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Public employment agency and job matching efficiency – A new perspective using establishment level data

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Abstract

Using detailed German establishment level data, we model the relationship between job matching efficiency and employment growth. We use a policy reform (Hartz III) which was explicitly framed at improving the placement process of the Public Employment Agency (PEA) in Germany. Baseline difference-in-differences estimates reveal that reforming the Public Employment Agency results in an increased creation of employment among the users of the placement services relative to non-users. After the Hartz III reform was in place, establishments using the PEA grew roughly 2 percentage points faster in terms of employment relative to non-users. We also provide robustness checks using inverse-probability weighting for our identification strategy which highlights the internal validity of our results. Due to the scarcity of studies investigating the Hartz reforms on the establishment level, our results are highly relevant for policy makers trying to improve job matching efficiency. In this view, we gain new insights in the mode of action in one of the most profound labor market programs in the last decades.

JEL classification: J21, J64, J68

Keywords: Public Employment Agency, difference-in-differences, matching efficiency, Hartz reforms, active labor market policy programs, ALMP

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1 Introduction

The functioning of frictional labor markets largely depend on the efficiency of the matching process between unemployed and vacancies (e.g. Mortensen and Pissarides 1994, Petrongolo and Pissarides 2001). In recent years, economies, firms and employees are faced with serious challenges within the labor market. First, automation of tasks within jobs is accelerated and an increasing fraction of jobs is at risk of being replaced by advanced technologies (e.g. Acemoglu and Restrepo 2018, Brynjolfsson and McAfee 2014, Frey and Osborne 2017). Second, the labor market in several European countries is further challenged by large inflows of asylum seekers which have to be efficiently integrated into the labor market (e.g. Battisti et al. 2019). Thus, the matching of unemployed people and vacancies will become an increasingly relevant task which is at the same time extremely complicated and highly important for government spending. On the establishment or firm level, this process of reemploying is mostly not analyzed in detail, although it has been shown that matching rates are not an aggregate object but rather firm-specific (e.g. Davis et al. 2013, Kaas and Kircher 2015). Moreover, it is obvious that the placement process depends on the effectiveness of labor market institutions such as the Public Employment Agency (PEA).

During the first years of the 21st century, various labor market reforms were implemented in Germany. In this paper, we investigate one important policy reform which was explicitly framed at improving the PEA in terms of job matching efficiency in Germany. The reform was embedded in the so-called Hartz reform package which was implemented successively in Germany from 2003-2005 (Hartz I – IV). Our quasi-experiment is based on the Hartz III reform, which was implemented January 1st 2004. We exploit this exogenous policy intervention aiming at improving efficiency of the PEA and investigate whether establishment using the PEA services for their job recruitment do in fact benefit from an augmented placement service in terms of increased employment creation and share of hirings.

We apply difference-in-differences estimation in which the establishments which use the PEA constitute the treatment group and establishments which not constitute the control group. Using this estimation framework allows us to: (1) estimate the causal link between reforming a PEA and employment creation within establishments and (2) account for macroeconomic common shocks and the fact that the Hartz reforms were implemented during an expansionary

time in Germany (e.g. Bradley and Kügler 2019).[1] Additionally, selection effects for choosing the PEA as a recruitment channel in the first place are controlled for using inverse-probability-weighting (IPW). The unweighted regression results indeed show positive reform effects for establishments using the placement services relative to establishments which do not use the PEA. The effects are in the order of magnitude between 0.4 and 2 percentage points increase in the share of hirings. In terms of employment creation due to more stable supply of job seekers, the employment growth is between 2.6 and 4 percentage points increase. The weighted regression results are slightly smaller, however, also significant. We also provide robustness tests in the last sections of this paper.

Our paper contributes to the microeconomic literature on matching efficiency as well as to the literature on the evaluation of the Hartz reforms.[2] There are some macroeconomic papers that examine the impact of Hartz III, e.g. by considering unemployment duration or aggregate flows into and out of unemployment. In contrast, we use a microeconomic approach and examine labor demand and the effect of the reform on the establishment level. Thus, we examine whether the behavior of establishments has actually changed (in terms of employment growth and hiring rates).

The paper proceeds as follows. In the next section we provide a literature review on micro- and macroeconomic studies regarding matching efficiency. Section 3 provides theoretical arguments for the connection between matching efficiency and employment growth. Our empirical study is provided in section 4 and finally, the last section draws a conclusion.

2 Literature review

In the last decade there is a burgeoning literature on the evaluation of the Hartz reforms. Regarding Hartz II, Bradley and Kügler (2019) found an increase in mini-job workers from 13 percent in 2003 to 16 percent in 2006. Dlugosz et al. (2014) investigate the Hartz IV reform and show that the reduction of unemployment benefit entitlement provides incentives to stay employed for older workers. In a similar vein, Krebs and Scheffel (2013) use a calibrated model to simulate the effects of Hartz IV which reduced structural unemployment by 1.4 percentage points. In combination with Hartz I-III, the aggregated effect is a 1.5 percentage point reduction in structural unemployment. Gehrke et al. (2018) find positive labor market performance shocks which are caused by the Hartz reforms. They argue that these reforms are

[1] Davis and Haltiwanger (1992) in this connection report that significant job creation and destruction coexist at all phases of the business cycle.
[2] A comprehensive summary of micro-evaluation studies can be found in Akyol et al. (2013).

the key driver for good performance during the great recession in Germany. Regarding the Public Employment Agency, Holzner and Watanabe (2015) show that half of all vacancies in Germany are registered by the Employment Services. If firms decide to use the private market instead of the Employment Service in order to fill vacancies they pay lower wages since applicants send by the Services are usually less suited for the job.[3] Pellizzari (2010), however, exploits a policy intervention in the Italian employment and recruitment services aimed at making this market more competitive. The author finds higher wages for employees being matched via more efficient employment agencies.

While the studies discussed so far examine other effects of the Hartz reforms, more closely related to our research are some recent macroeconomic studies, which consider matching efficiency. For example, Stops (2016) estimates parameters of macroeconomic matching functions before, during and after the Hartz Reforms. He finds that matching productivity increased during all reform stages even after controlling for the business cycle. Fahr and Sunde (2009) show that the reforms accelerate outflows from unemployment to employment after the Hartz III reform had been implemented. Furthermore, the effects are more pronounced for East Germany. Launov and Wälde (2016) structurally estimate the reform effect of an increase in effectiveness on the unemployment rate. Their estimates show that the reorganization of the PEA is responsible for a .69-.88 percentage point decline of the equilibrium unemployment rate.[4] Furthermore, they found an unemployment paradox. A more effective PEA for long-term unemployed might crowd-out search effort for the short-time unemployed and hence the total effect is far from clear.

Klinger and Rothe (2012) also find increased matching efficiency by roughly 10 percent using simultaneous stock-flow matching functions for short-term and long-term unemployed. This result is supported by Klinger and Weber (2016) who find an extraordinary increase in matching efficiency after 2005. Hartung et al. (2018) argue that instead of an increased hiring rate, lower separation rates explain the decline in unemployment after the Hartz reforms. Recently, Bauer and King (2018) use a reallocation model to investigate the effects of the reforms. They found that the reforms significantly reduce reallocation costs and therefore unemployment in the long run in Germany. With regard to an increase in the duration of

[3] The authors also point out that more efficient Public Employment Services might crowd out private search effort. This result is also found by Launov and Wälde (2016).
[4] This is about 17.7 – 22.5 % decline in the post-reform unemployment. Hartz IV, however, is only responsible for a 4.6 to 5.1% post reform unemployment decline (Launov and Wälde 2016).

unemployment benefit, Le Barbanchon (2016) does not find any effects on the matching quality for France.

Finally, using a synthetic control method, Ehrich et al. (2018) find that the Hartz reforms raised labor force participation, specifically among women and older workers. Finally, Liechti (2019) shows for Switzerland, that recommendation from the PEA can act as a substitute for social contacts. These results have important policy implications since it is therefore a good strategy to improve connections between job seekers and employers.

Summing up, most of the literature focuses on macroeconomic effects and on the reduction on unemployment duration, but explicit microeconomic studies are missing. In the next section we briefly review the Hartz reforms and the connection between job matching efficiency, hirings and employment growth. In section 3 we empirically investigate the causal link between these variables. The last section draws a conclusion.

3 The Hartz reforms and matching efficiency

3.1 Facts of the reform

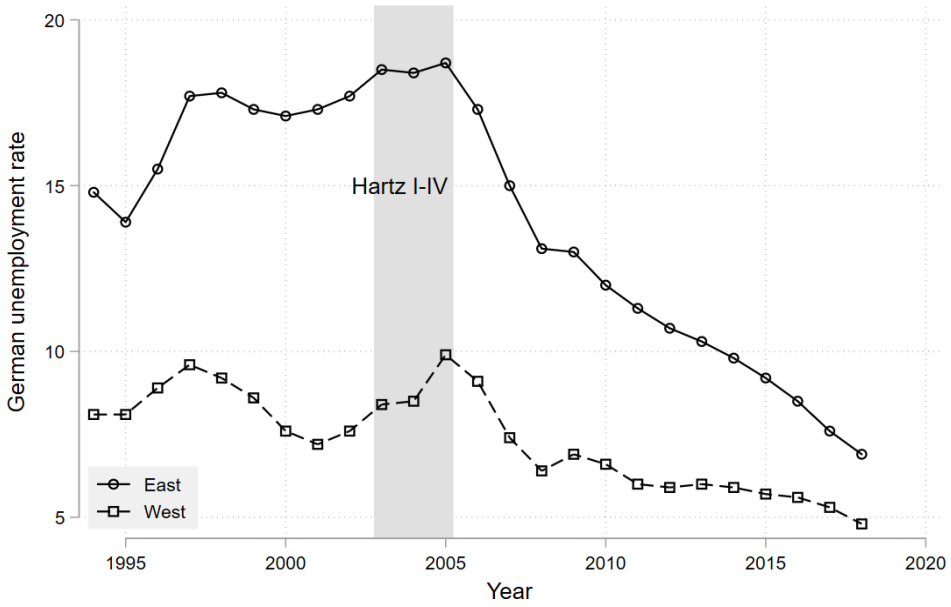
The early 2000s in Germany were characterized by a high and persistent unemployment rate at 10 percent with a peak at 11.1 percent in 2005 (Dustmann et al. 2014). The motivation for the introduction of labor market reforms has been further strengthened by the so-called placement scandal triggered by the Public Employment Agencies in 2002 (Fleckenstein 2008).[5] Due to these two main reasons the Hartz Commission was appointed on February 22nd 2002 to suggest labor market reforms.[6] The Hartz reforms consist of four packages which were introduced successively and affected almost all aspects of the German labor market. Since the reforms came with an evaluation mandate of the government, tremendous empirical studies are conducted regarding the Hartz Reforms.[7]

Hartz I and II were introduced in January 1st 2003 and aimed at improving labor market flexibility through Mini-Jobs legislation. Hartz I facilitates easier hiring of temporary workers and in addition further training is subsidized by vouchers. Hartz II reorganized marginal

[5] In this scandal the PEA has manipulated statistics and therefore significantly exaggerated the numbers of successfully placed job seekers.
[6] The Hartz Commission, named after the chairman of the Commission Peter Hartz, consisted of 15 experts from industry, politics and academia. The Commission published the suggestions for labor market reforms in August 2002 which led to the Hartz reform package.
[7] Regarding a conceptual framework for the evaluation see for example Fertig and Kluve (2004). Moreover, Jacobi and Kluvi (2006) provide an overview of many studies.

employment by raising the tax-free earnings threshold 325 to 400 EUR tax-free income per month.

Figure 1: German unemployment rate divided by East and West Germany



Notes: Source: Public Employment Agency; time series "Unemployment over time" divided into East and West Germany

Hartz III became effective as of January 1st 2004 and had the objective of increasing the internal efficiency of the Public Employment Agency. The most important change was the orientation of the Agency as a customer-oriented service facility, in which all claims of the unemployed were handled by only a single case-worker. The Hartz III reform changed the Employment Agency from a centralized budgeting system to a more management-by-objectives system with clearly defined tasks and goals (Akyol et al. 2013). Moreover, the contact time per unemployed was increased and different advisory services were introduced for the short- and long-term unemployed. Furthermore, so called "Job Centers" were implemented which further aimed at improving the placement process by enhancing competition. The main goal was to reduce frictions and improve the matching efficiency between employers and job seekers.

Finally, Hartz IV came into effect on January 1st 2005 and aimed at shorten the duration of the higher unemployment benefit ALG I (*Arbeitslosengeld*), which was initially paid, and to reduce the long-term unemployment benefit ALG II, which was paid in the long term. Furthermore, sanctions are implemented to incentivize more active labor market support. Up

to now, this is one of the most extensive and controversially discussed labor market reforms in Germany.

3.2 Job matching and the creation of employment

Labor market institutions such as the Public Employment Agency exert a strong influence on the job matching process. In particular, the PEA is responsible for bringing together supply and demand (e.g. unemployed who are looking for a job and employers who post vacancies). A match is characterized by the placement of an unemployed person in a vacancy. The connection between both parts is determined by the matching function (e.g. Davis et al. 2013, Petrongolo and Pissarides 2001).[8] Within this process the PEA provides job search assistance which helps unemployed to find suitable jobs and monitors the search effort of unemployed people (Cottier et al. 2018). With regard to these factors, the Hartz III reforms can be considered as a positive technological shock for the matching production function of the PEA (e.g. Petrongolo and Pissarides 2001).

After the restructuring of the PEA, unemployed workers are more closely monitored, in many cases better motivated and thus more suitable for the job market. The PEA sorts out less suited worker for the labor market which helps employers to better overcome information asymmetries. In a similar vein, Bauer and King (2018) argue that more efficient PEAs improve the placement process since unemployed workers might also search for potential jobs in other fields than their previous profession. This reduces mismatch due to imperfect labor mobility. Bryson and Nurmi (2011) point out that specific job-related tasks might be performed more efficiently which results in a competitive advantage. The reduction in search costs is associated with an increase in productivity since workers and establishments might consider potential matches more efficiently (Autor 2001, Pissarides 1990). More productive workers, in turn, lead to higher firm performance and production which creates employment growth.[9] Ultimately, better matches between employers and employees lower search and recruitment costs for employers which facilitate the process of job creation (e.g. Blasco and Pertold-Gebicka 2013, Pissarides 1990). This line of reasoning that lowering search costs is associated with higher productivity is well established in the labor market search theory (e.g.

[8] According to Davis et al. (2013) and various job search models, employers post vacancies to attract potential job seekers. Then, the matching function links the combination of job seekers and job vacancies and produce new hires.

[9] Furthermore, more capable job candidates due to efficient search channel results in better matches. And better matches might improve labor productivity and reduces the need for further training activities. Blasco and Pertold-Gebicke (2013) note that firms' performance in the short run might be reduced due to adaption costs, however, long-run effects might be positive.

Autor 2001, Pissarides 1990). Whether this hypothesis really applies is the subject of the empirical test.

In the end, however, the effects of Hartz III are difficult to identify, since the Hartz IV reforms were implemented almost simultaneously, in which the wage replacement benefits were reduced. This and the declining bargaining power of the trade unions probably reduced real wages (e.g. Akyol et al. 2013).[10] Dustmann et al. (2014) show that mainly the low paid realizes wage losses.[11] Bradley and Kuegler (2019) also find that the three Hartz Reforms resulted in a reduction of wages of around 4% which mostly affected low-skilled workers. The authors find that this is mostly driven by the reduction in unemployment benefits. In contrast, Visser (2006) argues that the decline in union density is associated with the wage decline which already started before the Hartz reforms.

4 Empirical analysis

4.1 Data and methodology

To examine the effect of the Hartz III reform on the establishment level, we use data from the German IAB Establishment Panel. This panel has been conducted since 1993 in West Germany and since 1996 in East Germany on an annual basis and surveys 16,000 establishments on an annual basis. The panel is designed to lead to a representative sample for Germany. The questionnaire asks a wide variety of establishment characteristics including the usage of the PEA. This information is available for the years 2000 to 2008.

We analyze how the Hartz III reform affects the employment decision on the firm level. Since our dataset covers four year before the implementation of the reform on January 1st 2004 and five years afterwards, we use a difference-in-differences approach in order to interpret the effect in a causal way. Our sample of 14,658 observations ranges from the year 2000 to 2008.

To divide firms into a treatment and control group we utilize the information whether firms use for their current hiring and placement processes the services of the PEA. More precisely, we use the following question from the questionnaire: “How many vacancies have you planned to be filled immediately? […] How many of these vacancies are registered with the employment office?” We exploit this information and construct a treatment indicator which

[10] Arent and Nagl (2013) indeed find negative wages effects in the range of -2.4 % for men and -2.6% for woman associated with the Hartz IV reform. However, Pellizzari (2010) finds for a reform of the public employment agency in Italy, that is is associated with higher wages for employees matched via the agency.

[11] Dustmann et al. (2014) therefore argue that the Hartz reforms contribute to growing wage inequalities in Germany.

takes unit value for firms which continuously report registered PEA vacancies greater than zero and additional report vacancies greater than zero at all for every year. The firms within our sample do not change the use or non-use of PEA services. We do not consider firms that constantly switch their job search behavior between 2000 and 2008. The control group consists of firms reporting zero PEA vacancies but otherwise report vacancies greater than zero. In doing so, we can distinguish firms between the year 2000 and 2008 which are directly affected by an improvement of the placement service and firms which are not.[12]

An overview regarding different establishment sizes and PEA usage is provided in table 1. As expected, smaller establishments tend to be more prone to our recruitment channels and bigger establishments tend to rely (also) more on the PEA as a recruitment channel.

Table 1: Distribution of observations over employee size and PEA status

	Non-PEA User		PEA User	
Size	Observations	Percentage share	Observations	Percentage share
1-19	1,928	30.56	1,717	20.57
20-49	1,267	20.08	1,343	16.09
50-199	1,644	26.05	2,239	26.82
200-499	849	13.45	1,618	19.38
500 +	622	9.86	1,431	17.14
Total	6,310	100	8,348	100

Notes: Years 2000 – 2008 of the IAB Establishment Panel. Establishments are classified according to Public Employment Agency (PEA) users and non-users. Overall sample size: 14,648 observations.

Regarding our dependent variable we focus on effects matching which are new hires. Specifically, we consider the share of hires in relation to total employment between year t and $t-1$. We expect that this share is positive affected by an increased employment service performance in the treatment group relative to the control group. In this view, we combine the approach by Blasco and Pertold-Gebicka (2013) who just consider new hires stemming from the pool of unemployed with Bauer and King's (2018) procedure, who consider reallocation (i.e. the transition from job to job). In this view we model the joint movement of job seekers

[12] Blasco and Pertold-Gebicka (2013) apply a similar classification for treatment and controls. They consider a firm as treated whether it is employing more than 33 % of its workforce from a region which is affected by an improving in matching efficiency. Moreover, and in the context R&D subsidies, Hud and Hussinger (2015) apply a similar approach in treatment assignment. Depending on the value of subsidies received by the Federal Ministry for Education Research (BMBF), the authors generate a treatment indicator equal to one if a firm receives subsidies and zero otherwise.

and job vacancies. Our second dependent variable is employment growth. For both dependent variables we apply a difference-in-differences specification. Furthermore, for the share of hirings as the dependent variable, we apply a heteroskedastic tobit (i.e. corner solution model) since our dependent variable is highly skewed to the right (i.e. there is a large fraction of firms which do not hire at all).

We test the reform of the PEA in terms of matching efficiency on treated firms relative to control firms with the following difference-in-differences specification:

$$Y_{it} = \alpha + \beta_1 PEAuser_i + \beta_2 HartzIII_t + \tau HartzIII_t \times PEAuser_i + \beta_m X_m + \gamma_t + \rho_i + \epsilon_{it}\,, \qquad (1)$$

where Y_{it}stands for two dependent variables in establishment i at year t. First, we start by estimating the effect of the Hartz III reform on establishment-level employment growth. As standard in the literature (see e.g. Davis and Haltiwanger 1992, Chodorow-Reich 2013) we compute the symmetric employment growth (job growth rate) rate as the difference in the number of employees E in establishment i at year t and year $t-1$, divided by the average of employees in both years:[13]

$$g_{it} = \frac{E_{it} - E_{it-1}}{(E_{it} + E_{it-1})/2} \qquad (2)$$

This measure is approximately normal distributed and frequently used in the industrial relations literature (e.g. Brändle and Goerke 2018, Bryson 2004, Wooden and Hawke 2000). Secondly, we use the share of hires as proposed by Gralla and Kraft (2018) which is defined as the number of hires h in the year $t+1$ divided by the number of employees E in establishment i at year t.

$$sh_{it} = \frac{100 * h_{it+1}}{E_{it}} \qquad (3)$$

HartzIII is an indicator for the Hartz III reform and takes the value one after the reform was enacted in the January 1st 2004 and is zero for all years before. $PEAUser_i$ is an indicator for the firm which uses the Public employment Agency (i.e. reports open vacancies to the PEA). Our estimation strategy identifies the treatment effect on the treated (i.e. treatment effect for thos firms using the PEA relative to these firms which do not). We cluster standard errors at

[13] The employment growth rate in (2) is bounded in the range [–2,2] and can accommodate entry and exit which help limit the influence of outliers (Chodorow-Reich 2013).

the unit of policy implementation (i.e. establishment level since this is the most disaggregated unit demanding labor) as proposed by Bertrand et al. (2004).

Control variables are represented by the vector X. First, we use values of the logarithm of employees as well as the log of employees squared to account for firm size effects. We use a dummy variable identifying whether the firm is a stand-alone independent establishment or part of a larger organization (i.e. firm group) with the variable "Single Establishment". To adjust for possible age effects of establishments and therefore different usage of the PEA, we include the dummy variable "Founded after 2000". Specific regional shocks within Germany are captured by the dummy variable "West Germany" which takes unit value for establishments in West Germany with East Germany being the reference group. In addition, we capture potential effects as to whether the company has the legal form of limited liability with the variable "Limited Liability". Furthermore, we adjust for effects arising from the coverage of a collective bargaining agreement with the variable "Sectorbargaining". To adjust for different effects from ownership we include a dummy variable whether the establishment has no mayor shareholder at all. Finally, to take employment expectations into account, we include a dummy variable whether the establishment has positive employment expectations.

Moreover, we adjust our difference-in-differences specification for the composition of the workforce. For this purpose, we include the "Share of part time employees", the "Share of female employees", "Share of qualified employees" as well as the "Share of fixed term employees" and the "Share of apprentices". Industry specific differences (i.e. differences in hiring behavior) are captured by a set of industry fixed effects ρ_i. Finally, we also add a set of time dummy variables in γ_t.[14]

Since the Hartz reforms consist of three measures (which might be interpreted as a stacked treatment) we think that the time dummy variables should capture the effects of the surrounding reforms. In a similar vein, Launov and Wälde (2016) also capture other reform effects using time dummy variables for the year 2002 and 2004 (among others). The idiosyncratic error term is denoted ϵ_{it}. Descriptive statistics are presented in the following table 2 in which they are divided according to their treatment status. Thus, the control group constitutes the non-PEA user and the treatment group constitutes the PEA user establishments which should be effects by the Hartz III reform.

[14] We also test our specification without time dummy variables; however, the results did not change much. Results without dummy variables are available upon request.

Table 2: Descriptive statistics of treatment and control group (N=14,658)

	Control group firms N = 6,310		Treatment group firms N = 8,348		Difference in mean	
	Mean	Std. dev.	Mean	Std. dev.		P-value
Dependent variables						
Share of hires	7.96	20.08	12.16	29.96	4.19***	.000
Employment growth	.022	.223	.027	.223	.005	.202
Establishment variables						
log of employees	3.91	1.76	4.51	1.74	.601***	.000
log of employees squared	18.36	14.61	23.37	15.82	5.01***	.000
West Germany	.771	.420	.718	.450	-.054***	.000
Founded in 2000 or later	.251	.433	.231	.421	-.020**	.004
Single Establishment	.634	.482	.608	.488	-.026***	.001
Limited Liability	.604	.489	.619	.486	.015*	.066
No mayor shareholder	.062	.242	.057	.231	-.006	.153
Positive employ expec.	.319	.466	.302	.459	-.017**	.028
Collective Bargaining Ag.	.473	.499	.523	.500	.050***	.000
Workforce composition						
Share of part time	.199	.241	.186	.226	-.013***	.001
Share of female	.414	.280	.410	.285	-.004	.356
Share of qualified	.699	.280	.691	.266	-.008*	.078
Share of fixed term	.055	.127	.094	.176	.038***	.000
Share of apprentices	.040	.075	.049	.087	.010***	.000

Note: IAB Establishment Panel, own calculations. Unweighted means are presented. Last column shows the p-value of a t-test for the difference in mean values. Industry and time dummy variables are not presented for the sake of clarity. The control group is defined as Public Employment Agency using establishments and the control group constitutes establishments which do not use the placement services since they do not report vacancies to the agency.

4.2 Baseline results

We first consider the impact of the PEA reform on employment growth. We rely on OLS as well as tobit difference-in-differences regressions as discussed above. For our dependent variable "share of hires", we consider the tobit model to account for corner solutions. First, we apply homoscedastic regressions and test for heteroscedasticity to prevent inconsistent coefficient estimates. In presence of heteroscedasticity, coefficient as well as standard error estimates in tobit models are inconsistent.

Our Wald test clearly rejects the assumption of homoscedasticity and we therefore replace the variance σ with $\sigma_i = \sigma \exp(w_i' \alpha)$ within the likelihood maximization (Greene 2008). The test statistic provides a value of 1204.02 with a p-value of 0.00. Thus, we apply a heteroskedastic

tobit model in which we consider groupwise multiplicative heteroscedasticity. In this case α denotes estimates paramters of the heteroscedasticity term and w_i' is a vector of variables in which we include establishment-size as well as industry dummy variables.

The regression results for both dependent variables (i.e. share of hires as well as employment growth) are presented in table 2. The tobit model explaining the share of hires is used to compute the intensive margin (i.e. the marginal effect for the data which is greater than zero $E(Y|Y > 0)$ according to McDonald and Moffitt (1980).

In the given context, the most important variable is the interaction term $HartzIII_t \times PEAUser_i$ as it measures the impact of increased PEA efficiency on the share of hires as well as employment growth in the treatment group relative to the control group. It turns out, that the coefficient of this variable is positive and at least significant at the 5 percent level indicating a positive effect of the reform. In particular based on the OLS and fixed effects models, the Hartz III reform increases the share of hires in the treatment group by 2 to 2.3 percentage points compared to the control group. According to the tobit models the effect is smaller (0.4 to 1.6 percentage points). Thus, the HartzIII reform does have a positive impact on the share of hires in the treatment group relative to the control group. These effects are in the range of the unemployment reduction effect due to the HartzIII reform found by Krebs and Scheffel (2013).

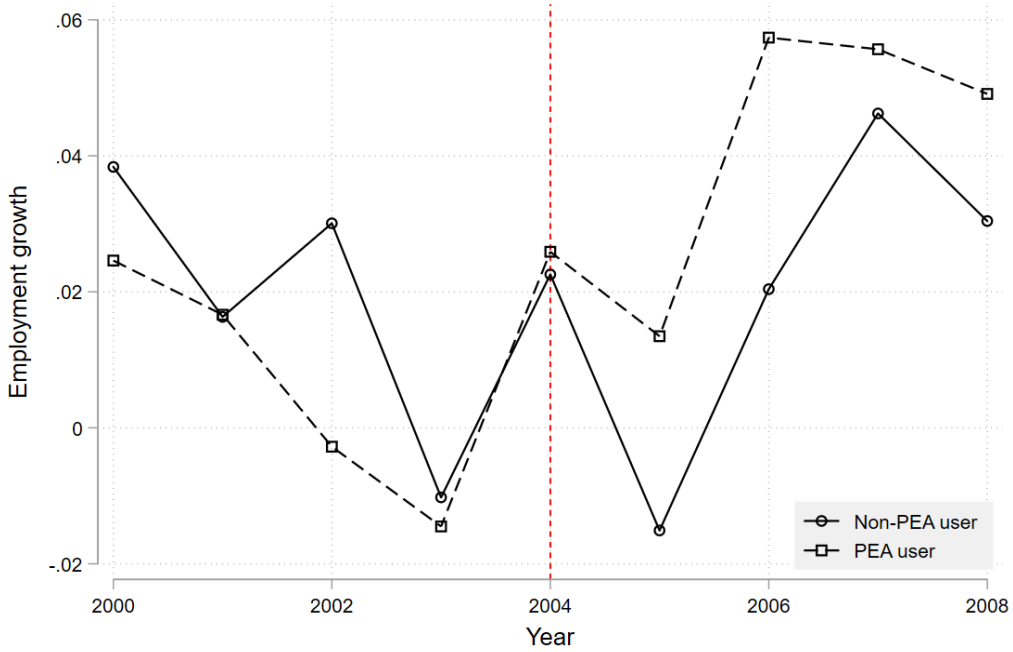
The control variables also have the expected signs. Our results also show that young firms exhibit faster employment growth than older firms which is also in line with the literature (e.g. Haltiwanger et al. 2013). Variables capturing establishment size and age effects are highly significant. For single establishment which do not belong to a multi-plant firm, we do not find any significant effects. More interestingly, though, are the effects of the workforce composition. First, we observe that the coefficient of fixed term contracts is highly significant and positive indicating that with a high share of fixed term contract workers tend to frequently use the PEA for recruiting. Second, establishment with a higher share of apprentices tend to use the PEA less frequently. This indicates that such establishments might use other channels for their recruiting.

Table 2: Results of OLS and tobit models on employment growth and the share of hires

Dependent variable	Share of hires			Employment growth
	(OLS)	Tobit (1)	Tobit (2)	(OLS)
HARTZIII	-3.75***	-1.91***	-.835***	-.021***
	(.842)	(.445)	(.152)	(.008)
PEA user	1.64***	.965***	.009	-.015***
	(.580)	(.301)	(.105)	(.005)
HARTZIII × PEAuser	2.16***	1.01**	.402***	.025***
	(.790)	(.415)	(.141)	(.007)
Log of employees	2.94***	4.86***	2.65***	.079***
	(.486)	(.416)	(.262)	(.007)
Log of employees squared	-.367***	-.410***	-.206***	-.007***
	(.050)	(.038)	(.023)	(.001)
West Germany	-.561	.134	.094	.006
	(.530)	(.270)	(.102)	(.005)
Founded 2000 and later	7.78***	4.54***	.670***	.067***
	(.745)	(.410)	(.163)	(.006)
Single Establishment	.689	.487**	.067	.016***
	(.474)	(.227)	(.078)	(.004)
Limited Liability	-.673	-.275	.551***	-.015***
	(.558)	(.289)	(.121)	(.005)
No mayor shareholder	-.757	-.048	.188	-.009
	(.770)	(.394)	(.153)	(.008)
Positive employ expec.	3.25***	1.75***	1.05***	.050***
	(.524)	(.266)	(.103)	(.004)
Collective Bargaining Ag.	-.092	-.417*	-.695***	-.018***
	(.493)	(.247)	(.095)	(.004)
Share of part time employees	.179	.240	1.00**	.043***
	(1.46)	(.751)	(.419)	(.013)
Share of female employees	-4.29 ***	-2.27***	-1.02***	-.001
	(1.26)	(.663)	(.358)	(.012)
Share of qualified employees	-6.27 ***	-2.24***	-.826***	.009
	(1.23)	(.612)	(.254)	(.010)
Share of fixed term empl.	32.57***	15.74***	14.28***	.043**
	(3.76)	(1.57)	(1.01)	(.021)
Share of apprentices	-18.66***	-11.09***	-5.67***	.026
	(1.95)	(1.32)	(.862)	(.028)
Constant	11.44***	24.58***	16.04***	-.172***
	(2.56)	(1.46)	(.463)	(.027)
Industry fixed effects	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓
R^2 / Pseudo R^2	.164	.027	.034	.072
Left (0) censored obs.		3,854	3,854	
Uncensored obs.		10,804	10,804	
Observations	14,658	14,658	14,658	14,658

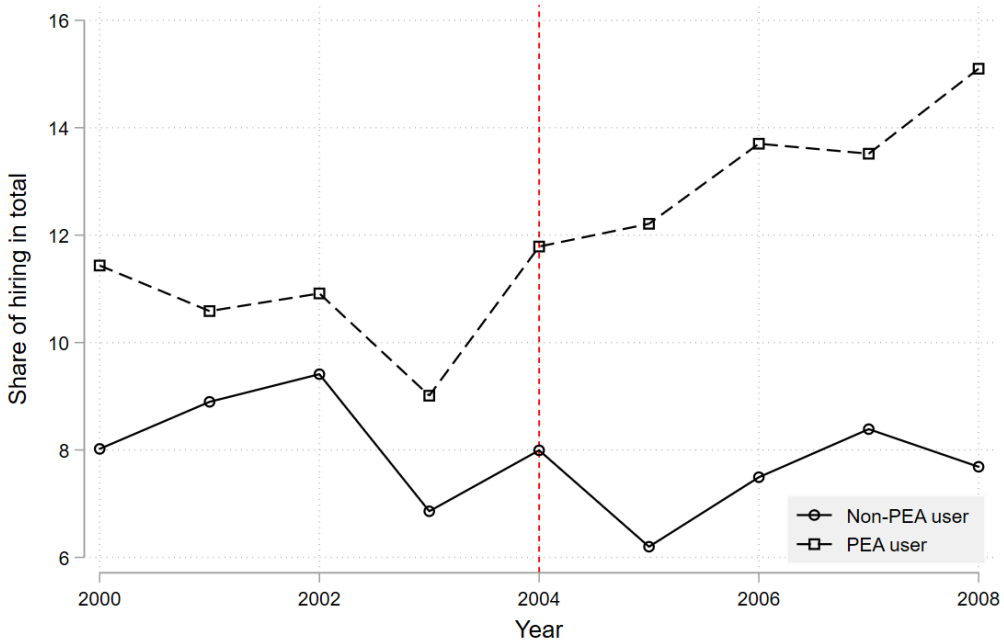
Notes: IAB Establishment Panel, own calculations. Cluster-robust standard errors at the establishment level in parentheses. Significance: *, **, and *** denote statistical significance at the .1, .05 and .01 level respectively. Tobit (1) denotes the homoscedastic tobit model and Tobit (2) denotes the heteroskedastic tobit model in which we include a vector of establishment size and industry dummy variables for the variance estimation. Year fixed effects include year dummy variables ranging from the year 2001 to 2008 with the year 2000 being the base category.

Figure 2: Employment growth between PEA-user and non-users



Notes: IAB Establishment Panel, own calculations. Graph calculated using 14,658 observations on 8,348 treatment and 6,310 control observations.

Figure 3: Share of hiring in total between PEA user and Non-PEA users



Notes: IAB Establishment Panel, own calculations. Graph calculated using 14,658 observations on 8,348 treatment and 6,310 control observations.

4.3 Test for common trend

A critical assumption for the identification of the causal effect within the difference-in-differences framework is the common trend assumption. As depicted in figure 1 and figure 2, the trends in the share of hires as well as employment growth are roughly similar before the treatment (i.e. HartzIII reform on 1st 2004). After the treatment, both trends diverge. Furthermore, and according to Mora and Reggio (2015), we also test whether the common trend assumption hold via the following augmented regression for both dependent variables.[15]

$$Y_{it} = \alpha + \beta_1 PEAuser_i + \sum_{t=2001}^{2008} \tau_t \times PEAuser_i \times Year_t + \beta_m X_m + \gamma_t + \rho_i + \epsilon_{it}\,, \tag{4}$$

We re-estimate the model given in equation (1) and replace the Hartz III dummy variable and interaction with a set of time dummies and a set of time treat interaction which yields the model presented in (4). For the common-trend to hold, we test whether all year-PEA user interaction variables in the pre-treatment period (i.e. before 2004) are jointly not different from zero. Thus, we test the parallel trend assumption with $H_0: \tau_t = 0\ \forall t \leq 2003$. Estimating model (4) using OLS and testing for the joint significance of the pre-treatment year-treat interaction effects reveals for (1a) the share of hires unweighted: F = .65 with a p-value of .580; and (1b) for the share of hires (IPW) weighted: F=.38 with a p-value of .768. For the employment growth dependent variable, we obtain (2a) unweighted: F=1.82 with a p-value of .141 and (2b) (IPW) weighted: F=1.69 with a p-value of .167. Thus, the common trends assumption is met for the share of hires variable (as depicted in figure 2) and also met for the employment growth variable (as depicted in figure 1). Estimation results are presented in the appendix in table A.3.

4.4 Selectivity of PEA usage

Although our difference-in-differences model include a large set of establishment control variables, there might also be pre-existing differences which determine the PEA user status which is not captured by these variables. There might be particularities which make some firms more likely to use the agency compared to other. In this case we face the problem of a selective usage of the employment services thus imposing an endogeneity problem. There might be unobserved variables affecting both, the decision to use the employment agency as well determinants of employment growth. For example, there might be unobserved positive

[15] A similar approach is applied by Giebel and Kraft (2019) and Hangoma et al. (2018) for example.

demand shocks which affect the usage of the Public employment agency (to speed up recruitment) and at the same time affect the hiring process.

We tackle this problem using inverse probability weighing (IPW), as suggested by Imbens and Wooldridge (2009).[16] The idea behind this approach is to create a similar sample of firms in which the treatment (PEA usage) is independent of observed confounders. This process follows a twostep approach. First, we estimate the propensity score for each available year from 2001 to 2008 using a probit model. The binary dependent variable is defined as the treatment indicator which takes unit value if the firm is in the treatment group and zero whether it is in the control group. We adjust for the composition of the workforce by including the share of part-time workers, the share of female workers, the share of high-qualified, apprentices as well as the share of workers which are based on a fixed contract scheme. We also include a comprehensive set of control variables which are the same as in the regressions above. We also include industry fixed effects. The results of the probit regressions which are used to compute the propensity score for each year are presented in the Appendix in table A.1. Second, we calculate the inverse of these obtained propensity score to re-weight the difference-in-differences regressions accordingly. Finally, we provide mean comparisons between the PEA users and non-users are provided in table A.2 in the Appendix.

Results of these re-weighted regressions are presented in table 3. As before the interaction term denotes the treatment effect which is positive and significant for the OLS and Tobit specifications. The coefficients in the difference-in-differences regressions changes only slightly. After the Hartz III reform is in place, establishments using the Public Employment Agency have a 2.2 percentage point's increased share of hires compared to the establishments not using the placement services. This result is significant at the 1 percent level. When we change the specification to the tobit or even to the heteroskedastic tobit mode, the coefficients decrease in magnitude, however stay significant. In terms of employment growth, our results show that establishments which use the placement services, indeed have also a higher employment growth in the magnitude of 2.4 percentage points.

These effects are robust to selectivity, Moreover, as we have shown in section 4.3, the important common trends assumption seems to be fulfilled.

[16] For a similar approach in the context of unemployment benefits and re-employment rates, see Uusitalo and Verho (2010).

Table 3: Results of IPW re-weighted OLS and Tobit models

Dependent Variable	Share of Hires			Empl. Growth
	(OLS)	Tobit (1)	Tobit (2)	(OLS)
HARTZIII	-3.94 ***	-1.88***	-.855***	-.023***
	(.907)	(.465)	(.164)	(.009)
PEAUser	1.82***	1.05***	.021	-.012**
	(.558)	(.289)	(.110)	(.005)
HARTZIII × PEAuser	2.19***	.913**	.346**	.024***
	(.800)	(.419)	(.169)	(.008)
Constant	11.10***	23.14***	15.78***	-.171***
	(2.64)	(1.18)	(.462)	(.028)
Industry fixed effects	✓	✓	✓	✓
Firm size fixed effects	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓
Control variables	✓	✓	✓	✓
R^2 / Pseudo R^2	.150	.025	.036	.072
Left (0) censored obs.		3,847	3,964	
Uncensored obs.		10,770	11,178	
Observations	14,617	14,617	14,617	14,617

Notes: Cluster-robust standard errors at establishment level in parentheses. Significance: *, **, and *** denote statistical significance at the .1, .05 and .01 level respectively. Tobit (1) denotes the homoscedastic tobit model and Tobit (2) denotes the heteroskedastic tobit model in which we include a vector of establishment size and industry dummy variables for the variance estimation. Inverse probability weights are applied for each regression.

5 Conclusion

In this paper we analyze the effectiveness of the matching process on the labor demand side. Using a unique exogenous shock in the matching technology of the Public Employment Agency in Germany allows us to investigate hiring behavior on the establishment level. We argue that increased matching efficiency is associated with lower search costs for establishments and therefore employees and firms might consider potential matches more rapidly. Thus, in turn, increase firm output and employment growth. Using a unique quasi-experiment, we investigate whether the exogenous shock of the Hartz reforms changes the matching efficiency of the labor market.

Applying difference-in-differences estimation in combination with inverse probability weighting (IPW), we find that the PEA indeed is beneficial for the job placement. Compared to other studies, we measure the effect not on the individual or macro level but rather on the establishment level. Comparing firms which use the placement service and firms which do not offers the unique opportunity to study the employment growth behavior between those groups

of firms. Moreover, adjusting for size, industry, and times effects, the PEA using firms face a higher share of hires relative to the workforce compared to firms which do not use the PEA.

Our paper, however, is not without limitations. An important extension to our study is the differentiation of employment into temporary and permanent employment. There might be substitution effect in a sense that firms substitute costly permanent employment with temporary agency workers. As Fougere et al. (2009) show, a more effective PEA channel is associated with an increased exit rate from unemployment, in particular for unskilled and low-educated people. Employment growth effects might be especially pronounced for low-skilled employees. It is therefore relevant to show whether these effects are also relevant for welfare considerations.

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Appendix A: Tables

Table A.1: Probit estimates for obtaining the propensity score

Dependent Variable: PEA user									
Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
log of employees	-.057	-.082	-.003	.174*	.143	.317***	-.019	.160**	.175**
	(.083)	(.084)	(.089)	(.096)	(.101)	(.100)	(.088)	(.079)	(.076)
log of employees squared	.019**	.024**	.015	.001	-.004	-.022**	.016	-.002	-.005
	(.009)	(.009)	(.010)	(.011)	(.011)	(.010)	(.010)	(.009)	(.009)
West Germany	-.238**	-.220**	-.258***	-.231*	-.202**	-.123	-.209***	-.086	-.125*
	(.101)	(.100)	(.082)	(.091)	(.095)	(.097)	(.078)	(.068)	(.065)
Founded in 2000 or later	-.052	.117	-.103	.075	.063	.011	-.038	-.071	.106
	(.109)	(.096)	(.089)	(.100)	(.099)	(.100)	(.081)	(.068)	(.065)
Single Establishment	-.037	.020	.001	.021	-.002	.122	.053	.113*	.164**
	(.072)	(.070)	(.079)	(.092)	(.090)	(.089)	(.076)	(.067))	(.066)
Limited Liability	-.134*	-.005	.002	-.098	-.024	.024	.106	.036	-.096
	(.076)	(.079)	(.087)	(.106)	(.110)	(.115)	(.096)	(.083)	(.078)
No mayor shareholder	-.008	-.136	.072	-.147	.245	.020	-.185	-.067	-.267**
	(.146)	(.136)	(.157)	(.173)	(.174)	(.177)	(.145)	(.132)	(.123)
Positive employ expec.	.109	.103	.002	-.037	-.089	-.001	.075	.012	-.005
	(.071)	(.070)	(.080)	(.092)	(.092)	(.095)	(.075)	(.064)	(.061)
Collective Bargaining Ag.	.029	.006	-.112	-.026	.045	.060	-.040	.037	-.019
	(.072)	(.068)	(.079)	(.090)	(.090)	(.090)	(.076)	(.067)	(.064)
Share of part time employees	-.035	-.157	-.361*	-.009	-.484**	-.181	-.327*	-.367**	-.459***
	(.191)	(.182)	(.192)	(.216)	(.221)	(.224)	(.184)	(.166)	(.151)
Share of female employees	-.237	-.023	-.021	-.032	-.117	-.140	-.017	.119	.049
	(.176)	(.166)	(.183)	(.210)	(.207)	(.221)	(.192)	(.160)	(.152)
Share of qualified employees	-.091	-.072	-.294*	-.097	-.008	.145	-.237	-.131	-.045
	(.133)	(.130)	(.144)	(.172)	(.175)	(.183)	(.159)	(.137)	(.126)
Share of fixed term empl.	1.20***	1.12***	.973***	.836***	.748***	1.06***	.988***	.530**	.681***
	(.318)	(.298)	(.273)	(.281)	(.277)	(.270)	(.241)	(.211)	(.191)
Share of apprentices	1.33***	1.26***	.841*	2.34***	.380	.156**	.241	1.16**	1.02**
	(.487)	(.407)	(.450)	(.607)	(.544)	(.682)	(.481)	(.501)	(.411)
Constant	.277	0.112	.161	.122	-.631	-.123	-.344	-.525	-.856**
	(.388)	(.333)	(.318)	(.480)	(.394)	(.097)	(.366)	(.342)	(.346)
Industry fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pseudo R^2	.098	.106	.109	.117	.116	.134	.101	.090	.092
Log likelihood	-1088.62	-1207.89	-976.82	-707.42	-717.69	-681.70	-976.21	-1235.78	-1349.85
Observations	1,773	1,979	1,621	1,179	1,198	1,144	1,574	1,986	2,163

Note: Robust standard errors in parentheses. *, **, and *** denote statistical significance at the .1, .05 and .01 level respectively.

Table A.2: t-Test for mean differences between re-weighted treatment and control group

Year	Mean		t-Test		Mean		t-Test		Mean		t-Test
2000	Control	Treated	p-value	**2001**	Control	Treated	p-value	**2002**	Control	Treated	p-value
log of employees	4.38	4.39	.891		4.27	4.28	.938		4.16	4.13	.813
log of employees squared	21.96	22.12	.840		21.17	21.24	.931		20.57	20.37	.838
Single Establishment	.617	.608	.733		.631	.627	.891		.636	.635	.966
Limited Liability	.578	.569	.759		.596	.593	.893		.543	.542	.977
Share of part time employees	.155	.160	.672		.176	.176	.980		.200	.203	.785
Share of female employees	.408	.411	.822		.415	.414	.955		.429	.426	.868
Share of qualified employees	.637	.640	.863		.671	.672	.952		.647	.664	.346
Share of fixed term empl.	.054	.054	.960		.056	.055	.874		.085	.075	.520
Share of apprentices	.053	.048	.578		.048	.048	.883		.063	.054	.519
No mayor shareholder	.059	.057	.912		.054	.057	.809		.051	.057	.666
Positive employ expec.	.322	.324	.944		.285	.288	.888		.238	.246	.728
Collective Bargaining Ag.	.576	.575	.984		.550	.548	.949		.511	.522	.701
West Germany	.862	.871	.663		.867	.876	.621		.722	.735	.665
Founded in 2000 or later	.113	.118	.794		.120	.121	.979		.190	.191	.955

Note: Weighted means for PEA user and PEA non-user. Weights calculated according to the inverse of the propensity score. Each last column shows a t-test for the difference in mean values. *, **, and *** denote statistical significance at the .1, .05 and .01 level respectively.

Table A.2: continued

Year	Mean		t-Test		Mean		t-Test		Mean		t-Test
2003	Control	Treated	p-value	**2004**	Control	Treated	p-value	**2005**	Control	Treated	p-value
log of employees	4.00	4.04	.754		4.39	4.40	.963		4.37	4.39	.895
log of employees squared	19.22	19.57	.735		22.52	22.57	.969		22.52	22.67	.893
Single Establishment	.659	.654	.852		.627	.615	.716		.562	.557	.894
Limited Liability	.576	.574	.935		.641	.654	.700		.628	.631	.935
Share of part time employees	.186	.193	.639		.187	.176	.520		.172	.176	.761
Share of female employees	.424	.429	.785		.417	.410	.695		.416	.415	.931
Share of qualified employees	.708	.704	.775		.687	.699	.541		.716	.723	.723
Share of fixed term empl.	.070	.073	.842		.095	.088	.636		.094	.097	.838
Share of apprentices	.046	.046	.975		.048	.046	.774		.044	.043	.882
No mayor shareholder	.056	.061	.736		.060	.063	.861		.068	.070	.902
Positive employ expec.	.265	.268	.928		.260	.261	.962		.281	.285	.893
Collective Bargaining Ag.	.477	.467	.781		.498	.509	.733		.514	.524	.769
West Germany	.683	.685	.936		.725	.729	.909		.714	.723	.782
Founded in 2000 or later	.227	.226	.966		.243	.236	.805		.255	.267	.689

Note: Weighted means for PEA user and PEA non-user. Weights calculated according to the inverse of the propensity score. Each last column shows a t-test for the difference in mean values. *, **, and *** denote statistical significance at the .1, .05 and .01 level respectively.

Table A.2: continued

Year	Mean		t-Test		Mean		t-Test		Mean		t-Test
2006	Control	Treated	p-value	**2007**	Control	Treated	p-value	**2008**	Control	Treated	p-value
log of employees	4.25	4.23	.916		4.18	4.17	.983		4.04	4.05	.911
log of employees squared	21.29	21.17	.899		20.58	20.54	.968		19.43	19.54	.873
Single Establishment	.623	.611	.661		.619	.615	.857		.634	.635	.981
Limited Liability	.635	.634	.955		.658	.654	.847		.627	.627	.990
Share of part time employees	.208	.209	.962		.193	.195	.860		.219	.216	.819
Share of female employees	.407	.409	.916		.395	.396	.943		.413	.410	.811
Share of qualified employees	.729	.730	.952		.722	.724	.887		.703	.702	.939
Share of fixed term empl.	.081	.084	.778		.093	.091	.834		.093	.094	.984
Share of apprentices	.045	.042	.608		.042	.040	.720		.045	.044	.757
No mayor shareholder	.062	.069	.697		.063	.058	.704		.066	.063	.809
Positive employ expec.	.307	.311	.866		.389	.394	.850		.330	.335	.826
Collective Bargaining Ag.	.454	.462	.796		.443	.444	.969		.456	.461	.860
West Germany	.693	.686	.785		.659	.660	.972		.659	.664	.841
Founded in 2000 or later	.292	.287	.846		.335	.330	.823		.359	.355	.850

Note: Weighted means for PEA user and PEA non-user. Weights calculated according to the inverse of the propensity score. Each last column shows a t-test for the difference in mean values. *, **, and *** denote statistical significance at the .1, .05 and .01 level respectively.

Table A.3: Test for common trends for both variables

Dependent variable	Share of hries		Employment growth	
	(OLS)	(OLS IPW)	(OLS)	(OLS IPW)
PEA user	2.81**	2.85**	-.012*	-.013
	(1.05)	(1.21)	(.009)	(.010)
PEA user × 2001	-1.45	-1.36	.014	.014
	(1.32)	(1.47)	(.013)	(.013)
PEA user × 2002	-1.84	-1.44	-.018	-.018
	(1.56)	(1.62)	(.014)	(.015)
PEA user × 2003	-1.58	-1.45	.005	.006
	(1.35)	(1.54)	(.016)	(.017)
PEA user × 2004	-.661	-.357	.009	.007
	(1.90)	(1.72)	(.016)	(.017)
PEA user × 2005	.705	.876	.035**	.045**
	(1.56)	(1.84)	(.017)	(.019)
PEA user × 2006	1.46	.928	.049***	.040***
	(1.48)	(1.63)	(.015)	(.015)
PEA user × 2007	1.03	1.15	.016	.010
	(1.51)	(1.67)	(.014)	(.015)
PEA user × 2008	1.63	2.32	.022	.028
	(1.59)	(1.70)	(.013)	(.015)
Constant	10.74***	10.59***	-.172***	-.171***
	(2.60)	(2.68)	(.027)	(.029)
H_0: Common pre-treatment trends:	0.65	0.38	1.82	0.65
F-statistic (p-value)	(.580)	(.768)	(.141)	(.580)
Industry fixed effects	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓
Control variables	✓	✓	✓	✓
R^2 / Pseudo R^2	.164	.150	.073	.073
Observations	14,658	14,617	14,658	14,617

Notes: Cluster-robust standard errors at the establishment level in parentheses. Significance: *, **, and *** denote statistical significance at the .1, .05 and .01 level respectively.