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Abstract

Using administrative data from Germany, this paper analyzes the relation between wages and past and current labor market conditions. Specifically, it explores whether the data is more consistent with implicit contract models (Beaudry/DiNardo, 1991) or a matching model with on-the-job search and cyclical selection (Hagedorn/Manovskii, 2013). The data suggests that wages are related to past labor market conditions as contract theories postulate. However, past labor market conditions also affect contemporaneous wages through the evolution of the match qualities over a worker's job history - the main hypothesis of the selection model. Refining the selection model by taking into account within company job regrading, we find that wages of workers who switched employers and occupations at the same time respond stronger to the cycle than wages of job stayers. In contrast, wages of workers who only switch employers or occupations are not more cyclical than wages of workers who stay at their previous employer and in their previous occupation.

Zusammenfassung

In dieser Studie wird untersucht, inwiefern Löhne von der vergangenen und gegenwärtigen Arbeitsmarktsituation determiniert werden. Mit Hilfe von administrativen Daten wird der Frage nachgegangen, ob empirisch das Modell impliziter Verträge nach Beaudry/DiNardo (1991) oder ein Suchmodell mit on-the-job Suche und zyklischer Selektion nach Hagedorn/Manovskii (2013) für den deutschen Arbeitsmarkt befürwortet wird. Die Daten zeigen einerseits einen Zusammenhang zwischen der vergangenen Arbeitsmarktsituation und kontemporären Löhnen, wie von vertragstheoretischen Ansätzen postuliert. Anderseits hat die Arbeitsmarktsituation in der Vergangenheit durch ihren Einfluss auf die Entwicklung der Match-Qualität ebenso Effekte auf kontemporäre Löhne, was für ein Suchmodell mit Selektion spricht. Eine Modellerweiterung des Suchmodells mit Selektion um eine berufliche Komponente ermöglicht es zudem Selektion innerhalb eines Betriebes zu erfassen. Dadurch kann gezeigt werden, dass Arbeitnehmer, die gleichzeitig Arbeitgeber und Beruf wechseln, stärker auf den Konjunkturzyklus reagieren als Arbeitnehmer, die weder Arbeitgeber noch Beruf wechseln. Wenn Arbeitnehmer beim gleichen Arbeitgeber in einen neuen Beruf wechseln oder aber im gleichen Beruf bleiben und den Arbeitgeber wechseln, sind sie ähnlich reagibel wie wenn sie beim gleichen Arbeitgeber im gleichen Beruf bleiben.

JEL classification: E24, E32, J31, J41

Keywords: Business Cycle, Wage, Wage Rigidity, Implicit Contracts, Match Quality

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1 Introduction

Understanding the determination of wages and its relation to the business cycle is a key question when studying the matching of workers and employers. The standard search and matching model (e.g., Mortensen/Pissarides, 1994) assumes wages to be set by period-by-period Nash bargaining, meaning that workers and firms constantly renegotiate over the match surplus. In this framework, wages do not depend on past conditions - they follow the up- and downswings of the business cycle, rising and falling reasonable symmetrically. Given the Nash wage equation, the wages of all workers are equally responsive to cyclical conditions. This assumption, however, has been challenged throughout the years. Pissarides (2009) surveys several empirical studies on wage cyclicality, especially of new hires and workers in ongoing employment relationships. There is substantial evidence that wages are procyclical and that wages of job switchers are more responsive to the business cycle than those of job stayers. Beaudry/DiNardo (1991) (henceforth BDN) pioneered this strand of literature. They explore the link between wages and different business cycle indicators. The core result is that their U.S. data suggest current wages to depend on functions of past labor market conditions rather than on contemporaneous conditions - a phenomenon that is often denoted as "history dependence in wages". These results are interpreted as wage rigidity induced by long-term implicit contracts which enable risk-sharing among workers and employers. In implicit contract models, risk neutral firms shield risk averse workers against income loss by absorbing the volatility in productivity as long as it is rational for both to remain matched. Thus, the wage does not constantly respond to current economic conditions but is only affected by conditions at the time the contract started. If workers can search on-the-job and are completely mobile across potential employers, firms have an incentive to increase the wage whenever cyclical conditions improve because if they would not, the worker would quit to start another job. The firm would have to costly search for another worker and pay higher wages due to better cyclical conditions. In the context of these results, Pissarides (2009) states that *"[...] whether wage stickiness is the answer to excess employment volatility or not depends on the consistency between the model and the empirical evidence"*. With regard to the baseline search and matching model, this means that the empirical results are problematic for both the model's spot wage assumption and for the attempts to improve the model's empirical performance by the introduction of wage rigidity (Shimer, 2005; Hall, 2005) because, as emphasized by Pissarides (2009), it is the wages of newly hired workers that matter for employment dynamics. These conclusions call for model modifications that make the baseline model more consistent with the empirical evidence.

Recently, Hagedorn/Manovskii (2013) (henceforth) offer a theoretical framework that is able to reconcile the empirical findings of history dependence in wages in a matching model with on-the-job-search without abandoning the assumption of spot wages. They show that the conclusions from regressions a la BDN should be taken with a grain of salt and argue that wages are driven by cyclical selection rather than by implicit contracts. In their model, workers may quit their jobs in favor of jobs with higher quality, leading to the selection of more productive matches over time, most predominantly during an economic upswing. Historical labor market conditions influence a worker's outside option, leading to wage changes, either directly through renegotiation or indirectly by triggering quits. The authors conclude that the regressions in BDN suffer from specification error such that variables which reflect past aggregate conditions appear to be important predictors of wages, although these variables proxy for unmeasured match productivities. In particular, when the authors include measures for match quality to correct for these confounding variables, the past labor market conditions are not important determinants of wages anymore. In addition, using their measures of match qualities, HM show that the wages of job stayers and job switchers are equally cyclical.

Along this line of literature, this paper recapitulates the potential links between wages and labor market conditions in the German labor market. First, we apply the BDN methodology, testing implications from their implicit contract models using administrative data from Germany. We continue by considering the model with on-the-job search proposed by HM in order to explicitly control for cyclical selection. As in HM, we use proxies for the number of job offers during a worker's history of jobs, without intervening unemployment to measure the quality of a match. In addition, we refine these proxies by making use of our rich data on workers' occupation history. This refinement allows us to separately identify different types of job switches and estimate the wage sensitivity to changes in aggregate unemployment, controlling for job selection (as in HM) and implicit contracts (as in BDN). This refinement is important because it has been found that changes in the composition of the workforce over the cycle can induce a countercyclical bias to the estimates. The argument is that if, for instance, low-skilled workers are laid off more often than high-skilled workers in recessions, their share in the total work is lower in recessions than in booms which leads to an underestimation of aggregate wage cyclicality (Bils, 1985; Solon/Barsky/Parker, 1994). Another issue when estimating the wage cyclicality is the presence of cyclical job regrading (up- and downgrading). The idea is that during recessions workers rather switch to low paid jobs than losing their job. In economic upswings, this switching can be reversed. As pointed out by Gertler/Trigari (2009), not taking into account the cyclical up- and downgrading can lead to an overestimation of wage cyclicality.

Our results suggest that wages depend *both* on past *and* on contemporaneous labor market conditions. We find selection effects and general support for on-the-job search. However, we cannot confirm the results in HM that the effects of past labor market conditions on current wages are only due to the correlation with match quality. We find that, at first glance, wages of workers who switch employers appear more procyclical than those of job stayers, even after controlling for job selection and implicit contract proxies. However, when we disentangle the sources of different job switches and use finer controls for selection, we find that only the wage cyclicality of job switchers that simultaneously change occupation and employer is larger than it is for stayers. Wages of workers who change employers but stay in their previous occupation and wages of new hires from unemployment are not more responsive than wages of stayers. We argue that the occupational dimension of cyclical selection is important when comparing the wage cyclicality between job stayers and switchers. Not taking into account within company job-ladder effects (i.e., job-regrading) can lead to an underestimation of the cyclicality of job switchers and an overestimation of the cyclicality of job stayers.

At least two features of this analysis set it apart from previous work. First, to the best of our knowledge, this is the first paper that applies the method proposed by HM to control for cyclical selection on administrative data. We think that our data set is well-suited because it considers a large number of high-frequency observations on employment relationships and reliable wage information over a reasonably large sample period. It additionally carries a large set of observable worker information and contains a large amount of variation in aggregate business cycle indicators. Second, our results add to the debate on the correct measuring of the wage cyclicality of job stayers, job switchers, and of new hires from unemployment. The differentiation between these worker types is important because it has been found that not taking into account cyclical movements in the composition of job quality can lead to the false impression that wages are procyclical when in fact the procyclicality results from job changes (Gertler/Trigari, 2009; Stüber, 2016).

The remainder of the paper is as follows: in Section 2, we recapitulate the theoretical framework of implicit contracts and sketch HM's selection model. Section 2.3 provides refinements of the original selection model. In Section 3 we describe our empirical methodology and our data. Section 4 provides the empirical results. The last section summarizes and compares the results to the existing literature.

2 Theoretical framework

In this section, we recapitulate the theoretical models that previous research has derived to explain the relationship between past labor market conditions and contemporaneous wages. Specifically, we review and confront outcomes of implicit contract models with the cyclical selection model incorporating on-the-job search by HM.

2.1 Implicit contracts

In spot labor markets, the wage rate is only affected by contemporaneous market conditions. This includes any form of bargaining over the match surplus as long as it takes place period-by-period - like for example the canonical search and matching model which assumes continuous re-contracting between workers and employers. Real wages follow the up- and downswings of the cycle, rising and falling reasonable symmetrically. Contrary, the theory of implicit contracts focuses on the engagement of workers and firms in long lasting relationships enabling risk sharing.

BDN present two implicit wage contract models from which they derive implications about the potential link between wages and past labor market conditions. In the first model, risk-neutral employers insure risk-averse workers against income fluctuations over the business cycle. Employers commit to contracts while workers do not (one-sided commitment). The authors prove that in this environment, and when workers are completely mobile, the wage is only revised infrequently. Whenever the worker's outside option improves above its maximum since the start of the worker's tenure, employers are willing to adjust the wage upwards in order to prevent the worker from accepting a better job offer from another employer as long as it is jointly rational to continue the job. Thus, in this model, the worker's current wage is a function of all historical maxima of a worker's outside option.

The second model is a risk sharing model with full commitment by both, the worker and the employer. The optimal contract in this environment implies a constant wage that is equal to the initial wage negotiated when the worker and the employer formed a match. BDN test the implications of the two implicit contract models in an augmented Mincer wage regression using U.S. micro-level data. To control for the wage setting mechanism of the one-sided commitment model, they include the minimum unemployment rate since the start of a worker's current job (U^{min}) in the regression. They also include the unemployment rate at time of the hiring (U^{begin}) to account for the economic condition at the start of the employment relationship, representing the full commitment model. They let their measures of past labor market conditions compete against a spot wage model which is represented by the contemporaneous unemployment rate. They estimate the following wage equation:

$$w(i, t+s, t) = \gamma X_{i,t+s,t} + C(t, s) + \alpha_i + \eta_{i,t+s} \tag{1}$$

$$C(t,s) = \begin{cases} U_{t+s} & \text{contemporaneous conditions} \\ U_t^{begin} & \text{contracts with two-sided commitment} \\ U_{i,t+s,t}^{min} & \text{contracts with one-sided commitment} \end{cases} \tag{2}$$

The wage of worker i in the current period $t+s$ who started a job in period t is regressed on a vector of controls, $X_{i,t+s}$, which includes individual-specific characteristics such as labor market experience, tenure, gender, race, region, and schooling. To control for time-invariant unobserved worker characteristics, BDN include the worker fixed-effect α_i. $\eta_{i,t+s}$ is the usual error term. It is important to note that BDN can uncover the worker-fixed effect using panel data. However, they do not control for an unobservable idiosyncratic match component. $C(t, s)$ is a link variable distinguishing between the different model predictions about the relationship of current wages and labor market conditions. U_{t+s} represents the contemporaneous unemployment rate and is treated as an indicator for current labor market conditions. $U_{i,t+s,t}^{min}$ denotes the minimum unemployment rate since the start of the job, and U_t^{begin} denotes the unemployment rate at the time of the start of the job.

Estimating this equation separately for any combination of the unemployment variables using CPS data, they find that the coefficients are negative and significantly different from zero, except when nesting all three variables in one regression. In this case, the minimum unemployment rate variable dominates the two other variables. Specifically, the contemporaneous unemployment rate loses all its predictive power in the nested estimation. BDN conclude that the contract model with one-sided commitment fits the data best while the spot wage model does the worst job. In this context, one interpretation of the results is that wages are history dependent, meaning that they carry information of past aggregate labor market conditions, even long after the match was formed.

2.2 Cyclical job selection model

HM question the direct influence of historical labor market conditions on contemporaneous wages. The authors propose a matching model with on-the-job search, in which wages are determined by current labor market conditions and current idiosyncratic match quality only. However, the current match quality carries information on the evolution of past match qualities over a worker's employment career. This evolution is influenced by the labor market conditions at that time and thereby affects contemporaneous wages. The main argument is that the link between past conditions and wages is visible in the BDN regression because they do not account for any measures of match quality. The next section sketches HM's selection model and gives implications about the relation to past labor market conditions.

2.2.1 Environment

Workers are either employed or unemployed. Every period, unemployed workers receive a job offer with probability λ which is increasing in the business cycle indicator. Employed workers receive job offers with probability q. Matches dissolve exogenously. In this model, the wage only depends on contemporaneous conditions. On the one hand, it depends on the business cycle indicator C_t which is assumed to be an exogenous stochastic process drawn from a stationary distribution and common to all workers. On the other hand, it depends on the match specific idiosyncratic productivity m_{ijt}. The wage equation can be written as

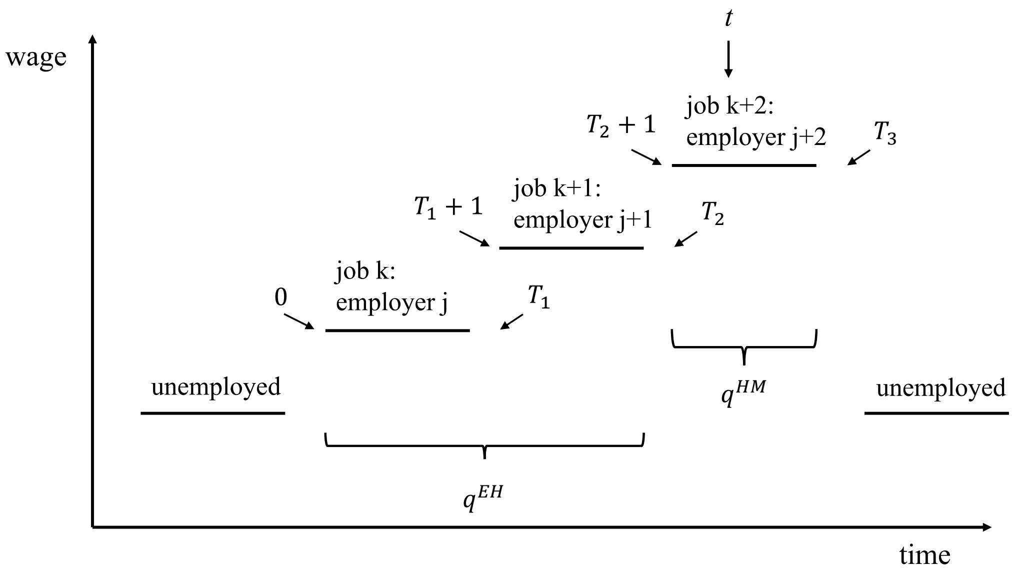
$$log\, w_{ijt} = log\, C_t + log\, m_{ijt}. \tag{3}$$

HM define the sequence of jobs between two unemployment spells as an employment cycle. Figure 1 displays this definition using the example of an employment cycle with three jobs at time t for worker i. In this example the worker switched employers at time $T_1 + 1$ and $T_2 + 1$.

While being employed in the k_{th} job, the worker receives job offers. The worker's decision to switch jobs depends on the worker's current match-specific productivity and the match-specific productivity in the potential new job. The worker quits the current job, if and only if, a job offer arrives which incorporates a higher wage. Better job offers must be due to a higher m_{ij}, since it is the only component of the wage that varies over different jobs. On the one hand, if an employed worker receives a job offer and accepts it, this means that the match quality must increase when switching. On the other hand, if the worker rejects the offer, the match quality of the offered job must be lower than in the current job. Hence, the number of job offers must be positively correlated with the quality of the match because either the match quality has improved or the current match is already of high quality.

HM derive measures that summarize the probabilities of a job offer within each job spell which corresponds to the total number of job offers. First, they define q^{EH} as the sum of job offer probabilities since the start of the first job until the beginning of the current job within

Figure 1: Definition of an employment cycle with three jobs



Note: own representation based on HM (p. 777).

an employment cycle. Second, they sum up all the job offer probabilities during all periods of the current job and define this sum as q^{HM}. The first is supposed to summarize the employment history and thereby the evolution of match quality. The second summarizes the selection of workers into better matches from the most previous job to the current one. HM prove that the expected value of the specific match productivity can be expressed by a linear function of q^{HM} and q^{EH} which makes it applicable for linear estimation.[1]

However, the number of job offers is usually hard to observe for the econometrician or the data collector. Since the probability of getting a job offer depends positively on the labor market tightness, HM use the sum of labor market tightness to define q^{HM} and q^{EH}. The idea is that in tight labor markets the arrival of job offers is more rapid and as a consequence the selection of workers into better matches via the switching of employer speeds up. This gives workers greater opportunities to attain a high quality match.

Replicating the regressions of BDN, HM find strong support for the predictions of their selection model. In particular, they find that, when including the match quality measures into the typical regression, the past unemployment variables lose both their economic and statistic significance. Their concluding critique is that these regressions fail to include mea-

[1] They first set up the conditional expected value of m_{ijt} for workers that have not been separated exogenously. Given that, they derive the distribution of m_{ijt}, using the job switching rule from above. It turns out that after further derivation, linearization and iteration, the following approximation holds: $\log(m_{ij}) \approx c_0 + c_1 \log(q^{EH}) + c_2 \log(q^{HM})$, where c_i are coefficients. For more details on this proof see HM, page 779 and Appendix IA, IB.

sures of unobserved match quality (m_{ijt}). They argue that the omitted match quality confounds the regressions. This leads to the false impression that wages are history dependent while in fact this is only due to the correlation of the past labor market conditions with the number of job offers and hence the quality of a match. Even though in their model wages by definition only depend on contemporaneous labor market conditions and contemporaneous idiosyncratic match quality, they are thus consistent with the findings of history dependent wages. The intuition is that if job offers are procyclical, the selection of better matches applies more stringently to those workers who experienced better economic conditions. That is because workers receive job offers with a probability that increases in the business cycle indicator which is higher in booms than in recessions. Hence, past unemployment affects current wages not directly but through the evolution of the match quality distribution.

2.3 Model extensions

2.3.1 Decomposition

In the HM model, every employed worker receives a job offer in every period with a certain probability. The offer arrival probability and hence the total number of job offers during a job is positively correlated with the sum of every period's labor market tightness. In an economic upswing vacancies are plenty and hence the level of tightness is high. This speeds up the selection process and workers quickly climb up the 'job ladder' which increases the quality of a match. The same is true for the duration of a job. The sum of labor market tightness is by definition higher the longer a job lasts because of the assumption that every worker receives a job offer in every period. Suppose in the following example that there are two identical workers. One is hired in a period of economic upswing and the other one is hired in a recession. Both jobs last exactly for the same amount of time, hence the same amount of job offers. However, in the model the first worker would receive and reject more job offers in total because the job arrival rate is increasing in the labor market tightness which is higher in booms than in recessions. Now suppose that the first worker is employed for one period longer than the second worker but the probability of the arrival of job offers and thus the average labor market tightness is exactly the same for both job spells. The first worker would receive more offers in total.

This logic gives rise to the idea of decomposing the match quality proxies into a pure labor market tightness component and a job duration component. We thus disentangle q^{HM} and q^{EH} in the following way[2]:

$$q^{HM} = (T_{end} - T_{start}) \frac{\sum_{t=T_{start}}^{T_{end}} (\frac{V_t}{U_t})}{T_{end} - T_{start}} = T_{start}^{end} \times \bar{q}^{HM} \tag{4}$$

$$q^{EH} = (T_{start} - T_0) \frac{\sum_{t=T_0}^{T_{start}} (\frac{V_t}{U_t})}{T_{start} - T_0} = T_0^{start} \times \bar{q}^{EH} \tag{5}$$

[2] Gallipoli/Yedid-Levi/Galindo da Fonseca (2016) do a similar excercise using NLSY data.

$(T_{end} - T_{start})$ denotes the length of the current job while $(T_{start} - T_0)$ denotes the length of all jobs before the current job. By taking logs, we get two independent measures which we can include in a linear wage regression. The objective of this decomposition exercise is to get an impression of the relative importance of the duration and cyclical component in the measures of match quality.

2.3.2 Occupational refinement

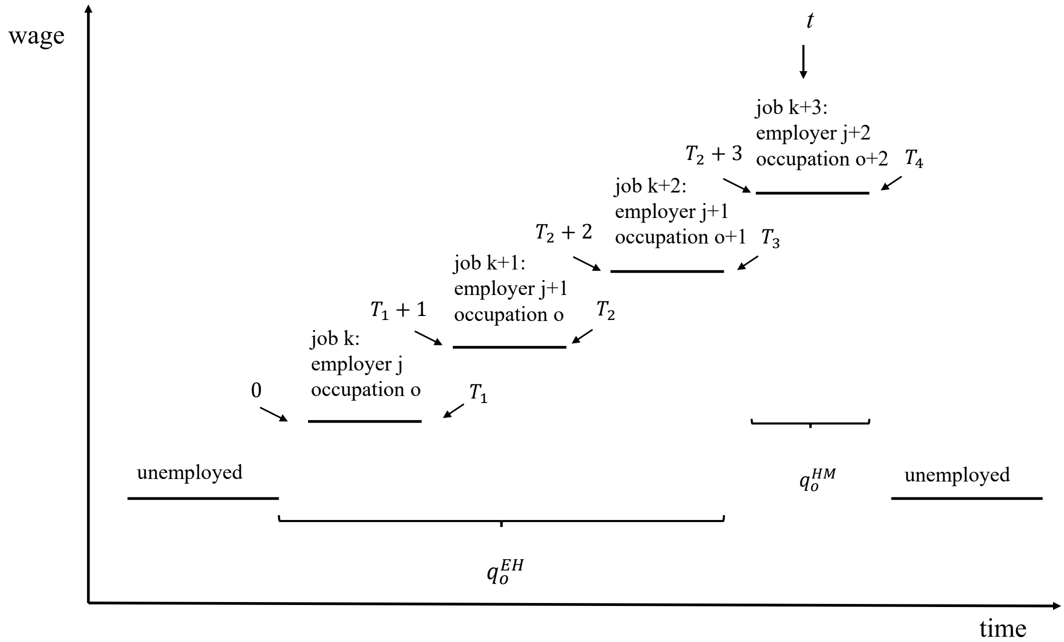
The main contribution of HM is the detailed derivation of a theoretical framework that takes into account the evolution of match quality and its relation to the business cycle. They show that this evolution can rationalize the empirical support for history dependence in wages even though the wages in their models are by definition pure spot wages. In the baseline HM model, a worker switches employers whenever the idiosyncratic match productivity is higher in the new match. However, it has been shown in the literature that internal "job" switches are important when studying wage cyclicality. Among others, Devereux/Hart (2006) show that the proportion of internal and external job moves varies over the business cycle and that wages of internal and external movers are considerably more procyclical than those of stayers (see also Hart/Roberts, 2011; Büttner/Jacobebbinghaus/Ludsteck, 2010). One reason for this is associated with within-firm job-regrading over the cycle. The intuition is that in a cyclical boom, employers react to labor shortages through internal promotions. Existing workers can be trained and upgraded from low to high paid jobs. In economic downswings, excess labor supply forces employers to downgrade certain workers within the firm, leading to lower wages. The procyclical up- and downgrading per se generates cyclicality in wages among internal job movers. The original HM model does not take into account these internal job movings. This leads to an underestimation of the true cyclicality of job switchers and an overestimation of the cyclicality of job stayers. Even their measures for match quality do not capture the effects of internal job switchings.

Following this argumentation, the main objective of this section is to develop a framework that accounts for both cyclical up- and downgrading within companies and cyclical selection across employers. By using detailed data on occupational labor market conditions, we are able to control for both types of selection.[3]

We start by relaxing the definition of a "job" and also allow for occupational switches at the same employer. Specifically, a worker can also receive job offers from their current employer but for a job in a different occupation. Given the new definition of a job, switching jobs means either (i) changing the employer but staying in an occupation or (ii) changing occupation but staying with the employer or (iii) changing occupation and employer simultaneously. Figure 2 shows all switching schemes using an illustrative employment cycle

[3] Occupational selection is only one aspect of different wage profiles among workers. Wage profiles along the employment cycles of workers in certain occupations could differ due to institutional settings or the investment in occupation-specific human capital. Workers could have different wage profiles over time because tenure is remunerated differently. Even the same firm could use different contracts to discriminate between workers in different occupations. Such patterns could be due to history dependence, or due to the coexistence of wage bargaining and wage posting (Gartner/Holzner, 2015), or even because of complementarities of unobserved firm and worker characteristics (Lochner/Schulz, 2016).

Figure 2: Definition of an employment cycle with four jobs and occupational refinement



Note: own representation.

with four subsequent jobs in between two unemployment spells. The switch from the first job to the second is due to i), while the switch from the second to the third results from ii). The last switch is illustrated in (iii).

The job switching rule is the same as above: the worker will change jobs (i, ii, iii), if and only if she receives a job offer that incorporates a higher match-occupation-specific productivity. For simplicity we assume that every time one of the three possible switches occurs, that is a new combination of worker, employer and occupation, a new value of the idiosyncratic match productivity is drawn from an exogenous distribution. We define the measures for job quality in the same manner as above, namely as the sum of the job offer probabilities. However, these measure are now occupation-specific. Again we use the definition of employment cycles where the current time period is stepwise moving over the employment cycles and disentangle the overall measure into a variable that controls for the history of the employment cycle (q_o^{EH}) and one for the selection in the current period (q_o^{HM}). To be clear about this, in the example at hand, we would define q_o^{EH} and q_o^{EH} in period t as $q_{o,t}^{EH} = q_{j,o,t-3} + q_{j+1,o,t-2} + q_{j+1,o+1,t-1}$ and $q_{o,t}^{HM} = q_{j+2,o+2,t}$.

2.3.3 Wage volatility of job stayers and switchers

In this section we discuss the theoretical predictions about wage cyclicality of job stayers and switchers in the light of contract and selection models.

Implicit contract models predict that wages of workers who switched jobs are more cyclical than those of stayers. the logic is simple: In the model with perfect mobility, job stayers hired before an economic downswing are protected against income loss by their contract. Their wage only responds during an upswing. In the two-sided commitment model, there is no wage cyclicality for job stayers at all because the wage is equal to the initial wage, irrespective of business cycle conditions, as long as the contract is effective. Wages of workers who change jobs, however, react to the economic conditions at the time the contract is in force. In the selection model, the wage is a function of the current business cycle condition and the current idiosyncratic match quality. The former is equal for all workers, irrespective if they change their job or not. The latter is assumed to be constant within a job, which implies that the business cycle condition is the only component that changes the wage of job stayers. The difference in the wage cyclicality between stayers and switchers thus is related to the idiosyncratic match component in wages. Since it is by definition increasing in the number of job offers and thereby also in economic upswings, the wage of job switchers is higher in booms than in recessions. Overall, the selection model predicts that wages of job switchers are more volatile than those of stayers.

In order to test these model implications, we show how we identify job stayers and job switchers using the definition of employment cycles. We suppose that each /th employment cycle starts in period t_l^{UE} and ends in period t_l^{EU}. The former is the first period of the first job after leaving unemployment and the latter is the last period of the last job before being unemployed. The worker starts new jobs in period t_l^{k+s}. The employment cycle can be defined as the vector

$$z_l = (t_l^{UE}, t_l^{k+1}, t_l^{k+2}, ..., t_l^{k+s}, t_l^{EU}) \tag{6}$$

and consolidated in a sequence of employment cycles, defined as

$$z_l = (z_1, z_2, ..., z_L). \tag{7}$$

In the original HM model, there are three types of workers: new hires from unemployment, job stayers, and job (employer) switchers. New hires from unemployment are identified by collecting any t_l^{UE} period. We collect each of these periods for every worker. To identify job stayers, we collect any period that is neither a t_l^{UE} nor a t_l^{k+s} period. This gives a sequence of periods in which a worker has stayed at the same job. For job switchers, we collect the sequence of the switching periods $t_l^{k+1}, t_l^{k+2}, ..., t^{k+s}$. Note that the measures for match quality (q^{EH}, q^{HM}) are constant within a job spell and that only employer switchers and job stayers, who have at least two jobs, have a history of labor market tightness within an employment cycle. For new hires from unemployment q^{EH} is per definition zero.

In the occupationally refined model, there are five worker types: new hires from unemployment, job stayers, workers who switch only their occupation, workers who switch only their employer, and those who switch both. The definition of new hires from unemployment and of job stayers is the same as above. For job switchers, we separately identify the source of job switch and separately collect each switching period.

3 Empirical methodology

3.1 Estimation approach

As in HM, we use the BDN methodology for studying the response of individual wages to changes in past and contemporaneous labor market conditions. The following measurement equation is the base of our analysis:

$$\ln w(i,t+s,t) = \beta_0 X_{i,t+s} + \beta_1 U_{t+s} + \beta_2 U^{min}_{i,t+s,t} + \beta_3 U^{begin}_{i,t} + \beta_4 q^{EH}_{i,t+s} + \beta_5 q^{HM}_{i,t+s} + \alpha_i + \eta_{i,t+s} \tag{8}$$

$\ln w_{i,t+s,t}$ denotes the daily log wage in period $t+s$ for a male full-time worker i, who started a job in period t. The vector of controls, $X_{i,t+s}$, includes dummies for education, experience, tenure, West/East Germany, and a 2^{nd} degree polynomial in time. α_i denotes a worker-fixed effect. U_{t+s} is the current unemployment rate - our primary indicator for current labor market conditions. $U^{min}_{i,t+s,t} = \min\{U_{t+s-z}\}^{s}_{z=0}$ is the minimum unemployment rate during a worker's tenure and reflects the implicit contract model with mobile workers. $U^{begin}_{i,t}$ denotes the unemployment rate in period t, the start of a job, representing the implicit contract model with full commitment. $q^{EH}_{i,t+s}$ and $q^{HM}_{i,t+s}$ are proxies for unobserved match quality, constructed as explained above. $\eta_{i,t+s}$ is the usual error term.

We estimate this equation separately for any of the unemployment variables and then add the proxies for cyclical job selection. The typical result in the literature is that the coefficients of both the past and current unemployment are negative but the latter loses predictive power (Grant, 2003; Devereux/Hart, 2007) or even turns insignificant (BDN) in a nested regression. The results in HM show that, when adding the proxies for cyclical selection the coefficients of past unemployment variables lose their economic and statistical significance.

When analysing the volatility of wages for job stayers and switchers, we follow the methodology in Gertler/Huckfeldt/Trigari (2016) and Carneiro/Guimaraes/Portugal (2012) to estimate the following regression considering the original HM model:

$$\begin{aligned}\ln w_{i,t+s,t} = {} & \beta_0 X_{i,t+s} + \beta_1 U_{t+s} + \beta_2 U^{min}_{i,t+s,t} + \beta_3 U^{begin}_{i,t} + \beta_4 q^{EH}_{i,t+s} + \beta_5 q^{HM}_{i,t+s} \\ & + \beta_{NH} I^{NH}_{i,t+s} + \beta_{NHU} I^{NH}_{i,t+s} U_{t+s} + \beta_{SW} I^{SW}_{i,t+s} + \beta_{SWU} I^{SW}_{i,t+s} U_{t+s} \\ & + \alpha_i + \eta_{i,t+s}\end{aligned} \tag{9}$$

I^{NH} (I^{SW}) equals unity for new hires from unemployment (employer switchers) and zero otherwise. Workers who stay at the same employer are the reference category.

We estimate the following equation in order to test the implications of the refined model with the occupational dimension.

$$
\begin{aligned}
\ln w_{i,t+s,t} = {} & \beta_0 X_{i,t+s} + \beta_1 U_{t+s} + \beta_2 U^{min}_{i,t+s,t} + \beta_3 U^{begin}_{i,t} + \beta_4 q^{EH}_{i,t+s} + \beta_5 q^{HM}_{i,t+s} \\
& + \beta_{NH} I^{NH}_{i,t+s} + \beta_{NHU} I^{NH}_{i,t+s} U_{t+s} + \beta_{OSW} I^{OSW}_{i,t+s} + \beta_{OSWU} I^{OSW}_{i,t+s} U_{t+s} \\
& + \beta_{ESW} I^{ESW}_{i,t+s} + \beta_{ESWU} I^{ESW}_{i,t+s} U_{t+s} + \beta_{OESW} I^{OESW}_{i,t+s} \\
& + \beta_{OESWU} I^{OESW}_{i,t+s} U_{t+s} + \alpha_i + \eta_{i,t+s}
\end{aligned}
\tag{10}
$$

I^{NH} is a zero/one indicator for new hires, I^{OSW} for occupational switchers but employer stayers, I^{ESW} for employer switchers but occupation stayers, and I^{OESW} for workers who switch both, employer and occupation. As in equation 9, all estimates must be interpreted in comparison to the reference group of job stayers. The coefficient in front of each interaction term measures the incremental effect of a job switcher in the wage responsiveness to changes in the unemployment rate.

3.2 Data

We use a 2 percent sample of German register data provided by the Institute for Employment Research (IAB), the so-called Sample of Integrated Labour Market Biographies (SIAB). This data set covers 80 percent of the German workforce since 1975 and provides information with daily precision on employment subject to social security, job search and receipt of unemployment compensation. Not included are civil servants, self-employed workers and students. As the data set is a merger of different sources, spells are partly overlapping (e.g. receiving unemployment insurance while on job search or in a training measure). Thus, we refine the sample to include only employment and job search spells. Workers are considered to be employed if they have a regular full-time job. Workers are considered to be unemployed if they receive unemployment benefits or are registered as unemployed. We exclude workers in part-time jobs, marginal jobs and apprenticeship to receive homogeneity with respect to working hours of employed individuals as only the daily wage, but not the hours worked are provided. Furthermore we exclude people that are only seeking advise at the Federal Employment Agency, or are sick up to 6 weeks, to get a homogeneous state of unemployment.
The data contain information on the age, gender, education, nationality, and for spells of employment, the wage, the occupation, and firm characteristics (e.g., share of females, firm size, share of high/medium/low skilled workers etc.). We restrict our sample to male workers between 20 and 65 years with regular wage notifications (i.e., no bonuses and extra payments[4]).

In order to construct the measures of match quality as in HM, we merge official statistics of the Federal Employment Agency on nationwide unemployment and nationwide vacancies to our data. We construct employment cycles analogously to HM. A cycle starts and ends in unemployment. If a part-time job spell or a period of apprenticeship lies in between spells of full-time working spells, we exclude the full employment cycle for this worker. As explained above, when considering the original model, workers start a new job when we

[4] However, regular yearly bonuses are likely to be included in the wage notification for most of the workers.

observe an establishment switch. This allows us to calculate the labor market tightness in every month and sum it over the employment cycle. q^{EH} is a cumulative sum over labor market tightness before the last job and q^{HM} summarizes labor market tightness of the last job in the employment cycle.[5] Based on the official unemployment rate, denoted by U in the following, we calculate the U^{min} as the lowest unemployment rate until a certain observation in time. The unemployment rate at the start of a job is denoted by U^{begin} and constant across a job but might vary across the employment cycle. The wage information refers to the average daily wage within the spell and is subject to a lower and upper censoring limit. We drop all observations with wages under the time-varying marginal employment threshold ("Geringfügigkeitsgrenze"). Concerning the upper limit, we use consistent top-coding over the years (Feng/Burkhauser/Butler, 2006). Afterwards we deflate wages with the CPI and take logs. Using the start and end date information on the employment and unemployment spells, which are accurate on a daily basis, we can easily calculate tenure at the establishment as well as overall labor market experience for every single individual in this data set. After all refinements, we keep only the employment cycle information in the sample, which we use for estimation and which corresponds to 399,101 individuals.

For our exercises on an occupational level we proceed in a similar fashion. We rely on the 2-digit occupational classification of the German Classification of Occupations (KldB88), which comprises around 33 different occupation sections. Because occupation specific unemployment rates are not available in the official statistics of the Federal Employment Agency, we extract this information from the data set by taking stocks of employed and unemployed workers at our evaluation date and approximate the unemployment rate as $U_{o,t}/(U_{o,t} + E_{o,t})$. To count the stock of unemployed workers in occupation o at point in time t, we assume that the unemployed workers proceed searching for a job in the occupation they worked in last[6]. Afterwards we merge occupation-specific vacancy data of the Federal Employment Agency to the data, which allows us to compute an occupation-specific labor market tightness and given that, q_o^{HM} and q_o^{EH}. To exploit all the advantages of the disaggregation, we modify the definition of a job in an employment cycle. In detail, that means we allow a new job not just to start by switching the employer but also by taking-up a new occupation at the same employer. The shortcoming of the occupation-level data is that vacancy numbers on the occupational levels are available only after 2000, which restricts our sample to a shorter time horizon. Furthermore, we lose a few occupations due to missing vacancy information. After all refinements and after just keeping full employment cycles, the data set contains 62,679 individuals.[7]

4 Results

4.1 Implicit contracts and cyclical selection

Table 1 shows the results for the estimation of Equation (8). Note that the tables contain only the estimated coefficients on the variables of our main interest. However, all the re-

[5] Note that q^{EH} and q^{HM} are constant across jobs, but q^{EH} is increasing in the employment cycle.

[6] Assuming instead that workers search in the occupation they take up after unemployment does not alter the results remarkably.

[7] Appendix A provides descriptive statistics for our samples.

Table 1: Baseline estimation results - comparable to HM

	(1)	(2)	(3)	(4)	(5)	(6)
U	-0.92***	-0.37***	-0.18***	0.08***	-0.50***	-0.07***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$ln(q^{EH})$		3.69***		3.63***		3.61***
		(0.02)		(0.02)		(0.02)
$ln(q^{HM})$		3.31***		3.14***		3.25***
		(0.02)		(0.02)		(0.02)
U^{min}			-1.52***	-1.00***		
			(0.01)	(0.01)		
U_{begin}					-1.04***	-0.77***
					(0.01)	(0.01)
Adj. R^2	0.8403	0.8452	0.8411	0.8456	0.8408	0.8455

Notes: dependent variable: $ln(w_{it})$; controls: west, dummies for education and schooling, dummies for tenure and experience, 2^{nd} degree polynomial in time; estimation details: fixed effects regression for males with robust standard errors; all coefficients and standard errors are rounded to two decimal places and multiplied by 100; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; source: SIAB-7514-V1

gressions contain the full list of variables described in the caption of each table. Column (1) of Table 1 shows the relationship between contemporaneous unemployment and wages. We find that wages are pro-cyclical: An one percentage point decrease in the unemployment rate is associated with a 0.92 percent increase in wages.[8] In column (2) we add q^{HM} and q^{EH} to the regression, thereby controlling for cyclical selection as proposed by HM. The coefficient for the contemporaneous unemployment rate is still procyclical but more than halves.[9] In line with the theory, the coefficients for q^{HM} and q^{EH} are both positive and statistically significant, indicating that the expected wage depends positively on the number of offers received before the current job started as well as during the current job. We take this as evidence that much of the wage cyclicality is due to cyclical selection as emphasized by HM. Column (3) and (5) replicate the results from BDN showing that past labor market conditions, U^{begin} and U^{min} are indeed important determinants of contemporaneous wages. In column (4) and (6) we include the match quality measures in the regressions that also contain the indicators for past unemployment. The coefficients for q^{HM} and q^{EH} are relatively similar compared to the regressions without past unemployment variables. However, we find that the coefficient of the contemporaneous unemployment rate shrinks in magnitude in the regression with U^{begin} (column 6) and even changes sign in the regression with U^{min} (column 4). Unlike in HM using U.S. survey data (NLSY), we do not observe that the past unemployment variables lose their predictive power. The coefficients of U^{min} and U^{begin} are negative and significant even after controlling for cyclical selection indicating that the predictions of the implicit contract models are not ruled out entirely by cyclical selection. These results indicate that the German data reject neither the implicit

[8] In order to interpret the coefficients of the unemployment variables as semi-elasticities, we multiplied the coefficients and standard errors by 100. The magnitude of the estimated coefficient of the contemporaneous unemployment rate is broadly in line with the magnitude of the reported coefficients in Table 4 in Stüber (2016).

[9] This result is also visible in HM. See Table 1 in HM for a detailed comparison of their results to ours.

contract predictions of history dependence in wages nor the selection model. However, we find that the coefficient for U^{min} and U^{begin} lose part of their power when we add the proxies for match quality indicating that past labor market conditions affect the evolution of match qualities. However, to a smaller extent than in HM. We conclude from these results that the historical unemployment variables independently affect contemporaneous wages, as the theory of implicit contracts predicts. [10]

4.2 Decomposition of match quality

Table 2: Baseline estimation results-decomposition into duration and average labor market tightness

	(1)	(2)	(3)	(4)	(5)	(6)
U	-0.92***	-0.34***	-0.18***	-0.00	-0.50***	-0.15***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$ln(dur^{qHM})$		2.88***		2.88***		2.96***
		(0.02)		(0.02)		(0.02)
$ln(dur^{qEH})$		3.28***		3.25***		3.21***
		(0.02)		(0.02)		(0.02)
$ln(\bar{q}^{HM})$		3.07***		1.38***		1.67***
		(0.07)		(0.07)		(0.07)
$ln(\bar{q}^{EH})$		0.66***		0.64***		0.58***
		(0.03)		(0.03)		(0.03)
U^{min}			-1.52***	-1.10***		
			(0.01)	(0.02)		
U^{begin}					-1.04***	-0.86***
					(0.01)	(0.01)
Adj.R^2	0.8403	0.8469	0.8411	0.8473	0.8408	0.8472

Notes: dependent variable: $ln(w_{it})$; controls: west, dummies for education and schooling, dummies for tenure and experience, 2^{nd} degree polynomial in time; estimation details: fixed effects regression for males with robust standard errors; all coefficients and standard errors are rounded to two decimal places and multiplied by 100; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; source: SIAB-7514-V1

Table 2 shows the results of the decomposition exercise described in Section 2.3.1. The first result is that all coefficients concerning aggregate unemployment remain relatively unaffected by the decomposition which indicates that the idea of the decomposition generally works well. The second result is that the coefficients of the duration terms are all positive and relatively high in magnitude. This result points towards the general idea of the model's switching rule stating that the higher the probability of a job offer, the longer an employment cycle and hence a job lasts. Furthermore, in the nested models (column (4) and (6))

[10] We applied a Davidson/MacKinnon (1981) J-Test to test both models against each other. The idea of the test is to first estimate both models separately and then include the fitted values of one model in the other and test whether the coefficient of the included fitted value is different from zero. If it is different from zero, the first model is rejected in favor of the second. The same procedure is then done reversely to check whether the fitted values of the second model is different from zero when introduced in the first model. When considering the implicit contract models (column (3) and (5)) and the selection model (column (2)), the test rejects the implicit contracts models in favor of the selection model but also the selection model in favor of the implicit contract models, with large t-values in both estimations. We take this as further evidence that the German labor market could be described by some mixture of both models.

Table 3: Baseline estimation results, 2000-2014

	(1)	(2)	(3)	(4)	(5)	(6)
U	-0.84***	-0.31***	-0.45***	-0.23***	-0.61***	-0.17***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$ln(q^{HM})$		3.94***		3.91***		3.92***
		(0.03)		(0.03)		(0.03)
$ln(q^{EH})$		3.56***		3.54***		3.49***
		(0.03)		(0.03)		(0.03)
U^{min}			-0.95***	-0.20***		
			(0.02)	(0.02)		
U^{begin}					-0.74***	-0.44***
					(0.02)	(0.02)
Adj. R^2	0.8259	0.8319	0.8261	0.8319	0.8261	0.8320

Notes: dependent variable: $ln(w_{it})$; controls: west, dummies for education and schooling, dummies for tenure and experience, 2^{nd} degree polynomial in time; estimation details: fixed effects regression for males with robust standard errors; all coefficients and standard errors are rounded to two decimal places and multiplied by 100; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; source: SIAB-7514-V1

the coefficient of $\bar{q}^{HM}$ decreases after we control for past labor market conditions. When a worker's outside options improve during a boom, U^{min} decreases and $\bar{q}^{HM}$ increases strongly. This result indicates that the selection mechanism that builds on the negative correlation between past labor market conditions and match quality primarily operates through $\bar{q}^{HM}$.

4.3 Refined model

One drawback when empirically testing the augmented model is that we have only data on occupational labor market conditions from 2000 to 2014. Another shortcoming is that we lose some occupations due to the lack of reliable vacancy and unemployment data.[11] In order to reveal the differences that occur only due to this sample selection, we first re-estimate the model without the occupational dimension for the same time span. Table 3 shows the results from the regressions without taking occupational variation into account and table 4 shows the results after we changed the definition of a job using the occupational information.

The first result worth mentioning is that the magnitude of the coefficient for the current unemployment rate in column (1) is higher in the refined model (Table 4) where we take into account the occupational history of workers. This might be due to the slightly different sample as explained above. The second result is that the coefficient of q^{HM} decreases in magnitude, after we refined the definition of a job, taking into account the occupational variation in job offers. Arguably, this is due to the finer fragmentation of jobs, leading to an increase in the overall number of jobs and to a decrease in the average duration of a job. This settles down in the duration over which we calculate q^{HM}. For q^{EH} this is

[11] See Appendix A for more information on the occupations in our sample.

Table 4: Estimation results of the refined model, 2000-2014

	(1)	(2)	(3)	(4)	(5)	(6)
U	-1.11***	-0.74***	-0.77***	-0.66***	-0.84***	-0.57***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$ln(q_o^{HM})$		2.66***		2.65***		2.68***
		(0.03)		(0.03)		(0.03)
$ln(q_o^{EH})$		3.26***		3.25***		3.16***
		(0.03)		(0.03)		(0.03)
U^{min}			-0.63***	-0.14***		
			(0.03)	(0.03)		
U^{begin}					-0.63***	-0.40***
					(0.02)	(0.02)
Adj. R^2	0.8089	0.8136	0.8089	0.8136	0.8090	0.8136

Notes: dependent variable: $ln(w_{it})$; controls: west, dummies for education and schooling, dummies for tenure and experience, 2^{nd} degree polynomial in time; estimation details: fixed effects regression for males with robust standard errors; all coefficients and standard errors are rounded to two decimal places and multiplied by 100; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; source: SIAB-7514-V1

not necessarily the case, since it is calculated by summing up the labor market tightness over all the durations of all jobs before the current one. The main result in Table 4 is that overall our conclusions are also valid in the refined model. We find a significant relation of past labor market conditions and contemporaneous wages, as well as selection effects. However, when we compare the original model with the refined model, we find that current unemployment produces the largest real wage response, irrespective of controlling for cyclical selection. This result contrasts the results from estimating the original model where we find past unemployment to be more important. One reason for this difference in the overall wage cyclicality is due to how the original model aggregates over all jobs and all occupations and neglects occupational job switchings. In particular, the original model only takes into account cyclical selection by workers who change employers. Our refinement allows us to identify more switches than the original model. If these switches are procyclical, this increases the aggregate cyclicality measured by the overall coefficient of the contemporaneous unemployment rate. We will see in the next section that the wage of employer switchers is very different from those workers who also change their occupation. By applying the refined model, we are able to separately uncover these job switchings and take the incorporated cyclicality into account.

4.4 Job stayers and switchers

In Table 5 we compare the estimates on the wage cyclicality for new hires from unemployment, job stayers and job switchers using the original model without the occupational dimension.[12] Without controls for selection and implicit contracts, wages of new hires from unemployment are less cyclical, and wages of employer switchers are more cyclical than

[12] Note that for the sake of readability, we provide only the coefficients of the interaction terms. The pure dummy coefficients can be found in Appendix B.

Table 5: Baseline estimation results - new hires, stayers, switchers

	(1)	(2)	(3)	(4)	(5)	(6)
U	-0.77***	-0.30***	-0.44***	-0.20***	-0.62***	-0.19***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$I^{NH}U$	0.12***	0.24***	0.44***	0.34***	0.37***	0.41***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
$I^{SW}U$	-0.73***	-0.26***	-0.38***	-0.16***	-0.44***	-0.07
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
$ln(q^{HM})$		3.86***		3.83***		3.85***
		(0.03)		(0.03)		(0.03)
$ln(q^{EH})$		3.39***		3.37***		3.32***
		(0.03)		(0.03)		(0.03)
U^{min}			-0.98***	-0.30***		
			(0.02)	(0.02)		
U^{begin}					-0.73***	-0.48***
					(0.02)	(0.02)
Adj. R^2	0.8268	0.8324	0.8270	0.8324	0.8270	0.8325

Notes: dependent variable: $ln(w_{it})$; controls: west, dummies for education and schooling, dummies for tenure and experience, 2^{nd} degree polynomial in time; estimation details: fixed effects regression for males with robust standard errors; all coefficients and standard errors are rounded to two decimal places and multiplied by 100; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; source: SIAB-7514-V1

those of employer stayers (column(1)). In the pure selection model (column (2)) as well as in the pure implicit contract models (column (3) and (5)), these results do not change qualitatively, although the incremental effect for new hires from unemployment increases, while the one for employer switchers decreases. The estimates from the nested models (column (4) and (6)) point to less procyclical wages for new hires from unemployment. Overall, we cannot confirm the conclusion in HM that controlling for selection equalizes the wage cyclicality of job switchers and stayers.[13]

Table 6 shows the results of the estimation of Equation (9) in the occupationally refined version. The results shown in column (1) are similar to those in the original model. We find that wages of job (employer or/ and occupation) switchers respond stronger to changes in the contemporaneous unemployment rate than those of new hires from unemployment and job stayers. Again, we can observe that the wage cyclicality of new hires from unemployment is significantly smaller than it is for job stayers. This result changes, however, in the pure selection model (column (2)): our finer controls for cyclical selections decrease the incremental effect of new hires from unemployment and the coefficient becomes statistically insignificant. Contrary, in the pure implicit contract models (column (3) and (5)) this is not the case. We take this as evidence that cyclical selection also has some impact on the cyclicality of new hires. When we estimate the model where we nested the contract model

[13] HM do not show estimates for the wage cyclicality of new hires from unemployment. In typical job ladder models, there is no clear-cut prediction for wage changes of new hires from unemployment. The usual assumption is that they accept any job offer that incorporates a wage at least as high as their reservation wage. It is not clear, how the match quality of the first job in an employment cycle is linked to the match quality of the last job in the previous employment cycle.

Table 6: Estimation results of the refined model - new hires, stayers, switchers

	(1)	(2)	(3)	(4)	(5)	(6)
U	-1.08***	-0.73***	-0.79***	-0.67***	-0.90***	-0.61***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$I^{NH}U$	0.15***	0.04	0.30***	0.07*	0.31***	0.15***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
$I^{SW}U$	-0.67***	-0.15***	-0.52***	-0.12**	-0.49***	-0.05
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
$ln(q_o^{HM})$		2.59***		2.58***		2.61***
		(0.03)		(0.03)		(0.03)
$ln(q_o^{EH})$		3.04***		3.02***		2.94***
		(0.03)		(0.03)		(0.03)
U^{min}			-0.61***	-0.13***		
			(0.04)	(0.04)		
U^{begin}					-0.55***	-0.37***
					(0.02)	(0.02)
Adj. R^2	0.8099	0.8141	0.8100	0.8141	0.8100	0.8142

Notes: dependent variable: $ln(w_{it})$; controls: west, dummies for education and schooling, dummies for tenure and experience, 2^{nd} degree polynomial in time; estimation details: fixed effects regression for males with robust standard errors; all coefficients and standard errors are rounded to two decimal places and multiplied by 100; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; source: SIAB-7514-V1

with one-sided commitment and the selection model (column (4)), the incremental effect for new hires effect is slightly positive and significant. In the model where we nested the proxies for selection and the contract model with two-sided commitment (column (6)), we find that the incremental effect for job switchers is again negative, although insignificant, and the incremental effect for new hires is positive, indicating that the nested estimation gives results somewhere in the middle of both models.

Table 7 presents the results of disentangling the source of every job switch. This differentiation allows us to analyze the wage cyclicality of different job switchings separately. In the regression which neither controls for selection nor proxies for history dependence (column (1)), we find that wages of new hires from unemployment respond less than those of job stayers, while wages of occupation switchers and wages of occupation and employer switchers respond stronger to changes of the contemporaneous unemployment rate. After controlling for selection (column (2)), we find no significant incremental effect for workers who only switch their occupation and no incremental effect for new hires from unemployment anymore. If we do not control for cyclical selection but for the minimum unemployment rate or the initial unemployment rate (column (3) and (5)), we find qualitative similar results as in the regression without controls for selection and past unemployment. However, if we control for both selection and past unemployment (column (4) and (6)), we only find a negative and significant incremental effect of those workers who switch their occupation and their employer at the same time, while the other incremental effects turn insignificant. The only exception is the regression where we include controls for selection and the initial unemployment rate (column (6)). Here we estimate a positive, significant incremental effect for new hires from unemployment.

Table 7: Estimation results of the refined model - new hires, stayers, different switchers

	(1)	(2)	(3)	(4)	(5)	(6)
U	-1.07***	-0.72***	-0.80***	-0.68***	-0.89***	-0.59***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$I^{NH}U$	0.14***	0.03	0.29***	0.05	0.31***	0.15***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
$I^{ESW}U$	-0.54***	-0.13*	-0.39***	-0.11	-0.36***	-0.03
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
$I^{OSW}U$	-0.70***	0.08	-0.56***	0.10	-0.52***	0.18
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
$I^{OESW}U$	-1.03***	-0.53***	-0.88***	-0.51***	-0.86***	-0.44***
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
$ln(q_o^{HM})$		2.58***		2.58***		2.61***
		(0.03)		(0.03)		(0.03)
$ln(q_o^{EH})$		3.10***		3.09***		3.00***
		(0.03)		(0.03)		(0.03)
U^{min}			-0.59***	-0.09*		
			(0.04)	(0.04)		
U^{begin}					-0.56***	-0.38***
					(0.02)	(0.02)
Adj. R^2	0.8099	0.8141	0.8100	0.8141	0.8100	0.8142

Notes: dependent variable: $ln(w_{it})$; controls: west, dummies for education and schooling, dummies for tenure and experience, 2^{nd} degree polynomial in time; estimation details: fixed effects regression for males with robust standard errors; all coefficients and standard errors are rounded to two decimal places and multiplied by 100; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; source: SIAB-7514-V1

5 Summary and discussion

Using administrative data from Germany, we empirically study the linkage between real wages and past and contemporaneous labor market conditions.

First, we explore the relative importance of implicit contracts vs. spot markets using the methodology proposed by BDN. Unlike BDN who use U.S. data, we find that the minimum, initial and current unemployment rate independently are important determinants for contemporaneous wages in Germany. This result is also found in different labor markets, e.g., by Grant (2003) using U.S. survey data and by Devereux/Hart (2007) using British survey data. We then test the implications of HM's selection model, thereby testing the unobserved influences of match quality. We cannot confirm that the effect of past labor market conditions on wages only reflect the underlying evolution of match quality - one of the main findings in HM. Contrary, we find support for both history dependence in wages and selection effects. Overall, we do not conclude that one model supersedes the other. Both models independently help us understand the movement of wages over the business cycle.

Second, we investigate whether the wage cyclicality is different across employer stayers, employer switchers and new hires from unemployment, using the original HM model. As Gertler/Huckfeldt/Trigari (2016), we argue that it is important to disentangle the wage cyclicality of new hires from unemployment and on-the-job switchers because merging both worker types conflates the estimates through procyclical selection of the latter. Our data suggest that the wages of employer switchers are more volatile than those of stayers — even after using HM's controls for cyclical selection. Further we find that the wages of new hires from unemployment are slightly countercyclical. These results contrast the conclusion of HM who find that, after controlling for selection, the wages of both stayers and switchers are equally cyclical.[14] Since we are the first to apply the method of HM to German data, we cannot directly compare our results from the selection model with other (European) studies. However, there are studies that apply other techniques that account for cyclical regrading. Carneiro/Guimaraes/Portugal (2012) investigate wage cyclicality using Portuguese linked employer-employee data controlling for firm, worker and job heterogeneity. They show that the wages of newly hired workers – those from non-employment and between-firm movers – respond stronger to changes in the unemployment rate than those of employer stayers. These results are backed up by Martins/Solon/Thomas (2012) who find higher wage cyclicality for job movers using data from Portugal as well.

We continue with a refinement of the original model in order to account for cyclical job-regrading of workers across occupations within companies. The results from our refined model show that the overall wage cyclicality is higher when we use our more detailed (occupational) measures for selection. We show that occupational job switches are an important source of wage cyclicality. Not taking them into account can lead to wrong interpretations of the estimated wage cyclicality because occupational switchers would be counted as job stayers. By using finer definitions of a job, we are able to compare the wage cyclicality of

[14] HM do not show estimation results for new hires from unemployment explicitly. They state that their wage cyclicality is similar to that of employer switchers.

different job switchers. We find that after controlling for cyclical occupational selection and contracts with one-sided commitment, wages of job switchers who change their employer and occupation are more volatile than those of job stayers. Wages of workers who switch solely their employer or solely their occupation as well as wages of new hires from unemployment are not more cyclical than those of stayers. These results are broadly in line with Gertler/Huckfeldt/Trigari (2016) who study U.S. data, finding no excess wage cyclicality for new hires from unemployment and underlining the importance to control for cyclical regrading. In addition, our results are also consistent with the results in Stüber (2016), using data from Germany as well. He finds that wages from newly hired workers (from non-employment and employer switchers) are not significantly more cyclical than those of other workers when controlling simultaneously for worker and firm-occupation fixed effects. Our results contrast the results in Haefke/Sonntag/van Rens (2013), who find that wages of new hires from unemployment behave similarly to wages of job-to-job movers.

Throughout this paper, we strictly interpreted our results in the light of both the BDN implicit contract models and the HM selection model. However, we think that selection of high quality jobs is only one possible interpretation and that our results are also in line with the literature on non-linear tenure effects on wages. Specifically, the results of our decomposition exercise show that a large share of the effect of the "match quality measures" on wages is due to the duration of a job. Arozamena/Centeno (2006) show that higher job tenure implies that more match-specific human capital has been accumulated. Thus, in a contractual framework, wage cyclicality is lower the longer a job lasts because workers are more and more shielded from cyclical labor market conditions. The reason is that over tenure, the worker receives a larger fraction of the return to match-specific human capital which is less cyclical than the value of outside job opportunities. We think there is much scope for further research in order to explore the specific mechanisms at work.

References

Arozamena, Leandro; Centeno, Mario (2006): Tenure, business cycle and the wage-setting process. In: European Economic Review, Vol. 50, No. 2, p. 401–424.

Beaudry, Paul; DiNardo, John (1991): The Effect of Implicit Contracts on the Movement of Wages over the Business Cycle: Evidence from Micro Data. In: Journal of Political Economy, Vol. 99, No. 4, p. 665–688.

Bils, Mark J (1985): Real wages over the business cycle: evidence from panel data. In: Journal of Political economy, Vol. 93, No. 4, p. 666–689.

Büttner, Thomas; Jacobebbinghaus, Peter; Ludsteck, Johannes (2010): Occupational Upgrading and the Business Cycle in West Germany. In: Economics: The Open-Access, Open-Assessment E-Journal, Vol. 4, No. 2010-10.

Carneiro, Anabela; Guimaraes, Paulo; Portugal, Pedro (2012): Real Wages and the Business Cycle: Accounting for Worker, Firm, and Job Title Heterogeneity. In: American Economic Journal: Macroeconomics, Vol. 4, No. 2, p. 133–52.

Davidson, Russell; MacKinnon, James G (1981): Several Tests for Model Specification in the Presence of Alternative Hypotheses. In: Econometrica, Vol. 49, No. 3, p. 781–93.

Devereux, Paul J.; Hart, Robert A. (2007): The Spot Market Matters: Evidence On Implicit Contracts From Britain. In: Scottish Journal of Political Economy, Vol. 54, No. 5, p. 661–683.

Devereux, Paul J.; Hart, Robert A. (2006): Real Wage Cyclicality of Job Stayers, Within-Company Job Movers, and Between-Company Job Movers. In: Industrial and Labor Relations Review, Vol. 60, No. 1, p. 105–119.

Feng, Shuaizhang; Burkhauser, Richard V; Butler, JS (2006): Levels and long-term trends in earnings inequality: overcoming current population survey censoring problems using the GB2 distribution. In: Journal of Business & Economic Statistics, Vol. 24, No. 1, p. 57–62.

Gallipoli, Giovanni; Yedid-Levi, Yaniv; Galindo da Fonseca, Joao (2016): Revisiting the Relationship between Unemployment and Wages. In: unpublished.

Gartner, Hermann; Holzner, Christian (2015): Wage Posting as a Positive Selection Device: Theory and Empirical Evidence. CESifo Working Paper Series 5494, CESifo Group Munich.

Gertler, Mark; Huckfeldt, Christopher; Trigari, Antonella (2016): Unemployment Fluctuations, Match Quality, and the Wage Cyclicality of New Hires. Working Paper 22341, National Bureau of Economic Research.

Gertler, Mark; Trigari, Antonella (2009): Unemployment Fluctuations with Staggered Nash Wage Bargaining. In: Journal of Political Economy, Vol. 117, No. 1, p. 38–86.

Grant, Darren (2003): The Effect of Implicit Contracts on the Movement of Wages over the Business Cycle: Evidence from the National Longitudinal Surveys. In: Industrial and Labor Relations Review, Vol. 56, No. 3, p. 393–408.

Haefke, Christian; Sonntag, Marcus; van Rens, Thijs (2013): Wage rigidity and job creation. In: Journal of Monetary Economics, Vol. 60, No. 8, p. 887 – 899.

Hagedorn, Marcus; Manovskii, Iourii (2013): Job selection and wages over the business cycle. In: The American Economic Review, Vol. 103, No. 2, p. 771–803.

Hall, Robert E. (2005): Employment Fluctuations with Equilibrium Wage Stickiness. In: The American Economic Review, Vol. 95, No. 1, p. 50 – 65.

Hart, Robert A; Roberts, J Elizabeth (2011): Spot wages, job changes, and the cycle. Stirling Economics Discussion Papers 2011-11, University of Stirling, Division of Economics.

Lochner, Benjamin; Schulz, Bastian (2016): Labor Market Sorting in Germany. CESifo Working Paper Series 6066, CESifo Group Munich.

Martins, Pedro S.; Solon, Gary; Thomas, Jonathan P. (2012): Measuring What Employers Do about Entry Wages over the Business Cycle: A New Approach. In: American Economic Journal: Macroeconomics, Vol. 4, No. 4, p. 36–55.

Mortensen, Dale; Pissarides, Christopher A. (1994): Job Creation and Job Destruction in the Theory of Unemployment. In: Review of Economic Studies, Vol. 61, No. 3, p. 397–415.

Pissarides, Christopher A. (2009): The Unemployment Volatility Puzzle: Is Wage Stickiness the Answer? In: Econometrica, Vol. 77, No. 5, p. 1339–1369.

Shimer, Robert (2005): The Cyclical Behavior of Equilibrium Unemployment and Vacancies. In: The American Economic Review, Vol. 95, No. 1, p. 25 – 49.

Solon, Gary; Barsky, Robert; Parker, Jonathan A. (1994): Measuring the Cyclicality of Real Wages: How Important is Composition Bias. In: The Quarterly Journal of Economics, Vol. 109, No. 1, p. 1–25.

Stüber, Heiko (2016): The Real Wage Cyclicality of Newly Hired and In-cumbent Workers in Germany. In: The Economic Journal, Vol. forthcoming.

A Descriptives

Table 8: Descriptive statistics on aggregate variables - original model

Variable	Mean	Std. Dev.	Min.	Max.
U	9.8597	1.8578	3.3	14.1
U^{begin}	10.003	1.9485	3.3	14.1
U^{min}	9.3319	1.8029	3.3	14.1
θ (tightness)	0.0994	0.0411	0.022	0.4003
$ln(q^{EH})$	0.1636	0.7961	-3.6945	3.768
$ln(q^{HM})$	1.2155	1.4814	-3.6945	3.8593

Notes: Original model sample: descriptive statistics on aggregate variables, sample years 1980-2014. source: SIAB-7514-V1

Table 9: Descriptive statistics on tenure measures - original model

Variable	Mean	Std. Dev.	Min.	Max.
Experience	9.6091	7.66	0	41
Tenure occup.	6.0593	6.3573	0	41
Tenure firm	3.7627	4.7052	0	41

Notes: Original model sample: descriptive statistics on tenure measures, yearly tenure variables, calculated from 1974 onwards. source: SIAB-7514-V1

Table 10: Descriptive statistics on aggregate variables - refined model

Variable	Mean	Std. Dev.	Min.	Max.
U	9.7049	1.7964	7.2	14.1
U^{begin}	10.2309	1.7555	7.2	14.1
U^{min}	9.6113	1.6129	7.2	14.1
$ln(q^{EH})$	0.2086	0.8228	-4.1568	4.6594
$ln(q^{HM})$	1.2269	1.493	-4.2989	4.7188

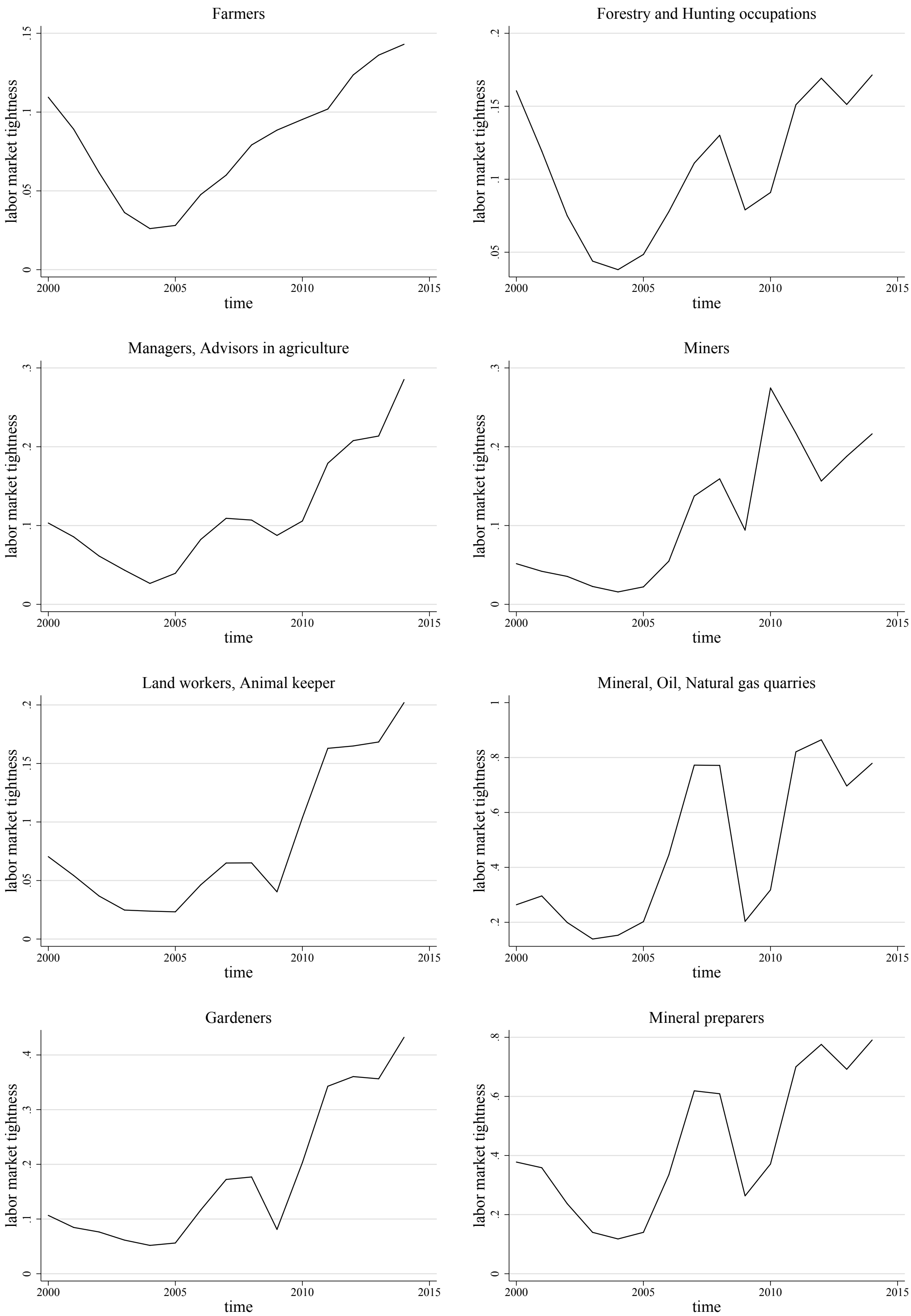
Notes: Refined model sample: descriptive statistics on aggregate variables, sample years 2000-2014. source: SIAB-7514-V1

Table 11: Descriptive statistics on tenure measures - refined model

Variable	Mean	Std. Dev.	Min.	Max.
Experience	9.2959	7.6314	0	41
Tenure occup.	5.2113	5.988	0	39
Tenure firm	2.6742	3.4964	0	35

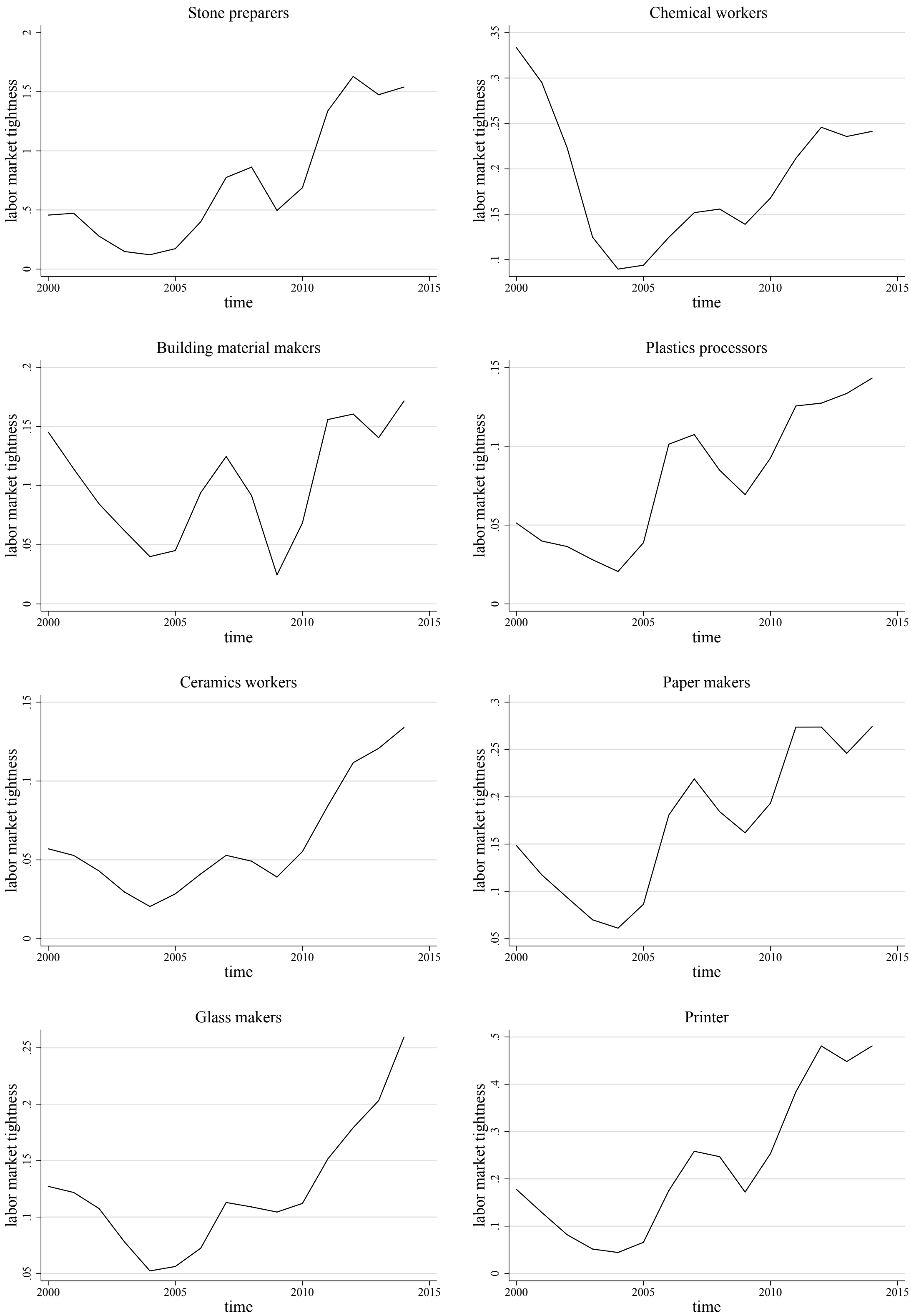
Notes: Refined model sample: descriptive statistics on tenure measures, yearly tenure variables, calculated from 1974 onwards. source: SIAB-7514-V1

Figure 3: Occupational labor market tightness – 2000-2014



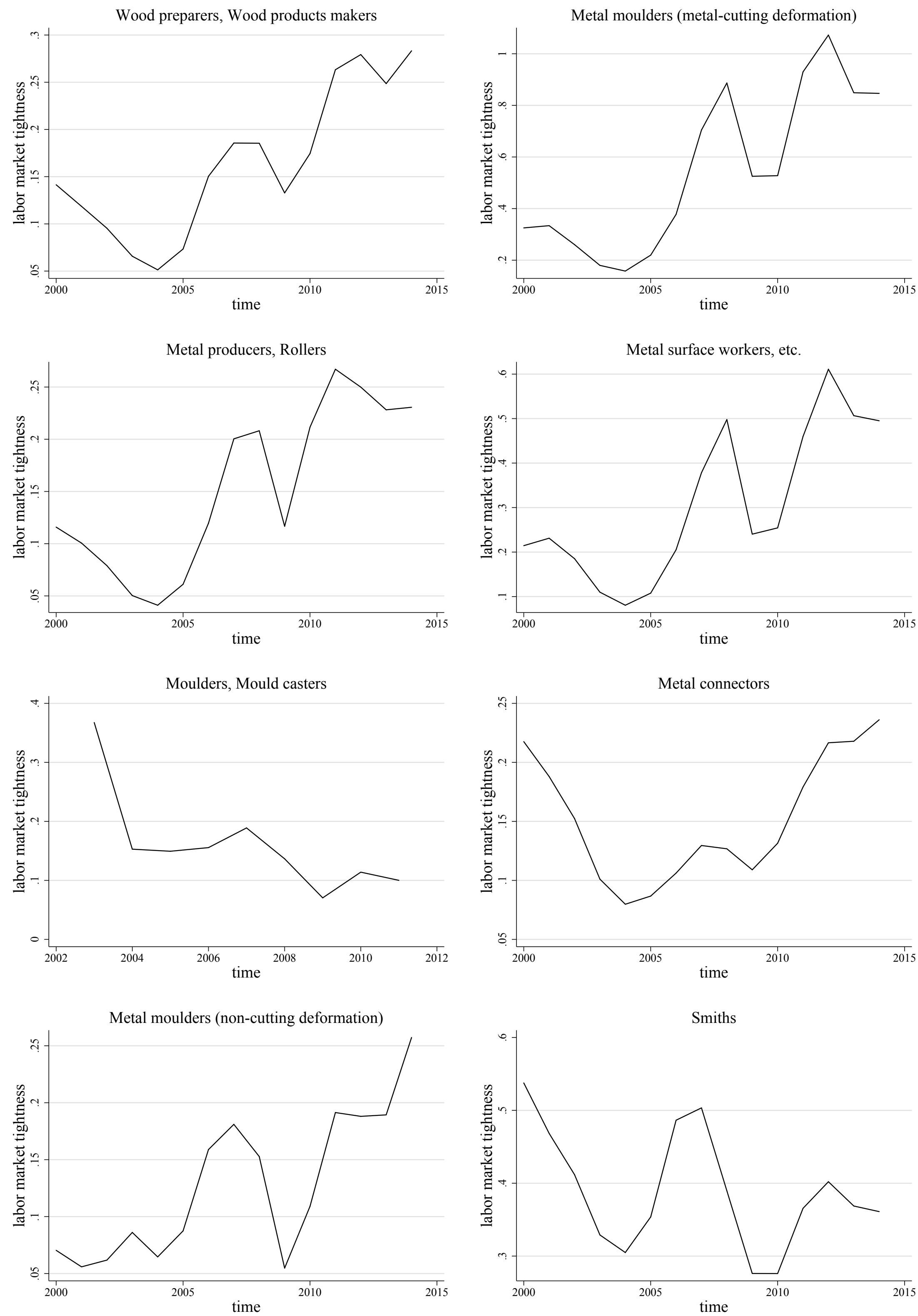
Note: Yearly average of the occupational labor market tightness. 2-digit occupational classification of the German Classification of Occupations (KldB88); source: SIAB-7514-V1

Occupational labor market tightness – 2000-2014



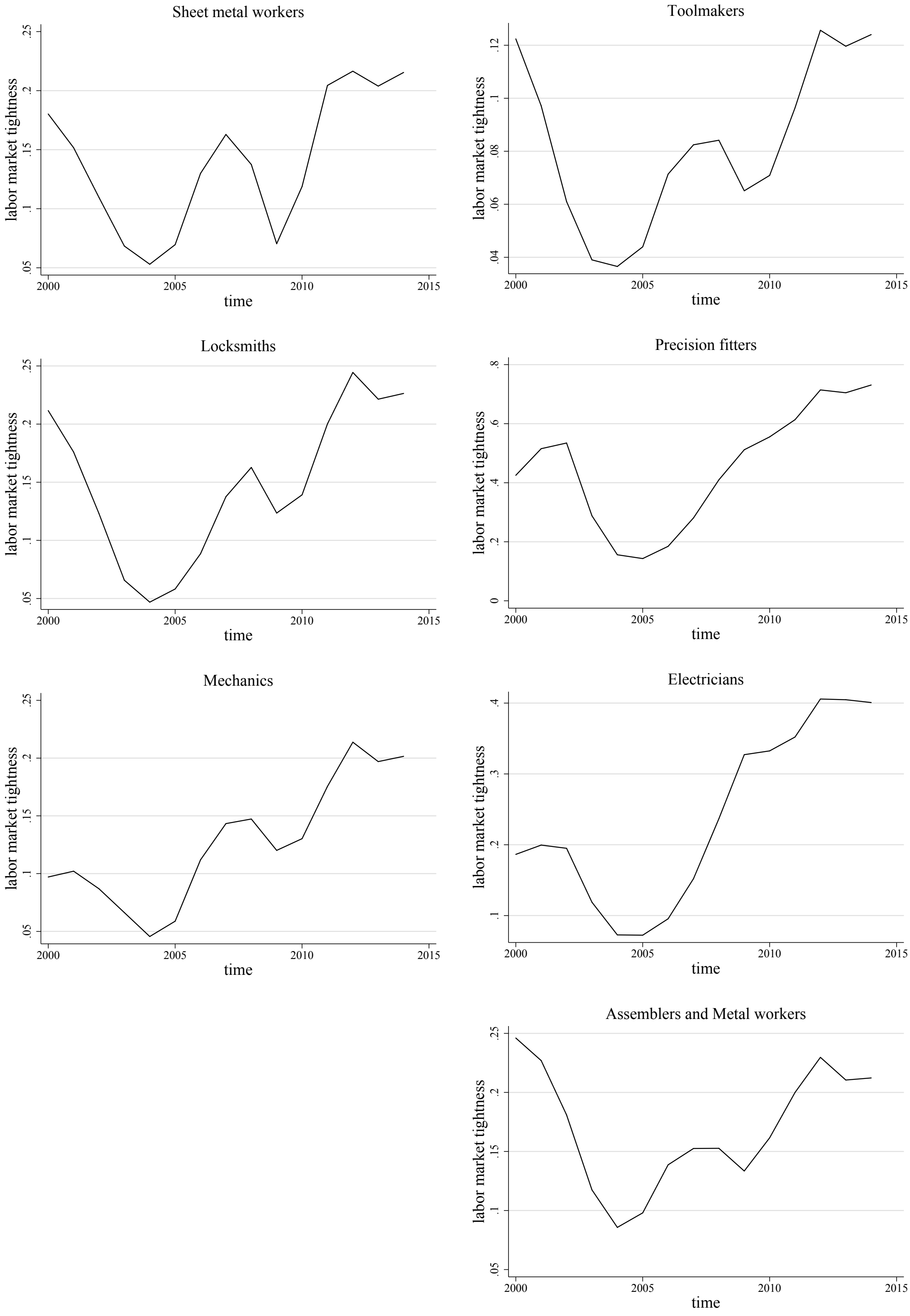
Note: Yearly average of the occupational labor market tightness. 2-digit occupational classification of the German Classification of Occupations (KldB88); source: SIAB-7514-V1

Occupational labor market tightness – 2000-2014



Note: Yearly average of the occupational labor market tightness. 2-digit occupational classification of the German Classification of Occupations (KldB88); source: SIAB-7514-V1

Occupational labor market tightness – 2000-2014



Note: Yearly average of the occupational labor market tightness. 2-digit occupational classification of the German Classification of Occupations (KldB88); source: SIAB-7514-V1

B Detailed tables from the text

Table 12: Baseline estimation results - new hires, stayers, switchers

	(1)	(2)	(3)	(4)	(5)	(6)
U	-0.77***	-0.30***	-0.44***	-0.20***	-0.62***	-0.19***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
I^{NH}	-2.47***	-2.61***	-5.37***	-3.49***	-5.01***	-4.33***
	(0.28)	(0.27)	(0.29)	(0.28)	(0.29)	(0.28)
$I^{NH}U$	0.12***	0.24***	0.44***	0.34***	0.37***	0.41***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
I^{SW}	11.57***	6.31***	8.43***	5.39***	8.70***	4.51***
	(0.38)	(0.38)	(0.39)	(0.39)	(0.39)	(0.38)
$I^{SW}U$	-0.73***	-0.26***	-0.38***	-0.16***	-0.44***	-0.07
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
$ln(q^{HM})$		3.86***		3.83***		3.85***
		(0.03)		(0.03)		(0.03)
$ln(q^{EH})$		3.39***		3.37***		3.32***
		(0.03)		(0.03)		(0.03)
U^{min}			-0.98***	-0.30***		
			(0.02)	(0.02)		
U^{begin}					-0.73***	-0.48***
					(0.02)	(0.02)
Adjusted R^2	0.8268	0.8324	0.8270	0.8324	0.8270	0.8325

Notes: dependent variable: $ln(w_{it})$; controls: west, dummies for education and schooling, dummies for tenure and experience, 2^{nd} degree polynomial in time; estimation details: fixed effects regression for males with robust standard errors; all coefficients and standard errors are rounded to two decimal places and multiplied by 100; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; source: SIAB-7514-V1

Table 13: Estimation results of the refined model - new hires, stayers, switchers

	(1)	(2)	(3)	(4)	(5)	(6)
U	-1.08***	-0.73***	-0.79***	-0.67***	-0.90***	-0.61***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
I^{NH}	-2.84***	-1.29***	-4.20***	-1.59***	-4.48***	-2.44***
	(0.30)	(0.29)	(0.31)	(0.31)	(0.31)	(0.30)
$I^{NH}U$	0.15***	0.04	0.30***	0.07*	0.31***	0.15***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
I^{SW}	10.35***	4.55***	9.07***	4.31***	8.57***	3.58***
	(0.40)	(0.41)	(0.41)	(0.41)	(0.41)	(0.41)
$I^{SW}U$	-0.67***	-0.15***	-0.52***	-0.12**	-0.49***	-0.05
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
$ln(q_o^{HM})$		2.59***		2.58***		2.61***
		(0.03)		(0.03)		(0.03)
$ln(q_o^{EH})$		3.04***		3.02***		2.94***
		(0.03)		(0.03)		(0.03)
U^{min}			-0.61***	-0.13***		
			(0.04)	(0.04)		
U^{begin}					-0.55***	-0.37***
					(0.02)	(0.02)
Adjusted R^2	0.8099	0.8141	0.8100	0.8141	0.8100	0.8142

Notes: dependent variable: $ln(w_{it})$; controls: west, dummies for education and schooling, dummies for tenure and experience, 2^{nd} degree polynomial in time; estimation details: fixed effects regression for males with robust standard errors; all coefficients and standard errors are rounded to two decimal places and multiplied by 100; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; source: SIAB-7514-V1

Table 14: Estimation results of the refined model - new hires, stayers, different switchers

	(1)	(2)	(3)	(4)	(5)	(6)
U	-1.07***	-0.72***	-0.80***	-0.68***	-0.89***	-0.59***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
I^{NH}	-2.78***	-1.15***	-4.10***	-1.36***	-4.44***	-2.31***
	(0.30)	(0.29)	(0.31)	(0.31)	(0.31)	(0.30)
$I^{NH}U$	0.14***	0.03	0.29***	0.05	0.31***	0.15***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
I^{ESW}	8.70***	4.06***	7.39***	3.88***	6.95***	3.10***
	(0.54)	(0.54)	(0.55)	(0.55)	(0.55)	(0.54)
$I^{ESW}U$	-0.54***	-0.13*	-0.39***	-0.11	-0.36***	-0.03
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
I^{OSW}	9.24***	0.24	8.15***	0.10	7.36***	-0.77
	(0.91)	(0.91)	(0.91)	(0.91)	(0.91)	(0.91)
$I^{OSW}U$	-0.70***	0.08	-0.56***	0.10	-0.52***	0.18
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
I^{OESW}	14.63***	9.45***	13.36***	9.28***	12.96***	8.53***
	(0.78)	(0.76)	(0.78)	(0.77)	(0.78)	(0.77)
$I^{OESW}U$	-1.03***	-0.53***	-0.88***	-0.51***	-0.86***	-0.44***
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
$ln(q_o^{HM})$		2.58***		2.58***		2.61***
		(0.03)		(0.03)		(0.03)
$ln(q_o^{EH})$		3.10***		3.09***		3.00***
		(0.03)		(0.03)		(0.03)
U^{min}			-0.59***	-0.09*		
			(0.04)	(0.04)		
U^{begin}					-0.56***	-0.38***
					(0.02)	(0.02)
Adjusted R^2	0.8099	0.8141	0.8100	0.8141	0.8100	0.8142

Notes: dependent variable: $ln(w_{it})$; controls: west, dummies for education and schooling, dummies for tenure and experience, 2^{nd} degree polynomial in time; estimation details: fixed effects regression for males with robust standard errors; all coefficients and standard errors are rounded to two decimal places and multiplied by 100; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; source: SIAB-7514-V1

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