lambda_i)} \right] = \log [\exp\{x_{it}\beta + \lambda_i\}] = x_{it}\beta + \lambda_i \quad (2)$$

where  $x_{it}$  is the vector of values of observable variables associated with person  $i$  at time  $t$  and  $\lambda_i$  is the unobservable worker effect. We are thus able to trace out the effect of an impulse to output growth on the log-odds ratio using the regression results. In order to do so, we estimate an autoregressive model for output growth,  $y_t$ . Using data on West German GDP for the time period 1980- 2014, we obtain the following equation:

$$y_t = 0.003 + 0.826y_{t-1} + 0.032y_{t-2} + 0.099y_{t-3} - 0.244y_{t-4} + \hat{\epsilon}_t \quad (3)$$

We use the estimation results in order to trace out the dynamic response of output growth to a one percentage point innovation to GDP growth. Then, we combine the resulting series with (i) the correlations between the flows under investigation and GDP growth, and (ii) the coefficients (log-odds) from the fixed effects models estimated in the previous section. We thus obtain the dynamic response of different transitions to a one percentage point innovation in GDP.

We conduct this exercise for hirings from unemployment, for total separations, and for separations to employment and to unemployment. Without adjusting for composition effects (left panel, “correlations-based”), transitions from unemployment to employment are procyclical for small and large establishments (Figure 5). However, they turn negative for small establishments after three quarters. This countercyclical movement at small establishments can be attributed to these establishments not hiring many unemployed individuals after the business cycle peak. By contrast, worker flows from employment to unemployment are countercyclical, and more so at small establishments than at large establishments (Figure 6). This leads us to

**Fact 4** *Hires out of unemployment are persistently procyclical at large establishments; at small establishments, this procyclicality is only short-lived; worker*

*flows from employment to unemployment are more (counter-)cyclical at small establishments than at large establishments.*

When comparing the impulse response functions displaying the overall dynamic response (left panel) with the impulse response functions adjusted for composition effects (right panel, “regression-based”), it becomes apparent that the differences between establishment size classes in the cyclicity of workers transitions become much smaller when composition effects are controlled for. This is least pronounced – but still visible – for worker flows from unemployment to employment (Figure 5), and most pronounced for job-to-job transitions (Figure 7) and for separations to unemployment (Figure 6), and it is strongest for the worker flows between unemployment and employment (Figure 5). The only exception to this are total separations (Figure 8).

In particular, hirings out of unemployment at large establishments appear pro-cyclical up to quarter 6 when looking at the mere correlation with GDP, but turn countercyclical from quarter 2 when controlling for composition effects. This implies that large establishments increase their hirings out of unemployment during an economic upswing by attracting “high-turnover” rather than “low-turnover workers”, not by attracting more “low-turnover workers” to their staff.

The composition effect also seems to play an important role for transitions from employment to unemployment, as the difference between large and small firms becomes much smaller when controlling for it. Interestingly, the composition effect *increases* the differences between small and large establishments for overall separations (i.e. EU- plus EE-separations). This indicates that the composition effects between these two flows work in opposite directions. We thus establish

**Fact 5** *Cyclical differences between small and large establishments are mainly due to composition effects.*

## 5 Summary and Discussion

The empirical evidence provided in Sections 3 and 4 yields the following picture of labour market cyclicity. As the economy enters into recession, the number of direct job-to-job transitions declines, while inflows into unemployment increase (Fact 2). The absolute number of transitions from unemployment to employment also increases, and unemployment supplies relatively more workers to establishments of all sizes (Fact 3). As the stock of unemployment rises faster, however, the exit rate out of unemployment declines. These facts can be explained by the consequences of a negative productivity shock, which leads to a reduction in the number of vacancies, thus reducing direct employer-to-employer transitions, and to a burst in job destruction resulting in increased flows into unemployment. The availability of many short-term unemployed workers as well as reduced reservation wages in turn lead to increased flows from unemployment to employment.

When looking at differences between establishments of different size classes, we find that overall, large establishments hire more from employment and less from unemployment than small establishments (Fact 1). Not adjusting for composition effects, hires out of unemployment appear more (pro-)cyclical at large establishments; this does not seem to be the case for separations (Fact 4). When taking into account composition effects in the econometric analysis, the differences disappear, and hirings out of unemployment by large firms become much less pro-cyclical (Fact 5). This implies that worker heterogeneity, both observed and unobserved, plays a crucial role for the cyclicity of labour market dynamics. In particular, the greater cyclicity of hires at large establishments seems to be driven by composition effects, i.e. by the fact that, compared to small establishments, large establishments are more likely to hire workers of *different types* over the business cycle.

In order to illustrate this, we assume that there are only two worker types, “high-turnover” and “low-turnover” workers. With respect to hirings out of unemployment, large establishments seem to be attracting more high-turnover workers during an economic upswing than during a recession. This could have important implications. First, the accumulation of high-turnover workers during periods of economic upswings may be creating the basis for the next downturn, as workers with a relatively low productivity are employed at relatively high wages. Second, it may also provide a new insight into the quality of existing job matches (Caballero and Hammour, 1994, and Barlevy, 2002). To the extent that high-turnover (low-productivity) workers are laid off during economic downturns, recessions exert a cleansing effect in this respect.

Finally, our results provide an empirical foundation for the inclusion of worker heterogeneity in macroeconomic models of the labour market, such as Pries (2008) who shows that worker heterogeneity can increase the volatility in the standard search-and-matching model. More recently, Lise and Robin (2017) have developed a stochastic model of random search on the job with ex-ante heterogeneous workers and firms and aggregate productivity shocks, which is generally in line with our empirical analysis:<sup>14</sup> Their model predicts an increase in hires of low-type workers by low-type firms as the economy recovers from a recession; in our empirical analysis, we show that at the beginning of a recovery, small (“low-type”) firms start hiring mainly out of unemployment rather than out of employment, i.e. they are predominantly hiring low-type workers.

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<sup>14</sup>Previous models include Mortensen and Nagypal (2007) who argue that comparative statics are sufficient to approximate out-of-steady-state dynamics. Their model features endogenous job destruction, but no on-the-job search. Moscarini and Postel-Vinay (2013) use a Burdett-Mortensen equilibrium search model which includes on-the-job search, but exogenous job destruction, and does not allow for worker heterogeneity. Fujita and Nakajima (2016) replicate the most important cyclical features of aggregate job and worker flows in a multi-worker model with heterogeneous firms and on-the-job search, but do not address the role of firm and worker heterogeneity in their results. Cairo and Cajner (2016) use a search and matching model with endogenous separations to analyse worker heterogeneity, but not firm heterogeneity.

## 6 Conclusion

Using two data sets on individual workers' labour market histories derived from German administrative data which allow us to identify heterogeneities on both sides of the labour market, we investigate the cyclicalities of worker and job flows. We find that small establishments hire more workers from unemployment than their larger counterparts. Conversely, large establishments hire much more workers out of an existing employment relationship, in all likelihood because large firms compete more successfully for employed job seekers than small firms.

As for the importance of heterogeneous firms and workers for the cyclicalities of labour market dynamics, we find that small firms hire mainly at the beginning of an economic expansion. Later on in the expansion, hirings more frequently result from direct job-to-job transitions, with employed workers moving to larger firms. This is in line with the model and the evidence in Moscarini and Postel-Vinay (2008, 2012, 2013). Our analysis also stresses the important role of composition effects for labour market dynamics over the cycle.

Our results thus provide a tentative answer to the question asked in the introduction: Inflows to unemployment increase during a recession mainly because employer-employee matches in large firms are separated (although this effect comes with a certain delay). Furthermore, while small firms increase their hirings already before the beginning of an economic upswing, large firms strongly reduce their hiring activity during recessions; they only start hiring much later, and do so hiring mainly "high-turnover" workers. As a consequence, unemployment outflows do not increase enough to keep unemployment duration from rising during a recession.



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## A Tables

Table 1: Worker flow rates across different establishment size categories

	$EE_{hir}$	NE	UE	$EE_{sep}$	EN	EU
All observations	0.095	0.160	0.067	0.095	0.153	0.075
1-19 employees	0.126	0.223	0.118	0.130	0.202	0.130
20-99 employees	0.112	0.173	0.083	0.115	0.163	0.088
100-999 employees	0.084	0.138	0.045	0.082	0.136	0.052
1000 and more employees	0.053	0.102	0.018	0.048	0.105	0.030

*Source:* Authors' calculations based on SIAB 1975-2014, for West Germany.

*Note:* EE: Employer-to-employer flows; NE: Nonparticipation-to-employment flows; UE: unemployment-to-employment flows; EN: Employment-to-nonparticipation flows; EU: Employment-to-unemployment flows. All figures are weighted averages of the annual values (1980-2013).

Table 2: Distribution of sources and destinations by establishment size

Establishment size	Hirings from			Separations to		
	E	N	U	E	N	U
All observations	0.296	0.497	0.207	0.294	0.473	0.233
1-19	0.270	0.477	0.253	0.281	0.437	0.281
20-99	0.305	0.469	0.226	0.314	0.446	0.240
100-999	0.315	0.517	0.168	0.303	0.505	0.192
1000 and more	0.304	0.590	0.106	0.261	0.576	0.163

*Source:* Authors' calculations based on SIAB 1975-2014, for West Germany.

*Note:* Establishment size classes are based on size in the contemporaneous year. All figures are calculated as described in Section 3.2, they are weighted averages of the annual values (1980-2013).

Table 3: Logit estimation, separations

	Small establishments			Large establishments		
	<i>Corr.</i>	<i>RE</i>	<i>FE</i>	<i>Corr.</i>	<i>RE</i>	<i>FE</i>
GDP(t)	-0.00129*** (0.00006)	0.00035*** (0.00007)	0.00005 (0.00024)	-0.00063*** (0.00005)	0.00048*** (0.00005)	0.00204*** (0.00025)
GDP(t-1)	0.00109*** (0.00007)	0.00011 (0.00008)	-0.00030 (0.00027)	0.00064*** (0.00006)	0.00005 (0.00005)	-0.00036 (0.00028)
GDP(t-2)	-0.00077*** (0.00008)	0.00052*** (0.00007)	0.00131*** (0.00025)	-0.00033*** (0.00006)	0.00045*** (0.00005)	0.00211*** (0.00026)
GDP(t-3)	0.00158*** (0.00008)	-0.00064*** (0.00007)	-0.00193*** (0.00025)	0.00109*** (0.00006)	-0.00046*** (0.00005)	-0.00211*** (0.00026)
GDP(t-4)	-0.00051*** (0.00007)	0.00035*** (0.00007)	0.00035 (0.00024)	-0.00014*** (0.00005)	0.00038*** (0.00005)	0.00056** (0.00025)
empl dur 2-5		-0.01717*** (0.00022)	0.02754*** (0.00107)		-0.01781*** (0.00014)	0.00484*** (0.00120)
empl dur 6-10		-0.04334*** (0.00022)	-0.02722*** (0.00132)		-0.03130*** (0.00013)	-0.04247*** (0.00174)
empl dur 11-20		-0.05196*** (0.00024)	-0.03467*** (0.00155)		-0.03698*** (0.00015)	-0.04705*** (0.00193)
empl dur 21-30		-0.05307*** (0.00026)	-0.01855*** (0.00202)		-0.03644*** (0.00014)	-0.02736*** (0.00214)
empl dur > 30		-0.05889*** (0.00029)	0.08103*** (0.00218)		-0.04821*** (0.00021)	0.06877*** (0.00212)
No. of obs.	9,911,120	9,911,120	9,289,685	10,879,530	10,879,530	9,662,102

*Source:* SIAB, transformed to a quarterly data set by the authors, for West Germany 1980/I-2013/III.

*Note:* Results come from logit models estimated using random effects (RE) and fixed effects (FE) specifications. Numbers shown are marginal effects; a \*\*\*/\*\*/\* indicates a 1%/5%/10% level of significance; standard errors in parentheses. Base category: individuals aged 15-24, with 1 quarter of previous (un)employment. Quarterly and age group dummies included.

Table 4: Logit estimation, separations (EE transitions)

	Small establishments			Large establishments		
	<i>Corr.</i>	<i>RE</i>	<i>FE</i>	<i>Corr.</i>	<i>RE</i>	<i>FE</i>
GDP(t)	0.00043*** (0.00004)	0.00062*** (0.00003)	0.00658*** (0.00040)	0.00009*** (0.00003)	0.00049*** (0.00002)	0.00930*** (0.00050)
GDP(t-1)	0.00040*** (0.00004)	0.00017*** (0.00004)	0.00108** (0.00046)	0.00031*** (0.00003)	-0.00005* (0.00002)	-0.00230*** (0.00059)
GDP(t-2)	-0.00006 (0.00005)	0.00018*** (0.00003)	0.00193*** (0.00044)	-0.00011*** (0.00003)	0.00020*** (0.00002)	0.00416*** (0.00052)
GDP(t-3)	0.00060*** (0.00005)	-0.00007** (0.00003)	-0.00063 (0.00043)	0.00063*** (0.00004)	-0.00014*** (0.00002)	-0.00304*** (0.00049)
GDP(t-4)	0.00042*** (0.00004)	0.00056*** (0.00003)	0.00704*** (0.00040)	0.00002 (0.00003)	0.00037*** (0.00002)	0.00685*** (0.00048)
empl dur 2-5		-0.00466*** (0.00010)	0.00427*** (0.00157)		-0.00177*** (0.00008)	0.04699*** (0.00225)
empl dur 6-10		-0.00901*** (0.00010)	0.00829*** (0.00203)		-0.00468*** (0.00007)	0.05105*** (0.00270)
empl dur 11-20		-0.01189*** (0.00011)	0.03454*** (0.00241)		-0.00645*** (0.00008)	0.07764*** (0.00299)
empl dur 21-30		-0.01362*** (0.00011)	0.04914*** (0.00321)		-0.00759*** (0.00007)	0.09261*** (0.00349)
empl dur > 30		-0.01601*** (0.00012)	0.12726*** (0.00354)		-0.01038*** (0.00010)	0.17093*** (0.00383)
No. of obs.	9,911,120	9,911,120	5,572,456	10,879,530	10,879,530	4,870,773

*Source:* SIAB, transformed to a quarterly data set by the authors, for West Germany 1980/I-2013/III.

*Note:* Results come from logit models estimated using random effects (RE) and fixed effects (FE) specifications. Numbers shown are marginal effects; a \*\*\*/\*\*/\* indicates a 1%/5%/10% level of significance; standard errors in parentheses. Base category: individuals aged 15-24, with 1 quarter of previous (un)employment. Quarterly and age group dummies included.

Table 5: Logit estimation, separations (EU transitions)

	Small establishments			Large establishments		
	<i>Corr.</i>	<i>RE</i>	<i>FE</i>	<i>Corr.</i>	<i>RE</i>	<i>FE</i>
GDP(t)	-0.001194*** (0.000031)	-0.000508*** (0.000020)	-0.011077*** (0.000440)	-0.000429*** (0.000021)	-0.000158*** (0.000010)	-0.007366*** (0.000630)
GDP(t-1)	0.000211*** (0.000039)	-0.000042* (0.000030)	-0.001639*** (0.000500)	0.000056** (0.000026)	0.000014 (0.000010)	0.000363 (0.000590)
GDP(t-2)	-0.000222*** (0.000044)	0.000119*** (0.000020)	0.001544*** (0.000440)	-0.000074*** (0.000028)	0.000030** (0.000010)	0.001111** (0.000560)
GDP(t-3)	0.000147*** (0.000045)	-0.000205*** (0.000020)	-0.003622*** (0.000420)	0.000039 (0.000028)	-0.000112*** (0.000010)	-0.004981*** (0.000590)
GDP(t-4)	-0.000725*** (0.000035)	-0.000379*** (0.000020)	-0.008978*** (0.000420)	-0.000041* (0.000023)	-0.000052*** (0.000010)	-0.005999*** (0.000600)
empl dur 2-5		0.001215*** (0.000080)	0.083127*** (0.001840)		-0.000842*** (0.000040)	0.050427*** (0.003090)
empl dur 6-10		-0.006053*** (0.000070)	-0.017993*** (0.002330)		-0.003395*** (0.000040)	-0.032995*** (0.003620)
empl dur 11-20		-0.010137*** (0.000080)	-0.107819*** (0.002760)		-0.005059*** (0.000050)	-0.146377*** (0.006360)
empl dur 21-30		-0.011306*** (0.000070)	-0.164129*** (0.003690)		-0.005268*** (0.000040)	-0.208254*** (0.007540)
empl dur > 30		-0.014583*** (0.000090)	-0.130172*** (0.004340)		-0.007594*** (0.000060)	-0.123567*** (0.006980)
No. of obs.	9,911,120	9,911,120	4,350,272	10,879,530	10,879,530	2,718,756

*Source:* SIAB, transformed to a quarterly data set by the authors, for West Germany 1980/I-2013/III.  
*Note:* Results come from logit models estimated using random effects (RE) and fixed effects (FE) specifications. Numbers shown are marginal effects; a \*\*\*/\*\*/\* indicates a 1%/5%/10% level of significance; standard errors in parentheses. Base category: individuals aged 15-24, with 1 quarter of previous (un)employment. Quarterly and age group dummies included.

Table 6: Logit estimation, accessions (UE transitions)

	Small establishments			Large establishments		
	<i>Corr.</i>	<i>RE</i>	<i>FE</i>	<i>Corr.</i>	<i>RE</i>	<i>FE</i>
GDP(t)	0.000108*** (0.000034)	0.000020*** (0.000010)	0.001293*** (0.000490)	0.000228*** (0.000020)	0.000011*** (0.000000)	0.001010* (0.000530)
GDP(t-1)	0.000395*** (0.000043)	-0.000038*** (0.000010)	-0.003410*** (0.000500)	0.000156*** (0.000025)	-0.000007*** (0.000000)	-0.001966*** (0.000590)
GDP(t-2)	-0.000455*** (0.000040)	-0.000011 (0.000010)	-0.000399 (0.000600)	0.000039 (0.000025)	-0.000001 (0.000000)	-0.000333 (0.000610)
GDP(t-3)	0.000050 (0.000039)	-0.000032*** (0.000010)	-0.002612*** (0.000650)	-0.000043* (0.000024)	-0.000004* (0.000000)	-0.000303 (0.000630)
GDP(t-4)	-0.000597*** (0.000034)	-0.000022*** (0.000010)	-0.002109*** (0.000520)	-0.000161*** (0.000020)	-0.000007*** (0.000000)	-0.002441*** (0.000600)
unempl dur 2-5		0.869568*** (0.001420)	0.819826*** (0.007180)		0.806048*** (0.003300)	0.902224*** (0.012850)
unempl dur 6-10		0.875788*** (0.002200)	0.797853*** (0.007890)		0.830558*** (0.004830)	0.893801*** (0.013970)
unempl dur 11-20		0.883289*** (0.002800)	0.794149*** (0.007990)		0.822046*** (0.006790)	0.891217*** (0.014110)
unempl dur > 20		0.920607*** (0.002530)	0.793440*** (0.008060)		0.899610*** (0.005870)	0.890876*** (0.014240)
No. of obs.	9,911,120	9,911,120	5,660,270	10,879,530	10,879,530	5,334,644

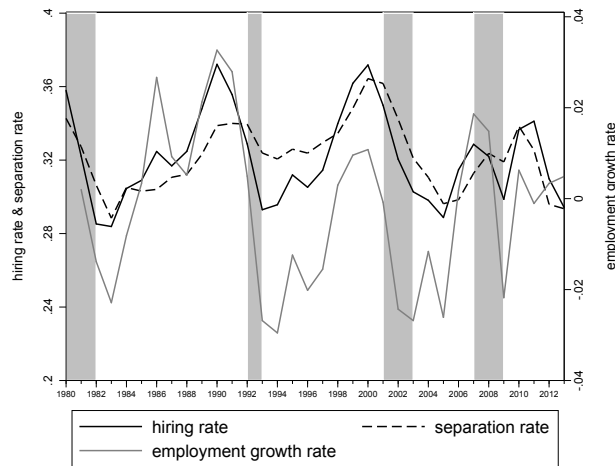
*Source:* SIAB, transformed to a quarterly data set by the authors, for West Germany 1980/I-2013/III.

*Note:* Results come from logit models estimated using random effects (RE) and fixed effects (FE) specifications. Numbers shown are marginal effects; a \*\*\*/\*\*/\* indicates a 1%/5%/10% level of significance; standard errors in parentheses. Base category: individuals aged 15-24, with 1 quarter of previous (un)employment. Quarterly and age group dummies included.



## B Figures

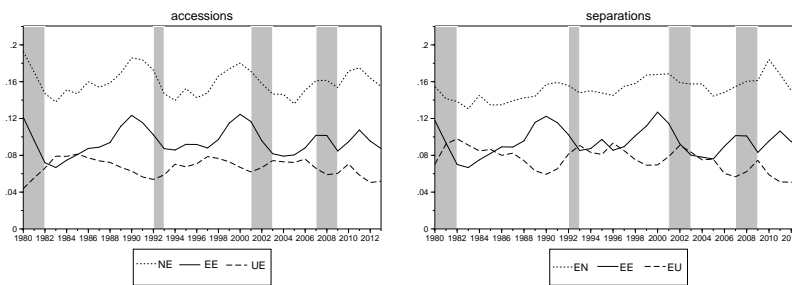
Figure 1: Accessions and separations, 1980-2013, yearly rates



*Source:* Authors' calculations based on SIAB 1975-2014, for West Germany.

*Note:* The figures are calculated as described in Section 3.2.. Shaded areas are times of recession.

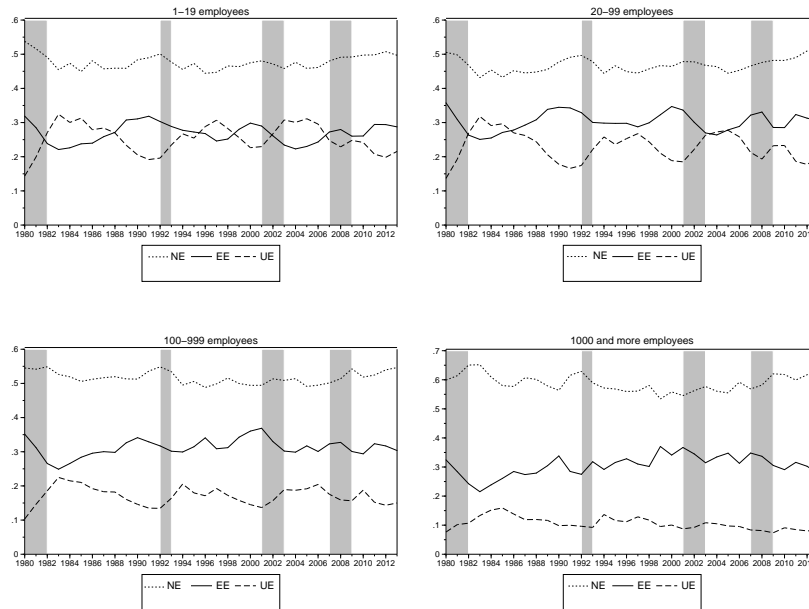
Figure 2: The dynamics of worker flows, 1980-2013, yearly rates



*Source:* Authors' calculations based on SIAB 1975-2014, for West Germany.

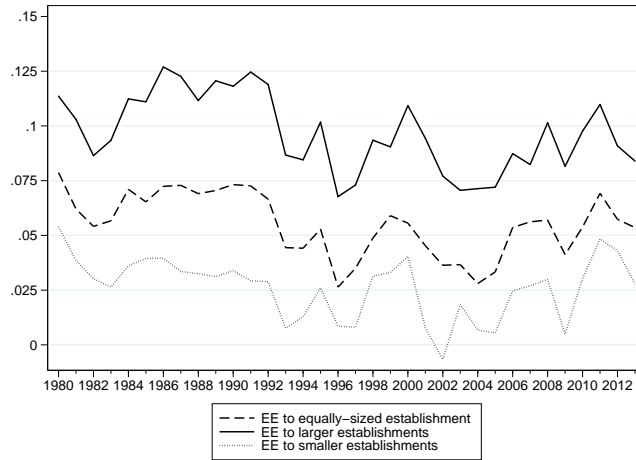
*Note:* EE: Employer-to-employer flows; NE: Nonparticipation-to-employment flows; UE: unemployment-to-employment flows; EN: Employment-to-nonparticipation flows; EU: Employment-to-unemployment flows. The figures are calculated as described in Section 2. Shaded areas are times of recession.

Figure 3: The shares in hirings by establishment size, 1980-2013, yearly rates



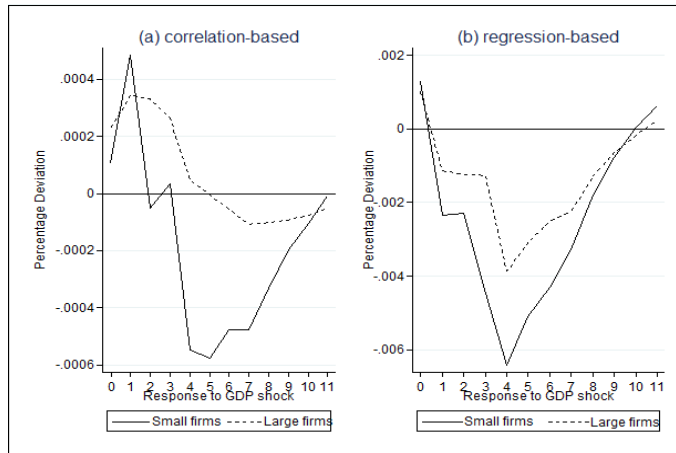
*Source:* Authors' calculations based on SIAB 1975-2014, for West Germany.  
*Note:* For each establishments size class the flows are computed as share of total hirings. Establishment size classes are based on size in the contemporaneous year. EE: Employer-to-employer flows; NE: Nonparticipation-to-employment flows; UE: unemployment-to-employment flows; EN: Employment-to-nonparticipation flows; EU: Employment-to-unemployment flows.

Figure 4: Wage growth for different types of job-to-job transitions



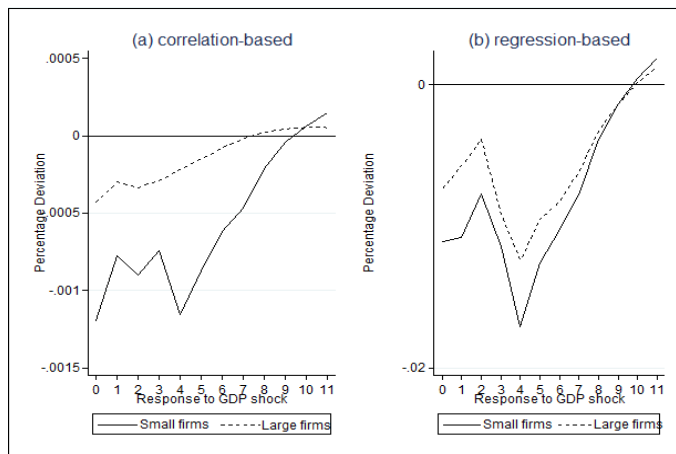
*Source:* Authors' calculations based on SIAB 1975-2014, for West Germany.  
*Note:* This figure shows the log wage growth which is associated with job-to-job transitions to equally-sized, larger and smaller establishment, respectively.

Figure 5: Impulse response function for UE flows



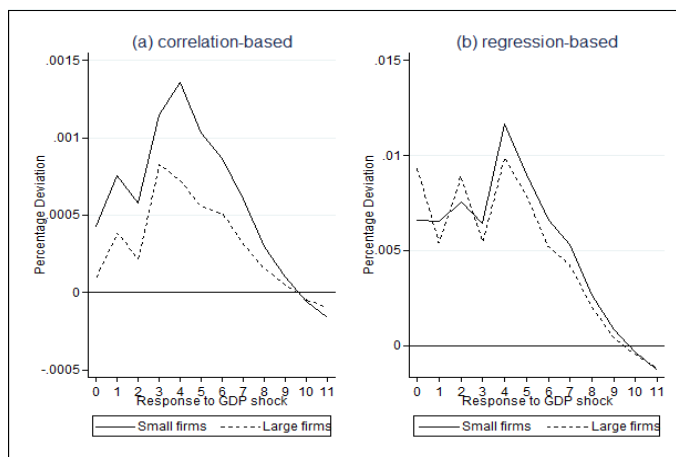
*Source:* Authors' calculations based on SIAB 1975-2014, for West Germany.  
*Note:* Impulse responses computed as described in Section 4.

Figure 6: Impulse response function for EU flows



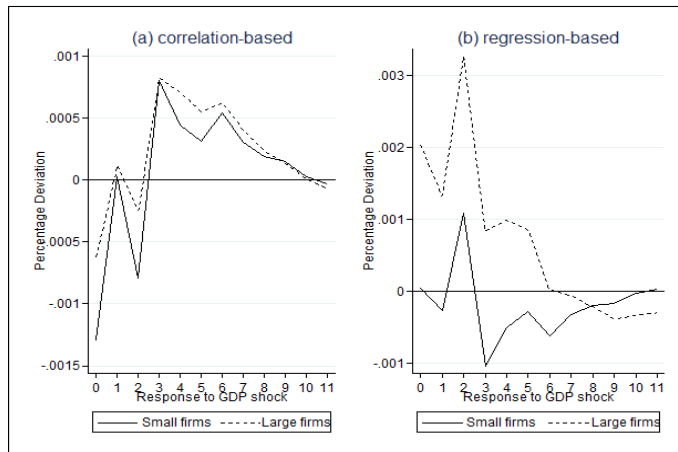
Source: Authors' calculations based on SIAB 1975-2014, for West Germany.  
 Note: Impulse responses computed as described in Section 4.

Figure 7: Impulse response function for EE flows (separations)



Source: Authors' calculations based on SIAB 1975-2014, for West Germany.  
 Note: Impulse responses computed as described in Section 4.

Figure 8: Impulse response function for total separations



Source: Authors' calculations based on SIAB 1975-2014, for West Germany.  
Note: Impulse responses computed as described in Section 4.

## C Supplementary material - Not intended for publication

Table 7: Summary statistics

Variable	Mean	Std. Dev.	Definition
$EE_{sep}$	0.0213	0.1445	Direct job-to-job transition (separations)
EU	0.0171	0.1297	Transition from employment to unemployment
EN	0.0378	0.1906	Transition from employment to nonparticipation
$EE_{acc}$	0.0214	0.1447	Direct job-to-job transition (accessions)
UE	0.0150	0.1216	Transition from unemployment to employment
NE	0.0402	0.1965	Transition from nonparticipation to employment
Separation	0.0762	0.2653	$EE + EU + EN$
Hiring	0.0766	0.2660	$EE + UE + NE$
Low-skilled	0.1235	0.3290	Individual holds a lower secondary school diploma but no professional degree.
Medium-skilled	0.7701	0.4208	Individual holds a lower secondary school diploma and professional degree; or a high school diploma and no professional degree; or a high school diploma and a professional degree.
High-skilled	0.1064	0.3084	Individual holds a degree from a university or a university of applied sciences
GDP	1.8016	2.1720	GDP growth rate (in %)
Large	0.5246	0.4994	Establishment with more than 100 employees (based on the establishment size on June 30th of the contemporaneous year)
Employment duration	21.396	22.686	Duration of previous employment spell (in quarters)
Unemployment duration	5.8642	9.6327	Duration of previous unemployment spell (in quarters)
Agriculture, Mining, Energy	0.0263	0.1600	Dummy for employment in specific industry
Production	0.3480	0.4763	"
Construction	0.0772	0.2670	"
Trade, Transport	0.2230	0.4163	"
Services	0.2680	0.4429	"
State	0.0575	0.2329	"

*Source:* Authors calculations from the SIAB, for West Germany; GDP are official figures from the German Statistical Office.

*Notes:* Statistics refer to the quarterly data set created by the authors and used in the econometric analysis. Flows normalized by employment (E). Time period considered: 1980/I-2013/III.

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