

Spatial Structure of Wage: A Test of Krugman Model for Iranian Provinces

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Abstract The purpose of this paper is to investigate the industrial wage inequalities based on Krugman model. For this, we've employed a panel method for 30 Iranian provinces during time period 2003-2007. The estimation results suggest that the new economic geography provides a good description of the spatial structure of wages in the provinces of Iran. Our findings indicate that market size and distance-weighted will have positive relationship with wages. The overall result of this study corroborates the notion of centralization in the Iranian economy. The large wage variations explained by economic geography could cause significant internal migration.

Keywords: *new economic geography, spatial structure of wage, centralization, size of market, transport costs*

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1. Introduction

Wage of labor force, from different dimensions of social and economic are concerned policy makers.

Wage is important because that determines the economic situation of the vast majority of society and considering the balance mechanism in the labor market wage. Therefore all factors must be evaluated to make the best decisions by policy makers [1]. Among these factors, it can be pointed to factors of the new economic geography theories. The new economic geography suggest by Krugman in 1991 that examined factors outside the labor market on wage [2]. NEG models are based on the idea that the level of market access to goods is an imperative condition for the scale of economic activity in any location. They emphasize the importance of the market access characteristics compared to the set characters of a location. This approach presents an alternative approach in characterizing the economy of scale and the geographic agglomeration of economic activities [3].

The goal of this study is to offer an analysis of the effects of agglomeration and dispersion Economies on the patterns of regional economic development in Iran. It investigates the factors affecting the industrial wage industries, more than 10 employees, between the provinces of Iran by to estimating [4] model. The hypothesis of this study is whether to be the relationship between size of market and transportation costs on provinces wage of Iran?

The paper is organized as follows. The following section outlines a theoretical framework to Survey the Spatial structure of wages and krugman model. Section 3 describes the data sources and variable construction.

Section 4 investigates Analysis and Results on wages in provinces Iran. Section 5 concludes.

2. Theoretical Framework

2.1. Spatial Structure of Wages: Krugman Model

During the last decade or so, economists have rediscover geography. The uneven distribution of economic activity across space has received renewed attention with surfacing of the "new economic geography" literature following [4]. Traditional neoclassical explanations for the uneven distribution of economic activities across space are due to "first-nature- geography", which is the physical geography of coasts, mountains, and endowments of natural resources but also location-specific differences in technology or institutions have received considerable attention in the literatures [5]. This new body of research stresses instead the role of "second nature geography" which is the location of economic agents relative to one another in space [6]. Economic activities tend to concentrate across space both in international and intranational contexts. This concentration usually leads to wage disparities across countries or regions within a country. Wages are higher in core countries or regions where economic activities agglomerate, than other peripheral ones [7].

One central proposition of NEG theory, which is found in the so-called "wage equation", is the importance of proximity to consumers: here nominal wages are modeled as a function of a region's "market access usually defined as the distance-weighted sum of the market capacity of surrounding locations [8]. The underlying idea is that

firms located in remoter locations pay higher trade costs on both their sales to final markets and their purchases of intermediate inputs. As such, they earn lower net revenues from export sales [9].

The Krugman model offers insight into economies of scale and describes the benefits that firms and industries gain by locating near each other. Based on the idea of economies of scale, as more similar firms cluster together, there would be more competing suppliers, greater specialization and division of labor. These factors decrease the cost of production and increase the markets for firms. [4] by studying the relation between agglomeration, increasing returns and market access, endogenously determines wages in a province as a function of wages and income in other provinces. He tests the spatial distribution of economic activity through the estimation of several structural parameters including elasticity of substitution, trade costs and share of income spent on industrial and manufactured goods [10].

This section presents very briefly the multi region version of the Krugman model. This model considers J regions ($j = 1, 2, \dots, J$); two productive sectors: the traditional sector and the industrial sector; two goods: the homogeneous good (H) and a composite differentiated good (D); and two factors of production: workers (that are perfectly mobile) and farmers (immobile). The H-good is produced under constant returns to scale by the traditional sector and the D-good is produced under increasing returns to scale by the industrial sector. The industrial sector is footloose (in the sense that can move production between locations) and the traditional sector is immobile. The factors of production are sector-specific: workers can only be employed in the industrial sector and farmers on the traditional sector. The model has a two-stage budgeting decision with upper tier symmetrical preferences of the Cobb-Douglas type:

$$U = D^\mu H^{1-\mu} \quad (1)$$

Where H and D are the consumption, respectively, of the homogeneous good and of the differentiated composite good; and μ is the share of income spent on differentiated goods, with $0 < \mu < 1$. The consumption of the composite differentiated good is a symmetric CES utility function as Dixit and Stiglitz (1977):

$$D = \left[\sum_{i=1}^r \left(\delta_i \frac{\sigma-1}{\sigma} \right)^{\frac{\sigma}{\sigma-1}} \right]^{\frac{\sigma-1}{\sigma}} \quad (2)$$

Where σ represents the elasticity of substitution between varieties (with $\sigma > 1$, i.e., products are homogenous if σ tends to infinite and varieties are very differentiated if σ is close to one), δ_i is the demand for variety i of the composite good and r is the number of varieties in the economy (i.e., $i = 1, 2, \dots, r$). The technology of the increasing returns sector is given by the usual linear cost function: $T_{Dij} = f + cQ_{Dij}$, where T_{Dij} are the workers used in the production of variety i in the region j , f are the fixed costs, c is the unit variable cost and Q_{Dij} is the quantity of variety i produced in region j .

Introducing now transport costs; it is assumed that the

homogeneous good is freely trade, while the differentiated good is subject to iceberg trade costs. According to the iceberg hypothesis a part of the good shipped “melts” in transit as expressed in the following equation:

$$V_{ijk} = e^{-\tau d_{jk}} \quad (3)$$

Where V_{ijk} is the fraction of the good i shipped from location j that arrives at k , d_{jk} is the distance between j and k and τ is the trade cost (with $\tau > 0$). Condition (2) and iceberg trade costs imply that the elasticity of demand facing any individual firm is σ . Also in equilibrium due to fixed costs and preference for variety implied by (2), each firm produces only one variety (therefore, the number of varieties equals the number of firms). Conversely, it is assumed that is not profitable for a firm to produce more than one variety. The profit maximizing behavior of a representative firm is then to set a price as a constant mark-up over marginal cost:

$$P_{ij} = \left(\frac{\sigma}{\sigma-1} \right) c w_j \quad (4)$$

Where w_j is the nominal wage rate in location j and P_{ij} is the price of variety i in region j . Then, the Marshall-

Lerner price-cost mark-up is $\frac{\sigma}{\sigma-1}$. The higher this ratio, the higher the degree of monopoly power by a firm. As a result, [4] understands σ as an inverse measure of scale economies, given that it can be thought as a direct measure of price distortion and as an indirect measure of market distortion due to monopolistic power. Specifically, given that $\frac{\sigma}{\sigma-1}$ is bigger than one, [4] sees this as the presence of increasing returns to scale. This model has four equilibrium conditions that are central for the empirical formulation. The first equilibrium condition predicts the equalization of real wages across regions:

$$\frac{w_j}{I_j^{-\mu}} = \frac{w_k}{I_k^{-\mu}} \quad (5)$$

Where I_j is price index of manufactures in region j . The second equilibrium condition envisages that total income in a region equals labor income in that region:

$$Y_j = (1-\mu)\phi_j - \mu\lambda_j w_j \quad (6)$$

Where Y_j is total income in region j , ϕ_j is the percentage of farmers in region j and λ_j is the percentage of workers in region j . Note that due to immobile farmers Y_j is always positive even if a region does not host any manufacture. The third equilibrium condition gives the supply of manufacturing goods. According to this, the price index of differentiated good is bigger in regions that have to import a greater percentage of this good:

$$I_j = \left[\sum_k \lambda_k \left(w_k e^{\tau d_{jk}} \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \quad (7)$$

Finally, the fourth equilibrium condition presents the labor demand function. This tells us that the labor demand is higher in regions with higher final demand:

$$w_j = \left[\sum_k Y_k \left(I_k e^{-\tau d_{jk}} \right)^{\sigma-1} \right]^{1/\sigma} \quad (8)$$

Therefore, it is not possible to estimate simultaneously all the four equilibrium equations. In alternative we substitute Eq. (5) in Eq. (8) to get [11]:

$$\log(w_j) = \theta + \sigma^{-1} \log \left(\sum_k Y_k w_k^{\frac{\sigma-1}{\mu}} e^{-\tau(\sigma-1)d_{jk}} \right) \quad (9)$$

Based on this equation, the three key variables in the theoretical model is affected on wage: the market wage, cost of transportation and Wages in other regions. an increase in The market size, raises agglomeration, Then increase the value of wage , [2,4,10,12]. In addition, the firm distance of market (as a proxy for transportation costs) is higher, than transportation costs will be higher and raises wage [4,13,14]. In addition, based on Assumption of labor mobility [4], Wages in a region has direct impact on wages in other regions [4].

In this study, particularly in the context of theoretical Krugman models, Will investigate spatial structure of wages.

2.2. Spatial Structure of Wages: Empirical Studies

[15] examined the spatial wage structure and consumer purchasing power across regions in West-Germany using data on 327 counties. He found that the wage in one region is indeed positively related to purchasing power in other regions. However, this relationship only holds for skilled wokers' salaries and wages, whereas it does not for the wages of untrained workers.

[16] examined the spatial structure of wages using Helpman model (1998), in Germany district with non-linear least squares method (NLS) and weighted least squares (WLS) in 1995. They find confirmation for a spatial wage structure. The advantage of the Helpman model is that it incorporates the fact that agglomeration of economic activity increases the prices of local (non tradable) services, like housing. This model thereby provides an intuitively appealing spreading force that allows for less extreme agglomeration patterns than predicted by the bulk of new economic geography models.

[17] estimated the agglomeration benefits that arise from vertical linkages between firms in Indonesia using data on 1342 firms. They used the method of nonlinear least squares (NLS) for 1983, 1991, 1999. They identify the agglomeration benefits off the spatial variation in firm's nominal wages. Using unusually detailed intermediate input data, they take account of the location of input suppliers to estimate cost linkages; and the location of demand from final consumers and other firms to estimate demand linkages. The results show that the externalities that arise from demand and cost linkages are quantitatively important and highly localized. An increase in either cost or demands linkages increases wages.

[3] estimated a spatial wage structure for the United States. He employs the market-access and supplier-access to using ordinary least square method for 1997 and 1999 years. After correcting for omitted-variable bias with exogenous 'first nature' repressors and using the appropriate instruments, he finds that the explanatory Power of access-variables is weak in this dataset.

[9] evaluated the role of economic geography in explaining regional wages for 29 Chinese provinces over 1995–2002 to using two stage least square and ordinary least square method. It investigates the extent to which market proximity can explain the evolution of wages, and through which channels. The estimation results suggest that access to sources of demand is indeed an important factor shaping regional wage dynamics in China. They investigate three channels through which market access might influence wages beside direct transport cost savings: export performance, and human and physical capital accumulation. Based on this Research a fair share of benefits seems to come from enhanced export performance and greater accumulation of physical capital. The main source of influence of market access remains direct transport costs.

[18] estimated link between wage disparities and market access for a sample of 42 Romanian regions in the year 2006. The paper reports two main results: 1) market access is statistically significant and quantitatively important in explaining cross-county variation in Romanian wages, 2) incentives for human capital accumulation and innovation activities arising from market access size are also affecting the shaping of county wages in Romania.

[19] used the new economic geography (NEG) model to determine the long-run equilibrium allocation of economic activity Based on a data set of 264 Chinese Prefecture cities for the period 1999-2005. The results shows that first, market access is an important determinant of Chinese city-wages, their estimations show that cities with higher market access also have higher wages. Second and using these estimation results as an input, the long-run equilibrium simulations with the NEG model indicate that increased labor mobility would lead to more pronounced core-periphery outcomes for China. In a qualitative sense, the NEG model predicts that increased labor mobility would primarily benefit centrally located, non-coastal Prefecture cities in the large and populous province.

[20] investigated the distributional aspect of market access using the New Economic Geography (NEG) model by employing data from U.S. metropolitan areas in 1990. They derive a spatial skill demand equation that positively links skill premiums to market access. They show that not only are average wages greater in metropolitan areas with higher market access, but wage differentials are also more unequally distributed. Specifically, greater market access is linked to relatively weaker (stronger) outcomes for those at the bottom (top) of the wage distribution. Further assessment finds that market potential is favorably associated with greater shares of high-skilled workers. The analysis provides further rationale for the much-observed positive relationship between the metropolitan area's share of high-skilled workers and its skilled-worker wage premium.

3. Model, Data, and Estimation Methodology

In order to test empirically the Factors affecting industrial wages in the provinces of Iran, we have pursued a panel data analysis. We study the case of 30 the provinces of Iran and use annual data for the 2003-2007 periods. The provinces are, East Azarbaijan, West Azarbaijan, Ardebil, Isfahan, Elam, Bushehr, Tehran, Chahar Mahal and Bakhtiari, Khorasan, South Khorasan, North Khorasan, Khuzestan, Zanjan, Semnan, Sistan and Baluchestan, Fars, Qazvin, Qom, Kurdistan, Kerman, Kermanshah, Kohkeloyh and Boyer Ahmad, Golestan, Gilan, Lorestan, Mazandaran , Markazi, Hormozgan, Hamedan and Yazd. In this study have been used the most important variable in Krugman model and the variables effectively in the labor market. The underlying specification is a model of the form:

$$\ln W_r = \alpha + \beta_0 \ln Y_r + \beta_1 \ln(D_{weight_{rs}}) + \beta_2 \ln B_r + \beta_3 \ln H_r + \beta_4 \ln E_r$$

Where w_r represents the Industries wage more than 10 employees in the province r, y_r is Market size in the province r, $D_{weight_{rs}}$ represents the distance weighted Between the two provinces r and s, B_r is productivity in the province r, H_r represents Human capital in the province r. E_r is Employment in the province.

To measure the Dependent variable is used of compensation per worker to the industry factory for more than 10 employees in constant prices 2004. To calculate the market size, GDP is used in constant prices 2004. To calculate the transportation cost, Similar to [2,21] study, is used weighted distance between the 30 provinces of Iran and is used as follows:

$$D_{weight_{rs}} = weight_s \times D_{rs}$$

$$weight_s = Y_s / \sum_j Y_j$$

Where $D_{weight_{rs}}$ represents the distance weighted Between Selected provinces and Tehran, $y_s / \sum_j y_j$ is weighted by the GDP, $\sum_j y_j$ is Total provinces GDP and D_{rs} represents the distance Between Selected provinces and Tehran.

To Measure the productivity is used the industrial added value per labor force. To measure the human capital index have been used the share of skilled employees in the industry for more than 10 employees that including skilled workers, technicians, engineers.

Finally, To Measure the employment is used labor force in the industry for more than 10 employees.

Method to measure the Factors determining of industrial wages and Also Expected sign of variables in present research is presented in Table 1 in summary. Also Data sources are described this table.

Table 1. Method of measuring wage determinants in present research

Variable	Proxy	Expected sign	Data source
Market size	Gross domestic product	+	Statistical Center of Iran
Transportation costs	Weighted distance	+	Iran National Cartographic Center
Productivity	Added value per labor force	+	Statistical Center of Iran
Human capital	The share of skilled workers	+	Statistical Center of Iran
Employment	Labor Force	-	Statistical Center of Iran

4. Empirical Results

Table 2 presents estimating results of the spatial structure of wages in Province of Iran by panel model with Random effects during 2003-2007. According to this table,

estimated equation has overall significance and According to the theory. Also, Chow's F verifies a panel technique. Furthermore, we have used Random Effect (RE) method based on Hausman test.

Table 2. Estimating Results of Spatial structure of wages in the provinces of Iran by panel model with random effects during 2003-2007

Variables	Coefficient	t-Statistic	Prob.
Constant	-3.740652	-6.286349	0.0000
$\ln Y_r$	0.284727	6.886610	0.0000
$\ln(D_{weight_{rs}})$	0.046426	3.625789	0.0004
$\ln B_r$	0.070673	1.954503	0.0526
$\ln H_r$	0.203154	1.90578	0.0587
$\ln E_r$	-0.101783	-1.677695	0.0956
Observations	150		
R^2	0.84		
F-statistic	22.31902		0.0000
F_{test}	8.451587		0.0000
Husman Test	0.000000		1.0000

Source: Researchers' calculations using Eviews 6

Based on regression results in Table 2, R^2 in regression shows that the variables can explain 0.84 the model and the F test indicates that total regression is significant.

Also, the estimated parameters coefficient of market size in equation (1) is positive and significant. This is in line with the previous research. Thus, Market size has positive effect and significant on wages in province of Iran. Coefficient of weighted distance between variable is significant and has a positive sign. Therefore, Distance also seems to affect wages, as they tend to be higher in regions closer to larger markets. One possible interpretation of this might be to suggest that Iran has a more distance sensitive trade structure. The distance sensitivity might be a result of several factors. First, the transportation system between provinces in Iran may be less developed, which enhances the effect of distance on trade. Second, Iran is a highly mountainous country with a very diverse geography. This might have direct effect on the development of transportation systems between provinces. The coefficient of the productivity is positive and significant. Coefficient of human capital index variable is significant and has a positive sign. Therefore, with increasing human capital, the wages will be higher. Finally, employment is negative and significant. Thus, increasing the employment decreases wage.

5. Conclusions

The goal of this study is to investigate the factors affecting the industrial wage, industries more than 10 employees, between the provinces of Iran by Krugman model. For this purpose the method of panel data is used for 30 provinces over the period 2003-2007.

Data from the provinces of Iran showed generally good fit for new economic geography models; This could be interpreted to mean that the provinces of Iran are generally subject to notions of 'New Economic Geography' and exhibit spatial wage structure. Based on this research, market size and distance-weighted in Krugman model, will have positive relationship with wages. Also, three control variables; productivity, human capital and employment; are used in this paper that has overall significance and According to the theory. The overall result of this study corroborates the notion of centralization in the Iranian economy. Industry, trade, and workers all have incentives to agglomerate in larger cities and especially in Tehran to benefit from economies of scale in the form of higher wages and profits. The large wage variations explained by economic geography could cause significant internal migration. Indeed, significant internal migration has been observed in Iran in past years. With attention to the results of this study, Should increasingly focus on economic development programs to benefit from its Agglomeration and impact on the wage. Also Understanding the provinces of unequal wage and the variables affecting on unequal level, is essential to

implement wisely economic policies in order to balance the distribution of income.

References

- [1] Kazerooni, A. R., & Mohammadi, A. R., "Examine the relationship between productivity and wages in the industrial sector in Iran", *Iranian Journal of Economic Research*, 9(31): 127-150, 2007.
- [2] Brakman, S., Garretsen, H., & Schramm, M., "The spatial distribution of wages estimating the Helpman-Hanson model for Germany", *Journal of Regional Science*, 44(3), 437-466, 2004.
- [3] Knaap, T., "Trade, Location, and Wages in the United States", *Discussion Paper Series*, 2006.
- [4] Krugman, P., "Increasing returns and economic geography", *Journal of Political Economy*, 99(3): 483-499, 1991.
- [5] Tripathi, S. and Fellow, D., "Estimating urban agglomeration economies for India: a new economic geography perspective", *Seminar/Conferences under SRTT Programs: Regional and Policy Dimensions of Innovation and Growth*, 2010.
- [6] Redding, S. J., "The Empirics of New Economic Geography", *Journal of Regional Science*, 50(1): 297-311, 2010.
- [7] Kiso T., *Does new economic geography explain the spatial distribution of wages in Japan*, Mimeo, 2005.
- [8] Fujita, Masahisa, Paul Krugman, and Anthony J. Venables, *The Spatial Economy: Cities, Regions and International Trade*, Cambridge, MA: MIT Press, 1999.
- [9] Hering, L. & Poncet, S., "The Impact of Economic Geography on Wages: Disentangling the Channels of Influence". *China Economic Review*, 20: 1-14, 2009.
- [10] Farmanesh, A., "Regional Dimensions of Economic Development in Iran, A New Economic Geography Approach", *MPRA Paper, No. 13580*, University of Maryland, College Park, 2009.
- [11] Pires, A. J.G., "Estimating Krugman's economic geography model for the Spanish regions", *Span Econ Rev*, (8): 83-112, 2006.
- [12] Roberts, M., Deichmann, U., Fingleton, B. & Shi, T., "On the road to prosperity? The economic geography of China's national expressway network", *Policy Research Working Paper Series*, NO. 5479, 2010.
- [13] Puga, D., "The Rise and Fall of Regional Inequalities", *European Economic Review*, 43: 303-334, 1999.
- [14] Hanson, G. H., "Market Potential, Increasing Returns, and Geographic Concentration", *NBER Working Paper, No. 6429*, National Bureau of Economic Research, Cambridge Massachusetts, 1998.
- [15] Roos, M., "Wages and market potential in Germany", *Jahrb Regional wissenschaft*, 21: 171-195, 2001.
- [16] Brakman S., Garretsen, H. & Schamm, M., "New Economic Geography in Germany: Testing the Helpman-Hanson Model", *HWWA Discussion Paper*, No. 172, 2001.
- [17] Amiti, M. & Cameron, L., "Economic Geography and Wages", *CEPR Discussion Papers*, 4234, 2004.
- [18] Faiña, A., Rodríguez, J., Gabriela, B. C. & Candamio, L. V., *Income Disparities in Romanian Regions: The role of Market Access*, 2010.
- [19] Bosker, M., Brakman, S., Garretsen, H. & Schramm, M., *The New Economic Geography of Prefecture Cities in China: The Relevance of Market Access and Labor Mobility for Agglomeration*, 2010.
- [20] Fallah, B. N., Partridge, M.D. Olfert, M. R., "New economic geography and US metropolitan wage inequality", *Journal of Economic Geography*, 11(5): 865-895, 2011.
- [21] Brakman S., Garretsen, H., Gorter, J., Horst, A. & Schamm, M., "New Economic Geography, Empirics and Regional Policy", *Netherlands Bureau for Economic Policy Analysis, CPB Special Publications*, No. 56, 2005.