Wage Inequality, Reservation Wages and Labor Market Participation –

Testing the Implications of a Search-Theoretical Model with Regional Data

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Abstract

The paper analyzes the variation of gender-specific labor-market partici-
pation rates across regions. A search-theoretical model with inter-temporal
optimization behavior of agents suggests that a higher regional wage level
fosters participation, while higher unemployment discourages workers. We
extend the standard model by introducing two measures of dispersion, one
below and one above the median. It is shown that wage dispersion in the
lower tail of the distribution decreases the value of search and leads to lower
participation rates while the reverse is true for wage dispersion in the upper
tail. These implications of the model are tested using spatial econometrics.

Keywords:

Participation behavior in regional labor markets, search models, reservation wage,

wage inequality, median-preserving spread, spatial econometrics.

JEL-classification: J21, R23

1   Introduction

One of the key issues of the current economic debate mainly in continental Europe is the question to which extent wage inequality should increase in order to foster the functioning of the labor market and to mobilize potential employment. Often the debate concentrates on the unemployment problem, thereby neglecting the important international and interregional differences in participation. However, as stressed by Lindbeck (1996) among others, there are good reasons to take the employment-to-population ratio —i.e. the product of the participation and the employment rate— as a more reliable indicator of labor market performance than the unemployment rate. A closer inspection reveals that in the early seventies the employment-to-population ratio in Europe was higher than in the U.S whereas in recent years the U.S. indicator exceeds the corresponding measure for Europe by about 10 percentage points (Glyn and Sollogoub (2005)). It is obvious that this substantial gap that has been developed over the last three decades cannot be explained by differences in unemployment rates alone. More than half of the gap is due to lower participation rates.

The question arises whether differences in wage dispersion matter in this context. Although several studies have inspected the impact of higher wage dispersion on unemployment (see, for instance, OECD (1996)), it seems somewhat surprising that little is known about the theoretical and empirical relationship between the wage dispersion and labor market participation behavior. This gives us the motivation to examine the topic in more detail.

In the present paper we aim at developing a search-theoretical model to analyze the decision between active and passive labor market behavior. The search-theoretical framework in the tradition of McCall (1970), Pissarides (1974), Mortensen (1977), Mortensen and Pissarides (1994) and others has been widely used for investigating the effect of institutions on the reservation wage and labor market behavior in general. Among others, the advantage of this approach is that it allows scrutinizing the consequences of changes in the spread of the wage distri-

bution on individual decisions. However, in order to adapt the search-theoretical framework to the analysis of participation behavior, some modifications are necessary. Modeling participation in the aggregate requires introducing heterogeneity across workers. It is assumed that individuals are heterogeneous with respect to the value they attach to leisure. Moreover, a suitable measure of wage dispersion is needed. Typically the concept of a mean-preserving spread has been used for this purpose. We argue that it might be preferable to differentiate between higher dispersion in the lower and upper tail of the wage distribution. Hence we introduce the concept of a *median-preserving spread* as an alternative.

The basic questions we address in the following are: Which factors determine participation behavior in general? Does wage dispersion affect the choice to enter the labor market? How does a higher spread below and above the median influence the reservation wage and the participation rate? It will be shown that it is possible to obtain unambigous results concerning these questions within the search-theoretical framework. In the empirical part the hypotheses derived from the theoretical model are tested using spatial econometric techniques on cross-sectional data for regional labor markets at the NUTS 3 level in Germany.

We find that several years after re-unification there are still important differences in gender-specific participation behavior in the two parts of the country. In this respect our analysis corroborates the results of the early study by Clark and Summers (1982) who analyze female participation behavior. These authors scrutinize participation rates of female workers in the U.S. that were recruited during World War II to substitute male workers. Clark and Summers (1982) describe the persistence in participation behavior showing that a relatively high share of those workers stayed active in the labor market after the war. After considering alternative economic rationalizations of the phenomenon, they reject the hypothesis of inter-temporal substitution and base their explanation on lock-in effects. German re-unification also represents an interesting case study of persistence in gender-specific participation rates.

The remainder of the paper is organized as follows. In section 2 we introduce

the theoretical model. In section 3 we describe the data and give some descriptive evidence. Section 4 introduces the econometric model and discusses spatial econometric issues. Section 5 concludes.

2   A search model of the labor market

2.1   Outline of the model

Since the pioneering work of Stigler (1962) and McCall (1970) search-theoretical approaches have been widely used in labor economics. Many authors applied search theory to elucidate differences in earned wages. Search models have been also used to explain the effect of unemployment benefits on search intensity and unemployment duration (Mortensen (1977)), the activity of an unemployment agency (Pissarides (1979)), interregional mobility (Burda and Profit (1996)), mandatory minimum wage (Eckstein and Wolpin (1999)) and monopsony power of firms (Van den Berg and Ridder (1998)). However, there are only few attempts to explain participation behavior on the basis of search theory.

In the following we construct a search model in the tradition of McCall (1970). The basic setting is as follows: The worker receives job offers that are drawn randomly from the job offer distribution. By varying search intensity she or he can influence the number of offers received per unit of time. In the optimum the marginal search costs and the marginal gains from search have to be equal. The solution has the reservation wage property, i.e. the worker accepts the offer if it exceeds a critical wage level and continues searching otherwise. We first analyze the effects of a mean-preserving spread in the wage-offer distribution on the reservation wage and search intensity for a group of identical workers. In order to allow for asymmetric changes of wage dispersion in the lower and upper tail of the wage distribution, we then consider the impact of a median-preserving spread below and above the median.

Since the aim of the paper is to explain labor-market participation behavior,

we have to allow for heterogeneity of workers in order to avoid corner solution (everyone or none participates). In this respect we adapt the idea of Albrecht and Axell (1984) by introducing heterogeneity of workers with respect to the esteem of leisure. In our paper we consider optimizing search intensity of agents. Furthermore we take separations into account. Variation in the value that workers attach to leisure gives rise to differences in search behavior and reservation wages. We show that a critical value of leisure exists which determines the indifference point between labor market participation and inactivity. We claim that the factors determining this critical value affect the aggregate participation rate in the like manner. As early as in the work of Stigler (1962) it has been advocated that the value of search increases with the wage dispersion. Since then it has been a standard result of search theory that reservation wages are positively affected by wage variability. Typically the measure of wage dispersion employed by various authors is a mean-preserving spread. It has to be emphasized, however, that in case of a non-symmetric wage offer distribution the concept of a mean-preserving spread is not an adequate measure of dispersion. Then it is crucial to differentiate between dispersion in the left and right tail of the distribution. Therefore, we argue that instead of a mean-preserving spread one should preferably use a *median*-preserving spread. Of course, in the special case of a symmetric distribution both are identical. The notion of a median-preserving spread has been applied in analysis of health economics and growth theory, for example.[1] To the best of our knowledge, however, the concept has not yet been utilized in the context of search-theoretical models. We show that differentiating between the spread in the wage distribution below and above the median alters the understanding of the relationship between search and participation behavior on the one hand and the shape of the wage offer distribution on the other. This approach is able to solve the empirical puzzle which we came up with in our previous work.[2]

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[1]See Hill, Perry and Willis (2005)
[2]See Möller, Aldashev (2004)

2.2 A model with identical workers

Consider a model where vacancies, V, are randomly offered to workers by firms. It is assumed that the parameters of the wage distribution can be observed at no cost and there are no other characteristics of jobs apart from the wage. All probability distributions are time invariant. No recall is allowed for.

Each wage offer is drawn independently from a wage offer distribution $F(w)$. The job offer arrival rate is denoted by λ. The number of job offers, m, received per time period of length, h, follows a Poisson process with probability distribution

$$\omega(m; \lambda, h) = \frac{\mathrm{e}^{-\lambda h}[\lambda h]^m}{m!}. \tag{1}$$

For simplicity assume that workers live forever and are wealth maximizers. Workers are able to increase the arrival rate of job offers per period of time by putting more effort into search:

$$\lambda = \lambda(\theta) \ \text{ with } \lambda_\theta > 0 \text{ and } \lambda_{\theta\theta} \leq 0, \tag{2}$$

where θ denotes search intensity.[3] Search costs are a positive function of search intensity

$$c = c(\theta) \ \text{ with } c_\theta > 0, c_{\theta\theta} > 0, c(0) = c_0 > 0. \tag{3}$$

The value of being employed at wage w is denoted by $W(w)$, the value of search by Ω and the value of a unit of leisure time by b. Furthermore, let δ be the discount rate and σ the separation rate for labor contracts. As shown in Appendix 1, the Bellman equation for the value of employment can then be written in continuous time as

$$W(w) = \frac{1}{\delta + \sigma}(w + \sigma\Omega). \tag{4}$$

According to standard results in the literature[4], the optimal value of search, Ω, exists and is unique. The search problem has the reservation wage property: The

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[3]Throughout the paper partial derivatives are denoted by subscripts.
[4]See Mortensen (1986)

optimal strategy is to accept any wage $w \geqslant r$, where the reservation wage r is defined by $W(r) = \Omega$, i.e. an individual is indifferent between a job offer at the reservation wage and continuing search. In Appendix 2 we derive the reservation wage r as

$$r = \delta\Omega = \max_{\theta > 0} \left\{ b - c(\theta) + \frac{\lambda(\theta)}{\delta + \sigma} K(r) \right\} \geqslant b \qquad (5)$$

with

$$K(r) := \int_{r}^{\infty} (w - r)\, \mathrm{d}F(w) = \bar{w} - r + \int_{0}^{r} F(w)\, \mathrm{d}w > 0, \qquad (6)$$

where $\bar{w}$ is the mean wage. Note that the function K can also be written in terms of the *median* wage, $\tilde{w}$:

$$K(r, \boldsymbol{s}) = \int_{\tilde{w}}^{\infty} w\, \mathrm{d}F(w, \boldsymbol{s}) - \int_{r}^{\tilde{w}} F(w, \boldsymbol{s})\, \mathrm{d}w - r + 0.5\tilde{w}. \qquad (7)$$

Here the vector $\boldsymbol{s}$ contains a measure of the spread below and above the median wage: $\boldsymbol{s} := \left(s^{\ell}, s^{u} \right)$.

Let θ^* denote optimal search intensity. The decision problem for the worker requires the simultaneous solution of the two equations in the endogenous variables r and θ^*:

$$r = b - c(\theta^*) + \frac{\lambda(\theta^*)}{\delta + \sigma} K(r) \qquad (8)$$

and

$$\frac{K(r)}{\delta + \sigma} - \frac{c_{\theta^*}}{\lambda_{\theta^*}} = 0, \qquad (9)$$

where (9) is derived from the first order condition for optimal search intensity. We specify the search cost function as follows:

$$c(\theta) = c_0 + \frac{1}{2} C\theta^2 \text{ with } C > 0. \qquad (10)$$

The fix costs component in (10) is justified by the fact that participation imposes certain restrictions on individual behavior since a participating person must be available to the labor market. In order to save notation we replace the variable b by the new variable $b^u := b - c_0$, thereby excluding the fixed cost component from the cost equation.

The job offer arrival rate λ can be modeled as depending on search intensity and labor market conditions as measured by the ratio of vacancies V to the number of searchers S:

$$\lambda(\theta) = \theta \frac{V}{S}. \tag{11}$$

Given these specifications, the optimal search intensity can be derived from (9) as

$$\theta^*(r) = \frac{K(r)V}{(\delta + \sigma)CS} \tag{12}$$

while the corresponding job arrival rate is

$$\lambda^*(r) = \frac{K(r)}{(\delta + \sigma)C} \left(\frac{V}{S}\right)^2. \tag{13}$$

Substituting (12) and (13) in (5) yields the implicit function

$$\Phi(r; \cdot) = b^u + \frac{1}{2C} \left[\frac{V}{S(\delta + \sigma)} K(r)\right]^2 - r = 0. \tag{14}$$

By using the implicit function theorem it is straightforward to derive the following proposition from (14):

Proposition 1. *The optimal reservation wage responds negatively to an increase in search costs C, the separation rate, σ, and the discount factor, δ. It increases with the mean of the wage offer distribution, $\bar{w}$, the number of vacancies per searcher V/S and the utility in case of unemployment, b^u, which includes the value of leisure and unemployment benefits net of the costs of being available to the labor market.*

Proof: see Appendix 2.

We are also interested in the response of the reservation wage to an increase in the dispersion of the wage distribution. A common measure of dispersion in the literature is a *mean preserving spread*. To see the implications introduce a dispersion parameter s in the cumulative density function of the wage offer distribution $F(w; s)$. This dispersion parameter s is a mean-preserving spread of

the distribution $F(w; s)$ if for any $s_2 > s_1$ the following conditions hold:

$$\int\limits_0^\infty w \, \mathrm{d}F(w, s_1) = \int\limits_0^\infty w \, \mathrm{d}F(w, s_2)$$

and

$$\int\limits_0^x F(w, s_1) \, \mathrm{d}w \leqslant \int\limits_0^x F(w, s_2) \, \mathrm{d}w \quad \forall x. \tag{15}$$

We then obtain the following result:

Proposition 2. *The reservation wage increases with a higher mean preserving spread.*

Proof: see Appendix 3.

The intuition behind this result is that a mean preserving spread in wages raises the benefits of continuing to search. Since this makes agents pickier, their reservation wage rises. The incentive of continuing search after having already obtained a job offer with wage w is simply the possibility that you might be offered a wage above w. Greater wage dispersion increases the chance of finding a better opportunity.

A certain drawback of the concept of a mean-preserving spread is that it does not allow changing the shape of the distribution separately in the left and right tail of the distribution. In real-world situations, however, dispersion of low wages is often different from dispersion of high wages. For instance, if wage compression is from below because of a legal minimum wage or labor unions influences, then variation of low wages is less than variation of high wages.[5]

In order to control for asymmetric changes in the wage dispersion one has to abandon the concept of the mean-preserving spread as one cannot change the spread in the tails of the distribution separately without affecting the mean. In the following we therefore utilize the notion of a median-preserving spread

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[5]This is what Blau and Kahn (1996) and Blau and Kahn (2002) have found to be the case in typical European economies.

as introduced above. For a higher spread in the lower tail of the distribution $(s_2^\ell > s_1^\ell,\ s_2^u = s_1^u$) it holds $F(\tilde{w}, \boldsymbol{s}_1) = F(\tilde{w}, \boldsymbol{s}_2) = 0.5$ and

$$\int\limits_0^{\tilde{w}} F(w, \boldsymbol{s}_1)\,\mathrm{d}w \quad < \quad \int\limits_0^{\tilde{w}} F(w, \boldsymbol{s}_2)\,\mathrm{d}w. \tag{16}$$

while for a higher spread in the upper tail of the distribution $(s_2^\ell = s_1^\ell,\ s_2^u > s_1^u$) we have $F(\tilde{w}, \boldsymbol{s}_1) = F(\tilde{w}, \boldsymbol{s}_2) = 0.5$ and

$$\int\limits_{\tilde{w}}^{\infty} F(w, \boldsymbol{s}_1)\,\mathrm{d}w \quad > \quad \int\limits_{\tilde{w}}^{\infty} F(w, \boldsymbol{s}_2)\,\mathrm{d}w. \tag{17}$$

We then can derive the following result:

Proposition 3. *Other things being equal, the reservation wage increases with the median wage and a higher median-preserving spread in the upper tail of the wage distribution, whereas it decreases with a higher median-preserving spread in the lower tail.*

Proof: see Appendix 4.

The intuition behind this important result is that increasing the spread in the lower tail of the wage offer distribution moves some of the probability mass away to wages below the reservation wage. To compensate for the loss in the probability mass, the reservation wage should fall. In contrast to this, increasing the spread in the upper tail of the distribution moves some of probability mass away to higher wages. This increases the option value of search and hence the reservation wage.

2.3 Participation behavior in a model with heterogeneous individuals

So far we have assumed homogeneous individuals. For a model of participation behavior in the aggregate, heterogeneity of individuals is required, otherwise either all or none will participate. In order to introduce the source of heterogeneity,

let us be more precise in determining the value of leisure. In case of unemployment individuals have a money equivalent to the value of pure leisure, ℓ, plus transfers in form of unemployment benefits, t^u, minus the fixed costs of participation, c_0. In case of non-participation the individual enjoys pure leisure of value ℓ and receives an alternative income t^s (social assistance, for example). In the following it will be assumed that individuals are heterogeneous with respect to the value attached to pure leisure, only. Thus for an individual i the value of not working will be $b_i^u = \ell_i + t^u - c_0$ in case of unemployment and $b_i^n = \ell_i + t^n$ in case of non-participation. Define $\nu := b_i^n - b_i^u = t^n - t^u + c_0$. Moreover let $t^u - c_0 = 0$ and hence $b_i^u = \ell_i$ for the ease of exposition. The condition for participation is

$$\delta\Omega = r_i\left(b_i^u\right) \geqslant b_i^n. \tag{18}$$

It will be assumed that the participation rate is strictly positive but less than one. This implies that an agent with the lowest (highest) esteem of leisure in the population prefers participating (non-participating, respectively). Then there must be some critical value for leisure, $\tilde{\ell} > 0$, such that a person with $\ell_i = \tilde{\ell}$ will be indifferent between participating or not. If $\ell_i > \tilde{\ell}$ holds, he or she will stay out the labor market.

The *participation indifference condition* can be stated as

$$\tilde{r} := r\left(\tilde{b}^u\right) = \tilde{b}^n = \tilde{b}^u + \nu, \tag{19}$$

where $\tilde{b}^n = \tilde{\ell} + t^n$ and $\tilde{b}^u = \tilde{\ell}$. Let $g(\ell)$ and $G(\ell)$ be the density and cumulative density, respectively, of the distribution of the value of leisure in the population. The probability that a randomly chosen person participates in the labor market is given by $G(\tilde{\ell})$, which corresponds to the participation rate in the aggregate:

$$\pi := G\left(\tilde{\ell}\right) = G\left(\tilde{b}^u\right) \text{ with } \frac{\partial \pi}{\partial \tilde{\ell}} = \frac{\partial \pi}{\partial \tilde{b}^u} > 0. \tag{20}$$

Hence participation behavior can be analyzed by investigating the determinants of the critical value of leisure $\tilde{\ell}$. In principle, this could be done on the basis of (14) using (19). However, (14) was derived for individual behavior taking the

actions of others as given. Hence the number of searchers S competing for the work places in the economy was treated as exogenous. From an aggregate point of view one has to consider the number of searchers as endogenously determined by the participation decision of individuals. If, for instance, a shock to one of the exogenous variables renders participation more attractive, the number of searchers will tend to increase. Higher competition among searchers then creates a dampening effect.

Let the population at working age be denoted by P. The total number of searchers, i.e. number of participants in the labor market, is given as $S := \pi P = G(\tilde{\ell})P$. By replacing the reservation wage, r, in (14) by $\tilde{b}^n$ and the wealth in case of unemployment, b^u, by $\tilde{b}^u$, we then obtain a function that implicitely determines the critical level of leisure $\tilde{\ell}$:

$$\Theta\left(\tilde{\ell}; .\right) = \frac{1}{2C}\left[\frac{V}{(\delta + \sigma)PG(\tilde{\ell})}K\left(\tilde{\ell} + \nu, s\right)\right]^2 - \nu = 0. \qquad (21)$$

From (21) we can calculate the comparative static results for the critical level of the value of leisure that divides agents into participating and non-participating ones. The upshot of these considerations is summarized by

Proposition 4. *Participation increases with the number of vacancies, V, per head of population, P. It decreases with a higher separation rate, σ, higher search costs, C, and the impatience of agents as measured by the discount rate, δ. Participation falls with a lower ν, i.e. if being unemployed becomes less attractive compared to non-participating.*

Proof: see Appendix 5.

With respect to the median and the dispersion of the wage offer distribution we can derive

Proposition 5. *Other things being equal, the participation rate increases with the median wage and a higher median-preserving spread in the upper tail of the wage distribution, whereas it decreases with a higher median-preserving spread in the lower tail.*

11

The proof immediately follows from the results derived in Appendix 4.

3 Data and definitions

3.1 Data

We use the INKAR database (*Bundesanstalt für Bauwesen und Raumordnung, BBR*) for data on gender-specific unemployment and employment, active and non-active population and the share of in- and outgoing commuters at the county level (NUTS 3). The data on wages and wage dispersion were calculated from IAB-REG (*Institut für Arbeitsmarkt- und Berufsforschung, IAB*). IAB-REG is a 1% random sample from the employment register of the Federal Labor Office with regional information. The data set includes all workers, salaried employees and trainees being obliged to pay social security contributions and covers more than 80% of all employment. Excluded are public servants, minor employment and family workers. Because of legal sanctions for misreporting, the earnings information in the data is highly reliable. Among others, IAB-REG contains variables on individual earnings and skills. The regional information is based on the employer. The analysis here is confined to full-time workers of the intermediate skill group (apprenticeship completed without a university-type of education). All male and female workers were selected that were employed at the 30th of June, 1997. For all regions we then calculated the gender-specific median and the second and eighth decile of daily earnings.

In IAB-REG a total of 328 West German and 112 East German counties is available with Berlin being represented by two separate regions (West and East Berlin). In the INKAR data set, however, separate figures for East and West Berlin are partly unavailable. Therefore we decided to exclude Berlin from the data set. This leaves us with a total of 438 regions (i.e. 327 and 111 for West Germany and East Germany, respectively).

3.2 Definitions of variables

The employment-to-population ratio at the regional level will be calculated as

$$q_r = \frac{N_r - I_r + O_r}{P_r}, \tag{22}$$

where N_r is the total number of persons being employed in region r, I_r and O_r are the number of incoming (outgoing, respectively) commuters and P_r is the regional population at working-age. Hence total employment of region r citizens is measured as $E_r \equiv N_r - I_r + O_r$. The regional population at working age is split into inactive persons on the one hand and the labor force L_r on the other. The participation rate, π_r, will be defined as the fraction of the working-age population being active in the labor market, or, the labor-force-to-population ratio. We decided to exclude the self-employed. Hence the participation figures used in our empirical study are somewhat lower than official participation rates.

3.3 Descriptive evidence

Figure 1 depicts gender-specific participation and unemployment rates for East and West Germany. It is evident that East German regions suffer from much higher unemployment than their counterparts in West Germany. Participation of male workers in the East are not markedly different from those in the West (the so-called *old laender*). On the contrary, participation of female workers in the East is on average significantly higher than in the West. The regression line is downward sloping in all cases indicating a negative correlation between unemployment and participation. *Figure 1* also indicates that there is considerable variation of unemployment and participation across regions even within the two parts of the country.

In *figure 2* participation rates are plotted against the median nominal wage for male and female workers. The regression line is upward sloping in all cases. Hence first evidence corroborates the view that higher wage levels foster participation. For both genders participation rates at given wages are higher in East Germany (or the *new laender*).

4 Econometric analysis

4.1 Spatial econometric issues

Regions are not isolated areas but interact with their neighbors. Workers looking for employment might consider taking a job not in the region of residence but in another region that lies within an acceptable commuting distance. Local regional interactions might lead to spatial autocorrelation which can be modeled by two alternative models, the spatial lag and the spatial error model [e.g. Anselin (2001)]. Formally, the spatial lag model can be described as

$$\mathbf{y} = \rho \mathbf{W} \mathbf{y} + \mathbf{X}\beta + \varepsilon, \tag{23}$$

where $\mathbf{y}$ is a $(N \times 1)$ vector of the dependent variable, $\mathbf{X}$ is a $(N \times k)$ matrix of explanatory variables and β the corresponding coefficient vector. $\mathbf{W}$ denotes the $(N \times N)$ spatial weight matrix, ρ a spatial lag parameter to be estimated and ε a vector of disturbances.[6] Let ε_i and ε_j be two elements of ε, it is assumed that

$$\mathrm{cov}\left(\varepsilon_i, \varepsilon_j\right) = 0 \text{ for } i \neq j \text{ and } \varepsilon_i \sim N\left(0, \sigma_\varepsilon^2\right). \tag{24}$$

The spatial error dependence model is given as

$$\mathbf{y} = \mathbf{X}\beta + \varepsilon \text{ and } \varepsilon = \lambda \mathbf{W}\varepsilon + \varepsilon^* \tag{25}$$

where

$$\varepsilon^* = (\mathbf{I} - \lambda \mathbf{W})\,\varepsilon \tag{26}$$

is i.i.d. with variance $\sigma_{\varepsilon*}^2$.[7]

4.2 Modelling and testing for spatial dependence

The spatial weight matrix should reflect the intensity of interactions among regions. A common approach is to use geographically derived weights (measures

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[6]Note that (23) can be written as $\mathbf{y} = (\mathbf{I} - \rho \mathbf{W} \mathbf{y})^{-1} \mathbf{X}\beta + (\mathbf{I} - \rho \mathbf{W} \mathbf{y})^{-1} \varepsilon \quad = \tilde{\mathbf{X}}\beta + \tilde{\varepsilon} \quad$, where $\tilde{\mathbf{X}}$ and $\tilde{\varepsilon}$ are spatially filtered variables: $\tilde{\mathbf{X}} := (\mathbf{I} - \rho \mathbf{W} \mathbf{y}) \mathbf{X}$ and $\tilde{\varepsilon} := (\mathbf{I} - \rho \mathbf{W} \mathbf{y}) \varepsilon$.

[7]If the spatially filtered dependent and independent variables are defined as $\mathbf{y}^* = (\mathbf{I} - \lambda \mathbf{W}) \mathbf{y}$ and $\mathbf{X}^* = (\mathbf{I} - \lambda \mathbf{W}) \mathbf{X}$ (25) can be stated as $\mathbf{y}^* = \mathbf{X}^* \beta + \varepsilon^*$.

of distance, for instance). However, sheer distance gives only a very limited and in many cases even distorted picture of spatial dependence. Consider two small towns, A and B, in the periphery of a metropolitan city C. Assume equal distance between A, B and C. Typically economic conditions in A and B in such a situation are heavily influenced by strong gravity toward the center C. In contrast to this, the relationships between A and B, might be more or less negligible. Hence measures like distance or traveling time for constructing the spatial weight matrix do not capture the intensity of spatial dependence and, therefore, might be misleading. An alternative could be a mass to distance (or square distance) ratio in analogy to what is known in physics as the law of gravity. This approach seems to be more plausible than using a mere distance factor. However, with gravity being symmetric, the impact of region A on C, for instance, is forced to be the same as the impact of C on A. As the example shows, symmetry might not be adequate in modeling spatial interactions.

A suitable variable that quantitatively reflects the economic relationships among regions is commuter streams. Using data from the employment statistics of the German Federal Labor Office, we constructed a matrix depicting the commuting process among the 438 NUTS3 regions in our data set. With in- and outgoing commuter streams being different, the matrix is not symmetric.

A further problem concerns the normalization of the spatial weight matrix. Typically, the elements on the main diagonal are set to zero because a region cannot be a neighbor to itself [see, for example, Anselin (2001)]. Moreover, the sum of each row is normalized to one. The latter procedure, however, destroys the information across the rows of the matrix which, under the circumstances here, might also be considered problematic. A feasible alternative would be to normalize the spatial weight matrix by restricting the sum of rows *and* columns to unity while conserving the structure of interregional dependence as far as possible. This can be done by the so-called RAS method which is widely used in regional input/output analysis, among others. According to the iterative RAS algorithm the rows and columns of the matrix are alternately adjusted to fulfill

15

the restrictions until convergence is achieved. The method yields a compromise in the trade-off between preserving the structure within columns and within rows. Since the implications of the RAS method in the context of modeling spatial dependence are not well studied yet, we compare the results of the two variants, RAS and row normalization.

The OLS model with no spatial dependence is nested both in the spatial lag and the spatial error dependence model. A likelihood-ratio test can be used to test whether the restrictions of the OLS model hold against the more general alternatives. Building on earlier work of Davidson and MacKinnon (1993), Baltagi and Li (2001) have proposed a double-length artificial regression to test the H_0 in both variants of the model.

4.3 The empirical model

Based on the theoretical considerations in section 2, the regression approach outlined below captures the main influences on participation behavior at the regional level. Using cross-section data our approach stands in the tradition of the famous study of Clark and Summers (1982) on female participation behavior in the U.S. In our context, however, we are more oriented to analyze the implications of a search-theoretical model. We assume that the separation rate is captured by the unemployment rate.

In the theoretical part, we have shown that participation depends positively on the median and the median-preserving spread in the upper tail of the regional wage offer distribution and negatively on the median-preserving spread in the lower tail. The upshot of these considerations is to regress the labor-force-to-population ratio in region r on the median wage, the two types of spreads of the wage distribution and on the unemployment rate in that region.

Of course, the model relies on a number of simplifying assumptions. Because of lack of data, we cannot explicitly investigate the influence of differences in the regional price levels or search costs, for example. There are good reasons,

however, to assume that to some extent these factors can be captured by dummy variables indicating a specific type of region.[8].

A further aspect concerns the differences between West and East Germany. Four decades of a 'real existing socialism' likely gave rise to different patterns of participation behavior and it seems plausible that this still influences participation today. Hence a study of participation behavior using data for the old and new laender has to deal with these intra-country differences adequately. We therefore allow the parameters of the model to be different in both parts of the country.

The basic equation to be estimated is

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\pi_r = \left(a_0 + a_1 u_r + a_2 \ln w_r + \sum_{i=1}^{8} a_{3i} RT_{ir} + a_4 \ln DL_r + a_5 \ln DH_r \right) \times WEST
$$
$$
+ \left(b_0 + b_1 u_r + b_2 \ln w_r + \sum_{i=1}^{8} b_{3i} RT_{ir} + b_4 \ln DL_r + b_5 \ln DH_r \right) \times EAST + \varepsilon_r,
$$
$$
\tag{27}
$$

where index r stands for the region and RT_i ($i = 1, \cdots, 8$) are (0,1) dummy variables for region types. We use the decile ratios $DL := D5/D2$ and $DH := D8/D5$ as proxies for wage dispersion in the lower and upper tail of the wage distribution, respectively.

4.4 Results

4.4.1 Spatial correlation

Given the spatial matrix constructed from data on commuter streams and having it normalized by the two alternative methods described above, the question is whether the spatial lag or the spatial error dependence model is more adequate to describe the data. Hence we first present the results of specification tests. *Table 1* shows that spatial correlation is significant for the analysis of participation of male and female workers. Concerning the choice of model the

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[8]The classification by BBR comprises nine different types of regions, ranging from a metropolitan to rural areas (see table 4)

spatial lag model is accepted in all cases (although the significance is only weak if the RAS normalization is used.). Irrespective of the normalization method, the spatial error model is highly significant for male but not for female workers. The estimate of the spatial correlation parameter in the spatial lag model, ρ, is negative for male and female workers, while the estimated parameter for the error dependence model, λ, is about 0.4 for male and close to zero for female workers. The results show that qualitatively the Likelihood Ratio (LR) and the Double-Length-Artificial Regression Tests produce equivalent results. The LR-test seems to be less conservative especially in the case of the spatial error model.

4.4.2   Analysis of participation behavior

Table 2 gives the regression results for male workers for OLS and the spatial lag and spatial error model using the two alternative normalization methods. The table shows that the estimates are qualitatively the same in all variants. There are, however, certain differences in magnitude. The constant term is markedly higher in the spatial lag model, while the wage coefficients are generally higher in the spatial error model.

The signs of the estimated coefficients of unemployment and the wage level are in line with the predictions of the theoretical model. The negative effect of the unemployment rate on regional participation is highly significant in all cases. The magnitude of the estimated coefficients is similar for East and West German regions. According to our results, a one percentage point rise in unemployment decreases participation by about 0.4 percentage points. This indicates that participation is less attractive if employment becomes more unstable or labor market conditions deteriorate in general.[9] The magnitude of the wage effect for male workers differs between East and West. For the old laender the coefficient of log wages is between 0.6 and 0.8 for the old and about 0.2 for the new laender, where the t-statistics in the latter case are in some cases slightly below the

---

[9]In terms of traditional labor market analysis, this could also be described as a "discouraged worker effect".

5%-significance level.

According to proposition 5, a median-preserving spread in the lower tail of the distribution should reduce participation, while a higher spread in the right tail should increase it. In principle, our results support these theoretical predictions. In all variants we find that wage dispersion in the lower tail of the distribution exhibits a *negative* impact on participation, while the coefficients for the dispersion measure in the right tail are positive, but significant only for the model with the lowest standard error (RAS, spatial error). For West Germany the negative impact of dispersion below the median is highly significant and robust with respect to the different estimation approaches used here, while it is not statistically significant for the new laender.

Remembering that all explanatory variables are taken as deviations from the mean and this normalization is done separately for the West and the East, the constant term can be interpreted as the expected participation rate for the region with average characteristics except for the spatial lag model[10]. It turns out that the participation rate in the average region is quite similar between East and West for male workers.

All in all we have to conclude that the influence of economic variables in the new laender is only weak, while there are strong and highly significant effects in the West. The same is true for the regional type dummies. The corresponding effects are not statistically significant for East German regions. Hence for this part of the country we do not observe that participation of male workers differs with respect to population density and centrality. By contrast, a clear pattern emerges for West Germany: Regional types RT2 to RT4 and RT6, i.e. the periphery regions of metropolitan and intermediate core cities (RT1 and RT5), show lower participation *ceteris paribus*. Our results imply that participation behavior of male workers in core cities on the one hand and low-density regions on the other (RT7, RT8 and the reference type RT9) is fairly similar, if other influences are

---

[10]In case of the spatial error model it holds that $E(y) = E(X\beta)$, while in case of the spatial lag model we have $E(y) = (\mathbf{I} - \rho\mathbf{W}\mathbf{y})^{-1} E(X\beta)$, hence $E(y) \neq E(X\beta)$ if $\rho \neq 0$.

controlled for.

The results for female workers are contained in *table 3*. Again, we find that unemployment has a strong negative effect on regional participation behavior. For the sub-sample of West German regions the estimated coefficient is about 0.5 irrespective of the method used for estimation. Hence in the old laender the depressing effect of unemployment on participation of females is stronger than that of males. For female workers in the East the coefficient is slightly above 0.3 and thereby somewhat lower than the corresponding figure for males.

The estimated coefficient of the wage level is slightly lower than 0.1 in the West and somewhat higher than 0.1 in the East. For West German regions we find a remarkable difference in the wage coefficient between male and female workers. Irrespective of the estimation methods our results indicate that male participation compared to that of females is much more sensitive to wage changes in the West, while the reverse is true for the East.

Inequality has no significant effect on participation of female workers in the East, whereas for the West German regions we find that wage dispersion below the median exhibits a negative effect on participation which again corroborates proposition 5. The coefficient of wage dispersion above the median is generally insignificant.

With respect to the constant term, our results reveal a prominent disparity. Ranging between 15 and 17 percentage points, there are substantial differences between Western and Eastern female workers. This indicates a marked gap in participation behavior between the old and new laender. A further remarkable result is that, controlled for other influences, participation rates of females in the East are not markedly different from that of males.

In the West female participation is significantly lower (by 3 to 5 percentage points) in the periphery of the core cities while in the East there is no such pattern. The only effect we find for the East is that female labor force participation behavior in intermediate core cities falls behind the average by about 5 percentage points.

5 Conclusions

Using spatial econometric methods we have shown that regional variations in participation rates not only in West German regions but also in the new laender can be explained by economic factors. We provide empirical support to the predictions of the search-theoretical model: A higher regional (median) wage level fosters, while higher regional unemployment depresses labor-market participation markedly in both parts of the country. Concerning the latter, the strongest "discouraged worker effect" is observed for females in the West. According to our results a one percentage point rise in the unemployment rate decreases participation by between 0.3 and 0.5 percentage points. A further finding is that the regional wage level has a significant positive effect on participation in most cases. Sensitivity of participation with respect to earnings is higher for male workers in West than in East Germany. Moreover, our estimates indicate certain variation of active labor market behavior with respect to the type of the region in West Germany. Interestingly, we find similarities between core cities with high population density on the one hand and peripherical rural areas on the other. Both exhibit relatively high rates of participation if other economic factors are controlled for. By contrast, the surroundings of core cities typically have lower participation. These spatial patterns of participation are, however, not valid for East Germany. For the "new laender" we do not observe any systematic variation of participation with respect to the type of the region.

The main purpose of the paper was to study the effect of wage dispersion on labor supply. Our theoretical arguments suggest that the spread below and above the median work in opposite directions. Higher dispersion in the lower tail of the distribution drives the participaton rates down while higher dispersion in the upper tail pushes them up. These predictions of the search theoretical model are supported by our empirical findings for West Germany. For this part of the country we find a robust and statistically significant negative effect of wage inequality below the median on the participation behavior of male and female workers. The effect of the spread in the upper tail is positive and significant only

in one variant of the model.

All in all our results question the naive view that increasing the spread in the wage distribution is a remedy without adverse effects. Streching out the wage distribution to the left is likely to restrain workers from active job search. In this case, the remedy could be worse than the disease.

A further important result of our analysis is that —controlling for other factors— participation behavior of male workers in the West and the East is fairly the same. By contrast, this is not true for female workers. According to our results, under the same economic conditions female participation in East German regions would be about 15 percentage points higher than in the West. This evidence supports the lock-in phenomena described by Clark and Summers (1982).

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Appendix 1   Deriving the Bellman equation

For formulating the model in continuous time note that the following relationships hold:

$$
\begin{aligned}
\lim_{h \to 0} \frac{\omega\left(m = 1; \lambda, h\right)}{h} &= \lim_{h \to 0} \frac{e^{-\lambda h}\left(\lambda h\right)}{h} &=& \quad \lambda \\
\lim_{h \to 0} \frac{\omega\left(m > 1; \lambda, h\right)}{h} &= \lim_{h \to 0} \frac{e^{-\lambda h}\left(\lambda h\right)^{m}}{m! h} \\
&= \lim_{h \to 0} \frac{m e^{-\lambda h} \lambda\left(\lambda h\right)^{m-1} - \lambda e^{-\lambda h}\left(\lambda h\right)^{m}}{m!} &=& \quad 0 \\
\lim_{h \to 0} \frac{1 - e^{-\delta h}\left(1 - \sigma h\right)}{h} &= \lim_{h \to 0} \delta e^{-\delta h}\left(1 - \sigma h\right) + \sigma e^{-\delta h} &=& \quad \delta + \sigma \\
\lim_{h \to 0} d(h) &= \lim_{h \to 0} \delta e^{-\delta h} &=& \quad 1 \\
\lim_{h \to 0} d(h) &= \lim_{h \to 0} \frac{1 - e^{-\delta h}}{h} &= \lim_{h \to 0} \delta e^{-\delta h} \quad =& \quad \delta
\end{aligned}
$$

From the Bellman equation for the value of employment follows

$$
\begin{aligned}
W\left(w\right) &= wh + e^{-\delta h}\left[\sigma h \Omega + \left(1 - \sigma h\right) W\left(w\right)\right] \\
\to \left[1 - e^{-\delta h}\left(1 - \sigma h\right)\right] W\left(w\right) &= wh + e^{-\delta h}\sigma h \Omega \\
\to \frac{1 - e^{-\delta h}\left(1 - \sigma h\right)}{h} W\left(w\right) &= w + e^{-\delta h}\sigma \Omega.
\end{aligned}
$$

and hence one obtains for the value of employment in continuous time

$$
W\left(w\right) = \frac{1}{\delta + \sigma}\left(w + \sigma \Omega\right). \tag{A-1}
$$

Appendix 2   Proof of Proposition 1

Note that the function $K(r)$ has a negative derivative:

$$
K_r = -\left[1 - F(r)\right].
$$

Hence the derivative of the implicit function in (14) with respect to the reservation wage r is negative as well:

$$
\Phi_r = -\frac{1}{C}\left[\frac{V^2}{S^2\left(\delta + \sigma\right)^2}K(r)\right]\left[1 - F(r)\right] - 1 < 0. \tag{A-2}
$$

25

From (14) one immediately obtains

$$\text{sign } \Phi_C > 0, \ \text{sign } \Phi_\sigma < 0, \ \text{sign } \Phi_\delta < 0, \ \text{sign } \Phi_{V/S} > 0, \ \text{sign } \Phi_{b^u} > 0.$$

Using (A-12) and the implicit-function rule one obtains for the sign of the derivative of of the reservation wage r with respect to an exogenous variable or parameter x: $\text{sign}(\partial r / \partial x) = \text{sign } \Phi_x$. This directly leads to the results stated in proposition 1. $\qquad \square$

Appendix 3   Proof of Proposition 2

Given the results of appendix 1, it is sufficient to prove $\text{sign } \Phi_s > 0$. Re-writing (14) by including the spread parameter s gives

$$\Phi\left(r, ; \cdot\right) = b^u + \frac{1}{2C}\left[\frac{V}{S(\delta + \sigma)} K(r, s)\right]^2 - r = 0. \qquad \text{(A-3)}$$

The derivative with respect to s is

$$\Phi_s = \frac{1}{C}\left[\frac{V}{S(\delta + \sigma)} K(r, s)\right] K_s. \qquad \text{(A-4)}$$

From (15) in the main text we obtain

$$K_s = \frac{\partial}{\partial s}\int_0^r F(w, s)\, \mathrm{d}w \geq 0,$$

where the derivative is strictly positive in the relevant range of the distribution. Hence the reservation wage is increasing with a higher spread in the wage offer distribution. $\qquad \square$

Appendix 4   Proof of Proposition 3

Using the definition of K in the main text one can write

$$K\left(r, \boldsymbol{s}\right) := \int_r^{\tilde{w}} (w - r)\, \mathrm{d}F(w, \boldsymbol{s}) + \int_{\tilde{w}}^{\infty} (w - r)\, \mathrm{d}F(w, \boldsymbol{s}). \qquad \text{(A-5)}$$

Solving the first term on the right-hand side of (A-5) by partial integration yields:

$$\int_r^{\tilde{w}} (w-r)\,\mathrm{d}F(w,\boldsymbol{s}) = 0.5(\tilde{w}-r) - \int_r^{\tilde{w}} F(w,\boldsymbol{s})\,\mathrm{d}w. \qquad \text{(A-6)}$$

For the second term in (A-5) one obtains

$$\int_{\tilde{w}}^{\infty} (w-r)\,\mathrm{d}F(w,\boldsymbol{s}) = \int_{\tilde{w}}^{\infty} w\,\mathrm{d}F(w,\boldsymbol{s}) - 0.5r. \qquad \text{(A-7)}$$

Adding up (A-6) and (A-7) yields

$$K(r,\boldsymbol{s}) = \int_{\tilde{w}}^{\infty} w\,\mathrm{d}F(w,\boldsymbol{s}) - \int_r^{\tilde{w}} F(w,\boldsymbol{s})\,\mathrm{d}w - r + 0.5\tilde{w}. \qquad \text{(A-8)}$$

Note that

$$\frac{\partial}{\partial \tilde{w}} \int_{\tilde{w}}^{\infty} w\,\mathrm{d}F(w,\boldsymbol{s}) > 0,$$

$$\frac{\partial}{\partial s^{\ell}} \int_r^{\tilde{w}} F(w,\boldsymbol{s})\,\mathrm{d}w > 0,$$

$$\frac{\partial}{\partial s^{u}} \int_{\tilde{w}}^{\infty} w\,\mathrm{d}F(w,\boldsymbol{s}) > 0$$

and

$$\frac{\partial F(w,\boldsymbol{s})}{\partial \tilde{w}} < 0.$$

This yields the following partial derivatives of $K(r,\boldsymbol{s})$:

$$\frac{\partial K(r,\boldsymbol{s})}{\partial \tilde{w}} = \frac{\partial}{\partial \tilde{w}} \int_{\tilde{w}}^{\infty} w\,\mathrm{d}F(w,\boldsymbol{s}) - \int_r^{\tilde{w}} \frac{\partial F(w,\boldsymbol{s})}{\partial \tilde{w}}\,\mathrm{d}w > 0$$

$$\frac{\partial K(r,\boldsymbol{s})}{\partial s^{\ell}} = -\frac{\partial}{\partial s^{\ell}} \int_r^{\tilde{w}} F(w,\boldsymbol{s})\,\mathrm{d}w < 0$$

$$\frac{\partial K(r,\boldsymbol{s})}{\partial s^{u}} = \frac{\partial}{\partial s^{u}} \int_{\tilde{w}}^{\infty} w\,\mathrm{d}F(w,\boldsymbol{s}) > 0 \qquad \text{(A-9)}$$

The implicit function for the reservation wage is

$$\Phi\left(r;\cdot\right) = b^u + \frac{1}{2C}\left[\frac{V}{S(\delta+\sigma)}K(r,\boldsymbol{s})\right]^2 - r = 0. \tag{A-10}$$

From this we obtain

$$\Phi_K = \frac{V^2}{CS^2(\delta+\sigma)^2}K(r,\boldsymbol{s}) > 0. \tag{A-11}$$

Given the results of appendix 1 it follows that $\mathrm{sign}(\partial r/\partial x) = \mathrm{sign}\,K_x$. One then immediately obtains

$$\mathrm{sign}\,r_{\tilde{w}} > 0,\ \mathrm{sign}\,r_{s^\ell} < 0,\ \mathrm{sign}\,r_{s^u} > 0.$$

Appendix 5 Proof of Proposition 4

In the main text it is shown that the participation rate depends on the critical value of leisure $\tilde{\ell}$ which is implicitly given by (21) in the main text:

$$\Theta\left(\tilde{\ell};.\right) = \frac{1}{2C}\left[\frac{V}{(\delta+\sigma)\,PG(\tilde{\ell})}K\left(\tilde{\ell}+\nu,\boldsymbol{s}\right)\right]^2 - \nu = 0.$$

Since the derivative of the function $K\left(\cdot\right)$ with respect to the reservation wage, K_r, is negative, we can conclude that the dervative of Θ with respect to ℓ is negative as well:

$$\Theta_{\tilde{\ell}} = \frac{K\left(\tilde{r},\boldsymbol{s}\right)}{C}\left[\frac{V}{(\delta+\sigma)\,PG(\tilde{\ell})}\right]^2\left[-\frac{1}{G(\tilde{\ell})}K\left(\tilde{r},\boldsymbol{s}\right) + K_r\left(\tilde{r},\boldsymbol{s}\right)\right] < 0 \tag{A-12}$$

with $\tilde{r} := \tilde{\ell} + \nu$. Using (A-12) and the implicit-function rule one obtains for the sign of the derivative of $\tilde{\ell}$ with respect to an exogenous variable or parameter x: $\mathrm{sign}(\partial\tilde{\ell}/\partial x) = \mathrm{sign}(\partial\pi/\partial x) = \mathrm{sign}\,\Theta_x$.

From (21) one obtains

$$\mathrm{sign}\,\Theta_C < 0,\ \mathrm{sign}\,\Theta_\sigma < 0,\ \mathrm{sign}\,\Theta_\delta < 0,\ \mathrm{sign}\,\Theta_{V/P} > 0,\ \mathrm{sign}\,\Theta_\nu < 0.$$

$$\square$$

Table 1: Maximum Likelihood estimates of the spatial correlation parameter and test statistics for the spatial lag and the spatial error dependence model

	spatial lag model		spatial error dependence model	
	male workers			
	ROW	RAS	ROW	RAS
spatial correlation parameter	-0.314^{**}	$-0.125^{(*)}$	0.340^{**}	0.387^{**}
	(0.068)	(0.071)	(0.061)	(0.061)
	test statistics			
	$H_0 : \rho = 0$		$H_0 : \lambda = 0$	
double-length artifical regression $\chi^2(1)$	20.319^{**}	$3.059^{(*)}$	4.266^{*}	7.463^{**}
Likelihood-ratio test $\chi^2(1)$	20.770^{**}	$3.084^{(*)}$	9.891^{**}	14.776^{**}
	female workers			
spatial correlation parameter	-0.210^{**}	$-0.110^{(*)}$	-0.075^{**}	-0.086
	(0.067)	(0.066)	(0.074)	(0.072)
	test statistics			
	$H_0 : \rho = 0$		$H_0 : \lambda = 0$	
double-length artifical regression $\chi^2(1)$	9.561^{**}	$2.739^{(*)}$	0.574	0.925
Likelihood-ratio test $\chi^2(1)$	9.675^{**}	$2.758^{(*)}$	0.736	1.121

Notes: (*), *, **: test statistic significant at least at the 10, 5 and 1% level, respectively; standard error of the spatial correlation parameter in parenthesis. ROW: row normalization of matrix W; RAS: row and column normalization of matrix W(RAS-method).

Table 2: Regression results for the labor-force-to-population ratio of male workers (327 West German and 111 East German NUTS-3-regions)

		dependent variable: labor-force-to-population ratio (in percent)			
	OLS	spatial lag		spatial error	
		ROW**	RAS[(*)]	ROW**	RAS**
West German Regions					
constant	**58.549**	**78.095**	**65.846**	**58.578**	**58.717**
unempl.r.	**−0.371**	**−0.449**	**−0.398**	**−0.463**	**−0.462**
ln wage	**0.597**	**0.584**	**0.584**	**0.780**	**0.777**
ln(D5/D2)	**−26.579**	**−28.553**	**−27.861**	**−27.474**	**−26.986**
ln((D8/D5)	3.677	3.168	3.080	13.217	**16.907**
RT1	0.800	2.041	1.395	−1.439	−1.746
RT2	**−5.260**	**−3.618**	**−4.629**	**−6.781**	**−7.033**
RT3	**−7.802**	**−6.711**	**−7.643**	**−8.652**	**−8.589**
RT4	**−7.142**	**−7.122**	**−7.280**	**−6.657**	**−6.799**
RT5	3.571	3.333	3.533	3.431	3.407
RT6	**−3.722**	**−3.074**	**−3.358**	**−4.479**	**−4.604**
RT7	−2.235	−1.909	−2.068	−2.203	−2.275
RT8	−1.257	−1.388	−1.260	−0.841	−0.648
N			327		
East German Regions					
constant	**61.350**	**80.868**	**69.023**	**60.910**	**60.840**
unempl.r.	**−0.420**	**−0.412**	**−0.410**	**−0.432**	**−0.463**
ln wage	0.190	0.171	0.182	**0.211**	**0.210**
ln(D5/D2)	−6.926	−6.918	−7.016	−7.114	−5.955
ln((D8/D5)	10.098	10.237	10.070	11.360	11.601
RT1	−0.772	−0.125	−0.468	−0.989	−0.572
RT2	−1.131	−0.386	−0.835	−1.568	−1.377
RT3	0.407	0.927	0.606	0.322	0.580
RT4	−2.013	−1.886	−1.868	−1.346	−1.435
RT5	1.456	1.966	1.732	1.316	1.563
RT6	0.666	0.991	0.788	0.890	1.130
RT7	0.475	0.677	0.523	0.599	0.846
RT8	−2.688	−2.802	−2.703	−2.994	−3.177
N			111		
test statistics					
s.e.	6.171	5.984	6.141	6.047	5.983
ln Likelih.	−1418.750	−1408.185	−1417.028	−1413.625	−1411.187

Notes: OLS: Regression disregarding spatial correlation; spatial lag: maximum likelihood estimates based on the spatial lag model; spatial error: maximum likelihood estimates based on the spatial error dependence model; ROW: row normalization of the spatial weight matrix, RAS: row and column normalization of the spatial weight matrix using the RAS algorithm; N: number of observation, coeff.: estimated coefficient; s.e.: standard error of the regression; all German counties except for Berlin and one further region that was excluded because of incomplete data; bold figures indicate that the corresponding coefficient is statistically significant at least at the 5% level (one-sided test).

Table 3: Regression results for the labor-force-to-population ratio of female workers (327 West German and 111 East German NUTS-3-regions)

		dependent variable: labor-force-to-population ratio (in percent)			
	OLS	spatial lag		spatial error	
		ROW**	RAS[(*)]	ROW	RAS
		West German Regions			
constant	**46.522**	**56.711**	**51.679**	**46.545**	**46.507**
unempl. rate	**−0.521**	**−0.560**	**−0.527**	**−0.509**	**−0.503**
ln wage	**0.088**	**0.098**	**0.090**	**0.084**	**0.085**
ln(D5/D2)	**−7.426**	**−7.219**	**−7.603**	**−7.490**	**−7.626**
ln((D8/D5)	−5.869	−4.447	−5.465	−6.179	−6.068
RT1	0.974	0.468	0.645	0.909	0.855
RT2	**−4.354**	**−4.327**	**−4.400**	**−4.291**	**−4.260**
RT3	**−3.406**	**−3.259**	**−3.427**	**−3.234**	**−3.172**
RT4	−1.702	−1.916	−1.872	−1.781	−1.775
RT5	**4.832**	**4.195**	**4.478**	**4.461**	**4.536**
RT6	−0.654	−0.534	−0.598	−0.587	−0.522
RT7	−0.543	−0.479	−0.511	−0.507	−0.444
RT8	0.860	1.028	0.939	0.872	0.909
N			327		
		East German Regions			
constant	**61.506**	**74.249**	**68.189**	**61.516**	**61.551**
unempl. rate	**−0.345**	**−0.321**	**−0.336**	**−0.339**	**−0.342**
ln wage	**0.161**	**0.162**	**0.162**	**0.157**	**0.157**
ln(D5/D2)	0.508	0.983	0.642	0.639	0.400
ln((D8/D5)	1.948	2.523	2.661	1.836	1.990
RT1	0.751	0.293	0.570	0.563	0.563
RT2	−0.003	0.275	−0.004	−0.094	−0.073
RT3	−0.740	−0.374	−0.754	−0.801	−0.765
RT4	**−5.148**	**−5.115**	**−5.182**	**−5.210**	**−5.215**
RT5	2.980	2.525	2.792	2.690	2.691
RT6	0.037	0.154	0.057	−0.014	0.011
RT7	−1.089	−0.936	−1.055	−1.114	−1.117
RT8	−1.745	−2.422	−2.037	−1.807	−1.816
N			111		
		test statistics			
s.e.	5.266	5.192	5.244	5.260	5.256
ln Likelihood	−1349.166	−1344.329	−1347.790	−1348.798	−1348.606

Notes: See table 2.

Table 4: Classification of regions

| District type (BBR-Classification)	Description of region type (BBR)
Regions with large agglomerations	
BBR1	Core cities
BBR2	Highly urbanized districts in regions with large agglomerations
BBR3	Urbanized districts in regions with large agglomerations
BBR4	Rural districts in regions with large agglomerations
Regions with features of conurbation	
BBR5	Central cities in regions with intermediate agglomerations
BBR6	Urbanized districts in regions with intermediate agglomerations
Regions of rural character	
BBR7	Rural districts in regions with intermediate agglomerations
BBR8	Urbanized districts in rural regions
BBR9	Rural districts in rural regions
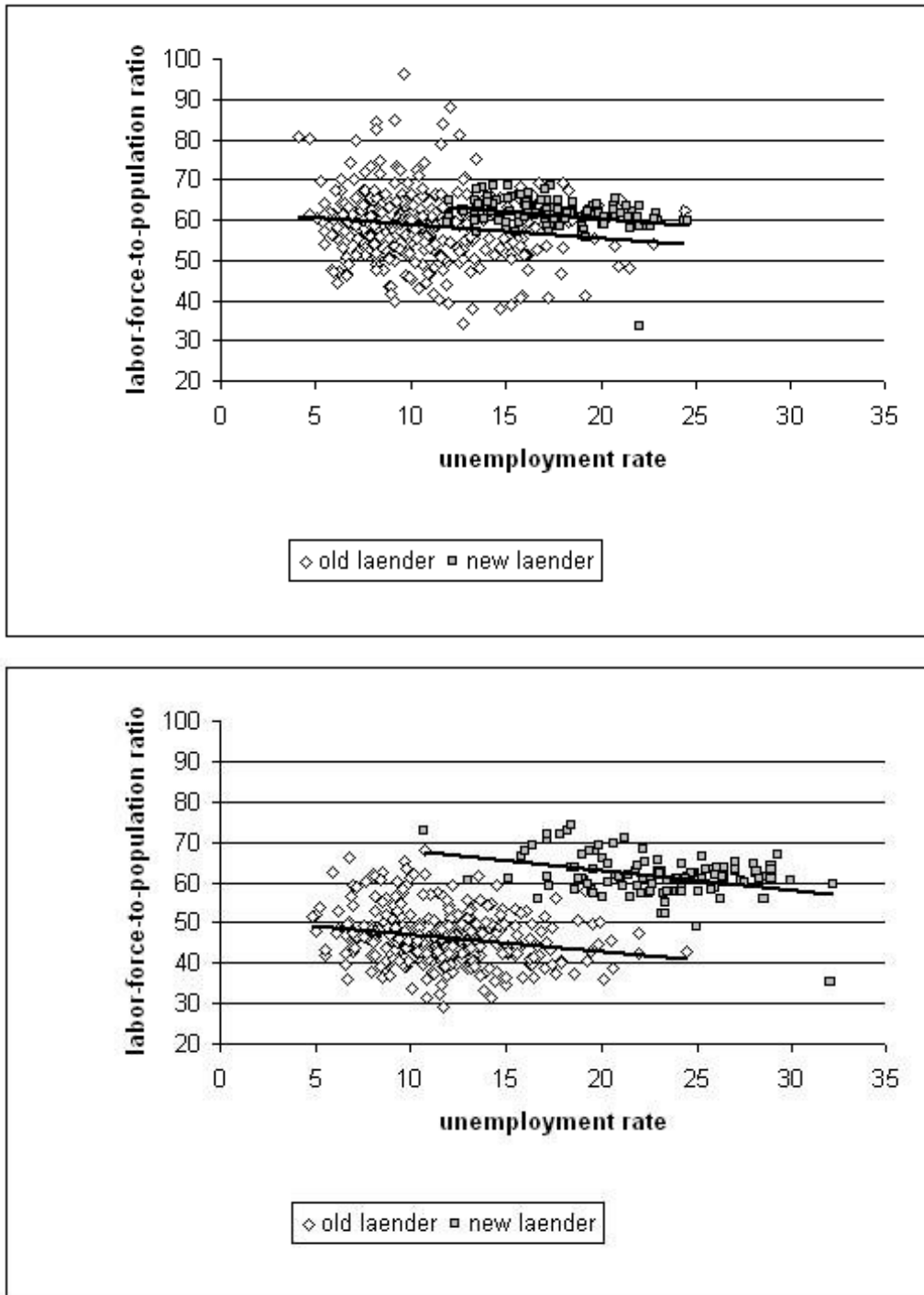
Figure 1: The unemployment rate and the labor-force-to-population ratio in West and East Germany for male (upper panel) and female workers (lower panel) (438 NUTS-3-regions/ counties, 1998)
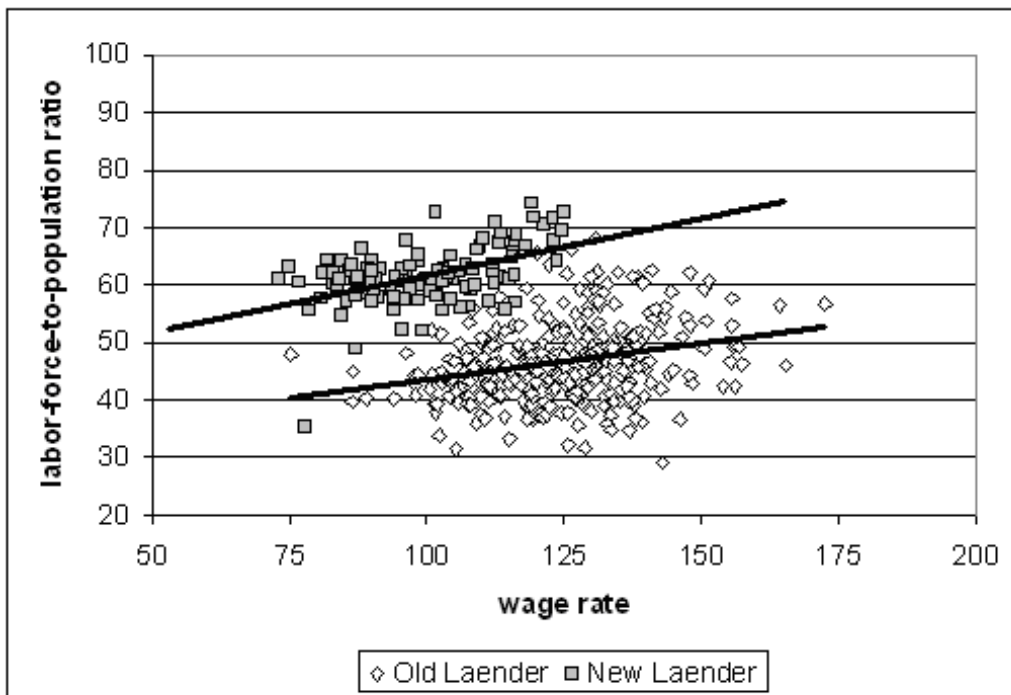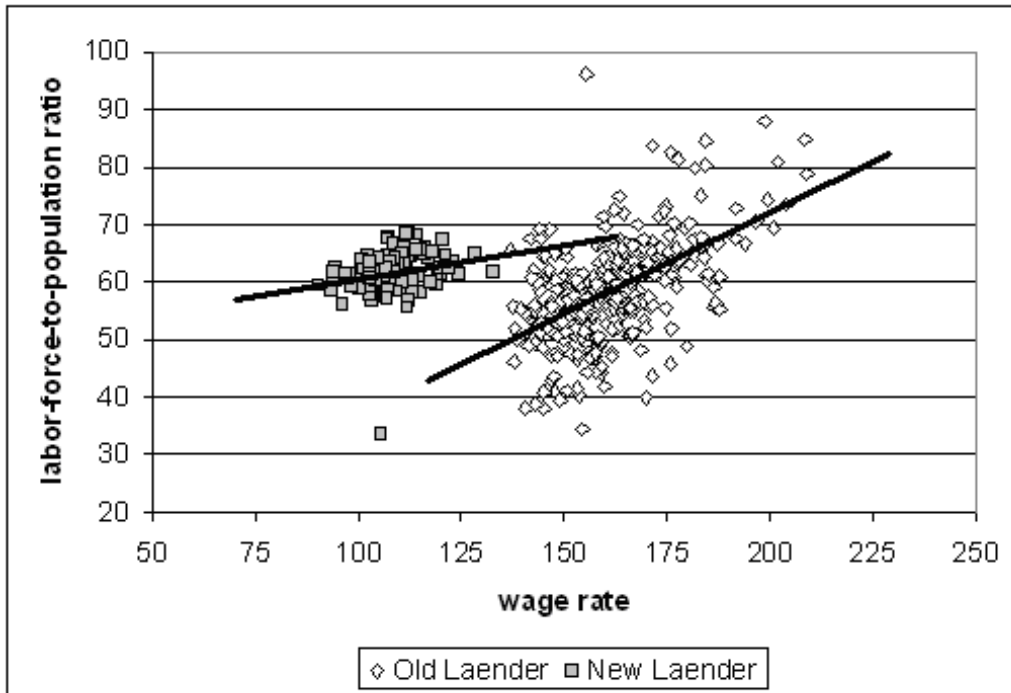
Figure 2: D5/D2 wage inequality and the labor-force-to-population ratio in West and East Germany for male (upper panel) and female workers (lower panel) (438 NUTS-3-regions/ counties, 1998)