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Abstract

According to the often cited rent-sharing theory of multinational firms they transfer superior technology to their foreign affiliates, enabling higher productivity of employees and their higher wages. But oftentimes studies have shown that, this effect does not stem from foreign ownership per se, but from other characteristics, which are positively related to wages and are more prevalent in foreign than in domestically owned firms (for example size, capital intensity, focus on high wage industries, etc.). However, recent research argues that large shareholders (foreign or domestic) differ from each other, and that changes in companies' policy are greater in the presence of specific groups of active blockholders (Bertrand, Mullainthan, 2003, Cronqvist, Fahlenbrach, 2007).

The aim of our paper is to disentangle the relationship between ownership and wages for the Slovenian joint stock companies using cross-section data, while accounting for spatial dependencies in wage determination. Space in this paper is not considered in a geographical context, but as a set of relations between companies originating from same blockholder. We apply methods of spatial econometrics while giving more attention to the creation of "shareholder" spatial connectivity matrix. This is the first time to use Slovenia as a research playground for spatial analysis in an economic setting.

Keywords: Spatial econometrics, ownership, wage differentials, wage spillovers

JEL codes: C21/C23; F21; J31

1 Introduction

Why do some companies pay higher wages to their workers than others? Differences in wages can usually be explained by differences in capital intensity, productivity, education of workers, firm size etc. Globerman et al. (1994) find that foreign companies do pay higher wages than their domestic counterparts, which is explained by above mentioned factors. He claims that foreign firms pay wage premium because they are larger, more productive, and more capital intensive. Similarly, Lipsey and Sjöholm (2004) have shown that 6 to 7 per cent wage premium in industry sector disappear after controlling for firm size. A review of more recent research (eg. Heyman et al., 2004) reveals that wage differences can be explained by individual effects. In this paper an attempt has been made to model relations between corporations using spatial econometric techniques. For that reason a special connectivity matrix has been developed where measure of geographical distance is replaced by "*capital distance*" and neighbourhood is defined as "*having the same owner*". Matrix is later on used in an estimation of wage equation. Findings are interesting since they confirm that proximity in a "*capital space*" matters and that further research in that field is needed.

2 Wage Equation

Even beyond factors that imply higher wages such as size, productivity and capital intensity there exists theoretical foundations for the empirically unexplained notion that foreign firms still seem to be paying higher wages than domestically-owned firms:

1. Rent – sharing hypothesis, based on the internalization theory of FDI (Dunning, 1989; Caves, 1996) assumes that the possession of firm-specific, largely intangible assets (such as brand name, organisational advantages …) is necessary for companies becoming multinationals, as they help to overcome the inherent disadvantages of foreign firms in the host country. If these are transferred to subsidiaries in the host countries, we can expect their advantage over indigenous firms to translate into higher marginal productivity and relatively higher wages of workers in foreign firms. Additionally, in order to discourage costly worker turnover and thereby prevent leakage of firm-specific assets to competing firms, foreign firms are often willing to pay higher wages (Fosfuri et al., 2001).

2. Increased labour demand is based on the assumption of non-competitive labour markets. If the labour supply curve is upward sloping, then any additional production facility, such as foreign greenfield investment, or production expansion of firms, acquired by foreigners, will increase labour demand and result in higher wages for marginal workers (Martins, 2004).

3. Workers heterogeneity: it may be the difference in the average characteristics of workers in foreign and domestic firms that drives the pay gap, and not foreigners per se. For example,

multinational firms may employ higher skilled labour (Almeida, 2003), but since worker ability and skills are often imperfectly measured, it is possible that this could explain at least a part of the unexplained wage gap.

4. Other competing hypothesis, such as internal fairness policy (Navaretti, Venables, 2004) the hypothesis of monopsony position of foreign multinational companies (MNCs) in the labour market, their stronger bargaining power, ..., give us competing motives, arguments and theories to explain why foreign firms would pay higher (or even lower) wages than domestic firms, none in general superior to the other. If foreign firms do in fact pay relatively higher wages, remains

Whether the finding of foreign-owned firms being on average larger, more productive, more capital intensive and paying higher wages survives econometric scrutiny will be discussed later, but the overall impression is best put in the words of the most fruitful researchers in this area, who conclude: “If regions or countries encouraging inward investment are interested in encouraging high-wage plants, foreign investors seem to meet that desire.” (Lipsey, Sjöholm, 2004). Reviewing empirical literature, the following controls and econometric methods were found to be relevant in the estimation of the causal impact of the ownership on wages (at firm or worker level):

1. Firm size: The size-wage premium is empirically and economically large (Gaston, Nelson, 2001), and not controlling for the size of companies would in any case mean creating the possibility of an upward bias in the wage premium estimate.

2. Productivity: Based on the internalisation theory, it is reasonable to expect that more productive workers with higher marginal products in companies will receive higher compensations.

3. Location: It is likely that companies will be more attracted to regions or states with higher agglomeration of activity and higher level of development, which are often high-wage locations (Fujita et al., 1999; Driffield, Taylor, 2000). Hence, location (usually regional) variables can be important controls in the wage regression, if labour markets are segmented.

4. Nationality of the owner: Companies of different nationalities have been found to employ different management techniques, organizational routines and production systems (eg. lean production of Japanese firms) and employment and working practices. Consequently, the wage differential, along with productivity differences between domestic and foreign firms, can vary by foreign investor’s country of origin. For example, when disaggregating foreign

multinationals by nationality, Ramstetter (2004) finds significant differences in terms of the effect of both labour productivity and wages in Thai manufacturing[1].

5. Worker characteristics: Although the majority of research concludes that foreign companies pay relatively higher wages, even within industry and regions and controlling for the observed and unobservable firm characteristics, it remains unclear in most studies whether they pay higher wages to identical workers. In fact, Navaretti and Venables (2004) conclude that skilled workers are more likely concentrated in MNCs. Hence, part of the observed foreign wage premium might be explained by worker characteristics (Aitken et al., 1996; Lipsey, Sjöholm, 2002; Te Velde, Morrissey, 2001; and Cengodi et al., 2003).
In order to analyse the effect of ownership on wages, estimations were based on the following cross-section data model:

$$\ln(w) = \alpha + \beta X + \varepsilon \qquad (1)$$

where *ln(w)* denotes the average real wage rate of firm *i*, *X* is a vector of firm level variables which includes log values of sales, labour productivity, capital intensity, dummy variables for region and three-digit NACE industry-level sectors.

Ownership, which is not included in the above presented equation, is included later on after discussing the connectivity matrix and some basic spatial econometric concepts. Regional dummies ought to control for the differences in the regional distribution of firms while the industry dummies control for differences in the sectorial distribution of firms. α_i is a variable of permanent firm-specific effects and ε is the error term, assumed to be distributed normally with zero mean and constant variance σ^2_ε.

3 Weights Matrix

Weights (*W* or connectivity) matrix in this paper is a key component in modelling the relation between companies' ownership and performance; this section is hence dedicated to the presentation of some assumptions and processes behind the creation of such a matrix. First assumption is that any pair of firms are neighbours if they share a common owner or in other words if they are placed in an owners' neighbourhood *N(i)*.

$$w_{ij} = \begin{cases} \omega & if\ j \in N(i) \\ 0 & otherwise \end{cases}, \ j \neq i \qquad (2)$$

[1] On the other hand, Globerman et al. (1994) find no significant productivity or wage differential based on the nationality of ownership in Canada.

The second assumption is about the symmetry of the matrix, which implies that owner's influence between any pair of firms is the same in both directions, while the third assumption is that weights can be summed; this comes handy when two firms have at least two owners present in both firms.

Given these three basic assumptions we can show how the W-matrix can be created in "*capital space*", while leaving out the key component of calculating elements of the matrix, presented in the following section. To simplify the calculation, real data was not used to show the process, but the same logic was applied to the full sample. In Table 1 there are 4 firms, each with 2 owners (O_A and O_B) and their share of stock C.

Table 1: Input data for W-matrix

Firm	O_A	O_B	C_A	C_B
1	1	2	C_1	$1-C_1$
2	2	3	C_2	$1-C_2$
3	3	1	C_3	$1-C_3$
4	2	1	C_4	$1-C_4$

Since same owners are present in different firms it is possible to create "*capital space*" matrix based on the input data. First, if we only use assumption 1 and 2 we can see that firm *F1* has 4 connections: two connections originating from owner *O1* and two from owner *O2*. Since firms *F2* and *F4* have the same owners (*O1* and *O2*) we can sum the weights which lead us to the following specification of the matrix.

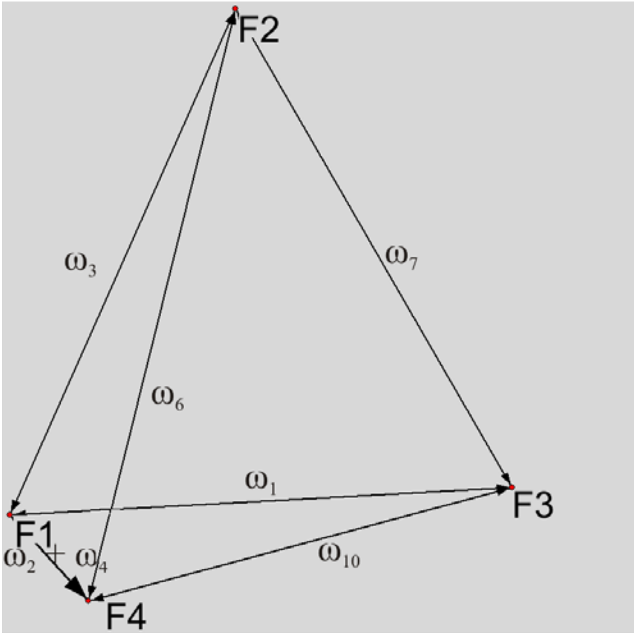
Table 2: W-matrix

	1	2	3	4
1	0	ω_3	ω_1	$\omega_2 + \omega_4$
2	ω_3	0	ω_7	ω_6
3	ω_1	ω_7	0	ω_{10}
4	$\omega_2 + \omega_4$	ω_6	ω_{10}	0

Source: Author's own source

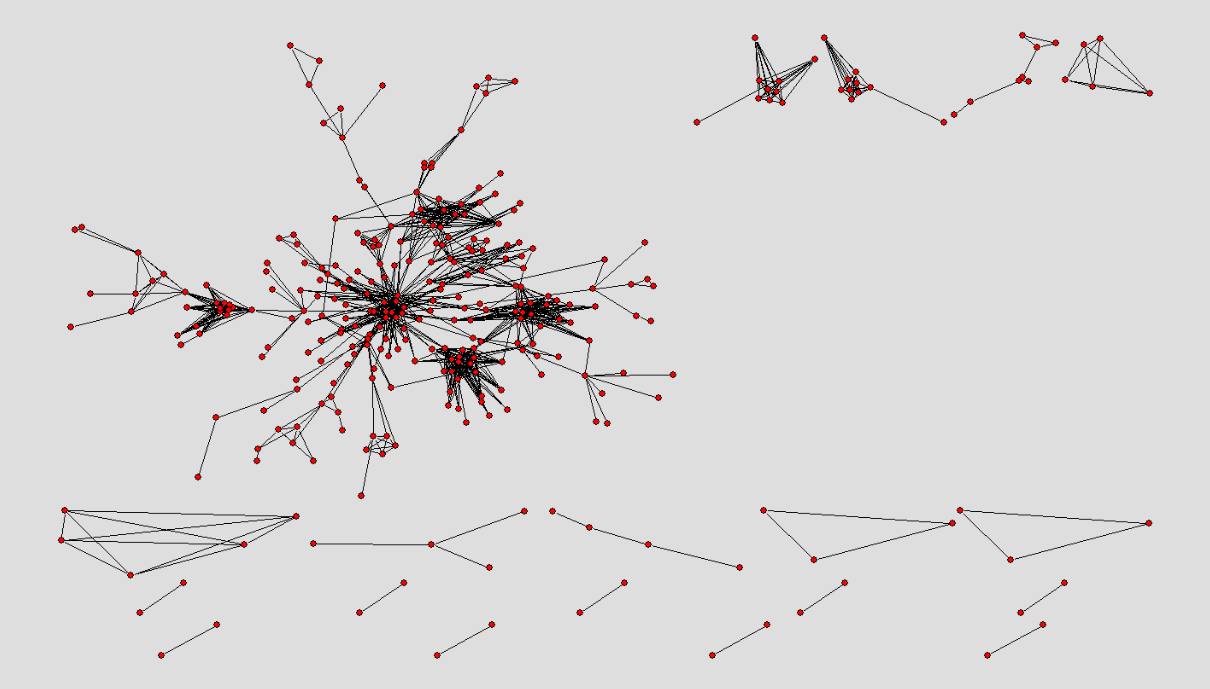
A quick glance at Table 2 reveals that diagonal elements are 0, since a firm cannot be a neighbour to itself, and that elements belonging to firm *F1* and *F4* are the sum of weights belonging to owners *O1* and *O2*, which are present in both firms. Table 2 can be drawn in a two-dimensional space where weights represent the distances between units as it is shown on Figure 1.

Figure 1: Graphical representation of W-matrix



To calculate each element of the *W*-matrix we used the simplest form of averaging the owners' shares. We could use a product of owners' shares ($\omega = (C_1 + C_2)/2$; $\omega = (C_1 \times C_2)$ ...), but it would pose a small problem with assumption 3. Also a cut-off point has been left out implying that even the smallest owner has some influence of firm's policy. This could be the issue if all the stock owners of the company were used, but since only largest 5 were used, this is not an issue. For the ease of interpretation the relations from *W*-matrix can be presented in a graphical context with spatial features or coordinates. In the context of wage determination it can be tested whether companies that are closer choose to determine wages similar to their surroundings. Figure 2 shows the relations originating from ownership on the whole Slovenian set of joint stock companies. Using the assumptions presented above and software called Pajek it is possible to draw the relations in a two-dimensional space using Kamada-Kawai (2006) separate components technique.

Figure 2: Graphical representation of W-matrix (real data)



Source: KDD, 2004; Author's own calculation

4 Methods: Spatial models

Spatial models have been developed to deal with dependencies taking place in space. Interactions among (spatial) units are modelled by introducing the connectivity (or spatial weights) matrix *W*, which imposes the structure of spatial interactions.

In the context of spatial econometrics, the weight matrix is transformed into a spatial lag, which is the average of the neighbouring units if the weight matrix is row standardized. Row standardization means that:

$$w_{ij}^{*} = \frac{w_{ij}}{\sum_j w_{ij}} = \frac{w_{ij}}{\eta_i} \qquad (3)$$

where $\sum_j w^{*}_{ij} = 1$.

4.1 Spatial autoregressive model (SAR)

In the specification of the Spatial lag model (SAR – spatial autoregressive model), spatial dependency concept means that the dependent variable is not defined only by the set of exogenous explanatory variables, but also by the value of the dependent variable in surrounding units, and this spatial dependence is given by the parameter on endogenous spatial lag (Wy). The SAR model for wage equation to be estimated is:

$$\ln(w) = \alpha + \beta X + \lambda \sum w_{ij} \ln(w) + u_i \quad (4)$$

where w_{ij} represents elements of connectivity matrix W and ρ is the autoregressive spatial parameter, corresponding to the intensity of inter-firm wage interactions.

The spatial lag parameter in the dependent variable (ρ) determines the strength of the average (across all units) association between setting of wages for a firm i and the average of those wages for their neighbouring units (Fischer, Getis, 2010).

The simultaneity between the spatially lagged variable Wy and the error term presents an obvious violation of the Gauss-Markov assumptions for the classical econometric methods (OLS), which means that alternative estimation methods (e.g. maximum likelihood) must be used.

4.2 Spatial error model (SER)

Spatial dependence can also be present in the form of spatially autocorrelated errors, which can be decomposed to

$$\varepsilon_i = \rho \sum w_{ij} \varepsilon_j + u_i , \quad (5)$$

where ρ is the spatial autoregressive coefficient and u is the vector of *i.i.d.* errors. Inserting the spatially lagged error term in the wage equation leads to specification of the SER model:

$$\ln(w) = \alpha + \beta X + \rho \sum w_{ij} \varepsilon_i + u_i \quad (6)$$

The SER model may be preferred when the autocorrelation is viewed more as a nuisance than a substantial parameter, which means that a random shock (in our case owners influence) in a firm affects wages in that firm and additionally impacts all other firms. The problem with SER model is that it often only reflects a common reaction of joint stock companies due to undefined, spatially correlated omitted variables. Although the empirical studies largely prefer the SER specification, this model has a smaller theoretical and interpretational meaning as SAR (Fingleton, López-Bazo, 2006).

4.3 SARAR models

In our econometric estimation of wage equation, we combined the above models by employing the SARAR model specification of a Cliff and Ord-type (Kelejian and Prucha, 1998; Anselin and Florax, 1995), which simultaneously allows for spatial lag in the dependent variable as well as lag in disturbances, giving the following wage equation:

$$\ln(w) = \alpha + \beta X + \lambda \sum w_{ij} \ln(w) + \rho \sum w_{ij} \varepsilon_i + u_i \qquad (7)$$

We further allow for processes where the innovations in the disturbance process are assumed to be heteroskedastic of an unknown form:

$$\varepsilon \sim N(0,\sigma_i) \qquad (8)$$

by estimating the SARAR models as a generalized spatial two step least squares model, which is a two steps procedure, alternating of GM and IV estimators and giving a consistent and efficient estimator (Kelejan, Prucha, 1998; Anselin, Florax. 1995)[2].

5 Data

Data used in the study comes from Central Securities Clearing Corporation[3] for the year 2004 containing all 644 joint stock companies present in Slovenia at that time. For each company five largest stock owners and their shares (number, value, and share) are given. As stated above variables used in explaining wage (*WAGE* in 1000 SIT) variability are number of workers or employees (*EMP*), sales (*Q* in SIT), capital intensity (*KINT*), labour productivity (*LPROD*), sector and region dummies. Firm level data comes from AJPES database. Basic statistics are given in Table 3.

[2]SARAR models with heteroskedastic innovations were estimated in R, using package “sphet”(Piras, 2009).
[3] *Centralna klirinško depotna družba* – KDD (slov.)

Table 3: Basic statistics

	WAGE	Q	EMP	LPROD	KINT
Min	593	32858	1	41	158
Max	14478	320771632	7301	224489	1413088
Average	3170	7794606	301	7187	42461
StDev	1565	23999027	595	14521	139892

Source: KDD, 2004; Author's own calculation

Although there were 644 joint stock companies operating in Slovenia in 2004, it was only possible to use 423 companies in the sample due to non-repeating owners in some firms. This implies that some firms did not have any neighbours and were left out for that reason (islands). Also profit was not included in the estimation since negative values cannot be transformed using a logarithmic function. Basic statistics reveal that there is a large variation in all the variables used in the estimation. Average yearly gross wage (*WAGE*) in the reduced sample was 3,170,120 SIT with standard deviation of 1,565,455 and minimum and maximum value corresponding to 592,649 and 14,478,200 SIT. Similar can be said for sales (*Q*), employment, labour productivity and capital intensity.

6 Results

Results from spatial models are presented in Table 4. All three above presented models were estimated: spatial autoregressive model, spatial error model and a combined, SARAR model, all with heteroskedastic errors of unknown form. Coefficients of interest are in our case lambda and rho which indicate whether or not stock owners have any effects on wage setting in a given firm where they have a significant share. Although all models explain the wage setting fairly well, with R square around 0.73, we believe the right specification of the model is spatial autoregressive model (SAR – spatial lag model) since SARAR model has only one significant spatial coefficient, lambda. This is additionally confirmed by Lagrange multiplier test (LM test) which is statistically significant in all three cases, while robust version points to SAR specification. This finding, regardless of the model we choose, provides an insight that joint stock companies are not independent units as considered in many empirical studies but are connected through the influence of their shareholders. For that reason more research is needed to obtain individual owner or stockholder effects.

Results from the view of the standard variables used in explaining the wage variation are mostly in line with expectations. Estimates of models' coefficients and their p-values (in brackets) reveal that more productive, more capital intense companies pay higher wages to their workers. Similarly, firms with higher amount of sales pay higher wages, while employment has a negative effect and is not in line with standard theory. This could be a consequence of previous socialist regime, where employment was kept high at all costs, and is still persistent in some state-owned enterprises. As already mentioned, main result are the two spatial coefficients; *lambda* and *rho*. In the case of SAR model lambda is estimated at 0.237 and is statistically significant, which implies that large stock owners either choose firms that set wages similarly or that they influence wage policy similarly in the joint stock companies where they have a significant share.

Table 4: Results

	SARAR	SAR	SER
(Intercept)	3.598	3.448	5.342
	(0.000)	(0.000)	(0.000)
LLPROD	0.108	0.109	0.110
	(0.000)	(0.000)	(0.000)
LKINT	0.079	0.079	0.082
	(0.000)	(0.000)	(0.000)
LEMP	-0.146	-0.145	-0.140
	(0.000)	(0.000)	(0.000)
LQ	0.134	0.134	0.130
	(0.000)	(0.000)	(0.000)
lambda	0.218	0.237	-
	(0.001)	(0.001)	
rho	0.072	-	0.256
	(0.502)		(0.001)
region dummies	yes	yes	yes
sector dummies	yes	yes	yes
LM test	12.409	10.616	9.411
	(0.002)	(0.001)	(0.002)
Robust LM test		2.998	1.794
		(0.083)	(0.181)
R^2	0.740	0.734	0.730

Source: KDD, 2004; Author's own calculation

Conclusion

This paper is a presentation of spatial connectivity matrix defined on a capital space. By trying to answer the question why some corporations pay higher wages to their workers than others, it was found that differences in wages can usually be explained by differences in capital intensity, productivity, firm size all statistically significantly explain wage variability, which is in line with previous empirical research and theory.

The additional insight into the topic offered by this paper is an attempt to model relations between corporations using spatial econometric techniques. Proximity of corporations is defined as an average of shares of the same owner present in different joint stock companies. In this sense, a special "capital world" connectivity matrix has been developed where measure of geographical distance is replaced by "*capital distance*". Although there are still open issues on the method of calculating *n* element of the connectivity matrix, results reveal that stock owners do matter in the process of wage setting in joint stock companies in Slovenia. Another finding is that these companies are not independent and hence standard (OLS) estimation procedures are not valid in similar cases.

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