

Institute for Employment
Research

The Research Institute of the
Federal Employment Agency

IAB

IAB-Discussion Paper

13/2010

Articles on labour market issues

The impact of labour market reforms and economic performance on the matching of short-term and long-term unemployed

Sabine Klinger
Thomas Rothe

The impact of labour market reforms and economic performance on the matching of short-term and long-term unemployed

Sabine Klinger, Thomas Rothe (IAB)

Mit der Reihe „IAB-Discussion Paper“ will das Forschungsinstitut der Bundesagentur für Arbeit den Dialog mit der externen Wissenschaft intensivieren. Durch die rasche Verbreitung von Forschungsergebnissen über das Internet soll noch vor Drucklegung Kritik angeregt und Qualität gesichert werden.

The “IAB-Discussion Paper” is published by the research institute of the German Federal Employment Agency in order to intensify the dialogue with the scientific community. The prompt publication of the latest research results via the internet intends to stimulate criticism and to ensure research quality at an early stage before printing.

Contents

Abstract	4
1 Introduction	5
2 Recent labour market reforms in Germany	8
3 Theoretical approach and previous empirical findings.....	9
3.1 Stock-Flow Matching	9
3.2 Model augmentation by reforms, economic performance, and heterogeneity ..	10
3.2.1 Technology shifts due to labour market reforms	10
3.2.2 Job-finding and the business cycle	13
3.2.3 Searcher heterogeneity and ranking by unemployment duration.....	14
4 Data	16
5 Empirical Analysis.....	18
5.1 Model specification and estimation strategy	18
5.2 Estimation results: The effects of labour market reforms and economic performance on matches.....	22
5.2.1 Matching from total unemployment	22
5.2.2 Matching from either short-term or long-term unemployment	25
5.3 Robustness	27
6 Conclusion	29

Abstract

As a reaction on high and persistent unemployment in Germany, the largest labour market reforms in post-war history were implemented between 2003 and 2005. We analyse the impact of the reform and its coincidence with an economic expansion on the efficiency of matching out of unemployment. Especially focussing on searcher heterogeneity, we estimate a system of simultaneous stock-flow matching functions for short-term and long-term unemployment (3SLS) on the basis of administrative data. In sum, matching efficiency accelerated for the short-term and particularly the long-term unemployed although we cannot rule out a slight negative effect of the reformation of the unemployment benefit system for the short-term unemployed. A tighter relationship between the business cycle and the matching efficiency during the latest economic expansion could not be proven.

Zusammenfassung

Als Reaktion auf die hohe und persistente Arbeitslosigkeit in Deutschland wurde zwischen 2003 und 2005 die umfangreichste Reform des Arbeitsmarktes und der Sozialordnung seit Gründung der Bundesrepublik Deutschland umgesetzt. In der vorliegenden Studie analysieren wir, ob die Reformen und ihr Zusammenwirken mit dem konjunkturellen Aufschwung der Jahre 2005 bis 2008 die Matchingeffizienz beeinflusst haben. Um die Heterogenität der Arbeitslosen zu berücksichtigen, schätzen wir ein System simultaner Matchingfunktionen für Kurz- und Langzeitarbeitslose (3SLS) auf Basis administrativer Daten. Den Ergebnissen zufolge hat sich die Matchingeffizienz für Kurz- und besonders für Langzeitarbeitslose erhöht. Einen kleineren negativen Effekt der Hartz-IV-Reform auf die Beschäftigungschancen der Kurzeitarbeitslosen können wir jedoch nicht ausschließen. Ein engerer Zusammenhang zwischen Konjunktur und Arbeitsmarkt in der vergangenen Aufschwungphase lässt sich nicht nachweisen.

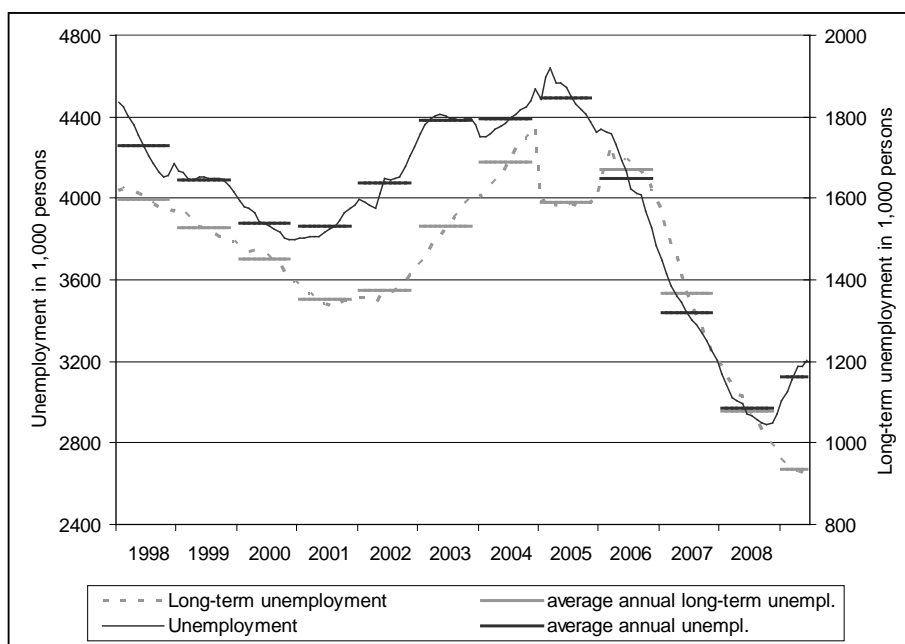
JEL-Classification: J64, E32, J68, C33

Keywords: labour market reform, macroeconomic evaluation, stock-flow matching.

1 Introduction

The German labour market had suffered from high and often persistent unemployment for many years. In 1997, unemployment amounted to its highest value after reunification at 11.4 percent according to national statistics (coming from 7.7 percent in 1992). Between January 1998 and June 2009, about 1.45 million people were long-term unemployed on average in each month. This counts for nearly one third of the average monthly stock of 3.96 million unemployed. At its peak in 2004, long-term unemployment had risen up to 1.8 million (Figure 1).

Figure 1: The stocks of unemployment and long-term unemployment in Germany, 1998m1 to 2009m6



Remarks: Monthly data, seasonally adjusted.

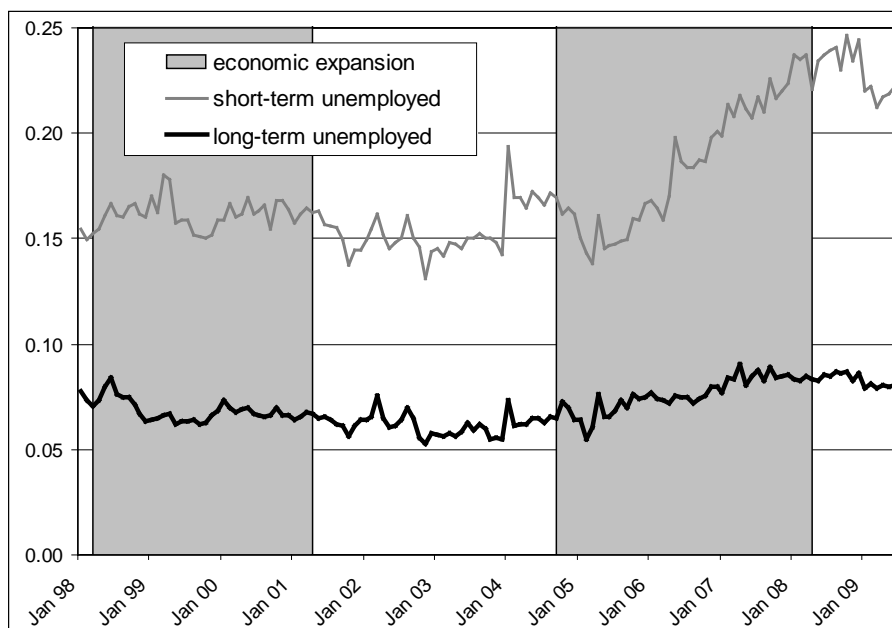
Source: Federal Employment Agency.

This was why the German government established a commission in February 2002 in order to modernize labour market institutions and, thus, reduce inflows into unemployment and ease the transition out of unemployment. The commission's work resulted into four laws concerning "modern services at the labour market", named more easily after the commission's chair the Hartz Reforms. They emerged as the largest social reform in German post-war history.

The Hartz Reforms came into force in four parts between 2003 and 2005. During these years, the German economy rather stagnated. However, just moderate wage increases were bargained between employers and labour unions and the international competitiveness of German products further increased. Exports and investment then boosted the economy, and the upswing reached the labour market in mid-2006. Within three years – from 2006 to 2008 – unemployment decreased by one third, long-term unemployment even by 40 percent (Figure 1).

Such tremendous decreases in the stock of unemployment are caused by either drops in inflows or jumps in outflows or both. Outflow rates of short- and long-term unemployed are given in Figure 2. They show, first, a cyclical dependence of the chance to leave unemployment. Second, outflow rates especially from short-term unemployment were much higher in the economic expansion following the Hartz Reforms than during the expansion before. Thus, the coincidence of the reforms and economic upswing might have caused unemployment to decrease so sharply. And third, the exit rate for the long-term unemployed is only one third of that for short-term unemployed. However, their chances to leave unemployment seem to have improved in the past upswing, compared to the first one, too, but only very slightly.

Figure 2: Outflows from short-term and long-term unemployment as share in the pre-period's stock



Remarks: Monthly data, seasonally adjusted.

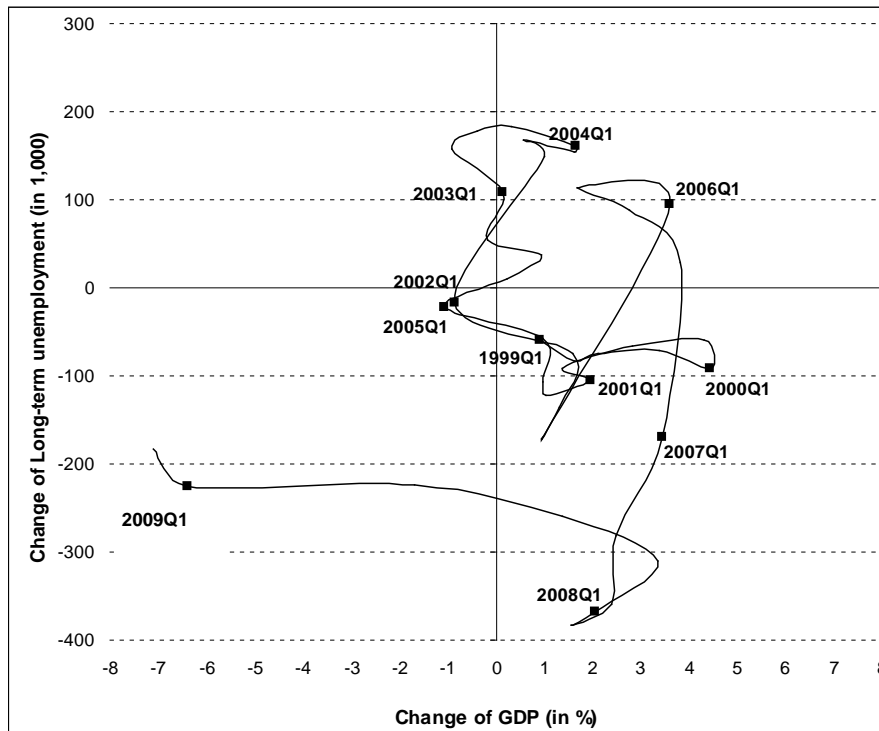
Source: Federal Employment Agency.

The reaction of the stock of unemployment to economic performance can also be seen in the Okun relation (Figure 3): There is a slight but not too convincing negative relationship between real GDP growth and long-term unemployment, with a coefficient of correlation at -0.5 till the end of 2004. Afterwards long-term unemployment fell strongly at given GDP growth rates. Again, we understand this finding as a hint that the business cycle might be more effective in reducing long-term unemployment than it has been before. However, long-term unemployment even continued to decrease when GDP growth turned negative in mid-2008.

Starting from these empirical findings, this paper contributes to the evaluation of the Hartz Reforms on the macroeconomic level using flow variables of the labour market. Following the matching approach of the evaluation literature (see section 3), we address three questions: First, did the Hartz Reforms change the matching

process? Second, if yes, did this change also happen through a tightened relationship between economic performance and matching? Through this coincidence of changes in labour demand and search intensity the Hartz Reforms might have eased the matching process. And third, did the Hartz Reforms also improve the matching of long-term unemployed – either directly or indirectly through a closer link to the economic upswing?

Figure 3: Okun relation of long-term unemployment and real GDP in Germany since 1999



Remarks: Quarterly data, seasonally adjusted.

Source: Federal Statistical Office and Federal Employment Agency.

The paper is organized as follows: In the next section we present the most important aspects of the recent labour market reforms in Germany. Afterwards we describe the matching technology as our analytical tool and refer to previous empirical findings. We augment previous studies on matching by considering long-term unemployment not only as an explanatory variable but as a research object with its own matching function. Moreover, to our knowledge, the interaction of the reforms and economic performance has not yet been scrutinised as explanatory factor. In section 4 we describe the data. In the empirical analysis (section 5), we estimate stock-flow matching functions for outflows from unemployment into regular employment as well as an equation system for matches from short-term and long-term unemployment. We apply three stage least squares estimation (3SLS) to the equation system. The final section draws some conclusions.

2 Recent labour market reforms in Germany

As a reaction to high and persistent unemployment in Germany the then government established the Hartz Commission in 2002 in order to modernize labour market institutions. The suggestions of the commission resulted into four laws that came into force in three waves. Each of the Hartz I to IV Reforms again consisted of various components (see Table 1 for an overview and the timing). Jacobi/Kluve (2007) summarize them into three core elements that may influence the job-finding probability of short-term as well as long-term unemployed workers:

1. Higher effectiveness and efficiency of labour market services and policy measures, for instance by re-organizing the Federal Employment Agency, by outsourcing of placement services into the private sector, or by choosing measures of active labour market policy that promised to be more effective.
2. More activation and higher self-responsibility of the unemployed, for instance by new start-up subsidies, by targets on re-integration efforts, by re-configuring the unemployment benefit and social assistance system towards less or shorter benefit entitlement and higher claims of search effort.
3. Labour market deregulation, for instance concerning temporary agency work, fixed term contracts, and employment protection.

All these parts of the Hartz Reforms pursue different strategies but they all serve to fulfil the commission's aim to reduce unemployment via the flow variables: The number of outflows could be raised if the unemployed search for jobs more intensively and if barriers for job creation in enterprises are reduced. As a consequence, unemployment duration and, thus, the stock of unemployment shall decrease (Hartz et al. 2002: 270). Some components of the Hartz Reforms do not produce more outflows from unemployment but help to reduce inflows into unemployment and long-term unemployment. For instance, a worker is now obliged to inform the local employment agency if a dismissal is imminent (Hartz I), otherwise the unemployment benefit will be frozen for up to twelve weeks (since January 2006).

Table 1: Elements and timing of the Hartz Reforms

	Elements of the Hartz-Reforms
<u>Hartz I:</u> Became operative in January 2003	<ul style="list-style-type: none"> • Tighten the obligation to register as job seeking • Definition of suitable work was broadened • Stronger sanctions if unemployed persons do not cooperate appropriately with the employment agency • Voucher system for placement services and training measures • Personal service agency: Temporary work agency especially for the unemployed • Company size for employment protection legislation increases from 5 to 10 employees • Collective bargaining in temporary work agencies – equal treatment obligation becomes obsolete
<u>Hartz II:</u> Became operative in January 2003	<ul style="list-style-type: none"> • Mini-Jobs (income up to 400 €) and Midi-Jobs (401-800 €) with reduced social security contributions • New start-up subsidy (Ich-AG)
<u>Hartz III:</u> Became operative in January 2004	<ul style="list-style-type: none"> • Re-organisation of the Federal Employment Agency and the local Employment Agencies • Implementation of Job-Centers • Case-management for the long-term unemployed
<u>Hartz IV:</u> Became operative in January 2005	<ul style="list-style-type: none"> • Reformation of the benefit system for unemployed workers and social assistance for needy job-seekers • Benefit type I: 60 percent (with children 67 %) of the last wage, for the first 6-12 months (administered by the local Employment Agency) (see also footnote 1) • Benefit type II: flat-rate and means tested benefit (administered in cooperation of Employment Agency and the municipality) • 69 municipalities administer the benefit type II alone • Workfare measures in the public sector (so called 1-Euro-Jobs)

3 Theoretical approach and previous empirical findings

3.1 Stock-Flow Matching

Our analytical framework for investigating the impact of institutional reforms on the labour market is a search and matching model as proposed by Pissarides (2000). This approach to the labour market is appropriate because it focuses on outflows from unemployment; outflows from short-term unemployment automatically imply inflows into long-term unemployment. The search and matching framework therefore

reflects the Hartz commission's idea to influence unemployment duration which is the reverse of the job finding probability.

$$(1) \quad 1/d = \frac{m(U,V)}{U}$$

with d denoting unemployment duration, U is the stock of unemployed and V the stock of vacancies. Matches m can be explained by empirical matching functions. Our analysis starts from this point of the literature.

Our benchmark is a stock-flow model of the matching function. Coles/Smith (1998) and Ebrahimi/Shimer (2010) derive the rationale of such a stock-flow model of the matching process on the labour market. They argue that unemployed first search the stock of vacancies and employers first screen the stock of unemployed (applicants). If they do not find a job or fill a vacancy in the first round, they will only screen newly incoming vacancies or unemployed in the second round – the inflows into the stocks actually. As a consequence, either matches of a newly incoming unemployed and a vacancy from the stock or matches of an unemployed in the stock and a newly incoming vacancy are more likely than stock-stock matches.

Our basic model reads as

$$(2) \quad m = f(A, U, V, u, v).$$

Capital letters denote stocks, small letters denote flows. f always abbreviates a function, regardless of the concrete functional form. A is an efficiency parameter. m is the outflow from unemployment into the regular labour market. U and V are the stocks of unemployment and vacancies, u and v are the analogous inflows. These variables are the source of potential matches.

3.2 Model augmentation by reforms, economic performance, and heterogeneity

Structural variables that further explain the matching process beyond the constituent variables may add to the matching function. From the overview given by Petrongolo/Pissarides (2001) we elaborate on the three components that are relevant for the impact of the Hartz Reforms and the business cycle on matching, with special focus on long-term unemployment.

3.2.1 Technology shifts due to labour market reforms

Institutional reforms on the labour market such as the re-configuration of unemployment insurance (benefit entitlement) or active labour market policy may shift the matching function because they may change search intensity or employability. This is why matching functions often contain a time trend which

usually has a negative sign indicating the slowing-down of the matching process since the 1970s in many developed economies.

Recently, several studies (Fahr/Sunde 2009, Hujer/Rodriguez/Wolf 2009, Dmitrijeva/Hazans 2007, Destefanis/Fonseca 2007, Hujer/Zeiss 2005) addressed policy-related shifts of the matching function (or Beveridge curve). Whereas measures of active labour market policy can be quantified more easily, broad labour market reforms usually enter the matching function as a dummy variable taking the value of 1 after the reform came into force (Fahr/Sunde 2009, for the Hartz I, II, and III Reforms in Germany, Dmitrijeva/Hazans 2007, for a reform of unemployment benefit and minimum wages in Latvia). Although these dummy variables collect all effects not captured by the other explanatory variables after the reform and suggest a constant impact on matching in any year after the reform (see check of robustness), we share this approach and define dummy variables for each of the Hartz Reforms (I and II go together). They augment the matching function towards

$$(3) \quad m = f(A, U, V, u, v) \quad \text{with} \quad A = f(\text{HartzI}, \text{HartzIII}, \text{HartzIV}, t).$$

We expect the first wave of the reforms (Hartz I and II) to have a positive impact on matches for several reasons: First, search intensity should have risen because the definition of suitable work was broadened and sanctions in the case of insufficient job search were tightened. Second, deregulation of temporary agency work, employment protection, or marginal employment provided employers with higher flexibility such they could offer jobs at lower cost. Di Tella/MacCulloch (2005) confirm empirical findings by Lazear (1990) – both without referring to matching – that higher flexibility raises the employment rate and helps to reduce unemployment. Third, the reduction in parts of the then tax-based unemployment benefit led to lower outside options of employees and, therefore, to lower bargained wages which is an incentive for companies to post more vacancies. Finally, the new start-up subsidy proved successful on the microeconomic basis not only with regard to the newly found companies but also with respect to formerly subsidized entrepreneurs finding a dependent job (Caliendo/Kritikos 2010).

The second reform wave (Hartz III) should also evolve a positive impact on matching because the re-organization of the German Federal Employment Agency might have reduced coordination failures (summarized in Petrongolo/Pissarides 2001: 401-2). Coordination failures may occur in an uncoordinated market: then applications are inadequately distributed across vacancies. Theoretically, a vacancy might receive no application. By law, it is one task of the Federal Employment Agency to re-integrate unemployed people into employment. For this purpose, new corporate policy strategies as of a service company were introduced, the organisational structure was changed, and contacts to potential employers were deepened (for deeper insight into corporate policy changes of the Federal Employment Agency see Fertig/Kluve/Schmidt 2006). Furthermore, measures of

active labour market policy were chosen with regard to their efficiency, mostly investigated on the microeconomic level (Stephan 2008). This might have helped to improve the job finding probability of unemployed workers.

The positive effects of the Hartz I to III Reforms are confirmed by previous literature. Fahr/Sunde (2009: 284) summarize that these reforms “had an impact in making the labor market more dynamic and accelerating the matching process”. Fertig/Kluve/Schmidt (2006) find a small positive effect on net-outflows from unemployment but only on gross-outflows from long-term unemployment.

The expectations on the third reform wave (Hartz IV) are mixed. A positive influence might again stem from higher search intensity of the unemployed and worse outside options of the employed: Hartz IV combined unemployment and social assistance into a means tested benefit at the lower social assistance level. Since then the benefit has not depended on the previous wage but has been flat-rate with the entitlement depending on the current income of the whole household. In this context, savings or other financial assets have had to be consumed first (up to a certain ceiling). Both these innovations make it more unpleasant or even painful to become and stay long-term unemployed. Especially short-term unemployed persons now have severe incentives to increase their search efforts to avoid becoming long-term unemployed. In addition, the period of entitlement to the insurance-based unemployment benefit type I was shortened. As a consequence, the incentives to accept a job before the end of the regular entitlement period (usually 12 months¹) rose substantially. Indeed, Kettner/Rebien (2007) found that companies assessed applicants as more ready to make concessions regarding working conditions.

However, the Hartz IV Reform also caused structural breaks in the statistics (Figure 1). The pooling of unemployment and social assistance forced former recipients of social assistance to register at the local employment offices. Thus, a number of hard-to-place people entered the statistics which worsened the average chance to leave unemployment. A similar composition effect on unemployment duration (thus exit probability) during recessions was shown by Rosholm (2001) and Kalwij (2010).

In summary, although one cannot clearly determine the direction of the Hartz IV effect we hypothesize that the reforms altogether should have accelerated the matching process. However, a negative side-effect that we cannot focus on in our analysis is that the quality of matches may decline and the expected job tenure could be shorter. According to a search model with endogenous separations due to

¹ Depending on the period of former work and, thus, social contributions the entitlement period varies between 6 and 12 months, and 15 months for unemployed workers over 50 years, if they were employed for a minimum of 30 months before unemployment. Political pressure caused the government to prolong the entitlement again in January 2008. Unemployed workers older than 58 years are now entitled to unemployment benefit I for up to 24 month, if their previous employment spell lasted for 48 months.

private information of firm and worker on adjustment costs to new production technologies (Matouschek/Ramezzana/Robert-Nicoud 2009), labour market reforms that decrease the cost of separation may lead to higher job-instability and, as a consequence, to welfare losses. Moreover, it is not clear how newly incoming unemployed will influence the matching process. On the one hand, higher inflows into unemployment indicate a worse labour market situation which would decelerate exit chances (crowding out). On the other hand, higher competition for vacancies in an environment of rising pressure and sanctions might even increase the search intensity and, thus, the number of matches.

3.2.2 Job-finding and the business cycle

Another augmentation to the matching model comes from the economic environment. The stock of unemployment correlates negatively with economic performance. With regard to the matching process it is influential whether the fluctuations of the stocks refer to changes in matches or to changes in separations. Empirical analyses find strong correlations between the business cycle and the job-finding rate, whereas separations are relatively flat over the cycle (Shimer 2007). In Germany, too, “the increase in unemployment during a recession seems to be caused by a reduction in hirings, i.e. match formations” (Bachmann 2005: 13). Rothe (2009) argues that the separation rate in Germany even decreases during a recession, similar to Rosholm’s (2001) findings about Denmark. One reason might be that workers are not willing to leave their job voluntarily because the opportunities to get a more appropriate or better paid job are poor in a recession. Thus, the number of job-to-job transitions decreases. Since every job-to-job-transition produces a new vacancy as long as a person out of unemployment gets a job (Akerlof/Rose/Yellen 1988: 496), the reduction of these vacancy chains also lowers the job finding probability of the unemployed and, thus, the number of matches.

Not only do separations and hiring vary over the business cycle but matching efficiency varies, too. For example, an employer may have to screen much more applications on a job vacancy if the economic situation is bad and unemployment is high. Sorting according to unemployment duration may become stronger (Blanchard/Diamond 1994). Hence the job-finding probability of a person that has been unemployed for a while is worse during a recession which leads to increasing unemployment duration and, accordingly, to a loss in human capital and a decrease in search activity.

Stops/Mazzoni (2010) include a business cycle variable in their matching function as a correction mechanism for the vacancy data. Companies assume the Federal Employment Agency to be less efficient in placing workers during upswings when the number of registered unemployed is low. Therefore, they report their vacancies countercyclically to the Federal Employment Agency. Since matches are actually

formed from all and not only registered vacancies the inclusion of the business cycle variable accounts for the fluctuation of the share of reported vacancies.

In Germany, we observed an upswing in the aftermath of the Hartz Reforms. The labour market situation improved substantially with employment rising by 3.0 percent and unemployment shrinking by 27.2 percent from 2006 to 2008 – down to its lowest value since 1992. We suppose that the coincidence of labour market reforms and economic upswing played a major role in raising matching efficiency and, finally, reducing unemployment. The success of an interaction of labour market policy and economic recovery in reducing long-term unemployment was reported for Sweden, for example (Bourdet/Persson 1990).

To find out about this issue we further augment the matching model by a business cycle variable² bc which is, additionally, interacted with the Hartz Reforms dummy variables. The new model reads as

(4)

$$m = f(A, U, V, u, v) \quad \text{with} \quad A = f(\text{HartzI}, \text{HartzIII}, \text{HartzIV}, t, bc, \sum_i bc \cdot \text{Hartz}_i).$$

3.2.3 Searcher heterogeneity and ranking by unemployment duration

A third aspect to augment the matching model is searcher heterogeneity. Search intensity as a choice variable depends on the individual cost and benefits of the job search. The Hartz Reforms increased the costs in the case an unemployed person does not (sufficiently) search. The reforms especially raised the pressure if people are threatened to fall out of the insurance system and then be cared for in the tax-financed system for needy job seekers. This usually happens after 12 months, when a person becomes long-term unemployed. We therefore focus the heterogeneity aspects on short-term and long-term unemployed.

The probability to find a job depends on previous unemployment duration for several reasons (Layard/Nickell/Jackman 2005: 256 ff., Shimer 2008, Bourdet/Persson 1990). One main problem for the unemployed is that the lack of work-experience during long periods of unemployment leads to a loss in human capital. If we assume that wages are not flexible enough to compensate the loss of human capital, this leads to a vicious circle: the probability to find a job decreases with the duration of

² In the labour market literature, business cycle fluctuations are often depicted by labour market tightness V/U (Kalwij 2010, for example). However, we do not rely on the assumption of constant returns to matching (Petrongolo/Pissarides 2001: 412) and choose an economic variable which reflects economic activity. Another typical measure, the stock of unemployment (Rosholm 2001, for example), is an explanatory variable anyway. This might cause collinearity in our econometric model, however.

unemployment, which in turn decreases the likelihood to find a job (Blanchard/Summers 1986).

Another factor is that firms rank applications to find the appropriate candidate. “When firms receive multiple acceptable applications, they hire the worker who has been unemployed for the least amount of time” (Blanchard/Diamond 1994: 417). For this ranking, or sorting, firms use the unemployment duration as signal for the loss of human capital and productivity. A worker who has been unemployed for only a short period has much better chances for a placement than a long-term unemployed worker, even if the latter has a higher formal qualification. However, empirical results for Europe differ: Steiner (2001) finds ranking by other characteristics than unemployment duration whereas Rosholm (2001) rejects the hypothesis of ranking completely for Denmark.

Not only does human capital (probably) decline with longer unemployment duration, but also self-esteem, and physical and mental power. The longer people are unemployed the less is their search intensity because they faced bad experience and appreciate their chances of being invited to an interview rather low (Layard/Nickell/Jackman 2005: 256 ff.; Falk/Huffman/Sunde 2006 a/b). As a consequence of less search, the job-finding probability of unemployed workers declines as unemployment duration rises. Moreover, family and health restrictions prevent long-term unemployed from finding a job because they are not able to work a full day (Thomsen 2009).

The heterogeneity between short-term and long-term unemployed could be empirically detected in two ways: first, the aggregate matching function contains the share of long-term unemployed which usually has a negative sign because the individual duration dependent loss in search success deteriorates the average efficiency, too (for a summary of confirming studies see Petrongolo/Pissarides 2001: 411). We follow this literature and augment the aggregate matching function by the share of long-term unemployment:

(5)

$$m = f(A, U^S + U^L, V, u^S + u^L, v)$$

$$\text{with } A = f(\text{HartzI}, \text{HartzIII}, \text{HartzIV}, t, bc, \sum_i bc \cdot \text{Hartz}_i, \frac{U^L}{U^S + U^L}, \sum_i \frac{U^L}{U^S + U^L} \cdot \text{Hartz}_i)$$

As the Hartz Reforms are in principle suited to pursue the dynamics of the labour market and moderate negotiated wages we expect a decrease of the negative impact of long-term unemployment on matching after the reforms. In other words, the interaction terms of the share of long-term unemployment and the Hartz Reforms dummy variables are expected to have a positive sign.

Another identification strategy is to specify distinct functions of matches from either short- or long-term unemployment.

(6.1)

$$m^S = f(A^S, U^S, V, u^S, v) \quad \text{with} \quad A^S = f(\text{HartzI}, \text{HartzIII}, \text{HartzIV}, t, bc, \sum_i bc \cdot \text{Hartz}_i)$$

(6.2)

$$m^L = f(A^L, U^L, V, u^L, v) \quad \text{with} \quad A^L = f(\text{HartzI}, \text{HartzIII}, \text{HartzIV}, t, bc, \sum_i bc \cdot \text{Hartz}_i)$$

Similarly, Coles/Smith (1998) estimated for subsamples defined by unemployment duration. Since the short- and long-term unemployed act within some similar labour market we specify and estimate an equation system. Thus, we control for different search intensity (the matching efficiency) as well as different impacts of the Hartz Reforms and economic performance.

4 Data

In the context of an empirical matching function, one has to distinguish the relevant labour market for which matches of unemployed and vacancies are realistic. Economic literature suggests, for instance, the definition by occupations (Stops/Mazzoni 2010; Fahr/Sunde 2009) or by sectors (Broersma/van Ours 1999) or by regions (Dmitrijeva/Hazans 2007). Although occupations and sectors may be good concepts because they regard education and skills, we choose the geographic demarcation of the relevant labour market.

This choice results from our special focus on long-term unemployment: First, long-term unemployed persons are often low-skilled. Occupational differences are not as marked for them as they might be for higher qualified people fulfilling specialized tasks. Usually, the required qualifications are general and easy to learn. Long-term unemployed must search for jobs in different occupations and commonly for other jobs than what they have once learnt (if they finished an apprenticeship at all). The same holds for the employer who is seeking to fill a vacancy requiring low skills in a certain profession.

Second, regional mobility in Germany is rather small and most unemployed workers search for a job in their home region. Instead, “well earning, highly educated males and females who have never been unemployed nor recalled face the highest probability of being mobile” (Arntz 2005: 18). By contrast, 72 percent of unemployment benefit-II-recipients (the major group of long-term unemployed) in a survey in 2007/2008 could not imagine to move for a new job (Bender et al. 2009). However, they are more willing as well as legally obliged to make concessions regarding the distance to work. As a consequence of these findings, we choose the German federal states (Bundesländer) as appropriate demarcation of the relevant

labour market. Three of the 16 federal states are large cities (Berlin, Bremen, Hamburg). As agglomeration centres they attract many commuters. We add them to the next or surrounding federal state, to avoid spatial correlations³, and obtain 13 regional cross-sectional units thereafter.

Data on the constituent variables of the matching function – stocks, inflows and outflows from unemployment and vacancies – are provided by the Federal Employment Agency, mostly as from December 1997. The advantage of the administrative data in comparison to individual data is in its up-to-dateness. In order to represent two full expansions and the latest economic crisis as far as possible, we use monthly data from January 1998 to June 2009 (135 months). However, we restrict the time span for estimation from April 1998 to March 2008 (120 months) because the exceptional economic crisis started to hit Germany in the second quarter of 2008. As a check of robustness, we conduct our analysis including the crisis data.

We distinguish between short-term (up to 12 months continued unemployment) and long-term unemployment (longer than 12 months unemployed) at the day of counting, which was at the end of a given month until 2005 and changed then to the middle of the month. The dependent variables for the matching functions are the outflows from (short-term and long-term) unemployment into the regular labour market (not accounting for flows into job-creation schemes or job incentive programmes).⁴

Structural breaks due to new statistics in 69 municipalities caring for the long-term unemployed on their own and due to the necessity for former recipients of social assistance to register newly at local employment offices are captured by dummy variables *d2005m3* and *d2006m3*. They take the value of 1 in the first quarter of either 2005 or 2006 and are 0 else.

In contrast to many other countries there are official monthly time series for the stock and inflows of voluntarily reported vacancies in Germany. To better capture the regular labour market we do not use all registered vacancies but a selected number, the so called “normal” vacancies. They are covered by social security and exclude subsidized, marginal, seasonal, and some other kinds of atypical employment.

³ The Breusch-Pagan (1980) test on cross-sectional correlation in a macro-panel dataset ($T > N$) detects correlation between some of the units. Since we use a bootstrap procedure on our 2 or 3SLS estimations, however, cross-sectional correlation will not disturb the calculation of the residuals (Anselin 1988: 91 ff.).

⁴ One and the same person could enter and exit unemployment several times throughout the year. These flows are included. However, we do not count entries and exits due to illness.

However, it is optional for a firm to report vacancies. In order to prevent our results from being biased due to non-reported vacancies as good as possible, we correct the reported vacancies. We adopt a method according to Franz (2006: 106) which uses the ratio of newly registered vacancies to all hires (some kind of market share of the regional employment agency) to estimate all vacancies.⁵

Further modifications were necessary with respect to the business cycle variable. Real GDP growth is provided by the German Federal Statistical Office either on a regional yearly level or on the federal quarterly level. We disaggregate the latter to monthly data using a quadratic interpolation that matches a quarter's average. (Similar results would be obtained from a Hodrick-Prescott filter technique with low smoothing parameter or a moving average technique – both without matching the average). Monthly GDP growth is then weighted by a region's share in total turnover. Turnover is the only economic variable officially available for regions at monthly frequency. But turnover refers exclusively to manufacturing – which accounted for 21.9 percent of total gross value added in 2009. We therefore use the variable only for weighting GDP and as a check of robustness.

5 Empirical Analysis

5.1 Model specification and estimation strategy

Along the theoretical guidelines given in section 3 the empirical matching function is specified as the loglinear version of a Cobb-Douglas production function:

$$\begin{aligned}
 (7) \quad \log m_{rt} = & \alpha^{stock} \log U_{r,t-1} + \beta^{stock} \log V_{r,t-1} \\
 & + \alpha^{flow} \log u_{rt} + \beta^{flow} \log v_{rt} \\
 & + c + t \\
 & + \sum_{i=1}^{12-1} \mu_i month_i + \sum_{j=1}^{13-1} \rho_j region_j \\
 & + \varepsilon_{rt} \\
 & + \delta^I HartzI + \delta^{III} HartzIII + \delta^{IV} HartzIV + \delta^{2005} d2005m3 \\
 & + \pi gdp_growth_{r,t-1} \\
 & + \lambda LTU_share_{r,t-1} \\
 & + \kappa^I gdp_growth_{r,t-1} HartzI + \kappa^{III} gdp_growth_{r,t-1} HartzIII + \kappa^{IV} gdp_growth_{r,t-1} HartzIV \\
 & + \eta^I LTU_share_{r,t-1} HartzI + \eta^{III} LTU_share_{r,t-1} HartzIII + \eta^{IV} LTU_share_{r,t-1} HartzIV
 \end{aligned}$$

⁵ However, even our correction method cannot totally offset the structural differences between reported and total vacancies (Kettner/Stops 2009). Between 1992 and 2005, about 35 percent of all vacancies were reported (Kettner et al. 2007).

Symbols are explained in Table 2. Lagging the stock variables by one period rebuilds the appropriate time scheme of registering the data and possible matching from stocks. We first estimate a benchmark model which consists of the constituent stocks and flows of unemployment and vacancies as well as the constant as productivity term, a linear time trend, seasonal adjustment dummy variables, and regional fixed effects. Since we do not omit the constant, such a model would be plagued by perfect collinearity. We therefore exclude one month (June) and one region (Bavaria). Afterwards we augment the benchmark model including the dummy variables referring to the Hartz Reforms, the business cycle variable, and the share of long-term unemployment. As a third step we include interaction terms between either GDP growth or the share of long-term unemployment and the Hartz dummy variables.

Table 2: Symbols in the matching function

Metric variables	
<i>m</i>	outflow from unemployment into regular employment (matches)
<i>U</i>	stock of unemployment
<i>u</i>	inflow into unemployment
<i>V</i>	stock of normal vacancies
<i>v</i>	new vacancies
<i>t</i>	linear time trend
<i>gdp_growth</i>	monthly growth rate of real gdp
<i>LTU_share</i>	share of long-term in total unemployment
Dummy variables	
<i>c</i>	Constant, part of augmented productivity of matching
<i>d2005m3</i>	captures statistical reform effect, 1 in 2005m1 to 2005m3, 0 else
<i>d2006m3</i>	captures statistical reform effect, 1 in 2006m1 to 2006m3, 0 else
<i>HartzI</i>	captures Hartz I and II Reform effect, 1 after 2003m1, 0 else
<i>HartzIII</i>	captures Hartz III Reform effect, 1 after 2004m1, 0 else
<i>HartzIV</i>	captures Hartz IV Reform effect, 1 after 2005m1, 0 else
<i>month</i>	captures seasonal fixed effects, 1 in one of twelve months, 0 else
<i>region</i>	captures regional fixed effects, 1 in one of 13 regions, 0 else
Lower indices	
<i>i</i>	month
<i>l</i>	long-term
<i>r</i>	region
<i>s</i>	short-term
<i>t</i>	point of time
Other	
$\alpha, \beta, \delta, \kappa, \lambda, \mu, \pi, \rho, \eta$	parameters
ε	residual

Model specification is almost the same when we account for heterogeneity by estimating matching functions for the short-term and the long-term unemployed separately. For these two groups, matching processes cannot be totally separated. Short-term as well as long-term unemployed may even apply for the same job. Institutions are similar for the groups as well, especially with regard to the employers' side. They are therefore estimated as a system of simultaneous equations (8). The share of long-term unemployment is now omitted. Each variable related to unemployment now refers to either short-term or long-term unemployment.

(8.1)

$$\begin{aligned}\log m_{rt}^{short} &= \alpha_s^{stock} \log U_{r,t-1}^{short} + \beta_s^{stock} \log V_{r,t-1} \\ &+ \alpha_s^{flow} \log u_{rt}^{short} + \beta_s^{flow} \log v_{rt} \\ &+ c_s + t_s \\ &+ \sum_{i=1}^{12-1} \mu_{si} month_i + \sum_{j=1}^{13-1} \rho_{sj} region_j \\ &+ \varepsilon_{srt} \\ &+ \delta_s^I HartzI + \delta_s^{III} HartzIII + \delta_s^{IV} HartzIV + \delta_s^{2005} d2005m3 \\ &+ \pi_s gdp_growth_{r,t-1} \\ &+ \kappa_s^I gdp_growth_{r,t-1} HartzI + \kappa_s^{III} gdp_growth_{r,t-1} HartzIII + \kappa_s^{IV} gdp_growth_{r,t-1} HartzIV\end{aligned}$$

(8.2)

$$\begin{aligned}\log m_{rt}^{long} &= \alpha_l^{stock} \log U_{r,t-1}^{long} + \beta_l^{stock} \log V_{r,t-1} \\ &+ \alpha_l^{flow} \log u_{rt}^{long} + \beta_l^{flow} \log v_{rt} \\ &+ c_l + t_l \\ &+ \sum_{i=1}^{12-1} \mu_{li} month_i + \sum_{j=1}^{13-1} \rho_{lj} region_j \\ &+ \varepsilon_{lrt} \\ &+ \delta_l^I HartzI + \delta_l^{III} HartzIII + \delta_l^{IV} HartzIV + \delta^{2005} d2005m3 + \delta^{2006} d2006m3 \\ &+ \pi_s gdp_growth_{r,t-1} \\ &+ \kappa_l^I gdp_growth_{r,t-1} HartzI + \kappa_l^{III} gdp_growth_{r,t-1} HartzIII + \kappa_l^{IV} gdp_growth_{r,t-1} HartzIV\end{aligned}$$

Estimation strategy of these models is chosen with respect to an implicit logical relationship between the development of stocks and the outflows:

$$(9) \quad U_{rt} = U_{r,t-1} + u_{rt} - outflows_{rt}$$

with matches m being a large part of all *outflows*. As a consequence, m_{t-1} is an implicit right hand-side variable. If the residuals ε_{rt} are autocorrelated of first order, there will be a correlation between explanatory variables and the error term. The similar process shows up for vacancies. Since the Wooldridge test of serial correlation in panel data detects first order autocorrelation of the residuals indeed, OLS estimation of equations (7) and (8) would be inconsistent. To avoid inconsistency, we use the stocks of unemployment and vacancies with a time lag of

two periods instead of one as instruments and apply two or, for the system of equations, three stage least squares estimation (2SLS, 3SLS).⁶

In order to obtain robust standard errors in the presence of autocorrelation and heteroscedasticity, we use a bootstrap approach for statistical inference. Doing 1,000 replications we apply the widely used percentile method (Efron/Tibshirani 1986) to derive the bootstrapped confidence intervals.

5.2 Estimation results: The effects of labour market reforms and economic performance on matches

5.2.1 Matching from total unemployment

The stock-flow matching theory suggests a positive impact on matches by the inflow of new vacancies, negative crowding out effects of the stock and inflow of unemployment and no impact of the stock of vacancies (Coles/Smith 1998: 244). However, as matches are also formed from the stock variables our estimation results for matches from total unemployment (Table 3, model 1)⁷ show that the stock of unemployed seems to match with new as well as old vacancies. The elasticities of all three variables (U , V , v) are positive and significant, but new vacancies are more important for match formation than old ones. The sum of the elasticities of vacancies reaches an absolute scale known from the previous literature (Broersma/van Ours 1999: 84).⁸ The elasticity of the stock of unemployed at 0.6 percent is in the range given by Petrongolo/Pissarides (2001: 393). Inflows into unemployment have no significant effect in our estimation, probably because it is hard to come in and leave unemployment for a new job within the same month even though these persons can screen vacancies that are already available.

⁶ Other system estimators such as panel data SUR in the place of heteroscedasticity and autocorrelation (Blackwell 2005) or system GMM (Roodman 2006) are not applicable for our macro panel data set with a large number of time periods (T) but just a small number of cross section observations (N).

⁷ Results for the seasonal and regional fixed effects are not reported but surrendered on request.

⁸ Sunde (2007) suggests the elasticities to be biased because one cannot account for matches stemming from on-the-job-seekers (not relevant in our case because we focus on outflows from unemployment) or unregistered vacancies.

Table 3: Impact of labour market and economic variables on the matching of unemployed

dependent variable: log outflows from unemployment into regular employment (matches)			
	model 1	model 2	model 3
	benchmark	augmented	with interactions
log unemployment (lag1)	0.557 *** (0.046)	0.550 *** (0.047)	0.552 *** (0.051)
log normal vacancies (lag1)	0.059 *** (0.025)	0.086 *** (0.028)	0.092 *** (0.029)
log inflows into unemployment	0.039 (0.033)	-0.013 (0.034)	-0.012 (0.035)
log inflows into normal vacancies	0.099 *** (0.026)	0.115 *** (0.027)	0.115 *** (0.027)
constant	0.899 (0.828)	1.235 (0.834)	1.202 (0.848)
Hartz I		0.085 *** (0.015)	-0.136 * (0.074)
Hartz III		0.045 *** (0.016)	0.222 *** (0.080)
Hartz IV		-0.013 (0.013)	0.015 (0.073)
dummy 2005m3		-0.156 *** (0.024)	-0.158 *** (0.025)
GDP growth (lag1)		0.702 *** (0.140)	0.595 *** (0.203)
interaction GDP growth (lag1) * Hartz I			0.133 (0.461)
interaction GDP growth (lag1) * Hartz III			0.053 (0.585)
interaction GDP growth (lag1) * Hartz IV			0.047 (0.512)
share of long-term unemployment (lag1)		-0.533 *** (0.103)	-0.698 *** (0.141)
interaction share of LTU (lag1) * Hartz I			0.660 *** (0.213)
interaction share of LTU (lag1) * Hartz III			-0.506 ** (0.211)
interaction share of LTU (lag1) * Hartz IV			-0.073 (0.190)
Obs. (sample: 1998m4-2008m3)	1,560	1,560	1,560
overall significance (prob value)	0.000	0.000	0.000
Root MSE	0.114	0.11	0.11

Remarks: ***,** and * denote significance at the 1%, 5% and 10% level; sample: 1998m4-2008m3; bootstrap standard errors in brackets.

Source: own estimations on the basis of monthly data of the Federal Employment Agency and the Federal Statistical Office.

The elasticity of unemployment being much higher than the elasticity of vacancies suggests that an additional unemployed leads to a new match with a higher probability than an additional vacancy (Fahr/Sunde 2004: 411). This justifies the Hartz Reforms being designed to stimulate labour supply in the first place, for instance by restricting benefits or benefit duration and by tightening activation strategies.

The augmentation of the benchmark model by reform dummy variables, GDP growth, and the share of long-term unemployment (model 2) confirms the result of Fahr/Sunde (2009) that the first waves of the Hartz Reforms improved matching efficiency. The Hartz I plus II Reforms – for instance the deregulation of temporary agency work and the decrease of unemployment assistance – accelerated the speed of matching by about 9 percent⁹ and the Hartz III Reform, the organisational re-configuration of the employment agencies, by 5 percent. The Hartz IV Reform, the merger of unemployment and social assistance, did not change the matching process significantly. The 2005m3 dummy variable that captures the structural break in the statistics caused by the Hartz IV Reform turns out to be negative and significant. During the first three months of the reform year 2005 matching efficiency decreased sharply, probably due to the massive inflow of hard-to-place people.

The parameter of regional GDP growth confirms matching efficiency to be pro-cyclical. A month-to-month acceleration of economic activity by 1 percentage point will accelerate matches from unemployment by 0.7 percent. The interaction terms of the business cycle and the Hartz dummy variables (model 3) are all insignificant. Thus, the hypothesis that the Hartz Reforms changed the matching process indirectly through a closer reaction to the economic expansion is rejected.

The heterogeneity aspect is captured by the share of long-term unemployed. As expected, an increase in that share reduces matches because it lowers the average job finding probability. But the interactions with the Hartz dummy variables show that changes regarding long-term unemployment are crucial for understanding the macro-effect of the reforms: First, the negative effect of the share of long-term unemployment substantially moderates after the reforms – even if one takes into account that the sharp increase by 0.7 percent was partly offset shortly after. The marginal impact of an increase in the share of long-term unemployment is a decrease of matches by 0.6 percent. Second, the residual impact remaining with the pure Hartz Reform dummy variables changes. All the positive influence – an acceleration of the speed of matching by 22 percent – is now summarized into the second wave (Hartz III), whereas the positive impact of the first wave found in model 2 is completely transferred to the interaction with the share of long-term unemployment.

In summary, the matching function from total unemployment reveals that the speed of matching accelerated after the first two waves of the Hartz Reforms which can be traced back to better chances of the long-term unemployed but not to a closer link to the economic expansion. The next subsection will show whether this finding is

⁹ The relative effect of a dummy variable is given by $(\log m(D=1) - \log m(D=0)) / \log m(D=0) \Leftrightarrow (\delta - 0) / 0$ which is in terms of de-logarithmized matches $(e^\delta - e^0) / e^0 = e^\delta - 1$. For small values of δ this term approximately equals the estimated parameter δ .

confirmed when we estimate a system of matching functions for either short-term or long-term unemployed.

5.2.2 Matching from either short-term or long-term unemployment

Estimation results for the system of simultaneous equations for the matches of short-term and long-term unemployed into a regular job are given in Table 4. Regarding matching efficiency as the constant alone, the speed of matching is higher, that is the durations of the unemployment spell and vacancy are shorter, for short-term unemployed (1.8 versus -5.7 in the benchmark estimation, model 4).

The constituent components reveal some differences in the matching technology. First, the elasticity of the stock of long-term unemployment is much higher than the elasticity of the stock of short-term unemployed. According to Petrongolo/Pissarides (2001) this finding implies less congestion (elasticity-1) for the long-term unemployed. Second, in contrast to the short-term unemployment equation, inflows into long-term unemployment also raise matches with an elasticity of 0.2 percent. Persons having been unemployed for one year and then becoming long-term unemployed may behave similar to persons who are already long-term unemployed. Consequently, the parameters of the stock and the inflows show the same sign. In addition, the persons concerned might search even harder because the change into long-term unemployment has been connected to higher constraints regarding financial endowment and personal development after the Hartz IV Reform. Third, if newly incoming long-term unemployed behave similar to persons who are already long-term unemployed, those persons certainly also restrict their search effort to newly arriving vacancies. This might explain why the stock of vacancies is an positively influential variable only for matches from short-term unemployment. Finally, new vacancies are of approximately equal importance for both groups.

The Hartz Reforms aimed at changing the institutional framework to make the labour market more dynamic and fighting (long-term) unemployment by reducing inflows and raising outflows. Seemingly, this aim has been reached (model 5): The first wave's effect is positive and even larger for the matches from long-term unemployment (8 versus 11 percent acceleration of the matching process). Moreover, the Hartz III Reform has a positive influence which is similar at 6 percent for both groups. The Hartz IV Reform causes a slight negative effect on matches from short-term unemployment but it does not hamper matches from long-term unemployment. Thus, for the short-term unemployed, the composition effect seems to outperform the potential of higher search intensity: former recipients of social assistance as well as (originally long-term unemployed) returnees from measures of active labour market policy might worsen the job-finding probability of the group of short-term unemployed. The statistical effect between January and March 2005 sharply decreased matches from both groups. The second statistical effect stemming from a worse composition among the long-term unemployed at the beginning of 2006 is not significant.

Table 4: Impact on the matching of short-term and long-term unemployed

dependent variable: log outflows from short-term unemployment into regular employment (matches)			
	model 4	model 5	model 6
	benchmark	with Hartz & GDP	with interactions
log short-term unemployment (lag 1)	0.555 *** (0.034)	0.580 *** (0.040)	0.581 *** (0.040)
log normal vacancies (lag 1)	0.075 *** (0.022)	0.122 *** (0.026)	0.122 *** (0.026)
log inflows into unemployment	-0.075 *** (0.029)	-0.082 *** (0.029)	-0.082 *** (0.028)
log inflows into normal vacancies	0.122 *** (0.023)	0.123 *** (0.026)	0.123 *** (0.026)
constant	1.834 *** (0.622)	1.060 (0.680)	1.035 (0.685)
Hartz I		0.082 *** (0.015)	0.081 *** (0.016)
Hartz III		0.058 *** (0.015)	0.058 *** (0.015)
Hartz IV		-0.030 ** (0.013)	-0.030 ** (0.013)
dummy 2005m3		-0.139 *** (0.026)	-0.139 *** (0.024)
GDP growth (lag 1)		0.700 *** (0.150)	0.597 *** (0.208)
interaction GDP growth (lag 1) * Hartz I			0.173 (0.446)
interaction GDP growth (lag 1) * Hartz III			0.014 (0.576)
interaction GDP growth (lag 1) * Hartz IV			0.034 (0.525)
overall significance (prob value)	0.000	0.000	0.000
Root MSE	0.116	0.112	0.112
dependent variable: log outflows from long-term unemployment into regular employment (matches)			
	benchmark	with Hartz & GDP	with interactions
log long-term unemployment (lag 1)	0.902 *** (0.024)	0.856 *** (0.027)	0.858 *** (0.028)
log normal vacancies (lag 1)	-0.040 * (0.022)	0.008 (0.026)	0.008 (0.025)
log inflows into long-term unemployment	0.225 *** (0.020)	0.211 *** (0.023)	0.211 *** (0.024)
log inflows into normal vacancies	0.121 *** (0.027)	0.090 *** (0.032)	0.091 *** (0.031)
constant	-5.730 *** (0.366)	-5.236 *** (0.453)	-5.271 *** (0.452)
Hartz I		0.109 *** (0.017)	0.110 *** (0.018)
Hartz III		0.059 *** (0.017)	0.058 *** (0.017)
Hartz IV		0.021 (0.018)	0.020 (0.018)
dummy 2005m3		-0.171 *** (0.031)	-0.170 *** (0.031)
dummy 2006m3		0.030 (0.019)	0.030 (0.019)
GDP growth (lag 1)		0.559 *** (0.173)	0.567 ** (0.213)
interaction GDP growth (lag 1) * Hartz I			-0.396 (0.565)
interaction GDP growth (lag 1) * Hartz III			0.389 (0.737)
interaction GDP growth (lag 1) * Hartz IV			0.160 (0.651)
overall significance (prob value)	0.000	0.000	0.000
Root MSE	0.137	0.133	0.133

Remarks: ***, ** and * denote significance at the 1%, 5% and 10% level; sample: 1998m4-2008m3; bootstrap standard errors in brackets.

Source: own estimations on the basis of monthly data of the Federal Employment Agency and the Federal Statistical Office.

The pro-cyclical behaviour of the matching efficiency is confirmed for both, short-term and long-term unemployed. The Wald test on whether the GDP effect is different between matches from either short-term or long-term unemployment is not significant. This finding contradicts the expectation that structural disadvantages, such as lower formal qualification, health restrictions, or language barriers for migrants, cannot be easily offset by the business cycle under given institutional conditions. The interaction terms between economic performance and the reforms (model 6) again are all insignificant. They allow the conclusion that the economic expansion was not the driving force in reducing unemployment so much more effectively than in the past. The institutional change as such was far more important.

5.3 Robustness

So far, economic performance was operationalised by GDP growth, disaggregated to months and regions. As a check of robustness, we repeat the system estimation as in Table 4 (with interactions, model 6) using monthly turnover growth in manufacturing by region which is the only economic variable officially available for our data structure. The results in Table 5 confirm the previous findings with respect to the labour market variables of interest (U ; V ; u ; v) and the dummy variables for the Hartz Reforms. Unlike the first estimations, the interaction terms between turnover growth and the Hartz Reforms reveal a closer link of economic performance to matches after 2003 which was offset shortly after. The marginal effect at 0.7 percent is equal to the GDP version. In sum, we interpret this compensation as another rejection of an indirect Hartz-business cycle channel.

For the econometric analysis we cut the time series at March 2008 to avoid influence of the extraordinary economic crisis in 2008 and 2009. Since our data are available until June 2009 we investigate the robustness of our previous findings (Table 4, model 6) by extending the sample. In the main, matching technology does not change remarkably when including the crisis data. But the results (Table 5, column 2) emphasize the positive role of the Hartz Reforms for the matching out of long-term unemployment. The parameters of all three waves are larger than before. The Hartz IV Reform is now estimated to have had a significant positive impact. The results illustrate that long-term unemployment on average was not affected by the crisis because the just usual relationship between economic performance and matching was compensated by a higher matching efficiency.

Table 5: Robustness of the matching function

	turnover in manufacturing as business cycle variable	including crisis (1998m4-2009m6)	subsequent inclusion of reform dummies	
			Hartz I + II	Hartz I + II and III
dependent variable: log outflows from short-term unemployment into regular employment (matches)				
log short-term unemployment (lag1)	0.581 *** (0.041)	0.555 *** (0.033)	0.534 *** (0.036)	0.547 *** (0.038)
log normal vacancies (lag1)	0.122 *** (0.027)	0.131 *** (0.025)	0.092 *** (0.023)	0.112 *** (0.026)
log inflows into unemployment	-0.082 *** (0.029)	-0.049 * (0.026)	-0.062 ** (0.027)	-0.062 ** (0.028)
log inflows into normal vacancies	0.121 *** (0.026)	0.111 *** (0.025)	0.125 *** (0.024)	0.107 *** (0.025)
constant	1.076 (0.698)	1.048 * (0.575)	1.746 *** (0.617)	1.549 *** (0.638)
Hartz I	0.071 *** (0.015)	0.088 *** (0.015)	0.089 *** (0.015)	0.081 *** (0.015)
Hartz III	0.062 *** (0.016)	0.058 *** (0.015)		0.040 *** (0.014)
Hartz IV	-0.031 ** (0.014)	-0.023 * (0.013)		
dummy 2005m3	-0.137 *** (0.025)	-0.130 *** (0.023)	-0.147 *** (0.022)	-0.155 *** (0.023)
economic growth (lag1)	0.779 *** (0.148)	0.620 *** (0.211)	0.704 *** (0.148)	0.704 *** (0.148)
interaction economic growth (lag1) * Hartz I	0.728 *** (0.258)	0.214 (0.430)		
interaction economic growth (lag1) * Hartz III	-0.929 *** (0.313)	-0.056 (0.605)		
interaction economic growth (lag1) * Hartz IV	-0.092 (0.290)	-0.235 (0.526)		
overall significance (prob value)	0.000	0.000	0.000	0.000
Root MSE	0.111	0.113	0.111	0.112
dependent variable: log outflows from long-term unemployment into regular employment (matches)				
log long-term unemployment (lag1)	0.858 *** (0.028)	0.947 *** (0.025)	0.886 *** (0.026)	0.855 *** (0.029)
log normal vacancies (lag1)	0.002 (0.026)	0.046 * (0.026)	-0.023 (0.022)	0.010 (0.026)
log inflows into long-term unemployment	0.204 *** (0.023)	0.177 *** (0.021)	0.196 *** (0.022)	0.213 *** (0.023)
log inflows into normal vacancies	0.087 *** (0.032)	0.042 (0.031)	0.136 *** (0.027)	0.104 *** (0.030)
constant	-5.088 *** (0.448)	-5.870 *** (0.412)	-5.640 *** (0.376)	-5.432 *** (0.386)
Hartz I	0.098 *** (0.016)	0.139 *** (0.017)	0.118 *** (0.017)	0.110 *** (0.018)
Hartz III	0.064 *** (0.017)	0.067 *** (0.017)		0.067 *** (0.017)
Hartz IV	0.026 (0.020)	0.035 ** (0.018)		
dummy 2005m3	-0.183 *** (0.032)	-0.176 *** (0.029)	-0.145 *** (0.028)	-0.155 *** (0.027)
dummy 2006m3	0.022 (0.021)	0.045 ** (0.019)	0.056 *** (0.018)	0.048 *** (0.018)
economic growth (lag1)	0.731 *** (0.159)	0.680 *** (0.234)	0.560 *** (0.171)	0.557 *** (0.167)
interaction economic growth (lag1) * Hartz I	0.777 ** (0.323)	-0.508 (0.558)		
interaction economic growth (lag1) * Hartz III	-1.182 *** (0.396)	0.370 (0.733)		
interaction economic growth (lag1) * Hartz IV	-0.191 (0.362)	-0.020 (0.605)		
overall significance (prob value)	0.000	0.000	0.000	0.000
Root MSE	0.131	0.138	0.133	0.133

Remarks: ***, ** and * denote significance at the 1%, 5% and 10% level; sample: 1998m4-2008m3; bootstrap standard errors in brackets.

Source: own estimations on the basis of monthly data of the Federal Employment Agency and the Federal Statistical Office.

As dummy variables map the influence of the broad labour market reforms, their effect is restricted to be constant over time. To get an idea of the usefulness of this assumption, we include the dummy variables subsequently. If the parameter of a certain reform wave gets smaller after including a further dummy variable, the effect supposedly rises over time, but the increase is captured by the later dummies. As can be seen from Table 5, columns 3 and 4, there is only a very slight decrease of the Hartz I plus II parameter such that the effect is rather stable. However, the parameter of the second wave becomes larger for the short-term unemployed when including the Hartz IV dummy variable. Accordingly, the effect of the re-organisation of the Federal Employment Agency might shrink over time, but this decrease is captured by the following dummy variable. In this respect, the slight negative impact of the Hartz IV Reform on the matching of short-term unemployed is not necessarily due to this reform wave itself but maybe due to a diminishing positive effect of the previous wave. After all, the reforms altogether did improve the operativeness of the labour market.

6 Conclusion

As a reaction on high and persistent unemployment in Germany the then government implemented the largest labour market and social reforms in German post-war history in three waves between 2003 and 2005. In order to evaluate the macro effects of the so called Hartz Reforms this paper described the development of the stocks and flows of short-term and particularly long-term unemployment during the last decade. The Hartz Reforms took place right before the latest expansion through which unemployment decreased sharply. We therefore analysed not only a direct reform effect but also an indirect effect caused by a tightening of the relationship between labour market and economic performance. For this purpose, we used a stock-flow matching framework and administrative data by the Federal Employment Agency on the regional level of German federal states (Bundesländer). In augmentation to common approaches we accounted for searcher heterogeneity by distinguishing between short-term and long-term unemployment.

The estimation results for the stock-flow matching functions can be summarized as follows: First, the Hartz Reforms in total, but especially the first wave (deregulation of labour market segments, more pressure on unemployed) and the second wave (re-organisation of the Federal Employment Agency) increased matching efficiency by about 10 to 20 percent. The third wave (combination of unemployment and social assistance, means-tested benefits) had a slight negative impact only on matches from short-term unemployment, probably because many hard-to-place people entered unemployment at the beginning of 2005 or because the positive effect out of the second wave tends to decline over time.

Second, in an empirical matching function, stocks and flows of unemployment and vacancies already reflect the tightness of the labour market and in this respect also the economic situation at least partially. Nevertheless, the inclusion of a business cycle variable provides direct evidence for the pro-cyclicality of the matching efficiency. This can be explained by the cyclical variations in the recruitment process (e. g. ranking of applications) as well as in the number and length of vacancy chains the last link of which offers a job for an unemployed person. However, there is no evidence that the coincidence of economic expansion and Hartz Reforms contributes to explaining the sharp decline of unemployment.

Finally, the long-term unemployed benefitted from the reforms above average. Not only did the negative impact of the share of long-term unemployed in a general matching function moderate after the reforms, but the direct reform effects were also up to 6 percentage points larger than for the short-term unemployed.

The process of improving labour market efficiency was not completed when the economic crisis hit Germany. The robust reaction of the labour market as well as the on-going decline in long-term unemployment can be at least partially traced back to the far-reaching Hartz Reforms. One should bear in mind, however, that especially the last wave of the reforms may have induced changes in definitions, statistics, and behaviour which are not completely separable and that our analysis cannot give insight into job quality and job duration of the newly formed matches.

References

- Akerlof, George A.; Rose, Andrew K.; Yellen, Janet L. (1988): Job Switching and Job Satisfaction in the US Labor Market, *Brookings Papers on Economic Activity*, Vol. 2: 495-594.
- Anselin, Luc (1988): *Spatial econometrics: methods and models*, Dordrecht: Kluwer.
- Arntz, Melanie (2005): The geographical mobility of unemployed workers: evidence from West Germany, *ZEW discussion paper*, No. 05-34, Mannheim.
- Bachmann, Ronald (2005): Labour market dynamics in Germany: hirings, separations and job-to-job transitions over the business cycle, *SFB 649 Discussion Paper 2005-045*, Humboldt-University, Berlin.
- Bender, Stefan; Koch, Susanne; Mosthaf, Alexander; Walwei, Ulrich (2009): *Erwerbsfähige Hilfebedürftige im SGB II: Aktivierung ist auch in der Krise sinnvoll*, IAB-Kurzbericht 19/2009, Nuremberg.
- Blanchard, Olivier J.; Diamond, Peter A. (1989): The beveridge curve, *Brookings Papers on Economic Activity*, Vol. 1: 1-76.
- Blanchard, Olivier J.; Diamond, Peter A. (1994): Ranking, unemployment duration and wages, *Review of Economic Studies*, Vol. 61: 417-434.
- Blanchard, Olivier J.; Summers, Lawrence H. (1986): Hysteresis and the European unemployment problem, *NBER Macroeconomics Annual*, Vol. 1: 15-90.

Blackwell, J. Lloyd (2005): Estimation and testing of fixed-effect panel data systems, *The Stata Journal*, Vol. 5 (2): 202-207.

Bourdet, Yves; Persson, Inga (1990): Long-term unemployment in a recovering economy, *Labour*, Vol. 4 (2): 51-76.

Breusch, Trevor; Pagan, Adrian (1980): The Lagrange Multiplier Test and its Applications to Model Specification in Econometrics, *The Review of Economic Studies*, Vol. 47 (1): 239-253.

Broersma, Lourens; Van Ours, Jan C. (1999): Job searchers, job matches and the elasticity of matching, *Labour Economics*, Vol. 6 (1): 77-93.

Caliendo, Marco; Kritikos, Alexander S. (2010): Start-ups by the unemployed: characteristics, survival, and direct employment effects, *Small Business Economics*, Vol. 35 (1): 71-92.

Coles, Melvyn G.; Smith, Eric (1998): Marketplaces and matching. *International Economic Review*, Vol. 39 (1): 239-254.

Destefanis, Sergio; Fonseca, Raquel (2007): Matching efficiency and labour market reform in Italy: A macroeconometric assessment, *Labour*, Vol. 21 (1): 57-84.

Di Tella, Rafael; MacCulloch, Robert (2005): The consequences of labor market flexibility: Panel evidence based on survey data, *European Economic Review*, Vol. 49 (5): 1225-1259.

Dmitrijeva, Jekaterina; Hazans, Mihails (2007): A stock-flow matching approach to evaluation of public training programme in a high unemployment environment, *Labour*, Vol. 21 (3): 503-540.

Ebrahimy, Ehsan; Shimer, Robert (2010): Stock-flow matching, *Journal of Economic Theory*, Vol. 145 (4): 1325-1353.

Efron, Bradley; Tibshirani, Robert (1986): Bootstrap methods for standard errors, confidence intervals, and other measures of statistical accuracy, *Statistical Science*, Vol. 1 (1): 54-77.

Fahr, René; Sunde, Uwe (2004): Occupational job creation: patterns and implications, *Oxford Economic Papers*, Vol. 56: 407-435.

Fahr, René; Sunde, Uwe (2009): Did the Hartz Reforms Speed-Up the Matching Prozess? A macro-Evaluation Using Empirical Matching Functions, *German Economic Review*, Vol. 10 (3): 284-316.

Falk, Armin; Huffman, David; Sunde, Uwe (2006 a): Self-confidence and search, *IZA Discussion Paper*, No. 2525.

Falk, Armin; Huffman, David; Sunde, Uwe (2006 b): Do I have what it takes? Equilibrium search with type uncertainty and non-participation, *IZA Discussion Paper*, No. 2531.

Fertig, Michael; Kluge, Jochen; Schmidt, Christoph M. (2006): Die makroökonomische Wirkung aktiver Arbeitsmarktpolitik – eine Panelanalyse auf Ebene regionaler Arbeitsmärkte, *Zeitschrift für Arbeitsmarktforschung*, Vol. 39 (3/4): 575-601.

Franz, Wolfgang (2006): *Arbeitsmarktökonomie*, 6th Edition. Springer, Berlin.

- Hartz, Peter et al. (2002): *Moderne Dienstleistungen am Arbeitsmarkt. Vorschläge der Kommission zum Abbau der Arbeitslosigkeit und zur Umstrukturierung der Bundesanstalt für Arbeit, Bundesministerium für Arbeit und Sozialordnung, Berlin.*
- Hujer, Reinhard; Rodrigues, Paulo J. M.; Wolf, Katja (2009): *Estimating the macroeconomic effects of active labour market policies using spatial econometric methods, International Journal of Manpower, Vol. 30 (7): 648-671.*
- Hujer, Reinhard; Zeiss, Christopher (2005): *Macroeconomic impacts of job creation schemes on the matching process in West Germany, Applied Economics Quarterly, Vol. 51 (2): 203-217.*
- Jacobi, Lena; Kluve, Jochen (2007): *Before and after the Hartz Reforms: The performance of active labour market policy in Germany, Journal of Labour Market Research, Vol. 40 (1): 45-64.*
- Kalwij, Adriaan (2010): *Unemployment durations and the pattern of duration dependence over the business cycle of British males, Empirical Economics, Vol. 38: 429-456.*
- Kettner, Anja; Rebien, Martina (2007): *Hartz-IV-Reform: Impulse für den Arbeitsmarkt, IAB-Kurzbericht 19/2007, Nuremberg.*
- Kettner, Anja et al. (2007): *Estimation of vacancies by NACE and ISCO at disaggregated regional level, IAB-Bibliothek 310, Institute for Employment Research, Nuremberg.*
- Kettner, Anja; Stops, Michael (2009): *Europäische Betriebsbefragungen über offene Stellen: Ist das Gleiche wirklich gleich? Österreichische Zeitschrift für Soziologie, special issue No. 9: 353-372.*
- Layard, Richard; Nickell, Stephen; Jackman, Richard (2005): *Unemployment, 2nd edition, Oxford / New York: Oxford Univ Press.*
- Lazear, Edward P. (1990): *Job security provisions and employment, The Quarterly Journal of Economics, Vol. 105 (3): 699-726.*
- Matouschek, Niko; Ramezzana, Paolo; Robert-Nicoud, Frédéric (2009): *Labor market reforms, job instability, and the flexibility of the employment relationship, European Economic Review, Vol. 53 (1): 19-36.*
- Petrongolo, Barbara; Pissarides, Christopher A. (2001): *Looking into the black box: a survey of the matching function, Journal of Economic Literature, Vol. 39 (2): 390-431.*
- Pissarides, Christopher A. (2000): *Equilibrium unemployment theory, Cambridge, MA und London: MIT Press.*
- Roodman, David (2006): *How to do xtabond2: An introduction to "difference" and "system" GMM in Stata, Center for Global Development, Working Paper 103, Washington DC.*
- Rosholm, Michael (2001): *Cyclical variations in unemployment duration, Journal of Population Economics, Vol. 14 (1): 173-191.*
- Rothe, Thomas (2009): *Arbeitsmarktentwicklung im Konjunkturverlauf: Nicht zuletzt eine Frage der Einstellungen, IAB-Kurzbericht 13/2009, Nuremberg.*
- Shimer, Robert (2007): *Reassessing the ins and outs of unemployment, NBER working paper 13421.*

Shimer, Robert (2008). The probability of finding a Job, *American Economic Review*, Vol. 98 (2): 268-73.

Steiner, Viktor (2001): Unemployment persistence in the West German labour market: negative duration dependence or sorting? *Oxford Bulletin of Economics and Statistics*, Vol. 63 (1): 91-113.

Stephan, Gesine (2008): The effects of active labor market programs in Germany. An Investigation Using Different Definitions of Non-Treatment, *Jahrbücher für Nationalökonomie und Statistik*, Vol. 228 (5/6): 586-611.

Stops, Michael; Mazzoni, Thomas (2010): Matchingprozesse auf beruflichen Teilarbeitsmärkten, *Jahrbücher für Nationalökonomie und Statistik*, Bd. 230 (3): 287-312.

Sunde, Uwe (2007): Empirical matching functions: searchers, vacancies, and (un-) biased elasticities, *Economica*, Vol. 74: 537-560.

Thomsen, Stephan L. (2009): Explaining the employability gap of short-term and long-term unemployed persons, *KYKLOS*, Vol. 62 (3): 448-478.

Recently published

No.	Author(s)	Title	Date
24/2009	Hohendanner, C.	Arbeitsgelegenheiten mit Mehraufwandsentschädigung: Eine Analyse potenzieller Substitutionseffekte mit Daten des IAB-Betriebspanels	12/09
25/2009	Dlugosz St. Stephan, G. Wilke, R.A.	Fixing the leak: Unemployment incidence before and after the 2006 reform of unemployment benefits in Germany	12/09
1/2010	Schmieder J.F. von Wachter, T. Bender, S.	The long-term impact of job displacement in Germany during the 1982 recession on earnings, income, and employment	1/10
2/2010	Heckmann, M. Noll, S. Rebien, M.	Stellenbesetzungen mit Hindernissen: Auf der Suche nach Bestimmungsfaktoren für den Suchverlauf	1/10
3/2010	Schmillen, A. Möller, J.	Determinants of lifetime unemployment: A micro data analysis with censored quantile regressions	1/10
4/2010	Schmieder, J.F. von Wachter, T. Bender, S.	The effects of unemployment insurance on labour supply and search outcomes: Regression discontinuity estimates from Germany	2/10
5/2010	Rebien, M.	The use of social networks in recruiting processes from a firms perspective	2/10
6/2010	Drechsler, J.	Multiple imputation of missing values in the wave 2007 of the IAB establishment panel	2/10
7/2010	Dauth, W	Agglomeration and regional employment growth	2/10
8/2010	Lietzmann, T.	Zur Dauer der Bedürftigkeit von Müttern : Dauer des Leistungsbezugs im SGB II und Ausstiegchancen	3/10
9/2010	Jahn, E. J. Rosholm, M	Looking beyond the bridge: How temporary agency employment affects labor market outcomes	6/10
10/2010	Danzer, A. M. Yaman, F.	Ethnic concentration and language fluency of immigrants : quasi-experimental evidence from the guest-worker placement in Germany	6/10
11/2010	Yankova, K.	Der Selektionsprozess in Maßnahmen der aktiven Arbeitsmarktpolitik : eine explorative Untersuchung für die deutsche Arbeitsvermittlung	7/10
12/2010	Stephan, G.	Wages, employment and tenure of temporarily subsidized workers: Does the industry matter?	7/10

As per: 29.07.2010

For a full list, consult the IAB website

<http://www.iab.de/de/publikationen/discussionpaper.aspx>

Imprint

IAB-Discussion Paper 13/2010

Editorial address

Institute for Employment Research
of the Federal Employment Agency
Regensburger Str. 104
D-90478 Nuremberg

Editorial staff

Regina Stoll, Jutta Palm-Nowak

Technical completion

Jutta Sebald

All rights reserved

Reproduction and distribution in any form, also in parts,
requires the permission of IAB Nuremberg

Website

<http://www.iab.de>

Download of this Discussion Paper

<http://doku.iab.de/discussionpapers/2010/dp1310.pdf>

For further inquiries contact the author:

Sabine Klinger

Phone +49.911.179 3255

E-mail sabine.klinger@iab.de

Thomas Rothe

Phone +49.911.179 3343

E-mail thomas.rothe@iab.de