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# **Analyzing the determinants of agglomeration for the manufacturing industry in Turkey**

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**Abstract:** The traditional way of industrial production has transformed into high added-value products and services sector while the geography of manufacturing has been changing accordingly. On the other hand, both determinants and impacts of industrial location decisions and agglomeration economies have been crucial topics for researchers since Alfred Marshall (1920) (Krugman, 1991; Ellison and Glasser, 1997; Mccann, 2001; Fujita and Thisse, 2002; Rosenthal and Strange, 2006; Puga, 2009; Guimaraes et al., 2000). According to Isard (1956), who is the pioneer of implementing the location theory's extended version in regional economy, location choice is not only caused by inter-regional differences, but also, it has a significant effect on the occurrence of inter-regional disparities. The existence of industry in a region is fundamental for that region's economical development by its stimulating effects on manufacturing employment and other sectors.

Even though the traditional location choice factors have been changing in time, initial advantages, reducing transportation costs, accessibility to market and accessibility to skilled labor pool, are still significant for generating agglomeration tendencies (Fujita and Thisse, 1996; McCann, 2001; Parr, 2002; Capello, 2007). In addition, the companies' competitiveness based on clustering pattern increases the region's competitiveness. Therefore, industrial clusters are expected to be positively effective on the region's economical development (Porter, 1990; Stimson et al., 2006; Keise, 2008; Capello, 2009).

The purpose of this paper is to explore the determinants of agglomeration economies in Turkey in 2000 as the turning point of 21th century. At first, the paper will initially present the changing and concentration pattern of industrial employment in the NUTS 2 level regions from 1992 to 2008. Secondly, the regression analysis is used to explore the determinants of agglomeration economies at the provincial level. The findings of global regression pointed out the power of the market potential, labor pool and public investment as the determinants of agglomeration.

**Key words:** manufacturing employment, agglomeration, Turkey

## **1. Introduction**

One of the main questions in the regional economics literature has long been why some economic activities are concentrated in a certain number of regions. Even though the traditional location choice factors have been changing in time, initial advantages, low transportation costs, accessibility to market and skilled labor, are still significant forces generating agglomeration tendencies (Fujita and Thisse, 1996; McCann, 2001; Parr, 2002; Capello, 2007). Furthermore, the studies, which are exploring the concentration tendencies of sub-sectors, put forward different patterns (Ellison and Glasser, 1997). Alecke et al. (2008) indicated that the most concentrated manufacturing industries appear to be more traditional ones like textile and

leather industry, while majority of the most dispersed sectors are customer related services. The studies of Rosenthal and Strange (2006) pointed out that some industries require to be close to the natural resources such as wine industry, while soft-ware industries which do not have any raw material dependency, are concentrated as well because of the importance of face to face interactions of knowledge flows.

As Capello (2007) highlighted that space is a source of increasing returns and positive externalities that taking the form of agglomeration and localization economies. While the relationship between the regional disparities and concentration of economic activities has indicated an egg-chicken concept, existing natural resources were defined the initial advantages of industrialization process (Ottaviano and Thisse, 2003).

Neo-classical economist Marshall (1920) conceptualized external economies of agglomeration as source of territorial competitiveness. In detail, he identifies three sources of agglomeration economies; input sharing, labor-market pooling and knowledge spillovers. After Marshall, the role of urban space has become more significant as the place where agglomeration economies are generated. Hoover (1937) divided agglomeration economies into localization and urbanization economies. Localization economies are advantages of being located in the same location of a single or related industry, while urbanization economies are the advantages of being together of different sectors. Therefore, the concentration of people and economic activities in cities or core areas would be explained through the urbanization economies (Malmberg and Maskell, 2002). Based on different studies, Puga (2009) highlighted that the productive advantages of the large cities have been attributed to agglomeration economies. However the competitiveness within the large market pushes the firms being more productive. Moreover, Guimaraes et al. (2000) points out that urbanization economies are more important than industry-specific localization economies. Considering the location pattern of manufacturing industry, it is well known that firms are likely to cluster within the metropolitan areas when they have the larger markets and lower transport costs. On the other hand, cities provide a wide array of final goods and specialized labor markets that make them attractive to consumers and workers. As a result of the process, agglomerations are the outcome of cumulative processes involving both the supply and demand sides (Krugman, 1980;1991; Ottaviano and Thisse, 2003; Puga, 2009).

However there have been several studies explaining the importance of urbanization and localization economies, Rosenthal and Strange (2001) and Puga (2009) highlighted that the determinants of agglomeration have still needed to explore. On the other hand, there have been studies taking into account different levels of space and the choice of geographic unit affects the observed estimates of agglomeration economies. While Rosenthal and Strange (2001) have been analyzing the zip-code, county and state level of US, Sensier et al. (2011) investigated agglomeration economies through the NUTS2 (region) and NUTS 3 (city) level of some Western European Countries.

In this paper, we tried to explore the determinants of agglomeration for manufacturing industry in Turkey at the turning point of 21st century. The following section includes the descriptive analysis on manufacturing employment whether the spatial distribution and concentration pattern of manufacturing employment has changed in Turkey during the last decade. After the methodology and data section, the fourth section displays the findings of the regression analysis and the conclusion section discusses the results for further researches.

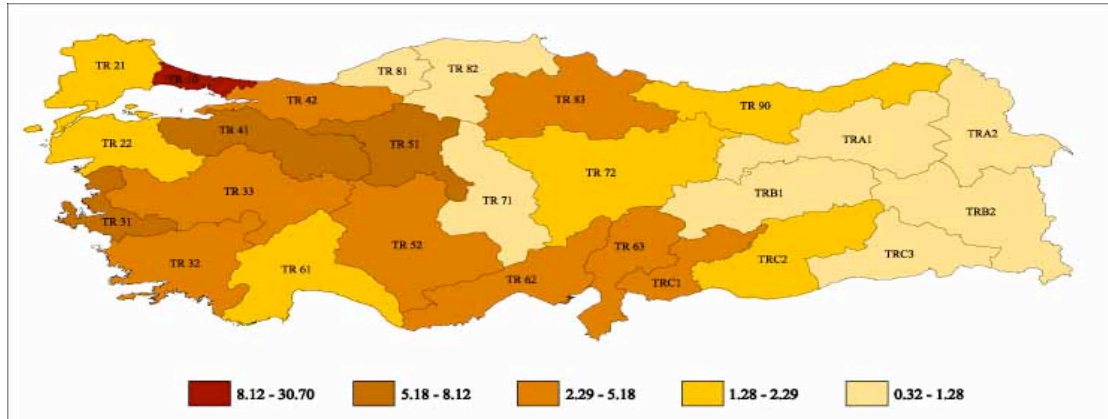
## **2. Concentration and dispersion pattern of manufacturing industry in Turkey**

In terms of regional disparities in Turkey, 30 provinces that are located in the western part take 78% of national product, while 51 provinces produce the rest in 2011 (Yeldan et al., 2012). Since the beginning, industrialization of Turkey has gone together with urbanization process and industry has been considered the engine of regional and national development. The domestic market was significant for location decisions of manufacturing activities during the initial period of industrialization. During the 1960s, public investments played a significant role in the creation of new industrial centers in Anatolia, mostly in the provinces such as Zonguldak, Kırşehir, Samsun, Malatya which were defined without any relation to the population. During the 1970s, there was an obvious dominance of Istanbul, and even though other neighboring provinces were developing with industrial investments, the distribution of manufacturing activities did not support the trend of decentralization in the East Marmara Region (Köroğlu and Köroğlu, 2004). Since the beginning of the 1980s, neo-liberal policies have become significant for the economy and regional disparities in Turkey. Export-based policies and attempts to integrate with the global markets, privatization of investments, and increasing financial capital are the main differentiations and make the developed regions more competitive and attractive for the investments.

There have been several studies, which analyze the geography of manufacturing industry in Turkey (Doğruel, 2006; Eraydın, 1999, 2002; Dinçer et al., 2003; Kazancı, 2007; Filiztekin et al, 2011; Çağlar and Kutsal, 2011; Elburz and Gezici, 2012a). The spatial distribution of manufacturing activities in Turkey enhances the east-west differentiation, since the developed provinces are the main concentration areas of the manufacturing sector as well. According to data from TUIK (2010), the total manufacturing employment share of three provinces (Istanbul, Izmir, Ankara) is %43 of the total.

While the metropolitan cities have been the traditional manufacturing centers, the inter-linkages between industries and labor market pool became the main advantages of metropolitan cities today in addition to geographical advantages of being close to Europe, proximity to the ports and accessibility to wider markets. Further, cumulative processes enhance the industrial agglomeration in those core regions. Secondly, the old state industrial cities such as Zonguldak and Kırıkkale, which used to be higher manufacturing employment cities, have been declined due to the privatization process.

Thirdly are the provinces that have the advantage of being close to metropolitan centers and the location of relocated firms, which especially are looking for expanding opportunities (from Istanbul to Tekirdağ, from Izmir to Manisa). Fourthly are the new industrial foci (such as Denizli, Konya, Gaziantep, Kayseri) that are the cases of endogenous growth by using their own potential in different locations of Anatolia (Gezici et al., 2009). The study of Çağlar and Kutsal (2011) pointed out that the distribution of Organized Industrial Zones displays more dispersed geography, while the most of them has not been working efficiently, since there have been several empty parcels.



**Figure 1.** The share of the manufacturing employment for each region from the total manufacturing employment, 2008 (Elburz, Gezici, 2012a)

Figure 1 presents the spatial distribution of the share of the total manufacturing employment in 2008 in NUTS 2 regions. It can be easily seen that manufacturing sector is still mostly concentrated in traditional industry centers like TR10-Istanbul, TR31-Izmir, TR51-Ankara, TR41-(Bursa, Eskişehir, Bilecik) and neighbors of these centers like TR42-(Kocaeli, Sakarya, Düzce, Bolu, Yalova) region. However, the choice of geographic unit (NUTS 2 level region) may cause some missing information as TR42 includes both the provinces of Kocaeli and Bolu, which has a significant gap between the employment data of two provinces.

**Table 1.** Regional manufacturing employment change and the values of L.Q (1992-2008) (Elburz, Gezici, 2012b)<sup>1</sup>

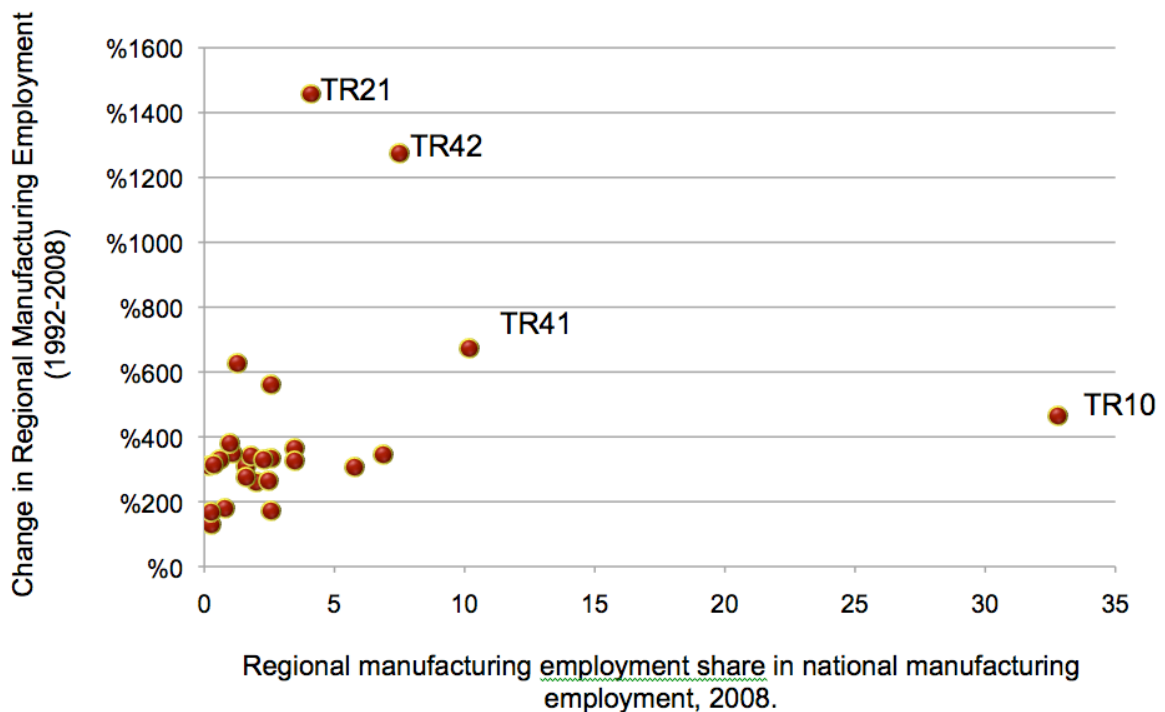
	1992					2008					Change in Regional Manufacturing Employment	Change in Regional Total Employment	Change in Regional Total Population
	A	B	C	D	E	A	B	C	D	E			
TR10	166.744	672.336	24,8	30,7	1,25	939.013	3.119.158	30,1	32,8	1,05	%463	%364	%74
TR21	7.535	53.261	14,1	1,4	0,72	117.203	245.752	47,7	4,1	1,66	<b>%1455</b>	%361	%27
TR22	11.104	63.506	17,5	2,0	0,88	45.562	174.531	26,1	1,6	0,91	%310	%175	%14
TR31	44.090	199.440	22,1	8,1	1,12	195.987	632.380	31,0	6,9	1,08	%345	%217	%41
TR32	21.897	112.290	19,5	4,0	0,99	100.986	402.966	25,1	3,5	0,87	%361	%259	%25
TR33	23.394	118.767	19,7	4,3	1,00	99.509	295.939	33,7	3,5	1,17	%325	%149	%6
TR41	37.947	147.732	25,7	7,0	1,30	292.736	624.246	<b>46,9</b>	10,2	1,64	<b>%671</b>	<b>%323</b>	<b>%42</b>
TR42	15.599	95.083	16,4	2,9	0,83	214.359	516.495	<b>41,5</b>	7,5	1,45	<b>%1274</b>	<b>%443</b>	<b>%45</b>
TR51	41.106	258.303	15,9	7,6	0,80	165.743	880.175	18,9	5,8	0,66	%303	%241	%41
TR52	17.107	72.403	23,6	3,1	1,19	74.140	258.344	28,7	2,6	1,00	%333	%257	%12
TR61	11.864	85.837	13,8	2,2	0,70	52.354	413.671	12,7	1,8	0,44	%341	%382	%38
TR62	28.143	155.118	18,1	5,2	0,92	75.709	375.189	20,1	2,6	0,70	%169	%142	%13
TR63	15.645	76.554	20,4	2,9	1,03	67.099	240.774	27,9	2,3	0,97	%329	%215	%45
TR71	6.944	44.052	15,8	1,3	0,80	31.175	124.086	25,1	1,1	0,88	%349	%182	-%2
TR72	11.492	64.093	17,9	2,1	0,91	75.731	261.180	29,0	2,6	1,01	<b>%559</b>	%308	%0
TR81	5.099	68.646	7,4	0,9	0,38	37.026	122.995	30,1	1,3	1,05	<b>%626</b>	%79	-%5
TR82	3.984	23.652	16,8	0,7	0,85	16.980	60.422	28,1	0,6	0,98	%326	%155	-%24

<sup>1</sup> The calculation at the second part of the table which indicates the changes in employment and population, done by the authors

	1992					2008					Change in Regional Manufacturing Employment	Change in Regional Total Employment	Change in Regional Total Population
	A	B	C	D	E	A	B	C	D	E			
TR83	16.083	96.032	16,7	3,0	0,85	57.669	235.509	24,5	2,0	0,85	%259	%145	-%4
TR90	12.453	78.154	15,9	2,3	0,81	46.637	227.859	20,5	1,6	0,71	%275	%192	-%12
TRA1	3.469	30.291	11,5	0,6	0,58	7.827	69.941	11,2	0,3	0,39	%126	%131	-%15
TRA2	1.756	17.935	9,8	0,3	0,50	7.149	53.363	13,4	0,2	0,47	%307	%198	%4
TRB1	6.111	42.664	14,3	1,1	0,72	29.113	129.188	22,5	1,0	0,79	%376	%203	%2
TRB2	2.887	23.939	12,1	0,5	0,61	11.917	82.273	14,5	0,4	0,51	%313	%244	%31
TRC1	20.140	70.896	28,4	3,7	1,44	72.846	218.569	33,3	2,5	1,16	%262	%208	<b>%40</b>
TRC2	7.810	51.498	15,2	1,4	0,77	21.782	169.232	12,9	0,8	0,45	%179	%229	<b>%46</b>
TRC3	2.763	24.449	11,3	0,5	0,57	7.364	78.475	9,4	0,3	0,33	%167	%221	<b>%40</b>
Total	543.166	2.746.931		100,0		2.863.616	9.989.155		100,0		%427	%264	%27

**A:** regional manufacturing employment **B:** regional total employment **C:** regional manufacturing employment share in total regional employment **D:** regional manufacturing employment share in national manufacturing employment **E:** L.Q

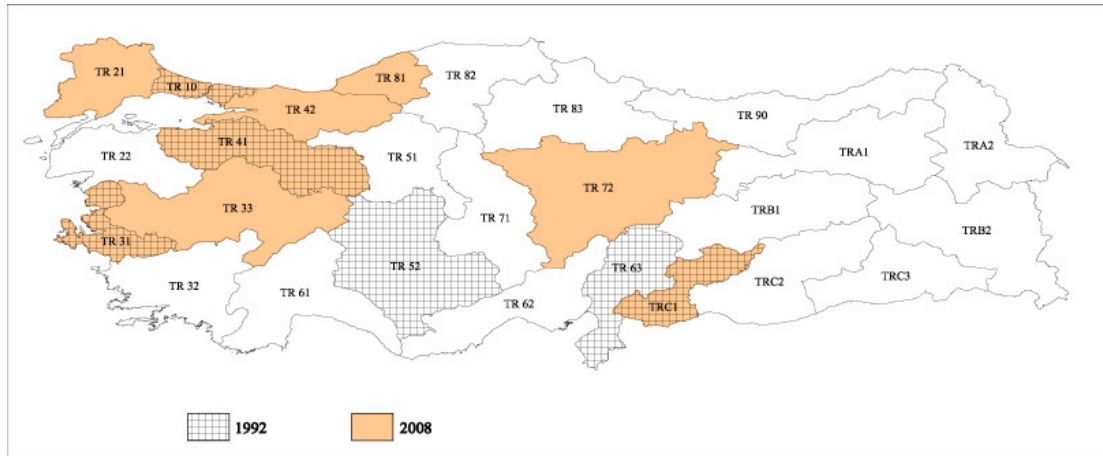
Table 1 presents the share of manufacturing employment in their region and in Turkey for both the year of 1992 and 2008. In 2008 TR10-Istanbul still has the largest manufacturing employment with 939.013, despite of an industry decentralization policy and increasing service-based activities. However, we should underline that the growth trend of manufacturing employment has been diminishing in main metropolitan areas, while especially the share of Eastern Marmara has been increasing sharply. TR41 and TR42 regions, being the main manufacturing concentration areas, are the ones that have more than %40 share of manufacturing employment in their total employment. The highest increase in manufacturing employment occurred in the neighboring regions of TR10-Istanbul as TR21-(Tekirdağ, Edirne, Kırklareli), TR41-(Bursa, Eskişehir, Bilecik) and TR42-(Kocaeli, Sakarya, Düzce, Bolu, Yalova) regions (Figure 2). While there has been a sharp increase of manufacturing employment in TR21, the population change is still the lower than the national average. Therefore, the decentralization policy of manufacturing industry from Istanbul has not really consider the development of those regions. Another important point is the fact that the share of all the provinces other than metropolitan areas, neighboring regions and new industrial centers have been diminishing in Turkey; on the other hand, the share of manufacturing employment has been increasing in their regional economy.



**Figure 2.** The correlation between regional manufacturing employment change and regional share in national manufacturing employment in 2008.



Furthermore, the location quotient values indicate that manufacturing industry have more concentrated in certain number of regions relative to the national level and the number of regions which have the higher value than 1 have increased from 1992 to 2008 (Table 1). These regions are, TR10- Istanbul, TR31- İzmir, TR41- Bursa, TR52-Konya, TR63- Hatay and TRC1- Gaziantep in 1992. In 2008, TR21- Tekirdağ, TR33-Manisa, TR42- Kocaeli, TR72- Kayseri and TR81- Zonguldak have also indicated specialization of manufacturing (Figure 3) If we could analyze on the province level, there would be different results as Kocaeli and Zonguldak are used to be the provinces for industrial concentration.



**Figure 3.** The regions which have the higher than 1 L.Q value of manufacturing industry (1992-2008). (Elburz, Gezici, 2012b)

The economic geography of Turkey follows the main assumptions from the literature. Since the larger market has been significant for agglomeration, the metropolitan areas with their population density have become the main concentration areas for manufacturing. On the other hand, between 1992 and 2008 there has been moving out process from the metropolitan areas to the neighboring regions because of the congestion, however firms prefer being close to the larger market. Therefore, the recent trend of industrial location is not a result of policy to develop relatively less developed areas, but it created new agglomeration areas, which are not matching with the population density as we see the case of Tekirdağ-Çorlu (see in Table 1).

### 3. Methodology and the data

In the previous section, the descriptive studies were done at the regional level because of the availability of the recent data in regional level. Therefore we could follow the changes and concentration patterns of manufacturing employment in the regional level, although it is known that all the provinces within the region do not represent the similar concentration pattern. Because of the limitation on the recent data availability of provincial level and the need to explore the missing parts of the regional level, the regression analysis will

be used the provincial data for the year of 2000. Thus, we could highlight the details by the help of the geographic unit. Moreover, the year of 2000 gives an opportunity to investigate the dynamics at the end of the twentieth century in order to understand the later effects of industrialization in Turkey.

Data was gathered by using a variety of methods and resources, while it was grouped under 4 datasets; demographic indicators, infrastructure, economic indicators and innovation. Demographic indicators were consisted of population, net migration, and urbanization rate, which were all collected from Turkish Statistical Institute (TUIK). The second dataset, infrastructure, was gathered from Ministry of Transport Maritime Affairs and Communications (DHMI), TUIK Turkish State Railways. Third one, economic indicators, was the most complicated one to put together since the resources were different for most of the variables. Population of 15-64 age, unemployment, service employment, industrial employment, number of industrial firms, number of established firms, import, export, GDP per capita, were collected from TUIK. Number of industrial parks and the capacity of industrial parks were organized by using two resources from the same entity; Ministry of Science, Industry and Technology. Public investment was collected from State Planning Organization; incentives were from Secretariat of Treasury and housing credits from Banking Regulation and Supervision Agency. The fourth and the final dataset, innovation is consisted of educational data (e.g. number of university graduates) were all composed from OSYM, where as number of patents was from Turkish Patent Agency.

In order to understand the relationships based on the manufacturing industry, the regression analysis method is used. Manufacturing employment is considered as the dependent variable as proxy for agglomeration. Before running the analysis to find the best explanatory model, different types of data exploration techniques are used. The process includes;

- Descriptive examination of the all possible explanatory variables
- Reducing the number of the variables by qualitative data assessment
- Statistical examining for the multi-collinearity by several tests such as Correlation Matrix, Variation Inflation Factor and Tolerance tests
- Removing some of the variables as a result of the statistical process
- Running a stepwise procedure with the all possible final independent variables to find the best explanatory ones.

-  
After following these steps, the factors that are in relation to the concentration of manufacturing industries in Turkey are investigated by the use of regression models.

#### **4. The findings of global regression analysis for the determinants of agglomeration**

As mentioned earlier, to be able to have a better understanding of the relationship and not to miss any detailed interpretation, data for the 81 provinces of Turkey were used after the general comparisons in regional

scale. The global regression model analyzes the relationships between the manufacturing employment and the related independent variables in 2000 at the province level in Turkey. The results can be seen in the following Table 2. According to the results, the independent variables taken into account in this analysis such as GDP per capita, export, unemployment and public investment are the best explanatory variables and they can together explain the 98% of the manufacturing industries' employment.

**Table 2.** Regression analysis results

Variable	Standardized Coefficients	t	sig.	Tolerance	VIF
	Beta				
Constant		-1.130	0.262		
GDP per capita	0.037	2.485	0.015	0.845	1.183
Export	0.946	65.946	0.000	0.905	1.105
Unemployment	0.051	3.541	0.001	0.908	1.101
Public Investment	0.089	5.853	0.000	0.808	1.237

*Dependent Variable: Employment in Manufacturing Industries*  
 $R^2 = 0,986$ ;  $Adj. R^2 = 0,985$ ;  $sig. = 0,000$

According to the results the independent variable GDP per capita, is one of the significant factor, which has an effect on the manufacturing employment ( $B = 0.037$ ;  $t$  value = 2.485; and  $sig. = 0.015$ ). The positive relationship between the dependent and the independent variable can be explained by several reasons. First of all, GDP can be seen to represent the development level of the region. This can be attractive to the workers and on the other hand it can be interpreted as the potential of the consumption for the industries. In another word, the regions with high GDP per capita would have a chance of good access to the market (Combes and Overman, 2003).

The volume of export is another important variable that affects concentration of manufacturing industries ( $B = 0.946$ ;  $t$  value = 65.946; and  $sig. = 0.000$ ), in Turkey. The positive relationship can be explained in economic terms. The variable can be the symbol of market potential and increase in the export volume can be seen as the increase of the manufacturing industries. The propositions of new trade theory enhance the result of the analysis: The existence of scale economies encourages firms to choose a single location; barriers to trade encourage firms to locate near to their main markets; agglomeration economies encourage firms to cluster in particular locations (Krugman, 1991; Puga, 2002).

There are some other studies that unemployment is used as an independent variable in order to understand and explain the industry based relationships. At first it can be thought the sign/type of the relationship should not be positive since the employment is high one can expect less unemployment. However,

there are some aspects that support our results. First, the big cities, which are attractive for the migrants, generally face to the problem of high unemployment rate, since the firm-startups do not match with the new comers not only due to the number of workers, but also the skill of the labor. (Filiztekin, 2011). Second, unemployment rate is relatively low where the agricultural employment is high. Besides, high unemployment rate is also appealing to investors, because it indicates the opportunity of a large labor market.

The last independent variable of the model is the public investment as it has a significant and positive effect on the dependent variable ( $B = 0.089$ ;  $t$  value = 5.853; and sig. = 0.000). The increase in the public investment will support or in other words accelerate the increase in the manufacturing investment and also employment. On the other hand, there are some findings that even though there is a positive relationship within the country, some regions can be negatively affected by the increasing public investment in Turkey (Karadag et al., 2002). The other important outcome of another research that can be related to this result is proven by Gezici and Hewings (2004) that public investments are not always so powerful to be the pulling factor for private investment in Turkey. Also for the economic development, public investment cannot be the only criteria, but this situation can be different for the manufacturing industries. The literature of location theory and agglomeration economies have long been emphasized the importance of transportation not only for the factor inputs but also market accessibility. Assuming that the public investments are mostly on physical infrastructure and especially transportation, the direct and positive relationship based on the public investment can make more sense in the case of manufacturing industries.

## **5. Conclusion**

The causes of agglomeration have long been the interest of many researchers and it still needs to be explored by the empirical studies considering the new theoretical contributions. Two important contributions might be the studies considering the sector-specific results and the geographic unit issues are being taken into account. First, sector-specific studies assume that all the sectors do not choose their location due to the similar factors, but mostly they have the benefits of agglomeration based on the different needs. Second, the studies, which are taking into account different levels of space pointed out that the choice of geographic unit affects the observed estimates of agglomeration economies. Furthermore, urbanization and localization economies have got the attention since Hoover's study; however, the recent studies have more emphasized the significance of urbanization economies due to the structural changes in production.

In this paper, we tried to find out the answer of two questions; 1) how the distribution and concentration of manufacturing employment changed in Turkey during the last decade and 2) what are the determinants of agglomeration. In the first part, we analyzed the share of manufacturing employment and the growth of the employment in the NUTS 2 regions between the year of 1992 and 2008. The results indicate that, Istanbul has still

been the highest rate of manufacturing employment in Turkey related to the size of population, however the growth trend of manufacturing employment has been diminishing in Istanbul. On the other hand, the highest manufacturing employment increase has occurred in the neighboring regions of Istanbul; as they are TR21-(Tekirdağ, Edirne, Kırklareli), TR41-(Bursa, Eskişehir, Bilecik) and TR42-(Kocaeli, Sakarya, Düzce, Bolu, Yalova) regions. The location quotient values indicated that only 11 of 26 NUTS2 regions have the values greater than 1, which means the main concentration areas for manufacturing employment relative to the national average. L.Q values of the regions of Istanbul, Izmir, Konya, Hatay and Gaziantep have been diminishing, the increasing ones match to the groups which are defined in previous studies: 1) the neighbors of Istanbul: the regions of Tekirdağ, Kocaeli, 2) the regions used to be industrial centers: the regions of Bursa and Zonguldak, and 3) new industrial centers: the regions of Manisa and Kayseri. However, the share of manufacturing employment have been increasing in the rest of the regions, the Eastern Marmara region has gradually the main concentration area of manufacturing activities.

The second stage of the paper analyzed the determinants of agglomeration in 81 provinces of Turkey in 2000 in order to explore the manufacturing geography, which we have seen through the descriptive analysis. The reason for making the analysis at provincial level is to catch the details we mentioned in the second section of the paper. The findings of the analysis mostly indicate the significance of urbanization economies considering the GDP per capita and export, which are most relevant to the larger cities and market. Furthermore, unemployment is another significant variable as the proxy to labor pooling. However, the labor market and the issues of unemployment need to be paid attention to, while there have been a sector and structural changes. Finally, the findings of the positive relationship between the manufacturing employment and public investment would be helpful for the industry and the regional policies to accelerate more dispersed manufacturing activities in Turkey.

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