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ABSTRACT

'Marginal Employment' and the Demand for Heterogenous Labour: Empirical Evidence from a Multi-Factor Labour Demand Model for Germany*

We develop a structural multi-factor labour demand model which distinguishes between eight labour categories including non-standard types of employment such as marginal employment. The model is estimated for both the number of workers and total working hours using a new panel data set. For unskilled and skilled workers in full-time employment, we find labour demand elasticities similar to previous estimates for the west German economy. Our new estimates of own-wage elasticities for marginal employment range between -.4 (number of male workers in west Germany) to -1 (working hours for women). We illustrate the implications of these estimates by simulating the likely labour demand effects of the recent increase of employers' social security contributions (SSC) on marginal employment in Germany.

JEL Classification: J21, J23, C51

Keywords: multi-factor labour demand for heterogenous labour, marginal employment

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1 Introduction

'Non-standard' employment, such as part-time work and 'marginal' employment, i.e. low-paying jobs with only a few working hours, has recently been expanding in several OECD countries, including Germany. There have been two opposing views on this development, and the expansion of marginal employment in particular. On the one hand; marginal employment has been seen as a means to improve labour market flexibility, to shore up financial incentives to take up low-paying work, and to reduce labour costs for firms, thereby increasing the demand for low-productivity workers. On the other hand; critics are sceptical about the potential of marginal employment to enhance job creation in developed economies and stress the danger of substitution of regular full-time jobs by often subsidised marginal employment.

Germany is a particularly interesting case for an analysis of the labour market impact of marginal employment: Firstly, while social security contributions weigh relatively heavy on low-productivity jobs, marginal employment is partly exempted from this burden in Germany. Secondly, marginal employment has substantially grown in Germany over the last couple of years, while overall employment stagnated in this period. Thirdly, in 2003 a reform of marginal employment policy - the so-called 'Mini Jobs' reform - was implemented with the aim of increasing work incentives in the low-wage sector of the economy. To curb the alleged substitution of full-time jobs by subsidised mini-jobs the employers contribution rate on these jobs was recently increased from 25% to 30%.

A large literature in labour economics attempts to estimate the parameters of demand functions for labour by skill type, traditionally distinguishing between skilled and unskilled workers (see, e.g., Hamermesh, 1993). However, this literature almost exclusively focuses on the demand for workers in full-time employment without further differentiating by type of employment relationship. To our knowledge, there are currently no empirical estimates of demand elasticities for workers and hours worked in marginal employment for Germany, or other countries, available.

The current paper aims to fill this gap. We empirically analyse the patterns of demand for marginal employment both in terms of the number of workers and total working hours, with respect to its own wage and in relation to other labour inputs. For this purpose, we develop a structural multi-factor labour demand model based on the Translog cost function, which differentiates between eight distinct labour categories: full-time (skilled and unskilled), conventional part-time, and marginal employment, where each of these categories is subdivided by gender. Furthermore, we estimate the labour demand model separately for east and west Germany because of the persistent labour market differentials which prevail in the two regions (see, e.g., Burda and Hunt, 2001). Our preferred specification thus consists of a system of share equations for 16 types of labour. To esti-

mate this model we construct a rich data base integrating micro data of the Employment Panel of the Federal Employment Agency for the years 1999-2003, data from the German Microcensus (Labour Force Survey) and the National Accounts.

The remainder of this paper proceeds as follows: In the next section, we provide some empirical and institutional background for the subsequent analysis, focusing on the evolution of marginal employment in the period since the late 1990s. Section 3 describes the derivation of the structural multi-factor labour demand model, the data, and the specification and estimation of the econometric model. Estimated own-price and cross-price elasticities for the various labour categories, both in terms of the number of workers and total working hours, are presented and discussed in section 4 and used in section 5 to assess the likely impact of the recent increase of employers' social security contributions on marginal employment in Germany. Section 6 summarises the main results of the paper and concludes.

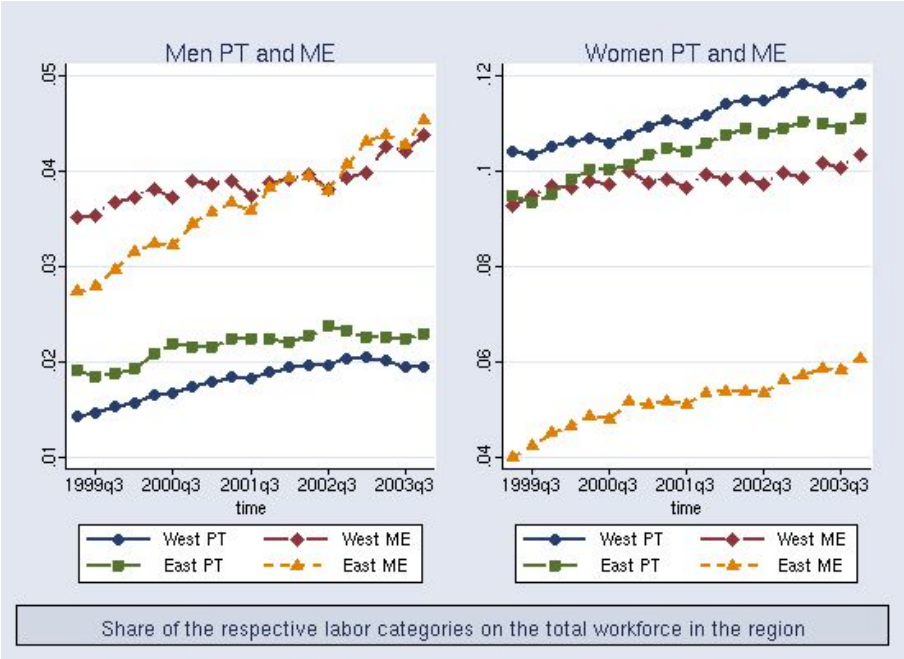
2 Empirical and Institutional Background

As mentioned above, marginal employment has increased substantially over the last couple of years. Figure (1) shows that the growth in the proportion of workers in marginal employment also outpaced the increase of the share of part-time workers in the workforce. The increase in marginal employment was more pronounced in west Germany than in the east, both for men and women. While the shares of women working part-time are quite similar in East and West, the shares of marginal employment differ greatly. Figure (2) shows that, while the shares of full-time workers, both unskilled and skilled, behave more steadily, they exhibit a continuous overall decline.[1] Particularly noticeable is that, the share of skilled men working full-time in the east has fallen from about 36% to 32%. Moreover, the shares of skilled women working full-time display pronounced differences between the east and the west. Of course, these developments overstate the relative importance of marginal and part-time employment because differences in working hours are not accounted for.

A more detailed analysis of the evolution of marginal employment reveals significant differences between industries. In Table (A1) in the Appendix we present the extrapolated numbers and the share of employees in marginal employment both at the beginning and at the end of the observation period. Across all industries, the proportion of workers in marginal employment increased from 11.6% to about 14% between 1999 and 2003, which amounts to about 700,000 workers. Most of this increase (about 650,000 of these jobs) occurred in industries which we identify as "marginal-employment intensive". An

[1] The difference remains if the different scaling in the graph is accounted for.

Figure 1: Shares of marginal and part-time employment

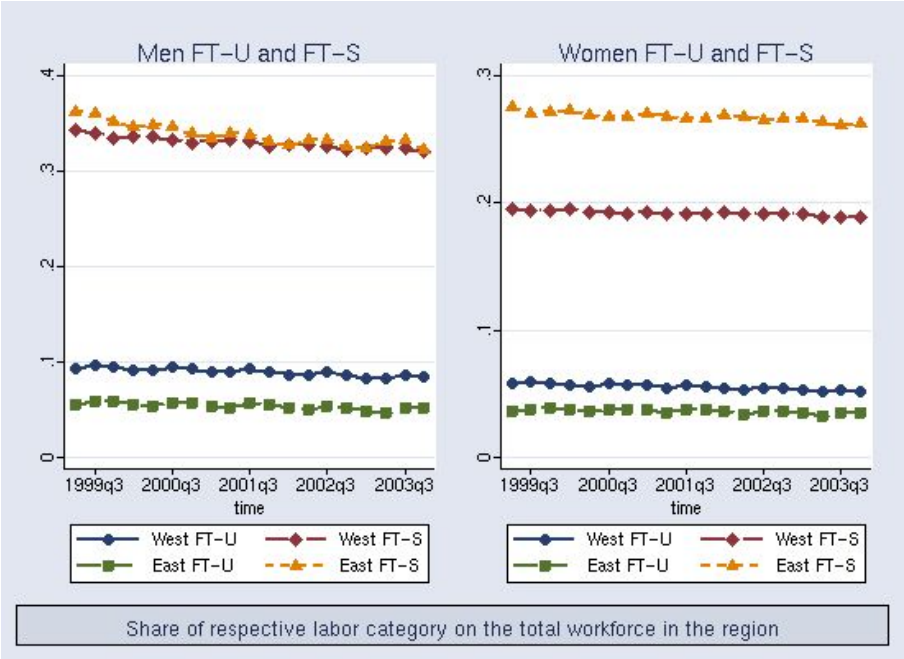


Source: EP-FEA, own calculations.

industry is classified to be marginal-employment intensive, if the overall share of marginal employment continuously exceeds 10% of all workers. The last column of Table (A1) indicates the respective industries concerned. We will use this classification of marginal-employment intensive industries in the empirical analysis below.

As mentioned in the introduction, there are special regulations concerning social security contributions on marginal jobs - better known as 'mini-jobs' in the German policy debate. Before 1999, jobs with an upper earnings threshold (325 Euro per month) and a maximum of 15 weekly working hours were exempt from social security contributions (SSC) on the side of the employee. The employer had to pay a 20 percent tax on gross wages. Since the 1999 reform the employer had to pay 22% SSC. Thus, little changed under this reform for the employers of individuals working in mini-jobs. The 'Mini-jobs Reform' of 2003 was intended to improve incentives to take up work in the low-wage sector. The restriction on maximum hours was abolished, and the upper threshold of exempted earnings was raised to 400 Euro. Moreover, earnings between 401 and 800 Euro are now subject to a modified SSC scheme (for more details, see Steiner and Wrohlich, 2005). Before June 2006, employers had to pay SSC at a flat rate of 25% of the employee's wage for earnings up to 400 Euro; since July 1, 2006, this rate is 30.1%. For part-time jobs with earnings between 401 and 800 Euro, employers pay the normal SSC rate of currently about 20 percent.

Figure 2: Shares of full-time unskilled and full-time skilled



Source: EP-FEA, own calculations.

3 Econometric Model

3.1 Cost functions, share equations and wage elasticities

The econometric model underlying the estimation of the demand for heterogeneous labour is based on the assumption of cost-minimising firms and a flexible specification of the cost function. Given the specification of the technology of an industry, conditional labour demand functions can be derived by using standard results on the duality between production and costs (see, e.g., Varian 1992, chapter 4). If the production function satisfies certain regularity conditions and if firms minimize variable costs, there exists a restricted cost function from which we can derive demand equations for different labour categories, conditional on the level of output.

Traditional demand models for heterogeneous labour distinguish between skilled and unskilled workers, and sometimes differentiate these two groups further by gender (see, e.g., Hamermesh, 1993, for previous work on Germany, see Buslei and Steiner, 1999). Given the focus of this study, we also need to disaggregate labour demand by type of employment, in particular full-time, part-time and marginal employment. These employment categories are explicitly identified in our data base. For data-related reasons, discussed in section 3.2, we do not distinguish part-time und marginal employment by skill level. In total, we distinguish between eight different labour categories and specify separate cost

functions for east and west Germany. Thus, it is assumed that, at least in the short-run, the demand for a category of labour in one region is unaffected by changes in the price of labour categories in the other region. The organisation of production in one region (and the corresponding cost structure), thus, depends only on the prices of the respective labour categories in that region.

The cost functions are assumed to have the following general form:

$$\begin{aligned} C^{West}(p_i, y, Q_h) \qquad & (i = 1, \ldots, 8) \\ & (h = 1, \ldots, 2), \\ C^{East}(p_i, y, Q_h) \qquad & (i = 9, \ldots, 16) \\ & (h = 2, \ldots, 3), \end{aligned} \tag{1}$$

where p_i indicates the wages for different labour categories, y measures output and Q_h represents quasi-fixed input factors. To be more precise, the specification will include the following variables:

$Q_h =$ quasi-fixed input factors (h=1, number of highly qualified employees in the West working full-time holding a college or university degree; h=2, net capital assets (in year 2000 prices); h=3, number of highly qualified employees in the East)

$y =$ gross output (in year 2000 prices)

$p_i =$ real wage measured by median wage of the group of employees i (p_1 to p_8 refer to eight labour categories in the West, p_9 to p_{16} to those in the East)

- $i = 1; 9$ men working full-time with neither secondary-school education nor vocational training (Men FT-U)
- $i = 2; 10$ men working full-time with secondary-school education or vocational training (Men FT-S)
- $i = 3; 11$ men working (conventional) part-time (Men PT)
- $i = 4; 12$ men working in marginal employment (Men ME)
- $i = 5; 13$ women working full-time with neither secondary-school education nor vocational training (Women FT-U)
- $i = 6; 14$ women working full-time with secondary-school education or vocational training (Women FT-S)
- $i = 7; 15$ women working (conventional) part-time (Women PT)
- $i = 8; 16$ women working in marginal employment (Women ME)

Capital and high-skilled labour categories are modelled as quasi-fixed input factors in the production, denoted as Q_h (see, e.g., Morrison, 1988). While the other labour inputs

are considered to adjust instantaneously to their long-run equilibrium, those quasi-fixed inputs are believed to adjust only partially within one period, due to adjustment costs. Also for the high-skilled labour category, only the number of workers with high education in the corresponding region are considered in the cost function for west and east Germany, respectively. Moreover, capital and output measures in the above specification always refer to the aggregate of east and west Germany, since the National Accounts do not provide regionally disaggregated data on capital and output.

Our preferred specification of the cost function is the Transcendental Logarithmic - or Translog - cost function (see, e.g., Christiansen, Jorgenson, and Lau, 1973). This functional form represents an approximation of an arbitrary twice differentiable cost function without imposing a-priori restrictions on the partial elasticities of substitution between the input factors. For west Germany the Translog cost function takes the following form:

$$\begin{aligned} \ln C^{West} &= \beta_0 + \sum_{i=1}^{8} \beta_i \ln p_i + \tfrac{1}{2} \sum_{i=1}^{8} \sum_{j=1}^{8} \gamma_{ij} \ln p_i \ln p_j \\ &\quad + \delta_y \ln y + \tfrac{1}{2} \delta_{yy} (\ln y)^2 + \sum_{i=1}^{8} \gamma_{iy} \ln p_i \ln y \\ &\quad + \sum_{h=1}^{2} \vartheta_i \ln Q_h + \sum_{i=1}^{8} \sum_{h=1}^{2} \eta_{ih} \ln p_i \ln Q_h \end{aligned} \tag{2}$$

Note that this specification already indicates the symmetry of $\gamma_{ij} = \gamma_{ji}$ which follows from the equality of the cross-derivatives of the price-terms. In addition, the following restrictions on the Translog cost functions could be imposed: homotheticity $\gamma_{iy} = 0,\ \forall\ i = 1, \ldots, 8$, homogeneity in output $\gamma_{iy} = 0\ \forall\ i = 1, \ldots, 8$ and $\delta_{yy} = 0$ (so homogeneity of a constant degree in output would depend on $\frac{1}{\delta_y}$), homogeneity of degree one would be imposed if $\gamma_{iy} = 0\ \forall\ i = 1, \ldots, 8$, $\delta_{yy} = 0$ and $\delta_y = 1$. The cost function will not be explicitly restricted in any of these ways. However, as the cost function itself is not included in the empirical model, no conclusions about the parameters of homotheticity or homogeneity can be drawn.

The cost function is assumed to fulfill the normal regularity conditions. Thus, the cost function is required to be monotonically increasing and concave in input prices. Furthermore, homogeneity of degree 1 in prices (output given) is desirable. For the latter condition to hold a number of restrictions on the parameters have to be fulfilled:

$$\begin{aligned} &\sum_{i=1}^{8} \beta_i = 1 \\ &\sum_{i=1}^{8} \gamma_{ij} = 0 \quad \forall j = 1, 2, \ldots, 8; y \\ &\sum_{i=1}^{8} \eta_{ih} = 0 \quad \forall h = 1, 2 \end{aligned} \tag{3}$$

For east Germany, the corresponding cost function is:

$$\begin{aligned}\ln C^{East} &= \beta_0 + \sum_{i=9}^{16}\beta_i \ln p_i + \tfrac{1}{2}\sum_{i=9}^{16}\sum_{j=9}^{16}\gamma_{ij}\ln p_i \ln p_j \\ &\quad +\delta_y \ln y + \tfrac{1}{2}\delta_{yy}(\ln y)^2 + \sum_{i=9}^{16}\gamma_{iy}\ln p_i \ln y \\ &\quad + \sum_{h=2}^{3}\vartheta_i \ln Q_h + \sum_{i=9}^{16}\sum_{h=2}^{3}\eta_{ih}\ln p_i \ln Q_h\end{aligned} \tag{4}$$

By logarithmically differentiating the Translog cost function, the cost share equations which will later be used for estimation are obtained. Note that the quasi-fixed inputs are not considered in the calculation of the total costs in the representation of the cost-share equations. For the Translog specification presented in equations (2) and (4) the cost share equations take the following form:

$$\frac{\partial \ln C^{West}}{\partial \ln p_i} = S_i = \beta_i + \sum_{j=1}^{8}\gamma_{ij}\ln p_j + \gamma_{iy}\ln y + \sum_{h=1}^{2}\eta_{ih}\ln Q_h \tag{5}$$

$$\forall i = 1, 2, \ldots, 8$$

$$\frac{\partial \ln C^{East}}{\partial \ln p_i} = S_i = \beta_i + \sum_{j=9}^{16}\gamma_{ij}\ln p_j + \gamma_{iy}\ln y + \sum_{h=2}^{3}\eta_{ih}\ln Q_h$$

$$\forall i = 9, 10, \ldots, 16$$

These share equations have the common feature that, within each industry-year combination, the shares of the labour categories in, respectively, east and west Germany add up to one. That is, in each of the share equation systems, only 7 equations are linearly independent. Dropping an arbitrary equation, the remaining free parameters can be estimated. We chose to drop the first equation for both regions.[2] Imposing the within equation zero homogeneity restriction, $\sum_{j=1}^{8}\gamma_{ij} = 0$, the share equations for each labour input category in the two regions can be transformed:

$$S_i = \beta_i + \sum_{j=2}^{8}\gamma_{ij}\ln\frac{p_j}{p_1} + \gamma_{iy}\ln y + \sum_{h=1}^{2}\eta_{ih}\ln Q_h + \sum_{l=1}^{3}\varsigma_{il}Z_{il} + u_i \tag{6}$$

$$\forall i = 2, 3, \ldots, 8$$

[2]The choice of which equation is dropped has no effect on the results obtained when the SURE estimator is iterated until convergence, as we will do in this analysis. By using this procedure, the estimates of the iterated SURE model equal maximum likelihood estimates which ensures that differences due to the choice of specific equations are eliminated, Berndt (1990:474).

$$S_i = \beta_i + \sum_{j=10}^{16} \gamma_{ij} \ln \frac{p_i}{p_9} + \gamma_{iy} \ln y + \sum_{h=2}^{3} \eta_{ih} \ln Q_h + \sum_{l=1}^{3} \varsigma_{il} Z_{il} + u_i$$

$$\forall i = 10, 11, \ldots, 16$$

From these equations, the parameters of the omitted first equation can be derived as follows, where the first expression relies on symmetry:

$$\gamma_{1i} = \gamma_{i1} = -\sum_{j=2}^{8} \gamma_{ij} \quad \forall\, i = 2, \ldots, 8$$

$$\gamma_{11} = -\sum_{i=2}^{8} \gamma_{1i} \ , \quad \beta_1 = 1 - \sum_{i=2}^{8} \beta_i$$

From these cost share equations all the parameters needed to calculate own-price and cross-price elasticities for the various labour inputs can be derived. Given the Allen partial elasticities of substitution, the factor-price elasticities can be derived by applying $\epsilon_{ij} = S_j \cdot \sigma_{ij}$. The Allen elasticity of substitution between input i and input j can be shown to be:

$$\sigma_{ij} = \frac{\gamma_{ij} + S_i\, S_j}{S_i\, S_j} \qquad \forall\, i \neq j \tag{7}$$

The Allen elasticity of substitution for the case $i = j$ is given by:

$$\sigma_{ii} = \frac{\gamma_{ii} + S_i^2 - S_j}{S_i\, S_i} \tag{8}$$

Consequently, the following expressions can be derived for the cross-price and own-price elasticities respectively:

$$\epsilon_{ij} = \frac{\gamma_{ij} + S_i\, S_j}{S_i} \qquad \forall\, i \neq j \tag{9}$$

$$\epsilon_{ii} = \frac{\gamma_{ii} + S_i^2 - S_i}{S_i} \tag{10}$$

These factor-price elasticities are constant-output demand elasticities and are to be interpreted for given levels of the quasi-fixed inputs and all other input prices.

In the empirical estimation of the share equations we distinguish between two specifications: In one specification, the share of labour input of a specific type in each industry in every year has been calculated using the information on wages, the weighted number of workers and the *average hours-worked* over all years. This specification will be referred to as *"heads"*-specification. Alternatively, the share was computed using the same wages and

number of workers, but the hours worked in every single year. We refer to this alternative as *"hours"*-specification. Both specifications are of interest as they relate to different margins of employment adjustment. While the first specification measures changes in the demand for workers, the latter identifies changes in total working hours. The distinction between those two effects is essential, especially for marginal and part-time employment.

There is a tradition in empirical labour economics to explicitly analyse the substitution between heads and hours in firms' production decisions (see, e.g., Calmfors and Hoel, 1988). Substitution between these two margins of labour demand depends, among other things, on relative marginal costs of adjusting workers and hours, which in turn, are determined by the overtime premium, fixed costs of hiring and laying-off workers, and training costs. However, this analysis typically assumes homogeneous labour and becomes exceedingly complex in case of heterogeneous labour. Furthermore, allowing for substitution between hours and workers in a general way would not only require measuring the cost of an additional working hour, including overtime-pay etc., but would also greatly increase the number of wages to be included in the cost function well beyond what can be estimated with some precision from the available data. Given the complexity, the short-term nature of our analysis, as well as the mentioned data restrictions, we will in the following stick to our simpler empirical approach to distinguish between adjustment in labour demand across these two margins.

3.2 Data

To estimate the labour demand model derived in the previous section, we construct a data set of a large number of *'industry / labour category / year'* cells from the newly available scientific use file, the Employment Panel of the Federal Employment Agency (EP-FEA), see Koch and Meinken (2004). The EP-FEA contains detailed quarterly information on employment and wages for a 2% random sub-sample of all employees subject to social insurance for the period 1998-2003, amounting to about 600,000 observations per quarter. Starting in 1999 it also includes data on marginal employment. Since every person is only represented in the data by their main labour activity, a secondary-job is not included in the definition of marginal employment.[3] Using these data, we can explicitly distinguish between (conventional) part-time employment and marginal employment. As our study focuses on the latter, the analysis is limited to the five consecutive years 1999-2003. Although marginal employment is subject to registration since the beginning of 1999, it was coded in the EP-FEA only after the first quarter of that year. To keep the year 1999 in

[3]Beginning with the second quarter of 2003, the Federal Employment Agency provides supplements containing also information on marginal employment as a secondary-job. After work on this paper was completed the data research centre of the FEA made available an update of this data base extending to the year 2005.

the analysis, we have imputed marginal employment for the first quarter of 1999 assuming that the ratio of the first quarter to the consecutive three quarters remains the same in 1999 and in 2000. We have supplemented the EP-FEA by data for working hours from the German Microcensus (Mikrozensus) as well as information on value-added, output prices, and the capital stock in each industry from the National Accounts in order to construct a data source specifically suited for the estimation of the multi-factor labour demand model specified above.

Following Steiner and Mohr (2000:189), we differentiate 25 industries according to the classification in Table (A2) in the Appendix. Then, using information on the level of qualification, gender, an individual's employment status (full-time, part-time, marginal employed) as well as the region of the firm, each observation is attributed to one of the sixteen labour categories in the model and one of the 25 industries. Moreover, several variables are computed at the level of each *'industry / labour category / year'* cell. These variables include the number of observed workers, the median nominal wage, the mean age of the workers, the median firm size category, the share of non-German workers, and the number of full-time employed high-skilled workers who are treated as quasi-fixed in the estimation.[4] The information of the four quarters per year given in the data set are pooled for each year to obtain yearly averages.

Due to the time required for data processing at the Federal Employment Agency, part of the observations feature outdated wage information referring to the previous year or even further back in time. Because deleting these observations could bias estimation results, we have estimated the probability of observing outdated wage information and re-weighted the sample accordingly. Another data problem concerns a relatively large number of missing values for the education variables, which we require for the construction of the skill groups. To overcome this problem, we have pursued two strategies. In a first step, we have used the panel structure of the data to impute missing information on an individual's level of education by using another observation (another quarter) for the same person.[5] In a second step, for remaining missing values, we have imputed education categories on the basis of a multinominal logit model.

Since the EP-FEA does not contain information on working hours, we have imputed them from the Microcensus (MZ).[6] The same 'industry / labour category / year' cells are constructed as above with the mean of working hours calculated for each of the cells and then merged to the corresponding cell in the EP-FEA. Since employment in the MZ

[4]For high-skilled workers even the median wage is censored at the upper social security threshold value, which is another reason for treating this group as quasi-fixed.

[5]To avoid wrongful imputations, the respective information were only used if the person was not currently employed in vocational training, and not younger than 31 years.

[6]The MZ is the main yearly official household survey for Germany covering 1% of all households. The scientific use file of the MZ available to us contains a 70% random sub-sample.

refers to one week of the year, normally the last week of April, temporary employment is systematically under-represented by this sampling scheme. As far as marginal employment is temporary, this sampling scheme does lead to a proper representation of marginal employment in terms of its contribution to the average labour input within a cell. The number of observations within some of these cells turned out to be quite small in the MZ, in particular for men working part-time and in marginal employment in east Germany. For the calculation of average working hours we have then aggregated several industries assumed to be similar.

Data on real output (value added), real capital (net assets) and product price indices were obtained for each industry-year combination from the German national accounts provided by the Federal Statistical Office.[7] Product price indices are used to deflate wages in order to express them in year 2000 prices. The number of workers and the total working hours are weighted to represent total employment in order to match the information about capital stock and output. Control variables include the mean age, the median firm size category and the share of non-German workers in each cell.

3.3 Model Specification and Estimation

The system of cost share equations given by equation (5) is estimated on pooled data on 25 industries, observed during the period of five years, resulting in 25x5=125 observations for each of the sixteen equations, eight for west and eight for east Germany. To control for common business cycle effects across industries, a full set of year dummies is included in each equation. In addition to the time-varying control variables mentioned in the previous section, we also include a full set of industry dummies in each equation to control for structural time-invariant differences between industries. To avoid spurious correlation due to potentially integrated time series, we estimate the system of share equations in first differences.[8] For west Germany, the system of estimating equations is:

$$(\Delta S_i)_{s,t} = \sum_{j=2}^{8} \gamma_{ij} \Delta \left(\ln \frac{p_i}{p_1} \right)_{s,t} + \gamma_{iy} \Delta \ln y_{s,t} + \sum_{h=1}^{2} \eta_{ih} \Delta (\ln Q_h)_{s,t} + \sum_{l=1}^{3} \varsigma_{il} \Delta (Z_{il})_{s,t} + \Delta \theta_{it} + \Delta u_{i,s,t} \tag{11}$$

Due to the differencing, the observations from the first year are dropped, thus, 100 ob-

[7] The German national accounts do no longer disaggregate these data by region. Furthermore, data on capital stock or output are not available for the sectors private households and helping activities related to banking and insurance, which therefore had to be excluded from the analysis.

[8] Given that our data only cover five years, there is no way to test whether the variables in the model are integrated or not. Estimating the model in first differences, therefore, seems the more appropriate specification than estimating it in levels.

servations per equation remain. At the same time the industry dummies drop out as well. The system for east Germany can be written accordingly. Instead of equation-by-equation estimation, higher efficiency can be gained by estimation of seemingly unrelated regressions (SURE) which accounts for the cross-equation correlations induced by common shocks affecting observations within the same industry-year cell. Using a Lagrange Multiplier (LM) test, we have first tested for correlation of residuals across equations in the west and in the east separately. Since the null hypothesis of no correlation could clearly be rejected[9], in a second step we applied the same procedure to test whether the two sets of equations are to be estimated jointly for the two regions. As there are 7 equations in each system, the test statistic depends on 49 correlation coefficients. The test statistic obtained is LM=130.38 with a critical value of $\chi^2_{0.95}(49) = 66.34$. We thus conclude that estimated equations in the two regions are correlated through error terms and that the 14 equations are best estimated jointly.

Imposing the theoretical cross-equation symmetry conditions, $\gamma_{ij} = \gamma_{ji}$, the number of parameters in the whole system can be reduced by 42. The validity of these restrictions can be tested using a likelihood ratio (LR) test. We obtained a value of the test statistic of 60.1, with the critical value given by $\chi^2_{0.95}(42) = 58.1$. The restricted model is therefore marginally rejected at the 5% level of significance. We nevertheless impose these restrictions in the estimation, as the null is only marginally rejected and symmetry is a desirable feature in the link between theory and empirical work.

While the assumption of exogenous wages may be innocuous when estimating the demand for labour of a single firm or a small industry, it is certainly more questionable for the industry aggregation used in this study. Following one common approach to account for the potential endogeneity of wages, we have used two-period lagged variables in levels as instruments for the first differences of wages. IV (3SLS) estimates turned out to be not much different from the SURE estimates. In the following, we therefore only report SURE estimation results derived under the assumption of exogenous wages. Due to the large number of estimated parameters and the inherent non-linearity of the share equations, parameter estimates are not very informative and therefore not reported here; instead, we sumarise estimated elasticities below.[10]

[9]The LM-test statistic is asymptotically χ^2-distributed under H_0. The critical value at the 0.05 level of significance is $\chi^2_{0.95}(21) = 32.67$ and the obtained test statistics are $LM_{West} = 123.83$ and $LM_{East} = 100.39$.

[10]Detailed results for the SURE and 3SLS estimations are available from the authors upon request.

4 Empirical Wage Elasticities

Own-wage and cross-wages elasticities for each labour input category are computed for each industry and year according to equations (9) and (10) in section 3.1. We derive average elasticities for both the demand for workers and total working hours, evaluated at the actual shares. Whereas the former captures only the adjustment in the number of workers, the latter also considers adjustments in total working hours induced by a change in wages. Average elasticities for the whole economy reported in section 4.1 are obtained by first computing their mean over time within the industry and then aggregating these means over all industries using the number of workers in the respective labour category as weights. In section 4.2, we also report average elasticities for marginal-employment intensive industries. Bootstrapped standard errors of estimated own-wage elasticities are reported in Table (A3) in the Appendix.

4.1 Own-wage and cross-wage elasticities for the whole economy

4.1.1 Demand for workers

Table (1) summarises the elasticity estimates of our preferred specification of the labour demand model in terms of workers ('heads'), which will be referred to as the heads specification in the following. The bold figures on the diagonal give the own-wage elasticities for the eight groups in west and east Germany, respectively; the off-diagonal elements show estimated cross-wage elasticities. For example, the cross elasticity in the first column and second (fourth) row shows that in west Germany a wage increase for full-time employed unskilled men by 10% increases the demand for skilled male workers by .85% (and decreases the demand for marginally employed workers by .19%). Thus, unskilled and skilled west German workers in full-time employment seem to be gross complements to each other, whereas the former group and marginally employed west-German workers are gross substitutes. Being uncompensated cross-wage elasticities, they have the same sign but are not symmetric between any two labour categories.

Corresponding to most previous empirical labour demand studies (see, e.g., Hamermesh, 1993), we find that own-wage elasticities for unskilled workers tend to be higher, in absolute value, than for skilled workers in full-time employment, although there are marked regional and gender differences. For west Germany, own-wage demand elasticities for unskilled and skilled workers in full-time employment are estimated to be, respectively, -0.51 and -0.20 for men and -0.37 and -0.16 for women. Similar elasticities were also obtained in previous work for west Germany covering an earlier period (see, e.g., Buslei and Steiner, 1999).[11] For east Germany, estimated own-price elasticities show the same general pat-

[11] Analysing west Germany over the period 1984 to 1995, Buslei and Steiner (1999) obtain the following

Table 1: Own- and cross-wage elasticities for the whole economy (heads)

		West							
		FT-U	FT-S	PT	ME	FT-U	FT-S	PT	ME
	FT-U	**-0.51**	0.419	0.003	-0.001	0.050	0.034	-0.048	0.055
Men	FT-S	0.085	**-0.20**	0.001	0.004	0.032	0.062	0.002	0.017
West	PT	0.023	-0.001	**-0.07**	-0.110	0.031	-0.268	0.204	0.186
	ME	-0.019	0.316	-0.246	**-0.13**	-0.093	0.187	0.148	-0.162
	FT-U	0.108	0.367	0.012	-0.013	**-0.37**	-0.055	-0.081	0.030
Women	FT-S	0.020	0.136	-0.014	0.005	-0.009	**-0.16**	0.071	-0.051
West	PT	-0.044	0.007	0.033	0.011	-0.044	0.196	**-0.26**	0.099
	ME	0.255	0.495	0.144	-0.058	0.056	-0.805	0.483	**-0.57**
		East							
		FT-U	FT-S	PT	ME	FT-U	FT-S	PT	ME
	FT-U	**-0.30**	-0.086	-0.076	0.028	-0.036	0.487	-0.008	-0.008
Men	FT-S	-0.002	**-0.11**	-0.008	0.005	0.006	0.091	0.015	0.005
East	PT	-0.135	-0.235	**-0.29**	0.006	0.114	0.235	0.302	-0.002
	ME	0.172	0.476	0.019	**-0.30**	0.152	-0.778	0.332	-0.073
	FT-U	-0.060	0.099	0.116	0.041	**-0.25**	-0.273	0.237	0.091
Women	FT-S	0.044	0.128	0.012	-0.011	-0.014	**-0.23**	0.076	-0.010
East	PT	-0.010	0.063	0.055	0.018	0.040	0.245	**-0.44**	0.032
	ME	-0.038	0.323	-0.008	-0.053	0.248	-0.582	0.437	**-0.33**

Source: EP-FEA, own estimates as described in the text.

tern but are somewhat smaller (in absolute value) than those for the west, except for skilled women in full-time employment for whom the elasticity is virtually the same as for unskilled women working full-time. One explanation for this atypical result might be that the relatively high level of formal skills acquired by women in the former GDR have depreciated in the post-unification labour market.

Estimated own-wage elasticities for part-time employment range from -.07 for men in west Germany to -.44 for women in east Germany. This elasticity is substantially larger in size than the one obtained for women in west Germany, of whom a relatively large share work part-time. A striking result is that the own-price elasticity for men working part-time is virtually identical to the one estimated for unskilled men working full-time in east Germany, whereas these two elasticities differ substantially in west Germany. It should be noted, though, that the share of men working part-time is rather small in both

estimates: -.61 for unskilled men, -.05 for skilled men, -.19 for unskilled women, and -.18 for skilled women. There are also a few other empirical studies on the demand for heterogeneous labour for Germany which, however, neither differentiate between heads and total working hours nor and between gender and region, see, e.g., Fitzenberger (1999), Falk and Koebel (2001, 2002), Addison et al. (2005).

regions.

Estimated own-wage elasticities for workers in marginal employment also differ by region and gender. Whereas they are virtually identical for men (-.30) and women (-.33) in east Germany, they differ significantly between men (-.13) and women (-.57) in the west. Whereas differences between these elasticities and those estimated for unskilled workers in full-time employment are substantial for both men and women in the west German labour market, the respective elasticities differ little in the east. For women, estimated elasticities for part-time work and marginal employment also differ significantly between the two regions. Whereas the elasticitiy for marginal employment is much larger, in absolute value, than the one for part-time work for west German women, this relation is reversed in the east.

To further investigate these differences in the demand for heterogeneous labour between the two regions, we have also tested whether regional differences in estimated elasticities are due to differences in the distribution of the labour categories in the employed labour force (and hence in the cost shares), or whether the technology parameters differ. Using likelihood ratio tests, in a first step only the parameters determining the own-wage elasticities were set equal in the two regions, while in a second test all parameters were restricted to be equal in both regions. Both tests reject the hypothesis that the technology parameters are homogenous for the two regions.

Whereas own-wage elasticities are of substantial size for most types of labour, estimated cross-wage elasticities are generally rather small. The only notable exception concerns changes in the wage of the skilled workers in full-time employment on the demand for other labour categories. As displayed in column 2 of Table (1), for example, skilled men in the west are substitutes to all other categories in this region (except for men in part-time employment, for whom the estimated cross-elasticity is virtually zero). In particular, an increase in the wage of skilled male workers would increase the demand for men (women) in marginal employment by about 3% (5%) in west Germany. Cross-wage elasticities between skilled labour and other labour inputs of similar size are also obtained for east Germany. In contrast, the impact of changes in the wages of marginal employment categories on other labour inputs is negligible in both west and east Germany. The only exception here is the category of women working in marginal employment in the west, for whom we find a relatively strong substitution effect on female part-time work with an elasticity of almost 0.2.

4.1.2 Demand for total working hours

Table (2) summarises estimated wage elasticities from our preferred specification of the labour demand model, which we will refer to as the 'hours' specification in the following.

Table 2: Own- and cross-wage elasticities for the whole economy (hours)

		West							
		FT-U	FT-S	PT	ME	FT-U	FT-S	PT	ME
	FT-U	**-.46**	0.399	-0.013	-0.007	0.043	0.075	-0,041	0.005
Men	FT-S	0.082	**-.32**	0.005	0.007	0.052	0.121	0.043	0.011
West	PT	-0.076	0.189	**-.31**	-0.038	0.004*	-0.304	0.318	0.212
	ME	-0.106	0.632	-0.100	**-.86**	-0.084	0.378	0.241	-0.103
	FT-U	0.092	0.644	0.003*	-0.010	**-.49**	-0.180	-0.121	0.059
Women	FT-S	0.033	0.262	-0.016	0.010	-0.029	**-.32**	0.066	-0.007
West	PT	-0.037	0.270	0.051	0.017	-0.062	0.183	**-.54**	0.118
	ME	0.019*	0.298	0.169	-0.033	0.124	-0.173	0.592	**-1.00**
		East							
		FT-U	FT-S	PT	ME	FT-U	FT-S	PT	ME
	FT-U	**-.33**	-0.052	-0.062	0.020	-0.033	0.448	0.053	-0.047
Men	FT-S	0.000*	**-.19**	0.002	0.007	0.010	0.135	0.022	0.015
East	PT	-0.112	0.028*	**-.62**	-0.007	0.076	0.374	0.272	-0.010
	ME	0.128	0.593	-0.028	**-.83**	0.272	-0.307	0.164	0.004*
	FT-U	-0.055	0.187	0.079	0.071	**-.27**	-0.391	0.319	0.060
Women	FT-S	0.041	0.191	0.019	-0.004	-0.021	**-.34**	0.113	0.003
East	PT	0.009	0.096	0.049	0.009	0.055	0.381	**-.60**	0.000*
	ME	-0.220	1.011	-0.031	0.003*	0.165	0.058*	-0.015*	**-.97**

Source: EP-FEA, own estimates as described in the text.

Own-wage elasticities in the hours specification range from -.19 for skilled male workers in east Germany to -1 for women in marginal employment. Except for men working part-time in west Germany, estimated own-wage elasticities in the hours specification exceed those for the heads specification, summarised in the previous section, in absolute value. A priori, this result seems plausible, as one would expect employers to respond to wage reductions by both hiring new workers and expanding working hours. As the heads specification captures only the adjustment in the number of workers, the resulting outcome should be smaller than the outcome in the hours specification, which considers both. However, these two effects need not go into the same direction due to substitution between workers and hours.

In particular, we find that own-wage elasticities for unskilled men in full-time employment do not differ significantly between the hours and the heads specification. For example, a 10% reduction in the wage of unskilled men working full-time in the west increases the demand for total working hours of this labour category by 4.6%, compared to

an increase of 5.1% in the heads specification.[12] For east-German unskilled men working full-time the hours elasticity is virtually the same as in the heads specification(-.33 and -0.30, respectively). Similar relations between elasticities in the two specifications are also obtained for unskilled women working full-time in east Germany as well as for full-time male and female workers in the two regions. This indicates that for these groups labour demand is almost completely adjusted by varying the number of workers employed.

Estimated own-wage hours elasticities for most of the part-time and marginal employment categories exceed those for the full-time categories in absolute value.[13] Hours elasticities for the part-time groups range between those of the full-time and the marginal employment categories: the part-time hours own-wage elasticity is about -.6 in east Germany, both for men and women, and -.3 for men and -.5 for women in the west. For the marginal employment groups, estimated own-wage hours elasticities range between -.83 and -1. For example, in east Germany the demand for working hours of women in marginal employment would increase by almost 10% following a reduction in this group's wage by 10%. A similar elasticity estimate is also obtained for west German women working in marginal employment.

Comparing these elasticity estimates to those obtained for the heads specification indicates that for women in west (east) Germany about half (two thirds) of the change in labour demand to a change in the respective wage rate is by adjustment in hours worked rather than in the demand for workers. In contrast, the adjustment of the demand for male workers in marginal employment is primarily in terms of working hours. This effect is especially strong in west Germany where the hours own-wage elasticity for this group is -.86, compared to a relatively small heads elasticity of -.13. For east Germany, the corresponding elasticities are -0.83 and -.30, respectively, which also indicates that the demand of male workers in marginal employment is adjusted to a large extent by varying working hours.

As for the heads specification, most estimated cross-wage elasticities are relatively small for the hours specification as well. Again, the major exception relates to skilled workers in full-time employment. As column 2 of Table (2) shows, an increase in the

[12]Buslei and Steiner (1999) report the following estimates in their hours specification for west Germany: -.67 for unskilled men, -.24 for skilled men, -.47 for unskilled women, and -.48 for skilled women.

[13]Men working part-time make up a very small share of all workers in some industries. In a first step, we therefore combined part-time and marginal employment for men into one category both in east and west Germany. Hence, in this model there are 7 labour categories in each of the two regions. Estimated elasticities for the combined part-time/marginal employment categories turned out to be very small in both regions. One possible explanation for this outcome is that, even though both part-time and marginal employment have increased substantially over time, the increase in marginal employment has been more pronounced. Thus, the composition within the joint group has been changed profoundly. As wages tend to be lower for the marginally employed, the changes in composition create an artificial decline in the median wage, which leads to a downward-bias of the estimated own-price elasticity of this aggregate labour category.

wage of skilled men in full-time employment by 10% would increase the demand for working hours of unskilled men by about 4% and of unskilled women by 6% in west Germany. A change in the wage of skilled men in full-time employment would also have relatively strong effects on the demand for hours of men (women) working in marginal employment in west (east) Germany. As before, the impact of changes in the wage of marginal employment categories on other labour inputs is negligible both in west and in east Germany, except for women working in marginal employment in west Germany who are gross substitutes for men and women working part-time.

4.2 Wage elasticities in marginal-employment intensive industries

Since wage elasticities in industries with a high share of workers in marginal employment may differ significantly from those for the whole economy, in Table (3) we report average elasticities for marginal-employment intensive industries. Whereas estimated elasticities in the hours specification are very similar between these two aggregates, there are some noticeable differences in the heads specification. In the following, we therefore report average elasticities in marginal-employment intensive industries for the heads specification only. Since cross-wage elasticities are also very small for this subgroup of industries, and do not change much compared to those obtained for the whole economy, we do not report estimation results for them here.

The most significant impact of this different aggregation of industries is on the own-wage elasticity of the demand for workers in marginal employment. For men (women) in west Germany, this elasticity increases from -.13 (-.57) for the whole economy to -.44 (-.74) for the marginal-employment intensive industries. In east Germany, this elasticity changes from -.30 to -.53 for men, and from -.33 to -.58 for women. These substantial differences in estimated elasticities between the two alternative aggregations of industries can be explained by the large fraction of positive own-wage elasticities for workers in marginal employment in industries not included in the group of marginal-employment intensive industries. This indicates that for industries with a small share of marginal employment, the pure number of workers is no longer a reliable measure for the quantity of work demanded, especially when one considers a strong variation in working hours. Thus, when analysing the demand for marginal employment one needs, first, to consider the hours dimension and, second, take into account that the aggregation over all industries may severely bias average wage elasticities.

Table 3: Whole economy vs. marginal employment intensive industries

		Hours		Heads	
		Whole economy	ME int.	Whole economy	ME int.
		1	2	3	4
	FT-U	-.46	-.38	-.51	-.44
Men	FT-S	-.32	-.38	-.20	-.24
West	PT	-.31	-.36	-.07	-.13
	ME	-.86	-.91	-.13	-.44
	FT-U	-.49	-.53	-.37	-.41
Women	FT-S	-.32	-.36	-.16	-.24
West	PT	-.54	-.61	-.26	-.39
	ME	-1.00	-.98	-.57	-.74
	FT-U	-.33	-.23	-.30	-.20
Men	FT-S	-.19	-.25	-.11	-.16
East	PT	-.62	-.63	-.29	-.31
	ME	-.83	-.88	-.30	-.53
	FT-U	-.27	-.34	-.25	-.32
Women	FT-S	-.34	-.36	-.23	-.26
East	PT	-.60	-.63	-.44	-.51
	ME	-.97	-.98	-.33	-.58

Source: EP-FEA, own estimates as described in the text.

5 Labour Demand Effects of a Higher Wage Tax on Marginal Employment

In this section we use the wage elasticities derived in the previous section to simulate the likely labour demand effects of the recent increase of employers' social security contributions (SSC) rate on marginal employment, which is a wage tax paid by employers. As described in section 2, in July 2006 the employers' SSC rate on marginal employment was increased from 25% to about 30%, which would increase the costs of marginal employment to the firm by 4% given the market wage for this group remained fixed. For workers in marginal employment, the assumption of a fixed market wage may actually hold, given that firms are prevented to pass on the tax increase to this group of workers by reducing their wages by collective bargaining agreements (Knoppik and Beissinger, 2003) or the implicit minimum wage given by the relatively high level of means-tested social transfers prevailing in Germany (see, e.g., Steiner and Wrohlich, 2005).

Given that a change in the wage for marginally employed workers has only very small effects on the demand for other labour types (see section 4.2, with one exception

briefly discussed below), we use only own-wage elasticitities for marginally employed workers to simulate labour demand effects. Empirical elasticities and the employment structure in 2003 used for these simulations are summarised at the bottom of Table (4). For the reasons discussed in the previous section, we use the own-price elasticities for the marginal-employment intensive industries instead of those for the whole economy.

Table 4: Labour demand effects of the recent increase of employers' SSC by 5 precentage points

	West Germany		**East Germany**		
	Men	**Women**	**Men**	**Women**	**Total**
Number of workers (in thousands)	-18.6	-75.1	-5.4	-7.9	-107.0
Total working hours (per year) (in millions)	-23.0	-57.9	-5.7	-8.2	-94.7
in 2003 equivalent workers (in thousands)	-36.3	-101.4	-8.4	-13.1	-159.4
Own wage elasticities					
Workers	-0.44	-0.74	-0.53	-0.58	
Total working hours	-0.86	-1.00	-0.83	-0.97	
Employment structure in 2003					
Number of workers (in thousands)	1055.4	2537.2	253.5	340.5	
Average weekly working hours	12.2	11.0	13.0	11.9	
Total working hours (in millions)	666.6	1448.5	171.6	210.1	

Source: EP-FEA, elasticity estimates from Table (3)

According to our simulations summarised in Table (4), the increase of the employers' SSC rate by 5 percentage points will reduce the demand for workers in marginal employment by about 107,000 individuals. The major share of this reduction is due to a reduced demand of more than 75,000 female workers in west Germany. In east Germany, demand for workers in marginal employment would fall very little for both men and women. Note, that this results from the relatively small number of people working in marginal employment in east Germany rather than from differences in own-wage elasticities.

The increase of the employers' SSC rate by 5 percentage points is estimated to reduce total working hours by about 95 million per year, or by almost 160,000 in 2003 equivalent workers in marginal employment. As Table (4) shows, the biggest share of this reduction again falls on women in west Germany, whereas there would be little reduction in the demand for workers in marginal employment in the east. Note that these calculations are based on the assumption of constant weekly working hours at the 2003 level, although these are known to change as well. Comparing the change in the number of workers demanded and the change in working hours under the assumption of a constant average number of hours per worker in marginal employment approximates the size of the hours effect in terms of equivalent workers in that category. Thus, the hypothetical decrease in the demand for workers in marginal employment, at given average working hours

would be almost 160,000 equivalent workers in 2003; compared to a simulated decrease of about 107,000 workers, this implies a reduction of working hours in marginal employment equivalent to the work performed by about 53,000 marginally employed workers.

Regarding the effects of the wage subsidy on other labour categories, the only non-negligible ones are those induced by the group of west German women in marginal employment on people working part-time. Using the respective elasticities from Tables (2) and (3) and the distribution of employment in 2003, we estimate that a total of about 14,000 part-time jobs would be gained, and total working hours would adjust such that about 4,000 additional equivalent part-time jobs would be gained.

6 Summary and Conclusions

We have estimated a structural multi-factor labour demand model and derived own-wage and cross-wage elasticities for eight distinct labour input categories: full-time (skilled and unskilled), conventional part-time, and marginal employment, where each of these categories is subdivided by gender. We have derived a system of sixteen share equations (eight for, respectively, east and west Germany) which we have estimated jointly imposing restrictions derived from economic theory. In the empirical estimation of the share equations we distinguish between the demand for workers ("heads") and total working hours, respectively. Both specifications are of interest as they relate to different margins of employment adjustment, which has been shown to be essential for marginal employment. To estimate these labour demand models, we have constructed a rich data base which integrates micro data of the Employment Panel of the Federal Employment Agency for the years 1999-2003, data from the German Microcensus (Labour Force Survey) and the National Accounts.

For unskilled and skilled workers we find labour demand elasticities similar to previous estimates for the west German economy. Our new estimates of own-wage elasticities for marginal employment range between those estimated for skilled and unskilled workers in full-time employed. More specifically they lie between -.4 for male workers in west Germany and -1 for working hours for women. Comparing elasticity estimates for the heads specification to those obtained for the hours specification indicates that for women in west (east) Germany about half (two thirds) of the change in labour demand to a change in the respective wage rate is by adjustment in hours worked rather than in the number of additional demand for workers. In contrast, the adjustment of the demand for male workers in marginal employment is primarily in terms of working hours. We have also shown that average own-wage elasticities in the heads specification may be afflicted by aggregation bias if calculated as simple weighted averages across all industries, including

those with very small shares of workers in marginal employment. In contrast to own-wage elasticities, estimated cross-wage elasticities in both the heads and hours specification are generally rather small, the only notable exception being between skilled workers in full-time employment and most of the other labour categories.

Finally, using elasticity estimates obtained for marginal-employment intensive industries, we have simulated the likely impact of the recent increase of employers' social security contributions on marginal employment in Germany. Our simulation results suggest that the increase of this wage tax by 5 percentage points will reduce the demand for workers in marginal employment by about 107,000 persons, or about 160,000 equivalent workers accounting for adjustments in total working hours, with the largest proportion of this reduction falling on the demand for female workers in west Germany. Taking potential substitution effects into account, we estimate that a total of about 14,000 part-time jobs would be created, and total working hours would adjust, such that about 4,000 additional equivalent part-time jobs would be gained. Given the validity of the assumptions underlying these simulations, we would therefore conclude that the recent increase of the wage tax on marginal employment has had a modest negative impact on the overall demand for labour in Germany.

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Appendix

Table A1: Level and share of marginally employed workers by industry

		1999-II		2003-IV		ME int.
		Level (in thousands)	**Share**	**Level** (in thousands)	**Share**	
	Total	3587	0.1159	4301	0.1396	
	ME intensive industries	2956	0.1685	3609	0.1967	
Industry						
1	Agriculture	67	0.114	218	0.212	x
2	Chemical industry	39	0.039	35	0.039	
3	Metal	74	0.050	88	0.065	
4	Machines	40	0.021	46	0.024	
5	Business machines	50	0.046	54	0.051	
6	Food industry	150	0.132	159	0.154	x
7	Wood, paper	48	0.074	48	0.088	
8	Construction	142	0.057	156	0.089	
9	Trade (cars,...)	95	0.126	108	0.141	x
10	Wholesale	186	0.118	204	0.136	x
11	Retail industry	580	0.215	652	0.246	x
12	Transport	182	0.109	254	0.149	x
13	Bank, insurance	31	0.031	23	0.024	
14	Publishing industry	99	0.205	107	0.243	x
15	Real estate industry	112	0.303	124	0.347	x
16	R&D	22	0.052	31	0.059	
17	Business services	579	0.217	692	0.234	x
18	Hotel, restaurant industry	307	0.296	361	0.347	x
19	Other services	92	0.255	113	0.303	x
20	Energy, water	13	0.027	17	0.039	
21	Health industry	338	0.104	418	0.119	x
22	Public administration	79	0.043	78	0.044	
23	Education	95	0.087	114	0.098	
24	Church, Lobby,.....	96	0.166	104	0.178	x
25	Culture, sport	73	0.195	97	0.244	x

Source: EP-FEA, own calculations.

Table A2: Aggregation of the industries

Number	Classification in the data	Aggregated industry
1	agriculture, forestry, hunting, fishing coal mining mining ores, stones, earth	agriculture, mining
2	chemical products, oil rubber, synthetics	chemical industry
3	glas, ceramics, stones and earth processing metal product, metal processing production of metal goods	metal industry
4	mechanical machinery car manufacturing other vehicles	machines
5	office machinery electrical machinery data processing machinery medical, technical, optical machinery	business machines
6	food, tobacco textiles clothing, leather	food & clothing
7	wood paper furniture, jewelry, music instruments	wood & paper
8	construction	construction
9	automobile trade, gas stations	trade (cars, gas)
10	wholesale	wholesale
11	retail industry	retail
12	land transportation, pipelines air, water transportation supporting labour in transportation data transfer	transportation
13	banking insurance	banking & insurance
14	publishing, printing	publishing, printing
15	real estate industry	real estate industry
16	data processing, databases R&D	R&D
17	renting maneuverable machinery services to businesses	business services
18	restaurant, hotels, accommodations	restaurants, hotels
19	other services	other services
20	energy, water supply, recycling sewage, waste disposal	energy, water
21	medicine, veterinary services	health care
22	public administration, public safety	administration
23	education	education
24	church, lobby, politics	church, lobby, politics
25	culture, sports, entertainment	culture, sport

Table A3: Elasticities and bootstrapped standard errors

		Hours-specification		Heads-specification			
		Whole economy		Whole economy		ME int.	
		ϵ	s.e.	ϵ	s.e.	ϵ	s.e.
		1	2	3	4	5	6
	FT-U	-.50	0.095	-.54	0.086	-.47	0.108
Men	FT-S	-.33	0.063	-.18	0.053	-.22	0.062
West	PT	-.33	0.114	-.10	0.130	-.16	0.129
	ME	-.85	0.083	-.11	0.147	-.42	0.109
	FT-U	-.50	0.186	-.39	0.190	-.44	0.183
Women	FT-S	-.33	0.109	-.13	0.126	-.22	0.102
West	PT	-.58	0.146	-.28	0.143	-.41	0.141
	ME	-.98	0.145	-.51	0.157	-.70	0.134
	FT-U	-.29	0.159	-.24	0.170	-.13	0.206
Men	FT-S	-.19	0.093	-.10	0.096	-.15	0.116
East	PT	-.63	0.124	-.30	0.138	-.32	0.132
	ME	-.80	0.091	-.27	0.110	-.51	0.095
	FT-U	-.31	0.096	-.27	0.094	-.34	0.093
Women	FT-S	-.35	0.121	-.23	0.144	-.26	0.130
East	PT	-.58	0.142	-.42	0.127	-.49	0.123
	ME	-.96	0.131	-.39	0.127	-.62	0.115

Bootstrapped standard errors, see, e.g., Efron and Tibshirani (1986), were calculated on the basis of 100 repetitions. Since own-wage elasticities ϵ were estimated using one-step SURE estimation to reduce computational burden of the bootstrapping procedure, they differ slightly from those presented in the main text which are derived on the basis of iterated SURE estimation. Since estimated elasticities for the whole economy and marginal-employment intensive industries differ only in the heads specification, we have not calculated standard errors of own-wage elasticities for total working hours in this subsector. Source: EP-FEA, own estimates as described in the text.