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Spatial determinants of sectors' wage inequities: Analysis for the region of Croatia

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Regional disparities within the countries appear to persist or even to grow. One of the most important indicators of the disparities is regional wage level. It is widely accepted that spatial effects have a different impact among sectors in developed countries. The traditional core-periphery pattern of manufacturing is weakening which tends to work towards regional convergence. On the other hand, service industries continue to concentrate in high-density areas thus reinforcing divergence. Compared to developed, less developed countries have different economic path. Thus, it is reasonable to test the influence of spatial effects among sectors for a less developed country such as Croatia.

This paper uses NUTS3 sub-regional data for Croatia to investigate the sources of the regional wages differences on the sector level from year 2000 forward. The recent literature recognizes two main determinants of spatial differences in wages; namely, the productivity and occupational composition. Therefore the paper uses shift-share analysis to decompose the spatial variation of wages into productivity effect and occupational composition effect exploring how the spatial variance in wages is attributable to variations in these effects among different sectors.

In the last step of the paper we examine the relationship between these two determinants of spatial differences and the proximity to economic mass instrumented by different measures of urbanization in the NUTS3 sub-regions.

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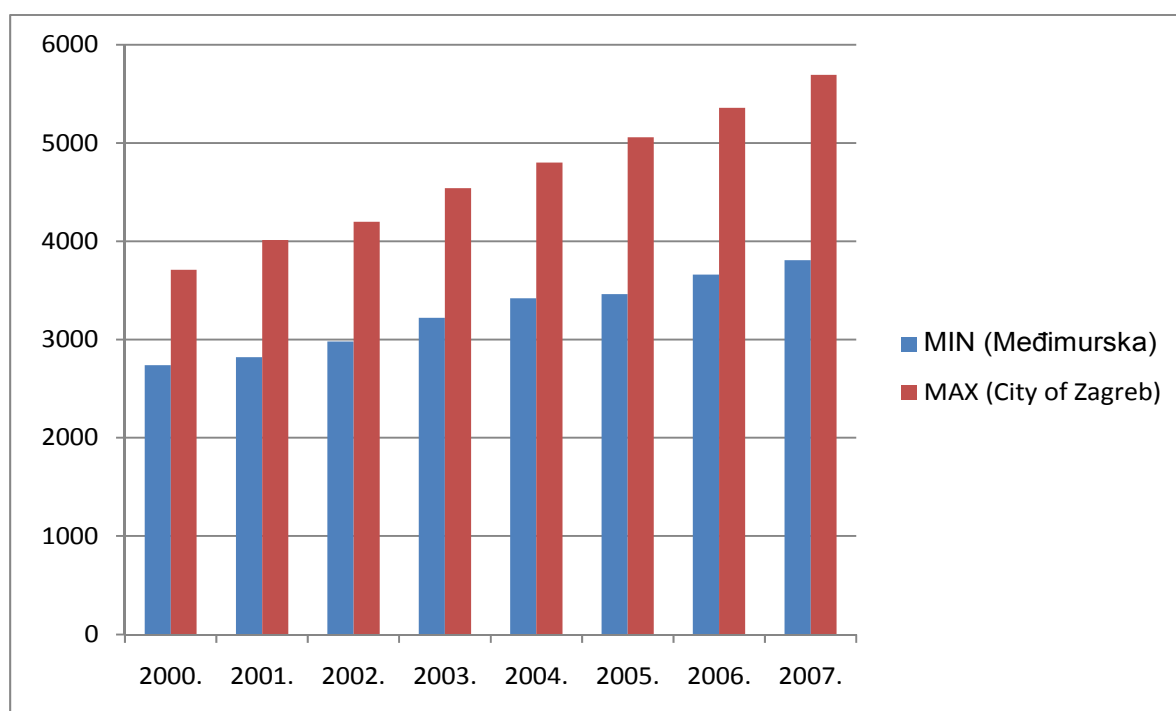
The aim of the paper to explore a new role of government and institutions in regional policy making, taking into account different paths of influence of government and public institutions on productivity and on occupational composition among different sectors.

1. INTRODUCTION

Regional inequalities are persistent feature of many economies, especially in less developed countries. One of the most important indicators of the inequalities is regional wage level. It is widely accepted that spatial effects have a different impact among sectors in developed countries. The traditional core-periphery pattern of manufacturing is weakening which tends to work towards regional convergence. On the other hand, service industries continue to concentrate in high-density areas thus reinforcing divergence. Compared to developed, less developed countries have different economic path. Thus, it is reasonable to test the influence of spatial effects among sectors for a less developed country such as Croatia.

The starting point of the study is well documented growing disparities in wages across the Croatian NUTS III regions for period 2000 – 2007 (Table 1.)

Table 1. Average monthly wages (in kunas), NUTS III regions, period 2000 – 2007



Source: Republic of Croatia - Central bureau of statistics

Thus in 2007 maximum average wage (city of Zagreb) was among Croatian NUTS III regions 49,5 % higher then the lowest average wage (county of Međimurska). Taking into consideration that the ratio was increased by 39,8 % from 2000 till 2007 it is easily to conclude that growing disparities in wages are significant source of considerable policy concern.

To explain large spatial wage disparities three broad sets of explanations can be proposed (Estaban, 1999).

First, differences in wages across areas could directly reflect spatial differences in **productivity of the workforce**. Thus, it can be that in this region productivity per worker is above the mean of Croatia.

Next explanation for wage differences is the **occupational composition of employment**. It implies that industries are not evenly distributed across areas and require different labor mixes. Consequently, we expect a higher mean wage in areas specialized in more skill-intensive industries. (Rice et al.; 2006.) For instance, the average productivity in agriculture, in industry or in the service sector could be identical across the regions. Yet, the regions specialized in services would have an average wage per worker higher than those specialized in agriculture.

Last possible source of wage differences is variation in **local amenities**. Amenities come in two kinds, although some are a mixture of both: consumption amenities increase household welfare, raising quality of life, and production amenities lower costs, raising productivity (Albouy 2009.). The values of the local amenities are reflected in local wages, as firms pay less in areas with consumption amenities.

Due to data limitations we take into consideration only first two sources. The recent literature (Combes et al., 2003.) indicates that amenities only appear to play insignificant role.

The present article extends the literature in two directions. The first direction is addressed by *disintegrating the economy of Croatia* in three (four) groups of sectors; (*agriculture*) *manufacturing sector, market services and non-market services* and decomposing the average earnings of each group on NUTS III region (county) level into a productivity effect and an occupational composition effect appreciating different determinants of each effect and therefore different implications for policy makers.

The article in second stage concentrates on occupational composition index for different sectors (sector composition index) or to be more precisely on relationship between these indexes and economic mass instrumented by specific measure of urbanization in the NUTS3 sub-regions in Croatia.

The paper is organized as follows. The next section covers data and descriptive issues, and derives data for decomposition of earnings into occupational composition effect and productivity effect for different sectors (agriculture, manufacturing, market services and non-

market services). The brief history of analysis of regional wage differences regarding shift-share analysis is reported in Section 3. Section 4. concentrates on relationship between sector composition index for different group of sectors and economic mass presented with a measure of urbanization, concentrating especially on non-market sector. Section 5 presents conclusion with directions for improving efficiency of regional policy.

2. DATA AND VARIABLES CONSTRUCTION

In the paper we have used panel data¹ for the subregional NUTS3 spatial units of Croatia, for the period 2000 – 2007, provided by Central Bureau of Statistics. Exception are variables for specific measure of urbanization. They cover period 2001 – 2007. In Croatia, NUTS3 subregional unit is the level of county. In the analysis we used data for all 21 counties. Variables are disaggregated two times. Firstly into 17 activities (occupations) according to National classification of activities 2002 and then in second stage these 17 activities are grouped into three (four) sectors: **(agriculture), manufacturing, market services and non-market services**.

The starting points for the modeling in the paper are articles: **Spatial determinants of productivity: Analysis for the regions of Great Britain** by Rice et al. and **Regional convergence in Europe and the industry mix: a shift-share analysis** by J. Estaban. In later author presents modified shift – share analysis originally proposed by Dunn (1960) and it was foundation for former paper where authors present model which spatial variation in average earnings derives from two sources—differences in the wage rates paid to workers in a given occupation (productivity), and differences in the occupational composition of employment (occupational composition).

Following papers by Rice et. al. and Estaban we present mechanical decomposition for separating contributions to the spatial structure of average wages on **occupational composition index (OCI), productivity index (PI) and allocative index (AI)**. Symbols w_{ijt} and p_{ijt} denote the wage and level of employment in occupation j and area i for a period t . The average wage and average level of employment of occupation j for a period t in the economy as a whole (i.e. aggregating across all i) is given by w_{jt} and p_{jt} . Thus the following

¹ The main advantages of using panel data are capturing both cross-section and time-series variation as well as allowing for meaningful inference using a sample with a relatively small number of cross-section observations over a short time period. Allowing for dynamics in the underlying process is relevant not only to infer on the persistence of the series but also to ensure that the estimates for other parameters are consistent.

equalities present average wage in Croatia for a period t as w_t and average wage for NUTS III region (county) i for a period t with **wit**:

$$w_t = \sum_j p_{jt} w_{jt} \text{ and } w_{it} = \sum_j p_{ijt} w_{ijt} \quad (1)$$

Now it is possible to define the three components of the regional deviation in wages.

The occupational composition index represent by **OCI**_{it} measures the differential wages accruing from region i's specific occupation composition in period t, assuming that occupation productivities in each region are equal to the Croatian averages for the same period. We thus write:

$$OCI_{it} = \sum_j (p_{ijt} - p_{jt}) w_{jt} \quad (2)$$

OCI_{it} takes positive values if the region is specialized ($p_{ijt} > p_{jt}$) in occupation with high wages at the Croatian level and de-specialized ($p_{ijt} < p_{jt}$) in occupation with low wage levels.

OCI_{it} is at the maximum if the region is specialized in the occupation with the highest wage in Croatia.

The productivity index component PI_{it} presents contribution of occupation productivity differences to the shift between regional and national average wages, on the assumption that the region's occupational composition coincides with national one. We then define PI_{it} as:

$$PI_{it} = \sum_j p_{jt} (w_{ijt} - w_{jt}) \quad (3)$$

PI_{it} is positive if the region has occupation productivities above the Croatian average.

The allocative component AC_{it} is defined as:

$$AC_{it} = \sum_j (p_{ijt} - p_{jt})(w_{ijt} - w_{jt}) \quad (4)$$

This component is an indicator of the efficiency of each region in allocating its resources over the different industrial occupations and can also be viewed as measuring the covariance between occupations specialization and productivity advantages.

Regarding the aim of the paper, or to be more precisely the analysis of the relationship between these indexes on **the level of sector** and economic mass instrumented by specific measure of urbanization in the NUTS3 sub-regions in Croatia, it is necessary to group the abovementioned activities into three (four) sectors. Considering the data limitations we offer four different options for this procedure introduced in **Table 2**. Due to grouping activities into

sectors it is necessary to adopt the mechanical decomposition. The adjustment is introduced in following manner:

The sector composition index represent by SCI_{it} measures the differential wages accruing from region i's specific sector composition in period t, assuming that sectors productivities in each region are equal to the Croatian averages for the same period². We thus write:

$$SCI_{it} = \sum_j (p_{ijt} - p_{jt}) w_{jt} \quad (5)$$

SCI_{it} takes positive values if the region is specialized ($p_{ijt} > p_{jt}$) in sectors with high wages at the Croatian level and de-specialized ($p_{ijt} < p_{jt}$) in sectors with low wage levels. SCI_{it} is at the maximum if the region is specialized in the sectors with the highest wage in Croatia.

The productivity sector index component PSI_{it} presents contribution of sectors productivity differences to the shift between regional and national average wages, on the assumption that the region's composition coincides with national one. We then define PSI_{it} as:

$$PSI_{it} = \sum_j p_{jt} (w_{ijt} - w_{jt}) \quad (6)$$

PSI_{it} is positive if the region has sectors productivities above the Croatian average.

The allocative sector component ASC_{it} is defined as:

$$ASC_{it} = \sum_j (p_{ijt} - p_{jt}) (w_{ijt} - w_{jt}) \quad (7)$$

Interpretation of the ASC_{it} should also be readjusted according aforesaid manner.

² For clarification it is relevant to indicate that each sector could be defined as sum of activities ($S_n = \sum_1^m j$)

where n stands for sectors (agriculture, manufacturing, market services, non-market services) and m for number of activities in each sector.

Table 2. Grouping activities from National classification of activities 2002 into sectors

Activites (occupations)	I.option	II. Option	III. Option	IV. Option	
Agriculture, hunting and forestry	Agriculture	Agriculture	Manufacturing	Manufacturing	
Fishing		Agriculture			
Mining and quarrying	Manufacturing	Manufacturing			
Manufacturing					
Electricity, gas and water supply					
Construction					
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	Market services	Market services	Market services	Market services	
Hotels and restaurants					
Transport, storage and communication					
Financial intermediation					
Real estate, renting and business activities					
Public administration and defence; compulsory social security	nonmarket service	nonmarket service	nonmarket service	nonmarket service	
Education					
Health and social work					
Other community, social and personal activities		Market services			Market services
Private households with employed persons		nonmarket service			nonmarket service
Extra-territorial organizations and bodies		nonmarket service			nonmarket service

Source: Central Bureau of Statistics of Croatia and authors analysis

3. DECOMPOSITION OF REGIONAL WAGE

In this section it will be provide theoretical and empirical evidences for modeling the determinants of wage differences according shift – share analysis.

Theoretical foundations have been presented in the articles: *Spatial determinants of productivity: Analysis for the regions of Great Britain* by Rice et al. and *Regional convergence in Europe and the industry mix: a shift-share analysis* by J. Estaban and it could be summarized by central equation (8):

$$w_{it} = \alpha + OCI_{it} + PI_{it} + AC_{it} + \varepsilon_{it} \quad (8)$$

where w_{it} stands for average wage in region i for period t , OCI_{it} for occupational composition index, PI_{it} for productivity index, AC_{it} for allocation index all for county i and period t . Constant term is presented by α and error term by ε_{it} for county i and period t .

The next step implies empirical confirmation of the equation (8). Evidence could be found in abovementioned articles. In paper by Rice et. al. productivity index and occupational index have been confirmed for NUTS3 sub-regional data for Great Britain. J. Estaban in his attempt to elucidate the extent to which existing interregional inequality per worker within the EU can be attributed to differences in the sectoral composition of activities, rather than to productivity gaps that are uniform across sectors has also provided evidences for shift – share analysis for EU regions.

Additional empirical argument is introduced by paper *Sources of spatial differences in wages: Analysis for the regions of Croatia* by Muštra et al. where abovementioned methodology was tested for NUTS III regions of Croatia. Thus, the exiting literature supports significance of productivity effect and, for our paper more important, **occupational effect for regional wage differences for developed and less developed countries.**

4. AGGLOMERATION ECONOMIES AND SECTOR COMPOSITION EFFECT

Taking into consideration previous confirmation of occupational index it is possible now to focus on main contribution of the paper, **empirical confirmation that sector composition index is influenced by economic mass instrumented by share of urban population and that this influence is different among sectors**³.

Starting point for the empirical confirmation is the model with the structure:

$$SCI_{it} = \alpha + X_{it}^T \beta + \delta Share_Urban_primacy_{it} + \varepsilon_{it} \quad (9)$$

where X_{it}^T presents control variable vector with dimensions 1 x k in county i for a period t and variable $Share_Urban_primacy_{it}$ share of urban population in county i for a period t. Control variables were chosen based on paper written by Xubei (2007) in which **education** and **age** have been found as significant variables for regional wage differences. Thus for control variable education we used share of employed people with high education⁴ (**share_high_education**) and for age we used average number of year of employed people (**AVGyear and AVGyear2**). It is assumed that ε_{it} are $IID(0, \sigma_\varepsilon^2)$; identically and independently distributed error terms.

Procedure starts with testing equation (9) for a four different options of grouping activities from National classification of activities 2002 already mentioned in table 2. The first challenging dilemma is recognizing is the process static or dynamic. The results of Durbin-Watson test for estimated static model (Fixed effect model, Random Effects model) under equation (9) indicate dynamic nature of our process and therefore we used dynamic model⁵. Thus we introduce modified equation which includes dynamic behavior of dependent variable. This dynamic dimension is characterized by the presence of lagged dependent variable among the regressors.

$$SCI_{it} = \alpha + \delta SCI_{i,t-1} + X_{it}^T \beta + \delta Share_Urban_primacy_{i,t-1} + e_{it} \quad (10)$$

That renders the OLS estimator biased and inconsistent even if ε_{it} are not correlated. As a result, a new method for estimation was required. Arellano and Bond (1991) proposed new

³ Before starting we will indicate that support for the assumption that it is possible to use share of urban population in each county as proxy for level of economic mass is documented for Croatia in paper written by Nejašmić (2000.) In the model economic mass will be presented by share of urban population in the biggest town (**Share_Urban_primacy**)

⁴ Education beyond the secondary level

⁵ The omitted results are available by request

estimator for the dynamic panel model. In paper two step Arellano and Bond GMM estimator is used because one step estimation assumes the error terms to be independent and homoskedastic across counties and over time. Two step estimator relaxes the assumption of independence and homoscedasticity by using the residuals obtained from the first step estimation to construct a consistent estimate of the variance-covariance matrix. Thus, when the error term ε_{it} is heteroskedastic the two step estimator is more efficient (Cole, Moshirian and Wu, 2008).

Before introducing results of two step Arellano-Bond dynamic panel estimator in the Table 3, it should be stressed that results indicate **empirical relevance of urban primacy** only for **SCI of non – market service sector**⁶ which could be interpreted as evidence for the main contribution of the paper, or more precisely, as a evidence for hypothesis that *influence of economic mass on sector composition index is different among different sectors*. Thus, table 3. represents only coefficients for sector composition index of non-market service sector.

It should be stressed that diagnostic tests (Sargan test and m_2 statistics) for estimated model in Table 3 are satisfying at 5 % confidence level and therefore proposed model is well specified. The correlation coefficients between each of the variables are reported in the lower part of the Table 3. The highest coefficient of correlation is 0.6258 and it indicates that we should not expected high risk of multicollinearity problem between variables of our interest.

Table 3. The results of two step Arellano-Bond dynamic panel estimator

Variable	Option 1	Option 2	Option 3	Option 4
SCI_nms	0,644*** (0,022)	0,639*** (0,02)	0,644*** (0,022)	0,639*** (0,02)
avg_age	18,19*** (2,779)	17,725*** (2,873)	18,19*** (2,779)	17,725*** (2,873)
avg_age2	(-)0,238***(0,035)	(-)0,231*** (0,037)	(-)0,238***(0,035)	(-)0,231***(0,037)
share_high_education	0,111*** (0,011)	0,063*** (0,014)	0,111*** (0,011)	0,063*** (0,014)
share_urban_primacy	0,129*** (0,049)	0,146*** (0,063)	0,129*** (0,049)	0,146*** (0,063)
cons	0,038 *** (0,008)	0,045*** (0,007)	0,038 *** (0,008)	0,045*** (0,007)
Number of observations	126	126	126	126
Number of individuals	21	21	21	21
Sargan test (p-value)	0,455	0,471	0,455	0,471
m1-test (p-value)	0,02**	0,012**	0,02**	0,012**
m2-test (p-value)	0,289	0,261	0,289	0,261
*, **, ***- indicate significance at 10%, 5% and 1% level				
the number in brackets are standard errors				

⁶ The omitted results are available by request

Correlation coefficients

	share_high_education	avg_age	share_urban_primacy
share_high_education	1.000		
avg_age	0.6258	1.000	
share_urban_primacy	0.5823	0.3084	1.000

Source: Calculation by authors

The coefficients on control variables are all statistically significant and have expected sign in all four options. The results on main variable ***confirm empirical relevance of our measure of economic mass (Share_Urban_Primary)*** in **explaining SCI differences** on significance level of 5%.

It should be stressed that the magnitude of coefficients should be carefully observed taking into consideration empirical limitation of procurable data. Hence we concentrate on the sign of coefficients rather than on coefficients magnitude. Thus sign of coefficient of the urban primacy variable implies significant evidence for relationship between sector composition index and agglomeration economies in Croatia.

However, taking into consideration that sources of agglomeration might be **economy-wide, location-specific or sector-specific** (Bottazzi et. al., 2008) the primary purpose is to find new facts about the drivers of agglomeration in less developed countries such as Croatia and not to ratify magnitude of the coefficients. Therefore, main contribution of the paper, fact that **confirmation of the relation between SCI and urban primacy holds only for non-market services** indicates **sector – specific dimension of the agglomeration economy in less developed country such as Croatia**. The aforesaid fact should be considered in analysis of the related phenomena such as localized knowledge spillovers, inter- vs. intra-organizational learning, knowledge complementarities fueled by localized labor pooling, innovative explorations undertaken through spin-offs and, more generally, the birth of new firms.

Last mentioned, birth of new firms could be used for a finding an answer on following question. What is possible theoretical background for confirmed sector-specific dimension of agglomeration economy?

Starting point is argument that reasons for entry firms and construction of sector composition index are similar. Therefore it is possible to use literature that tries to explain the regional differences in entry rates as a foundation for sector composition index explanation.

The literature usually identifies three major categories of factors influencing spatial differences: *local demand factors*, *the supply of founders* and *the policy environment* (Keeble et al. 1993; Johnson and Parker 1996).

The local demand factors reflect the market potential for the new firms. Are there sufficiently many potential customers in the region and can they afford to buy the good or service supplied by the entrants? *The supply of founders* perspective focuses on who the individuals starting new firms are. What other opportunities than to start a new firm do they have and what knowledge do the individuals in particular regions possess? *The policy environment* reflects, for example, what kind of support from local authorities, both in terms of financial support and knowledge support, is available to an individual that is planning to start a new firm. In some regions there might be policies aiming to keep exit rates low and therefore low level of sector composition index. All abovementioned factors consider agglomeration as a factor influencing a firm's decision to locate in or exit from a particular region and therefore main mark for possible theoretical explanation for confirmed sector-specific dimension of agglomeration economy.

Importance of finding aforesaid answer should be looked up among these three facts. Firstly, it may help to clarify whether, below the persistence of interregional inequalities in aggregate productivity per worker, there has been a convergence in productivity sector by sector. Secondly, a critical role for the sector composition would cast doubts on the relevance of the aggregative one-sector growth models in explaining the regional differences in per capita income. Finally, the results validate the appropriateness of the regional policy not only in Croatia but also in other countries with experience of transition, essentially based on instruments geared to generate uniform productivity increases in backward regions (infrastructure and human capital).

CONCLUSION

Growing disparities in wages are source of considerable policy concern. Therefore the paper tries to explore these inequalities by using shift – share analysis.

Shift – share analysis presents mechanical decomposition of wages on occupational composition effect and productivity effect. It is widely accepted that spatial effects have a different impact among sectors in developed countries. On the other hand, less developed countries have different economic path. Thus, it is reasonable to test the influence of spatial effects among sectors for a less developed country such as Croatia.

Focus of the paper encompasses influence of economic mass for occupational composition for four different sectors (agriculture, manufacturing, market services, non- market services). For this purpose it has been established new index, sector composition index, by aggregating similar activities from National classification of activities 2002.

The analysis of importance of the economic mass for sector composition index has been estimated by two step Arellano-Bond dynamic panel-data estimator and confirmed only for non-market service sector. In other words, the results indicate empirical relevance of urban primacy only for sector composition index of non – market service sector which could be interpreted as evidence for the main contribution of the paper, or more precisely, as a evidence for hypothesis that *influence of economic mass on sector composition index is different among different sectors.*

Taking into consideration that source of agglomeration might be economy-wide, location-specific or sector-specific the empirical confirmation of the relation between sector composition index non-market services and urban primacy only for no-market service sector indicates **sector – specific dimension of the agglomeration economy in less developed country such as Croatia.**

These findings should have significant effect on regional policy and therefore in next period research could be focused on recognizing and theoretical modeling relation between economic mass and sector composition appreciating possible different factors in developed countries and in less developed countries.

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