Fixed-Term Contracts and Employment Adjustment.

An Empirical Test of the Core-Periphery Hypothesis with German Establishment Data.

by Christian Pfeifer [*] (March 21, 2007)

Abstract

Fixed-term contracts (FTC) as important feature of the employment relationship of the peripheral workforce are analysed to test the following two hypotheses, which are based on dual labour market theory: (1) Firms use FTC for the peripheral workforce to adjust the level of employment to the profit maximizing level in case of demand fluctuations. (2) Thanks to the utilisation of FTC the core workforce is less exposed to employment adjustment. Both hypotheses are supported by the results of the econometric analyses with a large-scale German establishment panel. Several methods to estimate the probability and intensity of FTC utilisation and GMM estimates for dynamic labour demand functions are presented.

Keywords: core-periphery hypothesis, dual labour markets, dynamic labour demand, employment adjustment, fixed-term contracts

JEL classification: J23, J42, M51

---

[*] Christian Pfeifer, Institute of Labour Economics, Leibniz University Hannover, Germany. The study was financially supported by the State of Lower Saxony. The author would like to thank two anonymous referees of this journal, Knut Gerlach, Olaf Hübler, Wolfgang Meyer, participants of the Australian Conference of Economists 2005 in Melbourne, participants of research seminars at the IAB in Nürnberg and the Leibniz University Hannover for helpful comments on earlier drafts of this paper. Any remaining shortcomings are, of course, my own.

Address for correspondence: Christian Pfeifer, Institute of Labour Economics, Leibniz University Hannover, Koenigsworther Platz 1, 30167 Hannover, Germany; e-mail: pfeifer@aoek.uni-hannover.de.

Fixed-Term Contracts and Employment Adjustment.

An Empirical Test of the Core-Periphery Hypothesis with German Establishment Data.

Abstract

Fixed-term contracts (FTC) as important feature of the employment relationship of the peripheral workforce are analysed to test the following two hypotheses, which are based on dual labour market theory: (1) Firms use FTC for the peripheral workforce to adjust the level of employment to the profit maximizing level in case of demand fluctuations. (2) Thanks to the utilisation of FTC the core workforce is less exposed to employment adjustment. Both hypotheses are supported by the results of the econometric analyses with a large-scale German establishment panel. Several methods to estimate the probability and intensity of FTC utilisation and GMM estimates for dynamic labour demand functions are presented.

Keywords: core-periphery hypothesis, dual labour markets, dynamic labour demand, employment adjustment, fixed-term contracts

JEL classification: J23, J42, M51

I Introduction

The need for firms to adjust flexibly to demand-induced output fluctuations and the importance of employment flexibility have been recently discussed in many economic and management studies (Abraham, 1988; Carlsson, 1989; Hunter et al., 1993; Brodsky, 1994; Houseman, 2001). One instrument of employment flexibility are fixed-term contracts (FTC). According to dual labour market theory, employees with FTC can be interpreted as a firm's peripheral workforce, whereas a non-temporary employment relationship is a typical characteristic of the core workforce (Atkinson, 1987; Kalleberg, 2001; Cappelli/Neumark, 2004). The core-periphery hypothesis implies that non-temporary employees gain a higher degree of job security (probability of keeping the job) due to the use of a flexible workforce, since temporary employment is used as a "buffer", which is adjusted to demand fluctuations (Booth/Francesconi/Frank, 2002a). Moreover, the core workforce benefits from better working conditions including higher income. This should lead to lower voluntary turnover (quits) among the non-temporary employees, which results in a higher job stability (time spent on the job).

Empirical support of the core-periphery hypothesis is limited. Most prior research focused on interviews with employers, simply asking if they use a core and a peripheral workforce and for which purpose they do so (Hunter et al., 1993; Houseman, 2001). Cappelli and Neumark (2004) analyse the effect of contingent work on job security in the United States. They state that "the evidence paints a rather clear picture regarding the core-periphery hypothesis because we find that contingent work and involuntary turnover of the permanent workforce are positively and significantly related, contradicting the core-periphery hypothesis" (Cappelli/Neumark, 2004: 177). Pfeifer (2005) estimates the impact of fixed-term contracts and temporary agency work on the

number of layoffs and quits in German establishments. He also finds no evidence that the use of temporary employment lowers turnover among the core workforce. Therefore, other empirical strategies are used in this paper to test the core-periphery hypothesis.

The paper is organised in the following way: In the next section, some institutional background information about fixed-term contracts (FTC) in Germany is presented, which is accompanied by descriptive statistics about FTC. Section three focuses on theoretical considerations and the generation of research hypotheses. In section four, the data and the estimation techniques are explained, which are followed by the empirical results in section five. The paper ends with a short conclusion in section six.

II Fixed-Term Contracts in Germany

Fixed-term contracts (FTC) in Germany were highly regulated until the introduction of the Employment Promotion Act ("Beschäftigungsförderungsgesetz") in 1985. This legal change relaxed the former rule that the employer had to demonstrate the temporary nature of the work (objective reasons like, for example, seasonal fluctuations) and that FTC had a maximum duration of only six months. The Employment Promotion Act of 1985 allowed single FTC up to 18 months without justification for newly hired employees and apprentices without a regular job offer. In 1996, the duration of FTC was raised to 24 months with three renewals possible within this period. Moreover, employees after finishing their apprenticeship could be employed unconditionally in FTC and FTC for employees older than 60 years were allowed without any restrictions of the duration. Finally, if the contract was justified by an objective reason, the aforementioned restrictions did not apply. In January 2001, the regulation of FTC in

Germany was again renewed and regulated in a single law ("Gesetz über Teilzeitarbeit und befristete Arbeitsverträge") for the first time. The new legislation includes the prohibition of discrimination at the workplace, which refers to equal pay and treatment. Another change affects the definition of the elderly defined as older than 58 years and more recently older than 52.

Compared with other European countries, the share of FTC in total employment for Germany is about average. According to the European Union Workforce Census 2003, the share of FTC in all 25 EU countries is on average 12.8 percent and in Germany it is 12.2 percent. A comparison with other major European economies shows some differences. While the UK is located at the lower end with 5.8 percent, Italy has a share of 9.5 percent and France of 12.7 percent. In Spain nearly every third employee works in a FTC. There is some cross-country evidence that the share of temporary employment is larger in countries with higher levels of employment protection for permanent employees (OECD, 2004: 86-89).

Table 1 displays the structure of FTC employment among German employees (without trainees) in 2004.[1] The share of FTC in total employment is 7.7 percent. The differences between men (7.5%) and women (8.0%) as well as between blue-collar workers (7.9%) and white-collar workers (7.7%) are not worth mentioning. In West Germany 7.1 percent of employees work in FTC, whereas the share of FTC in East Germany is 10.7 percent. Furthermore, 7.4 percent of Germans work in FTC, while the share is 11.5 percent among non-Germans. The largest differences can be found between different

[1] The data base is the German Microcensus, which is a 1%-sample of all households. As datasets with different bases are used in this section, the shares differ.

age groups: especially younger employees work in FTC. One reason for these differences might be the difficult labour market situation for young people, non-Germans, and in East Germany. The pressure for accepting a FTC might be larger for those who are not eligible for generous unemployment benefits.

Some evidence of the reasons for being employed in FTC are available for 2002. Overall, most contracts are fixed-termed because of training purposes. However, if we exclude this training aspect, 18.5 percent work in FTC because they could not find a permanent job, whereas only 3.7 percent of the employees in FTC do not wish to work on a permanent basis. Another important reason (17.6%) is FTC as probationary period, i.e., firms use FTC to screen newly hired employees (Engellandt/Riphahn, 2005). Thus, FTC might serve as a stepping stone into permanent employment (Booth/Francesconi/Frank, 2002b).

- *insert table 1 about here*

The Hannover Firm Panel (see section IV and data appendix for a description of the dataset) contains additional information about FTC for the period 2000 to 2004. Table 2 informs about the spread and trend of FTC in the federal state of Lower Saxony. The share of firms which use FTC has increased from 10 percent in the year 2000 to 18 percent in 2004, while the share of employees (without trainees) is basically stable over time. About 5 percent of all employees and 10 percent of employees in firms using FTC are employed in FTC. The importance of FTC becomes larger if new hires are considered. Overall nearly 30 percent of all establishments hired new employees in the first six months of each year. While in 2001 only 27 percent of these firms hired employees on a fixed-term basis, this proportion increases to 41 percent in 2004. A similar trend can be detected for the share of FTC hiring in all hiring. In 2001, 37

percent of all hired employees had FTC, which increased to 46 percent in 2004. If only firms with FTC hiring are taken into account, the numbers are even more impressive: Three out of four newly hired employees work in FTC!

- *insert table 2 about here*

III Theory and Hypotheses

Firms have several options to react to demand-induced output fluctuations (Pfeifer, 2005). One is that a firm can vary the number of non-temporary employees or the number of temporary employees to adjust its employment to the profit maximizing level. Non-temporary employment has relatively high adjustment costs so that firms are often interested in stable employment relationships (Gerlach/Jirjahn, 1999). These adjustment costs include fixed employment costs (e.g., administration costs for hiring and layoff), investments in firm specific human capital, long-term work incentives (e.g., seniority wages), and separation costs due to institutional employment protection (e.g., severance pay, law suits). Conversely, varying the peripheral workforce can help to save such costs and to accelerate employment adjustment (Bentolila/Saint-Paul, 1992; Hagen, 2003). Typically the peripheral workforce consists of contingent workers with FTC, who have low levels of firm specific human capital and weaker employment protection (OECD, 2002: 127-185; OECD, 2004: 61-125).

Not taking into account dual labour markets in an economy (Berger/Piore, 1980; Bulow/Summers, 1986), this paper concentrates on internal dual labour markets, i.e., one firm employs a core as well as a peripheral workforce (Rebitzer/Taylor, 1991; Saint-Paul, 1991; Saint-Paul, 1996). Models of dual labour markets are usually based on efficiency wage models (Shapiro/Stiglitz, 1984), emphasising the level of effort an

employee is willing to provide (non shirking condition). In general, firms with high monitoring costs employ a core workforce with long term employment relationships and efficiency wages, whereas firms with low monitoring costs prefer a peripheral workforce which is closely monitored. This, however, does not yet lead to an internal dual labour market, in which both workforces are employed by one firm. Such internal dual labour markets emerge in the case of demand fluctuations. In the following, this is briefly illustrated in a simple two-period efficiency wage model.[2]

The non shirking condition in (1) requires that the expected lifetime utility of a non shirking worker is larger than the expected lifetime utility of a shirking worker. The non shirking lifetime utility contains in the first period the efficiency wage (w) minus the worker's effort (e>0). In the second period, the non shirker is still employed with the probability[3] $(1-\alpha)$ and obtains again the wage w and has the disutility e. Even if the worker does not shirk, he can be laid off due to a fall in demand with the probability α and gets only an alternative utility U_A, which could be the market wage or some kind of unemployment benefits. For a shirking worker the utility in the first period is simply the wage because he provides no effort (e=0). If the firm detects this misbehaviour, the shirker is laid off and gets only an alternative utility in the second period. The probability that the worker is caught shirking is denoted with β. Hence, the joint probability for a shirker to remain employed and to obtain the efficiency wage is

[2] The basic idea to show that the efficiency wage needs to be larger if the probability of being laid off in the case of a fall in demand increases is not affected by the number of periods or the discount rate, which is omitted in this simple model.

[3] The probabilities in this model can take on values between zero and one.

$(1-\alpha)(1-\beta)$, while the probability of being laid off and getting an alternative utility is $\left(1-(1-\alpha)(1-\beta)\right)$.

$$\left(w-e\right)+\left((1-\alpha)(w-e)+\alpha U_A\right)\geq w+\left((1-\alpha)(1-\beta)w+\left(1-(1-\alpha)(1-\beta)\right)U_A\right) \quad (1)$$

The non shirking condition wage (2) is obtained by solving (1) for *w*. Since we are interested in the impact of a variation in the layoff probability α, the first and second derivation of *w* with respect to α are calculated (see (3) and (4)). Both are positive, i.e., the firm has to set a higher efficiency wage if the layoff probability increases.

$$w\geq U_A+\frac{\left(2-\alpha\right)}{\left(1-\alpha\right)}\cdot\frac{e}{\beta} \quad (2)$$

$$\frac{\partial w}{\partial \alpha}=\left(\frac{1}{\left(1-\alpha\right)^2}\right)\cdot\frac{e}{\beta}>0 \quad (3)$$

$$\frac{\partial^2 w}{\partial \alpha^2}=\left(\frac{\left(2-2\alpha\right)}{\left(1-\alpha\right)^4}\right)\cdot\frac{e}{\beta}>0 \quad (4)$$

As a firm can pay the core workforce lower efficiency wages to get the same level of effort if it lowers their cyclical and structural layoff probability, it is profit maximizing to hoard the core workforce in bad economic states and to use a flexible peripheral workforce to adjust employment. In case of an increase in demand, this would mean that the firm hires temporary and not permanent employees. Furthermore, good working conditions and employment security should lower quits among the core employees saving for example training costs. Hence, the core workforce has higher employment security and stability due to the use of a peripheral workforce.

Accordingly, temporary employment reacts stronger to changes in demand than non-temporary employment. Therefore, the composition of the workforce changes if a firm is confronted with demand fluctuations. This can be easily shown with equation (5) for the share of FTC in total employment ($0 \leq \mu \leq 1$), where total employment (E) consist of temporary employment (F) and non-temporary employment (N) which all depend on some output measures (Y).

$$\mu(Y) = \frac{F(Y)}{E(Y)} = \frac{F(Y)}{N(Y) + F(Y)} \tag{5}$$

$$\frac{\partial \mu}{\partial Y} = \frac{\left(\partial F / \partial Y \cdot N\right) - \left(\partial N / \partial Y \cdot F\right)}{\left(N + F\right)^2} \tag{6}$$

If equation (5) is derived with respect to Y, we obtain (6). It can be seen that the share of temporary employment increases with an increase in demand ($\partial \mu / \partial Y > 0$) if $\partial F / \partial Y > \partial N / \partial Y \geq 0$ and $N \geq F > 0$. The first condition is fulfilled by the theoretical assumption that temporary employment reacts more strongly to changes in demand than non-temporary employment. In the extreme case, non-temporary employment is not adjusted at all $\left(\partial N / \partial Y = 0\right)$ so that $\partial \mu / \partial Y > 0$ is always given. The second condition that $N \geq F$ is the more likely case. However, even if $N < F$, $\partial \mu / \partial Y > 0$ can occur if $\partial F / \partial Y$ is large enough respectively $\partial N / \partial Y$ is small enough.

From the contemplated considerations about flexibility and internal dual labour markets the following two hypotheses about FTC and employment adjustment are generated:

Hypothesis 1: Firms use employees with FTC as a peripheral workforce to adjust their employment faster to the profit-maximizing level in case of changes in demand.

Hypothesis 2: Thanks to the utilisation of FTC the core workforce is less exposed to employment adjustment.

IV Data and Econometric Models

The Hannover Firm Panel is the sample for the federal state of Lower Saxony from the German IAB Establishment Panel (Gerlach/Hübler/Meyer, 2003). In the summer of every year approximately one thousand firms from Lower Saxony with at least one employee covered by social security are interviewed in a panel design survey. The sample is stratified according to establishment size and industry, with oversampling of larger firms, and can be weighted for all of the nearly 200,000 firms in Lower Saxony. The observation unit is the establishment, i.e., the local unit in which major activities of an enterprise are carried out. The main focus of the survey is to gain insights into the firm's most important parts of operation, decision-making, and specifically employment. A more detailed description of the dataset can be found in the data appendix.

For the econometric analysis the waves 2000 to 2004 are utilised in an unbalanced unweighted panel. Establishments which do not measure their business volume in sales are excluded from the analysis as well as establishments from the financial, public and

non-profit sector.[4] Tables A.1 and A.2 in the appendix present descriptive statistical information about the variables used for the econometric analysis.

The empirical analysis is divided into two parts: It is firstly tested if the use of FTC is positively correlated with an increase in demand as proposed by dual labour market theory. In the next step, dynamic labour demand equations for all employees, non-temporary employees, and temporary employees (FTC) are estimated to analyse differences in adjustment speed and output elasticities.

IV(i) Utilisation of FTC

The hypothesis that an expansion of total employment in case of a positive development of sales is implemented with an expansion of FTC is tested with several models. Before focusing on the estimation of the share of FTC, the probability of using FTC is estimated. The dependent variable is a dummy variable, which takes the value one if the share of FTC is larger zero ($F_{it}>0$) and zero if no employee with a FTC is employed ($F_{it}=0$). Such a binary choice model can be estimated with the probit technique in equation (7), where Φ is the standard normal cumulative distribution function. The coefficients are denoted with α and β, the constant term with γ, the error term with u_{it}, the firm index is i and the time index is t.

$$\Pr\left(F_{it}>0\right)=\Phi\left(\gamma+\alpha\left(\log Y_{it}^{e}-\log Y_{i,t-1}\right)+x_{it}^{'}\beta\right) \qquad (7)$$

[4] The establishments are asked if they measure their business volume in sales (normal case), balance sheet total (credit institutions), total premiums paid (insurance companies) or budget (public and non-profit establishments). Since the different definitions are not comparable and most firms report sales, the following investigation concentrates on these firms.

The development of sales is measured as the logarithm of the firms expected sales (Y^e_{it}) in Euros for the current year (t) minus the logarithm of realised sales ($Y_{i,t-1}$) in the last year ($t-1$). Both information are gathered during the same interview in the same year (t). Since the interviews take place in July and August, the expected sales for the current year comprise some factual information from the first half of the year. The use of the expected instead of the realised sales is reasonable due to the fact that employment decisions in t depend mainly on realisation until t and expectations built in t.

In addition, a row vector of control variables is included (x'_{it}). Differences in the employment structure of firms are taken into account by the following variables: shares of part-time, female, and qualified employees in total employment on June 30 in period t. Institutional labour relations are considered with dummy variables for the existence of works councils, industry-, and firm-level collective agreements. Because of employer size and industry effects, five establishment size classes, and ten industry dummies are included in the estimates. Aggregated influences (e.g., macroeconomic conditions like unemployment, legal changes) are taken into account with dummy variables for the years 2000 to 2004.[5]

The panel character of the dataset also allows estimating a random effects probit model to control for unobserved heterogeneity between firms. Such firm specific effects (v_i) can influence the probability of using FTC. Therefore, equation (8) is estimated.

---

[5] Of course, there may be other variables which influence the use of FTC. Since these additional information are only available for some observation periods and not for all firms, the focus is on some core control variables to make use of the panel nature of the dataset. Nevertheless, the impact of the firm's individual demand situation can also be demonstrated if additional control variables are included in regressions for single years.

$$\Pr\left(F_{it} > 0\right) = \Phi\left(\gamma + \alpha\left(\log Y_{it}^{e} - \log Y_{i,t-1}\right) + x_{it}^{'}\beta + v_i\right) \tag{8}$$

Now, we turn to our initial task: the estimation of the FTC intensity. According to dual labour market theory, the share of FTC (F_{it}/E_{it}) should be positively correlated with an increase in sales (see equations (5) and (6) in section III), i.e., the composition of the workforce should change in favour of FTC. Thus, the number of FTC (F_{it}) divided by the number of all employees (E_{it}) on June 30 of every year is regressed on an indicator for each firm's development of sales. Since the share of FTC in total employment can only take values between zero (no FTC) and one (only FTC), the total sample includes corner solutions. The tobit technique addresses this issue and is usually the first choice. Hence, equation (9) is estimated with a double-censored tobit model for the total sample with a lower limit at zero and an upper limit at one.

$$\frac{F_{it}}{E_{it}} = \gamma + \alpha\left(\log Y_{it}^{e} - \log Y_{i,t-1}\right) + x_{it}^{'}\beta + u_{it} \tag{9}$$

We can again extend the above equation with a firm specific error term (v_i) to control for unobserved heterogeneity between firms, which could influence the probability of using FTC as well as the intensity. Equation (10) is estimated with a random effects tobit model for the total sample with a lower limit at zero and an upper limit at one.

$$\frac{F_{it}}{E_{it}} = \gamma + \alpha\left(\log Y_{it}^{e} - \log Y_{i,t-1}\right) + x_{it}^{'}\beta + u_{it} + v_i \tag{10}$$

The standard tobit model (tobit I) has quite restrictive assumptions because the intensity has to be explained by the same variables like the probability of using FTC and the coefficients in both equations need to have the same signs (Verbeek, 2004: 227-236). Since it is known from other studies (Boockmann/Hagen, 2003; Pfeifer, 2005) that the

second assumption is violated for some variables (e.g., in firms with works councils the use of FTC is more likely but less intensive than in firms without works councils), tobit estimates for the total sample might be biased.

An alternative would be Heckman's selection model (Heckman, 1979), which is a so called tobit II model if maximum likelihood is applied. The sample selection model assumes that establishments with FTC are not a random sample and the decision of using FTC is different from the decision of how many FTC to employ. There are, however, some problems with Heckman's selection model, which are especially serious for small sample size (Kennedy, 1998: 256; Puhani, 2000; Dougherty, 2002: 297-301). One problematic issue is the identification problem, which cannot be solved if the probability and the intensity are determined by the same explanatory variables in both equations (Hamermesh, 2000: 372). Additionally, the results are very sensitive to changes of the specification.

Efficient and robust options are OLS (ordinary least squares) and WLS (weighted least squares) estimates for a restricted sample of firms which actually report a share of FTC. As the dependent variable is restricted to values between zero and one, a logit transformation is preferable (Greene, 2003: 686-689). Papke and Wooldridge (1996) recommend the use of a general linear model (GLM) instead of OLS or WLS to estimate individual reported fractional data. Following this suggestion, equation (11) is estimated with a general linear model with logits of the share of FTC and robust standard errors for establishments, which have in all observation periods at least one employee with a FTC in their workforce.

$$\ln\left(\frac{F_{it}/E_{it}}{1-F_{it}/E_{it}}\right)=\gamma+\alpha\left(\log Y_{it}^{e}-\log Y_{i,t-1}\right)+x_{it}^{'}\beta+u_{it} \qquad (11)$$

IV(ii) Dynamic Labour Demand

The hypothesis that temporary employment is adjusted faster and reacts more strongly to changes in output than non-temporary employment is tested with estimates for dynamic labour demand functions, in which the logarithm of the number of employees on June 30 is the dependent variable. In the following, the dynamic labour demand model is briefly derived (Nickell, 1986; Hamermesh, 1993). The starting point is the equilibrium labour demand (L^*) for firm i in period t in equation (12). Besides the control variables from the above estimates for the share of FTC, the logarithm of the sum of salaries per capita as a proxy for wages and the logarithm of the sum of investments per capita as a proxy for capital are considered (x'_{it}). The sum of salaries is the sum of all gross salaries without employer's social security contribution and without holiday pay for June of any given year. The sum of investments is the sum of all investments realised in the entire previous year. Both proxies are debatable because of serious shortcomings (e.g., no adjustment for working time, investments are not equally distributed over all years), but they are the best our data yield. Moreover, the logarithm of the expected sales in the current year (Y^{e}_{it}) is used.

$$\log\left(L_{it}^{*}\right)=\gamma+\alpha\log\left(Y_{it}^{e}\right)+x_{it}^{'}\beta+u_{it} \qquad (12)$$

The static model of labour demand (12) can be transformed into a dynamic form using the partial adjustment model in equation (13), which takes into consideration that, due

to disproportionate increasing symmetric adjustment costs, the actual labour demand can diverge from the optimal level of employment. The adjustment coefficient λ can take values between zero and one. If λ=0, employment is not adjusted at all. If λ=1, there is perfect adjustment. To derive the dynamic labour demand, the logarithm of (13) is used, solved for $log(L^*_{it})$, and inserted in (12). The new equation (14) is the dynamic labour demand function with partial adjustment.

$$\frac{L_{it}}{L_{i,t-1}} = \left(\frac{L^*_{it}}{L_{i,t-1}} \right)^{\lambda} \tag{13}$$

$$\log\left(L_{it}\right) = \gamma\lambda + \left(1-\lambda\right)\log\left(L_{i,t-1}\right) + \alpha\lambda\log\left(Y^e_{it}\right) + x'_{it}\beta\lambda + \lambda u_{it} \tag{14}$$

Of special interest in our analysis is the adjustment coefficient λ, which indicates how much of the adjustment is performed within one year. The median adjustment time in years can be calculated if $(1-\lambda)^{t^*} = 0.5$ is solved for t^*. Thus, the median adjustment time in quarters is $t^* = \frac{\ln(0.5)}{\ln(1-\lambda)} \cdot 4$. Furthermore, the coefficient for the expected output ($\alpha\lambda$) is the short-term output elasticity of labour demand. Larger adjustment coefficients and elasticities can be interpreted as higher adjustment flexibility for the firm and lower employment security for employees.

Since we are interested in differences between temporary (FTC) and non-temporary employees, several dynamic labour demand functions (14) are estimated. At first, the dynamic labour demand for all employees (E_{it}) is estimated, i.e., for temporary and non-temporary employees without trainees. Furthermore, separate estimates for non-temporary (N_{it}) and temporary (F_{it}) employees are performed. Afterwards, the speed of employment adjustment and the output elasticities of these three models can be

compared. In addition to estimates for all establishments, separate estimates for establishments with FTC and without FTC are carried out.

Due to the autoregressive form of equation (14) and first order autocorrelation an OLS estimator would be neither efficient nor consistent (Bond, 2002). Therefore, the Arellano and Bond (1991) method is applied, which was designed to estimate dynamic models with panel data. Arellano and Bond (1991) developed a GMM estimator that treats the model as a system of equations, one for each time period. The equations differ only in their moment condition sets. The predetermined and endogenous variables in first differences are instrumented with suitable lags of their own levels. Strictly exogenous regressors, as well as any other instruments, enter the instrument matrix in the conventional instrumental variables fashion, i.e., in first differences, with one column per instrument.

A problem with the original Arellano-Bond estimator is that lagged levels are often weak instruments for first differences. Blundell and Bond (1998: 115) note that "in dynamic panel data models where the autoregressive parameter is moderately large and the number of time series observations is moderately small, the widely used linear generalised method of moments (GMM) estimator obtained after first differencing has been found to have large finite sample bias and poor precision in simulation studies". Hence, Blundell and Bond (1998) extend the original Arellano-Bond estimator in the following way: predetermined and endogenous variables in levels are instrumented with suitable lags of their own first differences. This approach is supposed to yield more precise parameter estimates and to reduce potentially small sample biases, which stem from short sample periods of our panel data and which are likely to arise in the separate estimates for firms with and without FTC.

V Empirical Results

V(i) Utilisation of FTC

The results of the pooled sample probit and the random effects probit model together with their marginal effects are presented in table 3. An increase in demand leads to a higher probability that a firm uses FTC. The impact of demand changes is larger in the random effects model (mfx=0.366) than in the pooled sample model (mfx=0.264). In both estimates the impact is highly significant at the one percent level. The share of female employees is significantly positive and the share of qualified employees is significantly negative correlated with the probability of using FTC. Moreover, firms with works councils are more likely to use FTC. The other control variables are not significant.

- *insert table 3 about here*

The correlation between the share of FTC in total employment and changes in demand $(\log Y_{it}^{e} - \log Y_{i,t-1})$ is estimated with three approaches: a pooled sample tobit model, a random effects tobit model, and a general linear model for a restricted sample (see equations (9), (10) and (11) in section IV(i)). The results are presented in table 4. In all three models an increase in sales is significantly correlated with a higher share of FTC. In the pooled sample tobit model the coefficient of the demand change is 0.084 and significant at the one percent level, whereas with consideration of firm specific effects in the random effects tobit model the coefficient is 0.043 and only significant at the five percent level. In the restricted general linear model the coefficient of the demand change is significant at the one percent level and somewhat larger (1.170) than in the previous

tobit estimates. However, the marginal effect on the share of FTC has approximately the same size (0.086) like in the tobit model.

- *insert table 4 about here*

The share of part-time employment is not significant and has different signs in the tobit and the general linear model. The share of female employees is significantly positive in the tobit but not in the other models. Across all regressions the share of qualified employees is significant and negatively correlated with the use of FTC. This finding might indicate that internal labour markets are quiet important. For example, hiring and training costs are often larger for qualified employees so that short-term employment relationships are less attractive. Furthermore, qualified employees cannot be replaced easily by temporary employees with lower levels of human capital. From a labour supply perspective qualified employees have better overall employment chances (e.g., lower unemployment), which should lead to lower acceptance of FTC among qualified employees.

The variables for industrial relations are differently correlated in the tobit model for the total sample and the general linear model for the restricted sample, because of the ambivalent impact on the probability and the intensity of FTC. Industry as well as firm level collective agreements are not significant in the tobit model, but significant and positive in the general linear model. While works councils are positively correlated with the share of FTC in the tobit model, they are negatively correlated in the restricted general linear model. This occurs since the tobit model also measures the probability of FTC. However, this evidence corresponds with dual labour market theory, which predicts that the core workforce, represented by works councils, gains more job security due to a peripheral workforce. On the other hand, works councils try to protect the core

employees against substitution. Therefore, works councils increase the probability of using a peripheral workforce but decrease the intensity of its use (Boockmann/Hagen, 2003; Pfeifer, 2005).

The results give strong support to hypothesis 1 that firms make use of FTC as a peripheral workforce to adjust the level of employment in the case of demand fluctuations, because the composition of the workforce changes and depends on output variations. If this story is valid, the adjustment speed of temporary employment should be faster than the adjustment of non-temporary employment, which is considered as a proxy for the core workforce. The next section with the results for dynamic labour demand will address this issue.

V(ii) Dynamic Labour Demand

The estimation results for the dynamic labour demand equation (14) are presented in table 5 and 6. The estimated coefficients have the expected signs, but are not always significant. Sargan's test of over-identifying restrictions is not rejected in any estimate, which indicates a correct model specification. In addition, there is significant first order autocorrelation but no significant second order autocorrelation, which is a crucial assumption for the Arellano-Bond/ Blundell-Bond method. However, in the estimates for temporary employment in the total sample, second order autocorrelation exists, which could be due to the small number of firms using FTC. Hence, the results for FTC in all firms should be interpreted very cautiously. The interpretation of the results focuses on the first two variables and their coefficients, i.e., the lagged dependent employment variable $(1-\lambda)\log(L_{i,t-1})$ and the expected sales variable $\alpha\lambda\log(Y_{it}^{e})$.

From this, the speed of employment adjustment and the output elasticity are obtained and presented in table 7. These results are the basis for the following discussion.

- *insert table 5 about here*
- *insert table 6 about here*
- *insert table 7 about here*

First, the results for all establishments are discussed (see tables 5 and 7). A comparison of the adjustment coefficients and median adjustment time shows that total employment (E) is adjusted faster than non-temporary employment (N). While half of total employment is adjusted in 14.322 quarters, it takes non-temporary employment 16.011 quarters. This finding is supported by differences in output elasticity because total employment reacts more elastic to output changes than non-temporary employment. The short-term output elasticity for total employment is 0.107 and for non-temporary employment only 0.095. The faster adjustment of total employment can be ascribed to FTC because temporary employment is contained in total, but of course not in non-temporary employment. A look at the results for temporary employment (F) supports this finding. The adjustment coefficient is much larger than for total and non-temporary employment and the median adjustment time is only 2.487 quarters. Moreover, the short-term output elasticity is with 0.225 more than twice as large as for total and non-temporary employment. However, it should be kept in mind that the results for temporary employment in the total sample should be interpreted carefully because of second order autocorrelation.

The above differences between total employment and non-temporary employment in the total sample are not very large.[6] This could be due to the fact that many firms do not make use of FTC and that the share of FTC is not very high. Thus, in addition to estimates for all establishments, separate estimates for establishments with and without FTC are performed (see tables 6 and 7). In establishments with FTC half of total employment is adjusted in 10.007 quarters, while the median adjustment time for non-temporary employment is 17.184 quarters. Furthermore, the short-term output elasticity for total employment (0.174) is twice as large as for non-temporary employment (0.086). This difference can be ascribed to temporary employment, which has a median adjustment time of only 2.480 quarters and an output elasticity of 0.394 in the short-run. Hence, employment adjustment in firms with FTC is largely accomplished with the variation of temporary employment.

For establishments without FTC only one dynamic labour demand function is estimated, because total employment equals non-temporary employment ($E_{it}=N_{it}$; $F_{it}=0$). Compared with the results for total employment in firms with FTC, the median adjustment time (13.081) is larger and the output elasticity (0.095) is smaller in establishments without FTC. This finding can be interpreted in two ways: Firstly, firms which use FTC can adjust their total employment faster to the profit-maximizing level. Secondly, employees' job security is higher in establishments which do not use FTC. The latter interpretation, however, is misleading because firms with FTC have an

[6] In fact, the coefficient from one regression lies in the 95% confidence interval of the other, which indicates that the differences between total and non-temporary employment are not significant. However, in several performed estimates with different specification and for different subsamples the adjustment coefficient and output elasticity of total employment was always larger than for non-temporary employment. Moreover, the coefficients for FTC are significantly different from the other estimates.

internal dual labour market, in which the temporary employees are more exposed to demand fluctuations than non-temporary employees. Hence, to analyse the job security of the core workforce the results of the dynamic labour demand equation for firms without FTC have to be compared with non-temporary employment in firms with FTC, and not with total employment. This leads to a contrary interpretation because non-temporary employees in firms with FTC have higher job security than employees in firms without FTC. Overall, both hypotheses get support in the empirical analysis: Firms use FTC to adjust their employment faster and the core workforce is less exposed to employment variations.

A comparison with other empirical studies of dynamic labour demand reveals some differences. Nevertheless, the presented results are located in the wide range of these studies. If we look at studies for total employment in West Germany (Kölling, 1998), the median adjustment time varies between 3.6 and 57.6 quarters and the long-term output elasticity varies between 0.45 and 0.80. Following a review of studies by Hamermesh (1993) across countries and industries, the median adjustment varies between 1.6 and 26.3 quarters, the short-term output elasticity between 0.01 and 0.47, and the long-term output elasticity between 0.03 and 0.98.

Worth mentioning are the results of two studies which also deal with employment adjustment and temporary employment. Bentolila and Saint-Paul (1992) show that total employment in Spain is adjusted faster than non-temporary employment because the latter has a lower adjustment coefficient and a lower output elasticity. Hagen (2003) finds for Germany that employment adjustment is faster for FTC. However, his results cast some doubt because they are below the range of common results (Bentolila/Saint-Paul, 1992; Hamermesh, 1993; Kölling, 1998).

VI Conclusion

Earlier studies on the effects of temporary employment on job security and job stability of the core workforce used a rather direct approach (Cappelli/Neumark, 2004; Pfeifer, 2005). The number of layoffs or other indicators of job insecurity and job instability were regressed on the existence or the intensity of FTC. However, because of a complementary use of different instruments of external numerical flexibility, FTC and layoffs etc. were always positively correlated so that the core-periphery hypothesis could not be supported. Hence, the indirect approaches applied in this paper are more illuminating.

The econometric evidence strongly supports the ideas of dual labour market theory and the core-periphery hypothesis. The share of FTC in total employment varies with demand, the adjustment speed of FTC is faster, and the reaction to demand is more elastic than for non-temporary employment. Thus, both hypotheses derived from theory are supported: (1) Firms use employees with FTC as a peripheral workforce to adjust the level of employment in case of demand fluctuations; (2) due to the utilisation of FTC the core workforce is less exposed to employment adjustment.

References

Abraham, K.G. (1988), 'Flexible staffing arrangements and employers' short-term adjustment strategies', in Hart, R.A. (ed), *Employment, unemployment and labor utilization,* London, 288-311.

Arellano, M. and Bond, S.R. (1991), 'Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations', *Review of Economic Studies,* 58, 277-297.

Atkinson, J. (1987), 'Flexibility or fragmentation? The United Kingdom labour market in the eighties', *Labour and Society,* 12(1), 87-105.

Bentolila, S. and Saint-Paul, G. (1992), 'The macroeconomic impact of flexible labor contracts, with an application to Spain', *European Economic Review,* 36(5), 1013-1053.

Berger, S. and Piore, M.J. (1980), *Dualism and discontinuity in industrial societies*, Cambridge.

Blundell, R. and Bond, S.R. (1998), 'Initial conditions and moment restrictions in dynamic panel data models', *Journal of Econometrics,* 87, 115-143.

Bond, S.R. (2002), 'Dynamic panel data models: a guide to micro data methods and practice', *Portuguese Economic Journal,* 1(2), 141-162.

Boockmann, B. and Hagen, T. (2003), 'Works councils and fixed-term employment: evidence from West German establishments', *Schmollers Jahrbuch,* 123(3), 359-381.

Booth, A.L., Francesconi, M. and Frank, J. (2002a), 'Labour as a buffer: Do temporary workers suffer?', *IZA Discussion Paper,* No. 673.

Booth, A.L., Francesconi, M. and Frank, J. (2002b), 'Temporary jobs: stepping stones or dead ends?', *Economic Journal,* 112(6), F189-F213.

Brodsky, M.M. (1994), 'Labor market flexibility: a changing international perspective', *Monthly Labor Review,* 117(11), 53-60.

Bulow, J.I. and Summers, L.H. (1986), 'A theory of dual labor markets with application to industrial policy, and Keynesian Unemployment', *Journal of Labor Economics,* 4(3), 376-414.

Cappelli, P. and Neumark, D. (2004), 'External churning and internal flexibility: evidence on the

functional flexibility and core-periphery hypotheses', *Industrial Relations,* 43(1), 148-182.

Carlsson, B. (1989), 'Flexibility and the theory of the firm', *International Journal of Industrial Organization,* 7(2), 179-203.

Dougherty, C. (2002), *Introduction to econometrics,* 2nd edition, Oxford.

Engellandt, A. and Riphahn, R.T. (2005), 'Temporary contracts and employee effort', *Labour Economics,* 12(3), 281-299.

Gerlach, K., Hübler, O. and Meyer, W. (2003), 'The Hannover Firm Panel (HFP)', *Schmollers Jahrbuch,* 123(3), 463-470.

Gerlach, K. and Jirjahn, U. (1999), 'Längerfristige Beschäftigung, personalpolitische Konzepte und Beschäftigungsentwicklung', *Jahrbuch Ökonomie und Gesellschaft,* 15, 180-215.

Greene, W.H. (2003), *Econometric analysis*, 5th edition, New York et al.

Hagen, T. (2003), 'Does fixed-term contract employment raise firms' adjustment speed? Evidence from an establishment panel for West Germany', *Jahrbücher für Nationalökonomie und Statistik,* 223(4), 403-421.

Hamermesh, D.S. (1993), *Labor demand*, Princeton.

Hamermesh, D.S. (2000), 'The craft of labormetrics', *Industrial and Labor Relations Review*, 53(3), 363-380.

Heckman, J.J. (1979), 'Sample selection bias as a specification error', *Econometrica,* 47(1), 153-161.

Houseman, S.N. (2001), 'Why employers use flexible staffing arrangements: evidence from an establishment survey', *Industrial and Labor Relations Review,* 55(1), 149-170.

Hunter, L., McGregor, A., MacInnes, J. and Sproull, A. (1993), 'The 'flexible firm': strategy and segmentation', *British Journal of Industrial Relations,* 31(3), 383-407.

IAB (2005), 'Zahlenfiebel', *BeitrAB* 101.

Kalleberg, A.L. (2001), 'Organizing flexibility: the flexible firm in a new century', *British Journal of Industrial Relations,* 39(4), 479-504.

Kennedy, P. (1998), *A guide to econometrics*, 4th edition, Oxford, Malden.

Kölling, A. (1998), 'Dynamische Arbeitsnachfrage und asymmetrisches Anpassungsverhalten in der Bundesrepublik Deutschland – Eine Untersuchung mit Daten aus dem IAB-Betriebspanel', *MittAB,* 31(4), 637-647.

Nickell, S.J. (1986), 'Dynamic models of labour demand', *Handbook of Labor Economics,* 1, 473-522.

OECD (2002), *Employment Outlook 2002*, OECD, Paris.

OECD (2004), *Employment Outlook 2004*, OECD, Paris.

Papke, L.E. and Wooldridge, J.M. (1996), 'Econometric methods for fractional response variables with an application to 401(K) plan participation rates', *Journal of Applied Econometrics,* 11, 619-632.

Pfeifer, C. (2005), 'Flexibility, dual labour markets, and temporary employment – Empirical evidence from German establishment data', *Management Revue,* 16(3), 404-422.

Puhani, P.A. (2000), 'The Heckman correction for sample selection and its critique', *Journal of Economic Surveys,* 14(1), 53-68.

Rebitzer, J.B. and Taylor, L.J. (1991), 'A model of dual labor markets when product demand is uncertain', *Quarterly Journal of Economics,* 106(4), 1373-1383.

Saint-Paul, G. (1991), 'Dynamic labor demand with dual labor markets', *Economics Letters,* 36(2), 219-222.

Saint-Paul, G. (1996), *Dual labor markets: a macroeconomic perspective,* London.

Shapiro, C. and Stiglitz, J.E. (1984), 'Equilibrium unemployment as a worker discipline device', *American Economic Review,* 74(3), 433-444.

Verbeek, M. (2004), *A guide to modern econometrics*, 2nd edition, Chichester et al.

Data Appendix

The Hannover Firm Panel was one of the early data sets with firm level information of the labour demand side in Germany (Gerlach/Hübler/Meyer, 2003). On a yearly basis, various quantitative and qualitative characteristics relating to employment, innovations, international, and environmental activities of a fixed number of manufacturing establishments were collected. The first wave started in 1994 with 1,025 establishments. Because of panel mortality the number of participating firms decreased to 709 in the fourth wave (1997). Since funding expired in 1997, there seemed to be no opportunity to extend the panel to additional years. However, at the end of the nineties the IAB Establishment Panel project group suggested an integration of the Hannover Firm Panel into the IAB Panel as a regional subsample. Thus, a second project phase could be started in the year 2000.

In the first phase, only manufacturing establishments in Lower Saxony were chosen which had at least five employees at the time of the first survey. The observation unit is the establishment ("Betrieb"), which is a local unit in which major activities of an enterprise ("Unternehmen") are conducted. Since most decisions of interest are made there and the potential interview partners are involved in these decisions, this unit is appropriate to the scope of most research topics.

In the second phase, the planned sample size is again 1,000 and the sample is stratified according to establishment size and industry. Since the sample is enlarged to all sectors and to all establishments with one and more employees, it covers the entire economy of Lower Saxony. To prevent a large reduction in observations due to panel mortality an unbalanced panel design is adopted. The structure of the questionnaires did not change

in the second phase. Core questions are posed annually and other topics biannually or triennially. In addition, every year an issue of specific actual interest is addressed.

Table A.1: Summary statistics for used sample in probit and tobit estimates for FTC utilisation

	All firms		Firms with FTC		Firms without FTC	
	Mean	Std.dev.	Mean	Std.dev.	Mean	Std.dev.
FTC (dummy)	0.407	0.491	1.000	0.000	0.000	0.000
share of FTC employees	0.037	0.091	0.092	0.125	0.000	0.000
development of sales ($\log Y^{e}_{it}$-$\log Y_{i,t-1}$)	-0.068	1.033	0.002	0.157	-0.115	1.334
share of part-time employees	0.160	0.217	0.134	0.192	0.177	0.232
share of female employees	0.328	0.272	0.321	0.254	0.333	0.283
share of qualified employees	0.645	0.285	0.660	0.276	0.635	0.291
works council (dummy)	0.443	0.497	0.715	0.452	0.257	0.437
industry level collective agreement (dummy)	0.577	0.494	0.643	0.479	0.532	0.499
firm-level collective agreement (dummy)	0.087	0.282	0.122	0.328	0.062	0.242
establishment size 1-4 (dummy)	0.138	0.345	0.016	0.125	0.223	0.416
establishment size 5-19 (dummy)	0.233	0.423	0.071	0.256	0.345	0.475
establishment size 20-99 (dummy)	0.339	0.473	0.349	0.477	0.332	0.471
establishment size 100-499 (dummy)	0.235	0.424	0.448	0.497	0.089	0.285
establishment size ≥500 (dummy)	0.054	0.227	0.116	0.321	0.012	0.108
number of observations	3273		1332		1941	

Source: Hannover Firm Panel, waves 2000-2004

Table A.2: Summary statistics for used sample in GMM estimates for dynamic labour demand

	All firms		Firms with FTC		Firms without FTC	
	Mean	Std.dev.	Mean	Std.dev.	Mean	Std.dev.
FTC (dummy)	0.391	0.488	1.000	0.000	0.000	0.000
total employment in t (log)	3.614	1.558	4.749	1.229	2.886	1.288
total employment in t-1 (log)	3.641	1.548	4.754	1.236	2.927	1.284
non-temporary employment in t (log)	3.578	1.543	4.655	1.263	2.886	1.288
non-temporary employment in t-1 (log)	3.605	1.535	4.683	1.247	2.913	1.284
temporary employment in t (log)	0.788	1.225	2.015	1.170	0.000	0.000
temporary employment in t-1 (log)	0.801	1.221	1.722	1.388	0.000	0.000
expected sales in t (log)	15.182	2.098	16.560	1.620	14.298	1.882
sum of salaries per capita (log)	7.502	0.675	7.701	0.381	7.375	0.783
sum of investments per capita (log)	6.154	3.611	7.240	2.844	5.456	3.870
share of part-time employees	0.160	0.213	0.132	0.186	0.178	0.227
share of female employees	0.319	0.267	0.315	0.248	0.322	0.279
share of qualified employees	0.657	0.278	0.671	0.269	0.648	0.283
works council (dummy)	0.438	0.496	0.720	0.449	0.258	0.437
industry level collective agreement (dummy)	0.591	0.492	0.646	0.479	0.555	0.497
firm-level collective agreement (dummy)	0.079	0.269	0.122	0.328	0.051	0.219
number of observations	2008		785		1223	

Source: Hannover Firm Panel, waves 2000-2004

Tables included in text

Table 1: German employees in fixed-term contracts 2004

	Share of FTC in total (%)	Share of group in FTC (%)
total	7.7	100.0
West Germany	7.1	75.5
East Germany	10.7	24.5
men	7.5	51.1
women	8.0	48.9
blue-collar	7.9	38.4
white-collar	7.7	61.6
German	7.4	86.6
Non-German	11.5	13.4
age <25	23.4	23.9
age 25-44	7.9	55.7
age 45-59	4.1	17.8
age >59	4.8	2.6

Source: IAB (2005: table 3.7.1-3.7.3); German Microcensus, wave 2004

Table 2: Fixed-term contracts in Lower Saxony 2000-2004; weighted frequencies in percent

	2000	2001	2002	2003	2004
share of firms with utilisation [a)]	10	9	12	15	18
share of employees [a)] (basis: all firms)	5	4	5	5	6
share of employees [a)] (basis: firms with FTC)	10	9	11	9	11
share of firms with hiring [b)]	-	30	25	27	28
thereof share of firms with FTC hiring [b)]	-	27	28	38	41
share of FTC hirings in all hirings [b)] (basis: all firms)	-	37	39	38	46
share of FTC hirings in all hirings [b)] (basis: firms with FTC hiring)	-	72	72	75	75

a) June 30 of each year
b) First half of each year

Source: Hannover Firm Panel, waves 2000-2004

Table 3: Probability of FTC; pooled sample probit and random effects probit

	probit (pooled sample)	marginal effects	probit (random effects)	marginal effects
development of sales ($logY^{e}_{it}$-$logY_{i,t-1}$)	0.712*** (0.174)	0.264*** (0.063)	1.060*** (0.245)	0.366*** (0.082)
share of part-time employees	-0.118 (0.168)	-0.044 (0.062)	0.005 (0.265)	0.002 (0.091)
share of female employees	0.380*** (0.140)	0.141*** (0.052)	0.413* (0.235)	0.143* (0.081)
share of qualified employees	-0.400*** (0.102)	-0.148*** (0.038)	-0.377** (0.166)	-0.130** (0.057)
works council (dummy)	0.410*** (0.069)	0.153*** (0.026)	0.607*** (0.123)	0.211*** (0.042)
industry level collective agreement (dummy)	0.019 (0.065)	0.007 (0.024)	0.016 (0.105)	0.005 (0.036)
firm-level collective agreement (dummy)	-0.074 (0.103)	-0.027 (0.037)	-0.084 (0.162)	-0.029 (0.054)
constant	-1.472*** (0.219)		-2.141*** (0.391)	
year (dummies)	YES	YES	YES	YES
industry (dummies)	YES	YES	YES	YES
establishment size (dummies)	YES	YES	YES	YES
Likelihood ratio test	1365.520***			
Wald test			444.420***	
Pseudo R^2 (McFadden)	0.309		0.204	
number of observations	3273	3273	3273	3273
number of establishments	1243	1243	1243	1243

Note: Standard errors in brackets. Significant at the * 10%-, ** 5%-, and *** 1%-level.

Source: Hannover Firm Panel, waves 2000-2004

Table 4: Share of FTC; pooled sample tobit, random effects tobit, and GLM

	tobit (pooled sample)	tobit (random effects)	glm (restricted sample)	glm (marginal effects)
development of sales ($logY^{e}_{it}$-$logY_{i,t-1}$)	0.084***	0.043**	1.170***	0.086***
	(0.024)	(0.019)	(0.410)	(0.030)
share of part-time employees	0.012	0.020	-0.194	-0.014
	(0.022)	(0.024)	(0.373)	(0.027)
share of female employees	0.040**	0.030	-0.075	-0.006
	(0.019)	(0.022)	(0.286)	(0.021)
share of qualified employees	-0.075***	-0.060***	-0.806***	-0.059***
	(0.013)	(0.015)	(0.181)	(0.013)
works council (dummy)	0.024**	0.028**	-0.518***	-0.043***
	(0.010)	(0.012)	(0.115)	(0.011)
industry level collective agreement (dummy)	0.005	-0.001	0.235*	0.017*
	(0.009)	(0.010)	(0.126)	(0.009)
firm-level collective agreement (dummy)	0.006	0.009	0.369**	0.030**
	(0.013)	(0.014)	(0.160)	(0.015)
constant	-0.174***	-0.168***	-0.351	
	(0.029)	(0.039)	(0.405)	
year (dummies)	YES	YES	YES	YES
industry (dummies)	YES	YES	YES	YES
establishment size (dummies)	YES	YES	YES	YES
Likelihood ratio test	808.470***			
Wald test		342.660***	238.440***	
Pseudo R^2 (McFadden)	0.633		0.079	
number of observations	3273	3273	1024	1024
number of left-censored observations	1941	1941	0	0
number of uncensored observations	1328	1328	1024	1024
number of establishments	1243	1243	495	495

Note: Standard errors in brackets. Robust standard errors for GLM. Significant at the * 10%-, ** 5%-, and *** 1%-level.

Source: Hannover Firm Panel, waves 2000-2004

Table 5: Dynamic labour demand; GMM estimates for all establishments

	E	N	F
number of employees in t-1 (log) [1-λ]	0.824***	0.841***	0.328***
	(0.050)	(0.047)	(0.070)
expected sales in t (log) [α·λ]	0.107***	0.095***	0.225***
	(0.031)	(0.029)	(0.063)
sum of salaries per capita (log)	-0.014	0.013	-0.180
	(0.040)	(0.039)	(0.146)
sum of investments per capita (log)	0.001	0.001	0.011
	(0.004)	(0.004)	(0.014)
share of part-time employees	0.276***	0.189*	0.395
	(0.102)	(0.098)	(0.386)
share of female employees	0.003	-0.093	0.160
	(0.120)	(0.116)	(0.448)
share of qualified employees	-0.020	0.017	-0.200
	(0.073)	(0.070)	(0.274)
works council (dummy)	0.153*	0.095	0.343
	(0.089)	(0.086)	(0.311)
industry level collective agreement (dummy)	0.053	0.086	-0.224
	(0.073)	(0.071)	(0.273)
firm-level collective agreement (dummy)	0.146	0.121	0.427
	(0.118)	(0.114)	(0.456)
constant	-0.825	-1.034**	-0.413
	(0.526)	(0.501)	(1.699)
year (dummies)	YES	YES	YES
industry (dummies)	YES	YES	YES
Wald test (χ^2)	6170.700***	6476.770***	132.800***
Sargan test (p-value)	0.989	0.995	0.999
1st order autocorrelation (p-value)	0.000	0.000	0.000
2nd order autocorrelation (p-value)	0.727	0.435	0.011
number of observations	2008	2008	2008
number of establishments	860	860	860

Note: (E) total employment, (N) non-temporary employment, (F) temporary employment in FTC. Standard errors in brackets. Significant at the * 10%-, ** 5%-, and *** 1%-level.

Source: Hannover Firm Panel, waves 2000-2004

Table 6: Dynamic labour demand; GMM estimates for establishments with and without FTC

	Firms with FTC in t			Without FTC
	E	N	F	E=N
number of employees in t-1 (log) [1-λ]	0.758***	0.851***	0.327***	0.818***
	(0.071)	(0.073)	(0.073)	(0.051)
expected sales in t (log) [α·λ]	0.174***	0.086	0.394***	0.095***
	(0.058)	(0.057)	(0.116)	(0.035)
sum of salaries per capita (log)	-0.183**	-0.015	-0.792**	0.018
	(0.088)	(0.086)	(0.398)	(0.042)
sum of investments per capita (log)	0.002	0.003	0.030	-0.002
	(0.006)	(0.006)	(0.024)	(0.005)
share of part-time employees	-0.075	-0.432**	1.545**	0.274**
	(0.185)	(0.178)	(0.701)	(0.117)
share of female employees	0.128	0.269*	-1.201*	-0.101
	(0.154)	(0.153)	(0.649)	(0.148)
share of qualified employees	-0.072	0.016	-0.424	0.038
	(0.102)	(0.099)	(0.415)	(0.098)
works council (dummy)	0.112	0.026	0.194	0.121
	(0.075)	(0.076)	(0.308)	(0.112)
industry level collective agreement (dummy)	0.055	0.164**	-0.429	0.120
	(0.076)	(0.077)	(0.339)	(0.078)
firm-level collective agreement (dummy)	0.067	0.165	-0.647	0.151
	(0.105)	(0.104)	(0.444)	(0.145)
constant	0.363	-0.341	-5.625	-0.377
	(1.540)	(1.502)	(6.415)	(0.721)
year (dummies)	YES	YES	YES	YES
industry (dummies)	YES	YES	YES	YES
Wald test (χ^2)	2977.780***	3249.710***	109.870***	2213.850***
Sargan test (p-value)	0.975	0.996	0.737	0.999
1st order autocorrelation (p-value)	0.000	0.000	0.000	0.000
2nd order autocorrelation (p-value)	0.595	0.798	0.203	0.309
number of observations	785	785	785	1223
number of establishments	412	412	412	604

Note: (E) total employment, (N) non-temporary employment, (F) temporary employment in FTC. Standard errors in brackets. Significant at the * 10%-, ** 5%-, and *** 1%-level.

Source: Hannover Firm Panel, waves 2000-2004

Table 7: Speed of employment adjustment and output elasticity

all firms	E	N	F
adjustment coefficient [λ]	0.176	0.159	0.672
median adjustment time in quarters	14.322	16.011	2.487
short-term output elasticity [$\varepsilon_S=\alpha\cdot\lambda$]	0.107	0.095	0.225
firms with FTC	E	N	F
adjustment coefficient [λ]	0.242	0.149	0.673
median adjustment time in quarters	10.007	17.184	2.480
short-term output elasticity [$\varepsilon_S=\alpha\cdot\lambda$]	0.174	0.086	0.394
firms without FTC	E=N		
adjustment coefficient [λ]	0.182		
median adjustment time in quarters	13.801		
short-term output elasticity [$\varepsilon_S=\alpha\cdot\lambda$]	0.095		

Note: (E) total employment, (N) non-temporary employment, (F) temporary employment in FTC. Adjustment speed and output elasticities are calculated from the coefficients obtained by dynamic labour demand estimates in tables 6 and 7.

Source: Hannover Firm Panel, waves 2000-2004