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## Discourses in Social Market Economy



**Jüri Sepp / Helje Kaldaru / Uku Varblane**

**The Development and Typology of  
the Employment Structure in OECD  
Countries**

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## Summary

Sectoral changes are nowadays an integral feature of economic development in all countries and hence gaining attention of several economists. Structural changes occur in different aggregation levels, from inter-industry change to inter-sectoral change. In this paper we are considering shifts at more aggregated sectoral level. The purpose of this paper is to analyze the specificities of the process of tertiarization of OECD countries. For this purpose, multi-dimensional analysis of branch-structure of OECD countries is implemented using STAN (Structural Analysis) database. First, an overview of the OECD averages is presented. Then cluster analysis is applied to explain how the countries are grouped on the basis of the similarity of branch-structure. Also the changes in the period 2000-2009 are examined. Finally, discriminant analysis is applied to determine the latent indicators that distinguish the branch structure of the OECD countries. Then, the typology of countries and its dynamics, including the process of convergence of income levels, can be viewed in a more general space of discriminant functions.

## Keywords

Structural change, tertiarization, typology of countries, cluster analysis, discriminant analysis

**Jüri Sepp**, *University of Tartu, Faculty of Economics and Business Administration, Narva mnt 4, Tartu, [Juri.Sepp@ut.ee](mailto:Juri.Sepp@ut.ee)*

**Helje Kaldaru**, *University of Tartu, Faculty of Economics and Business Administration, Narva mnt 4, Tartu, [Helje.Kaldaru@ut.ee](mailto:Helje.Kaldaru@ut.ee)*

**Uku Varblane**, *University of Tartu, Faculty of Economics and Business Administration, Narva mnt 4, Tartu, [Uku.Varblane@ut.ee](mailto:Uku.Varblane@ut.ee)*

# The Development and Typology of the Employment Structure in OECD Countries

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## Introduction

Sectoral changes are nowadays an integral feature of economic development in all countries and hence gaining attention of several economists. Structural changes occur in different aggregation levels, from inter-industry change to inter-sectoral change. In this paper we are considering shifts at more aggregated sectoral level. According to the three-sector-hypothesis (Fisher 1939, Clark 1940 or Fourastié 1949) and the convergence argument of Chenery and Taylor (1968), European countries should have experienced similar development patterns and should achieve a similar economic structure with dominant tertiary sector. The results of previous studies (Eichengreen, Gupta 2009, Maroto-Sanchez 2010, Jorgenson, Timmer 2011, Dzhain 2012), confirm that the process of tertiarization (orientation towards the service economy) is spreading throughout the world, especially among the postindustrial countries. However, it is noteworthy that in terms of employment tertiarization the European Union (EU) significantly lacks behind United States (US), at the same time, in terms of value added, the difference is substantially smaller. This indicates that tertiarization is a complex, multidimensional phenomenon, which is influenced by sectoral returns and the internal structure of the economy, as well as the socio-economic characteristics of the countries (Gregory, Salverda, Schettkat 2007).

The gradually increasing share of service sector could be explained by various factors. In general this process is influenced by changes in both supply side and demand side. The former mostly reflects the developments in technology, the latter is influenced by consumer preferences (Schettkat, Yocarini 2003, Krüger 2008). The commonly accepted explanations are associated with works of Kuznets (1966), Baumol (1967) and Fuchs (1968). Baumol's concept of "cost disease" explains the

rising share of service sector in GDP and employment with the technological stagnation of the essential elements of the sector, which increases the relative price of the respective services. In other words, compared to manufacturing industry, technology plays significantly smaller role in the service provision and changes much less over time. Hence, the price of services are gradually increasing as there is less room for cost-reducing technological innovations and rationalization and skill upgrading is less pronounced (Heilbrun 2011).

Based on Maslow's hierarchy of needs, Fuchs propounded the quantitative legitimacy of tertiarization, which continues to find empirical proof: the correlations between the share of service sector and the income level of the country could be illustrated by the logistic curve. Another aspect to consider here under increasing prices is inelastic demand that may lead to the consumption of services provided by shadow economy, hence underestimating the employment in service sector.

In addition, the roots of tertiarization could be explained by the hypothesis of externalization and innovation. The former explains the rise in the share of service sector with work allocation and the development of existing production process (different support activities being integral part of the production process becoming now individual services). More services as R&D, marketing, financing and transportation are outsourced to specialized firms and hence the role of intermediate services has increased significantly (Gershuny and Miles 1983). The second hypothesis presents the general increase in knowledge intensity as a result of internationalization and globalization, which increases the demand for knowledge-intensive research, development and marketing services. A comprehensive empirical review of tertiarization is provided by Memedovic, Lapadre (2010).

But aggregate patterns often hide large differences at regional or national level. Different endowments of productive factors, specific historical and geographical conditions, all contribute to the great diversity of development paths across countries (Gürbus 2011, Szirmai 2012). The topic of varying economic structure between countries was brought up by Wacziarg, Imbs (2000) and from a convergence viewpoint by Wacziarg (2001) specifically. Studies on structural convergence include Höhenberger, Schmiedeberg (2008). Olczyk, Lechman (2011) used multidimensional taxonomy methods. Janger *et al.* (2011), Melihovs, Kasjanovs (2011) and Grodzicki (2014) have attempted to find a structural typology among European countries by

using cluster analyses. Sepp, Kaldaru, Eerma (2009), Paas, Sepp, Scanell (2010) and Sepp, Kaldaru, Joamets (2014) have combined factor and cluster analyses to show that European countries may be divided into certain groups which can be characterised by specific traits:

- Western- and Northern-European welfare states with developed private and public services and relatively small (in terms of employment) albeit productive manufacturing sector,
- Southern-European countries where tourism related traditional commerce still plays a major role. Public sector is small in terms of employment share, but relatively well-funded.
- Eastern- and Central-European transition economies with large share of employment in low value-added manufacturing sector. Business and public service sectors in these countries are still on the increase.

But there is still a research gap in the literature of structural change and tertiarization in terms of describing and explaining regional peculiarities of tertiarization. It is still unanswered whether all countries follow the same trajectories in tertiarization and whether the process always concerns specific branches within the service and manufacturing sectors.

The purpose of this paper is to analyze the specificities of the process of tertiarization of OECD countries. For this purpose, multi-dimensional analysis of branch-structure of OECD countries is implemented using STAN (Structural Analysis) database. First, an overview of the OECD averages is presented. Then cluster analysis is applied to explain how the countries are grouped on the basis of the similarity of branch-structure. Also the changes in the period 2000-2009 are examined. Finally, discriminant analysis is applied to determine the latent indicators that distinguish the branch structure of the OECD countries. Then, the typology of countries and its dynamics, including the process of convergence of income levels, can be viewed in a more general space of discriminant functions.

### **The data of empirical analysis**

Sectoral structure of each of the countries can be described as the shares of the sectors in total employment and/or gross value added. In current paper the economy is

divided into nine sectors in accordance with the OECD STAN database classification. The acronyms and the content of the branches is shown in Table 1 (in parentheses are the short names used later in the text).

**Table 1.** The classification of economic sectors

AGR	Agriculture, hunting, forestry and fishing (agriculture)
MIN	Mining and quarrying
MAN	Manufacturing
ELE	Electricity, gas and water supply (energy)
CON	Construction
WHO	Wholesale and retail trade - restaurants and hotels (commerce)
TRA	Transport, storage and communications
BUS	Finance, insurance, real estate and business services (business services)
SOC	Public admin. and defense - compulsory social security; education, health and social work, other community, social and personal services (public services)

*Source: OECD 2001; the author's explanations*

Prior the comparative analysis of the countries, we review the average structural parameters of the OECD countries and their dynamics in the years 2000–2009 (Table 2). By far the **highest employment rate** in the OECD countries is in the public service sector, followed by trade and manufacturing sector. The business services sector is not far behind from the latter. We can also point out an overall shrinkage of manufacturing-related branches (AGR, MIN, MAN, and ELE). On account of this, the share of employment in business services industry and public services (BUS and SOC) has increased considerably, which indicates continuing tertiarization in OECD countries. The share of traditional trade services has also slightly increased. Reallocation of employment from manufacturing industry to services has affected approximately 5% of the employees during 2000–2009.

However, the structural shifts in employment do not automatically change the structure of the gross value added. Additional considerable factors are the **relative productivities** of the sectors. The relative productivity in this paper is defined as the ratio of the sectoral shares in gross value added and employment. Relative productivity is particularly high in extractive industry and energy industry, which are the small-

est branches in terms of employment share and where the market is often dominated by a few capital-intensive conglomerates. The productivity of business services, transport and also manufacturing to some extent, is also above the average level. The average relative productivity increased particularly in branches with decreasing employment share and this also stands the other way round. The average relative productivity in extractive industries was already four and a half times higher than the average level in 2000 and the discrepancy has been growing. The same tendency is evident in the energy industry. The relative productivity has decreased in the business service sector that is the sector with the most considerable employment growth. Nevertheless, the productivity of the sector has remained 80% higher than the average. Public service sector has shown a slight increase in employment as well as increase in the relative productivity, but the latter is still substantially below the average level. Altogether, we can talk about the productivity divergence between the sectors as the differences have deepened.

**Table 2.** The shares of economic sectors in total employment and gross value added in OECD countries and relative productivities in percent

	Employment		Relative productivity		Gross value added	
	2000	2009	2000	2009	2000	2009
AGR	6,84	5,03	49	46	3,38	2,29
MIN	0,45	0,41	457	502	2,05	2,05
MAN	17,99	15,02	108	107	19,42	16,01
ELE	0,86	0,74	268	361	2,32	2,66
CON	7,33	7,74	82	79	6,03	6,08
WHO	19,98	20,41	73	69	14,67	14,09
TRA	6,44	6,17	122	115	7,85	7,06
BUS	12,94	15,20	186	179	24,06	27,15
SOC	27,16	29,29	74	77	20,22	22,61

*Source: OECD STAN database; author's calculations*

The previously observed two factors shape the branch structure of the **gross value added**. Business service industry is the largest sector in the terms of gross value added. It exceeds the public service industry due to the larger relative productivity. The manufacturing industry and trade are also important in creating the gross value

added, but their importance in total value added still remains about 5–10 percentage points less than business and public service sectors. Agriculture has the smallest share in total value added and despite the extremely high productivity, the share of extractive industry and energy sector is also inconsiderable. The results reflect that in creating the gross value added the decrease in the share of manufacturing and increase in the share of services, is the main trend. This confirms the process of tertiarization (exceptions here are trading, transport and communication services).

### Cluster analysis of the branch structure of employment

We applied cluster analysis in order to identify the groups of OECD countries with similar employment branch structure. Cluster analysis is a helpful tool in order to later highlight the differences between groups using discriminant analysis. We admit that cluster analysis is somewhat subjective method as there is no single accepted rule to determine the number and the size of the clusters. Thus the results of different studies might somewhat vary. In the current paper, one of the objectives was to form as equally sized groups as possible, so that the number of clusters would enable to analyze the differences between the branch structures from various aspects. After analyzing both three- and five-cluster distribution, we chose the four-cluster distribution is the most fitting (Table 3).

**Table 3.** The results of the cluster analysis

Cluster	1	2	3	4
Number of observations	9	15	13	25
Average distance from the center of the cluster	6,5	5,3	6,5	5,5
The nearest object to the center	HUN 2000	ITA 2000	NZL 2000	ISR 2009

*Source: OECD, authors' calculations*

The average variance of the distances within all clusters remained between 1.5 to 2.0 standard deviations. Since the cluster analysis is sensitive to the initial order of indicators, the control-clustering was performed. The resulting groups were not much



different from the previous results, thus the analysis will be based on the clusters described above. Let it be said that the main objective of the cluster analysis in this paper was to group initial data prior the discriminant analysis, and this goal was achieved: all of the objects were grouped to the expected clusters during the discriminant analysis.

Table 4 illustrates the average employment shares of sectors in four clusters. This allows us to assess the employment of objects belonging to a cluster and interpret the structural forms.

**Table 4.** The average shares of employment of sectors in four clusters (%)

Sector	Cluster			
	1 Production economy	2 Industrial	3 Trading	4 Service economy
AGR	<b>11,79</b>	5,71	8,60	2,93
MIN	<b>0,95</b>	0,34	0,32	0,38
MAN	<b>23,20</b>	<b>19,58</b>	15,08	13,41
ELE	<b>1,52</b>	0,92	0,58	0,61
CON	7,79	8,07	7,74	6,79
WHO	17,67	19,3	<b>25,07</b>	19,25
TRA	6,58	6,45	5,72	6,30
BUS	7,87	12,86	11,98	<b>17,01</b>
SOC	22,64	26,77	24,9	<b>33,32</b>

*Source: OECD, authors' calculations*

The **first cluster** is distinct from the rest by the largest share of employment in agriculture, energy, extractive and manufacturing industries. It is a cluster of **production economy**, in which the employment structure is the farthest from the service economy. This is also confirmed by the smallest share of employment in the business services compared to other clusters.

The **second cluster** is characterized by a large share of employment in **manufacturing industry**. Compared to the previous cluster, the share of employment is smaller in agriculture and higher in business services. The countries in the cluster also have higher share of employment in public sector which indicates that accordingly to the theory those countries have more advanced employment structure.

The **third cluster** is characterized by a large share of employment in trading sector. The share of manufacturing industry is somewhat smaller; such structure of employment could be regarded as the predecessor of the service economy. However, it should be noted that the share of employment in business and public services is smaller and in agriculture larger compared to the industrial cluster, which does not allow this structure of employment to be regarded more advanced compared to the previous cluster.

The **fourth cluster** combines countries with already relatively well established **service economy** employment structure. The share of employment in manufacturing industry and agriculture is the smallest and the share of employment in business and public services is significantly larger compared to other clusters.

Interesting trends emerge while analyzing the countries' allocation to the clusters and the **dynamics of the countries from one cluster to another** during the years 2000-2009 (Table 5). In theory, the nature of the evolution of employment structure should be from an agrarian-economy towards a service economy.

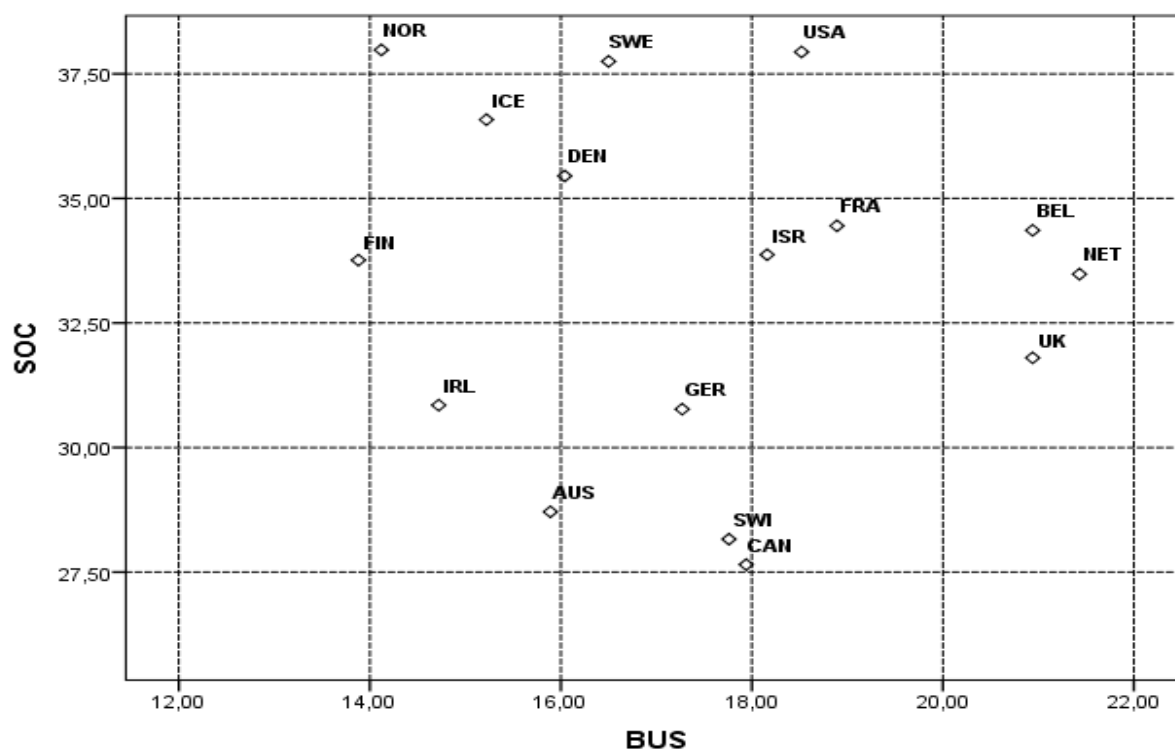
According to the results of this analysis 16 countries out of 31 (just over half) have not changed their position in the cluster. It has to be taken into account that nine of them were already in the service economy cluster in 2000. 15 countries have shifted and in general towards the service economy cluster. The transition countries have shifted from production economies to industrial countries (except Poland), that means they have risen next to the Austria and Italy, who have retained their position. The rest of the initial industrialized countries have moved to the service economy, while Spain is the only one that has shifted towards the trading cluster. This is the only example of development, where industrial stage is followed by trading. The initial agricultural-industrial countries Mexico and Portugal have also taken the direction towards trading. Thus, the industrial or trading stage of the employment structure could be considered as two alternative trajectories of moving towards a service economy. Canada and Australia have reached from trading cluster to countries with developed service economy. Together with additional seven countries, 16 of them had moved to the service economy employment structure by the end of the period. Thus, we can conclude that changes in the employment structure among the considered sample of countries have been consistent with the theoretical considerations, but on the other hand different paths of development were identified.

**Table 5.** The distribution of countries into four clusters according to the sectoral structure of employment in 2000 and 2009.

2000	2009	1. Production economy	2. Industrial	3. Trading	4. Service economy	Number of countries
Production Economy	POL	CZE, EST, HUN, SLK, SLV	MEX, POR			8
Industrial economy		AUT, ITA	SPA	FIN, GER, ICE, IRL, SWI		8
Trading			GRE, NZL, KOR, JAP	CAN, AUS		6
Service economy				BEL, FRA, ISR, NET, UK, USA, DEN, NOR, SWE		9
Number of countries	1	7	7	16	31	

Source: OECD, authors' calculations

**Figure 1.** The differentiation of the service economy countries by the shares of employment in business and public service sectors in 2009.



Source: OECD, authors' calculations

While considering more closely the 16-member group of the service economy countries in 2009 (Figure 1) in the aspect of the business and public service employment ratio, interesting moments occur. It turns out that this is not a homogenous group. On the one hand the previous industrial and trading countries (as Switzerland, Ireland and Germany; Australia and Canada) distinguish from the others by smaller share of employment in public sector. The tertiarization here has mainly occurred from the expansion of the business services. However, Finland and Iceland are the opposite cases as they have joined the service economy cluster while belonging to the Nordic group of countries in which the employment structure is characterized by a larger share of public services. In business services Great Britain and the Benelux countries form the leading group.

### **Discriminant analysis of the branch structure of employment**

Discriminant analysis provides a general insight to distinguish countries. It replaces the initial sectoral shares of the countries with a linear combination i.e. discriminant function (DF) in a way that the differentiation of countries on the basis of clusters is the most distinct. While using four clusters the discriminant analysis provides three DF-s. The relations between the initial indicators and discriminant functions are shown in the Table 6. The correlations that are the best to distinguish the groups of objects (clusters) are marked with a star. According to the relations it is possible to deduce relevant aspects that distinguishes clusters (distinctive features of economic structure).

**Table 6.** Correlations between discriminant functions and the employment shares of economic sectors by four clusters (structural matrix)

Sectors	Discriminant function		
	1. Tertiary	2. Trade	3. Industry
SOC	0,582*	-0,353	-0,284
BUS	0,551*	-0,114	0,021
AGR	-0,482*	0,208	-0,408
WHO	0,014	0,872*	-0,194
ELE	-0,366	-0,394*	-0,006
TRA	-0,023	-0,210*	0,131
MAN	-0,511	-0,323	0,658*
MIN	-0,160	-0,205	-0,419*
CON	-0,133	0,088	0,405*

\* The strongest correlation between relative importance of the sector and discriminant function.

Source: OECD, author's calculations

The first “**tertiary**” discriminant function directly reflects the level of modern tertiarization – the relative importance of business and public services and sectors of industrial production. The share of public and business services has the strongest positive correlation with the discriminant function whereas the share of agriculture and manufacturing has the strongest negative correlation. The higher the value of a function, the more service-economy like employment structure the state has. The first discriminant function describes 73% of the variation of initial variables.

The second discriminant function distinguishes traditional service-oriented economies and countries with significant share of employment in energy related and transportation sectors. For simplicity, we consider this as a „**trade**“ function. This function describes the 23% of initial variability. The third proves to be useful to distinguish manufacturing and construction oriented economies from others, mostly countries with large share of employment in the primary sector (AGR, MIN). Hence, we are calling this „**industrial**“ function. The generalizability of the third discriminant function is, however, rather low, due to its small share in overall explanatory power (only 4%).

Discriminant analysis demonstrated that based on the initial clusters, it is possible to find discriminant functions in a way that the composition of all clusters remains unchanged. Therefore, the mean values of DF-s could be used to assess in what extent the clusters are distinguishable from each other (see Table 7). In the first place, it can be seen that each of the DF-s is positive in only one cluster, in which countries

have similar employment structure and that makes them well-distinguishable. For the first DF, trading and industrial clusters show a negative average value, but are still located somewhat closer to a service economy cluster rather than the production economy cluster. Whereas the mean values of the DF that illustrates tertiarization key trends are roughly equal for the industrial and trading clusters, it is not possible to give advantage neither of them in terms of the level of development. The second discriminant function illustrates that countries with trading employment structure have already distanced themselves from countries oriented to production economy. However, development of modern service-based economic structure will still take some time. Also, in accordance with the mean values of the first DF, this cluster is the closest to the group of countries in industrial cluster. Both industrial and trading clusters are roughly at the same stage of development towards a service economy employment structure. However, in that process they have preserved industrial or trading specifics correspondingly.

**Table 7.** The mean values for the discriminant functions in four cluster.

Clusters	Discriminant function		
	1. Tertiary	2. Trade	3. Industry
1 Production economy	<b>-4,366</b>	-1,337	-0,548
2. Industrial	-0,634	-0,254	<b>0,940</b>
3 Trading	-0,677	<b>2,359</b>	-0,220
4 Service economy	<b>2,304</b>	-0,593	-0,252

*Source: OECD, author's calculations*

On the basis of the values of three discriminant functions, OECD countries are then placed in a three dimensional space, which can be used to create two dimensional projections (Figures 2, 3 and 4).

**Figure 2.** Location of countries in a “trade” and “tertiary” discriminant plane.

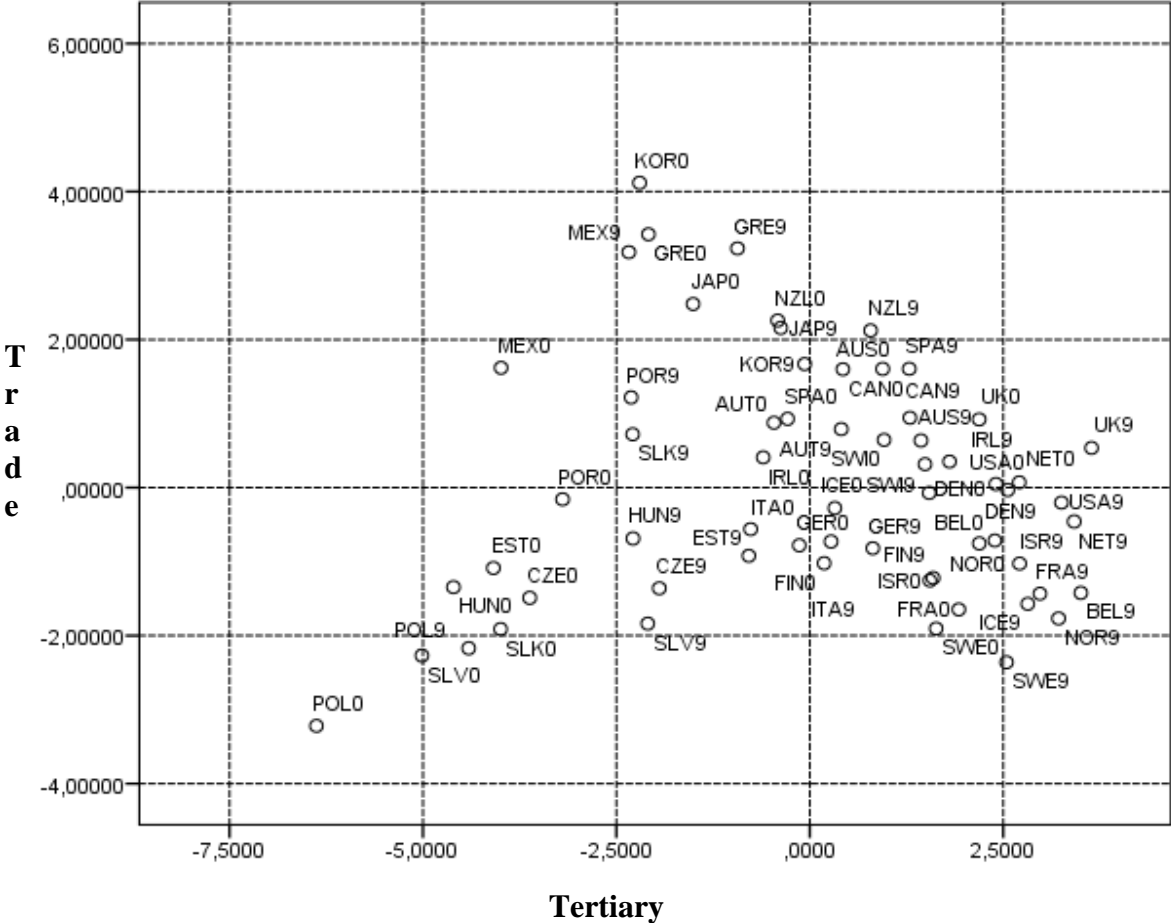


Figure 2 shows that, “trade” employment structure can be specifically attributed to Korea, Japan, Greece, Mexico and New Zealand, whereas during the last decade, this peculiarity has been diminished the most in case of Korea and increased in case of Mexico. Transition economies belong to so-called non-trade group of countries. However, since 2000, transition countries have managed to significantly reduce the discrepancies in employment structure compared to “trade” countries. Nevertheless, both of these groups are still far from advanced service economies. Some countries among the transition economies are more and some are less trade oriented. The relatively small employment share in trading sector is a characteristic feature for Nordic countries.

The negative values of the tertiarization discriminant function indicate the dominance of production economy, and as shown in the figure, there are more significant differences between those countries than between developed countries. Eastern European transition economies are clearly distinguishable as characterized by high share of employment in sectors related to production economy, the most representational

case is the agrarian Poland. It may, however, be noted that countries in this particular group have most rapidly developed their employment structure towards the service economy, while it has also accompanied by a slight shift in the direction of trading.

Figure 3 shows, in particular, that the “trade” countries are not a homogeneous group. Korea and Japan are distinguished from Greece and Mexico (all trade oriented countries) with substantially more developed industry. Generally non-trading transition economies are also dissipated over the figure. Some interesting insights can be still drawn. For example, the location of Poland and Czech Republic is rather diametrical in the figure. Countries which are not characterized neither industrial nor trade intensive employment structure, are either service economies like the United States or Norway, or the agrarian countries like Poland.

**Figure 3.** Location of countries in an “industry” and “trade” discriminant plane.

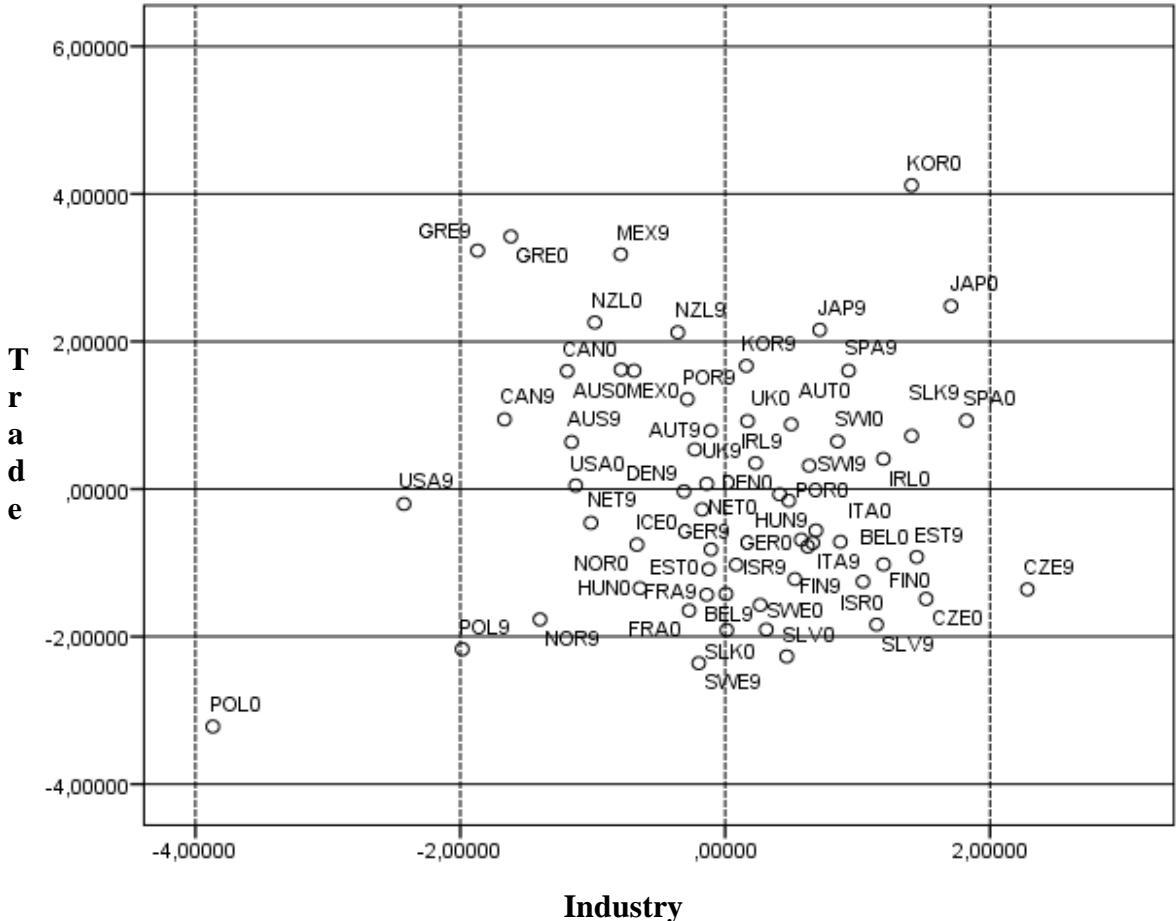
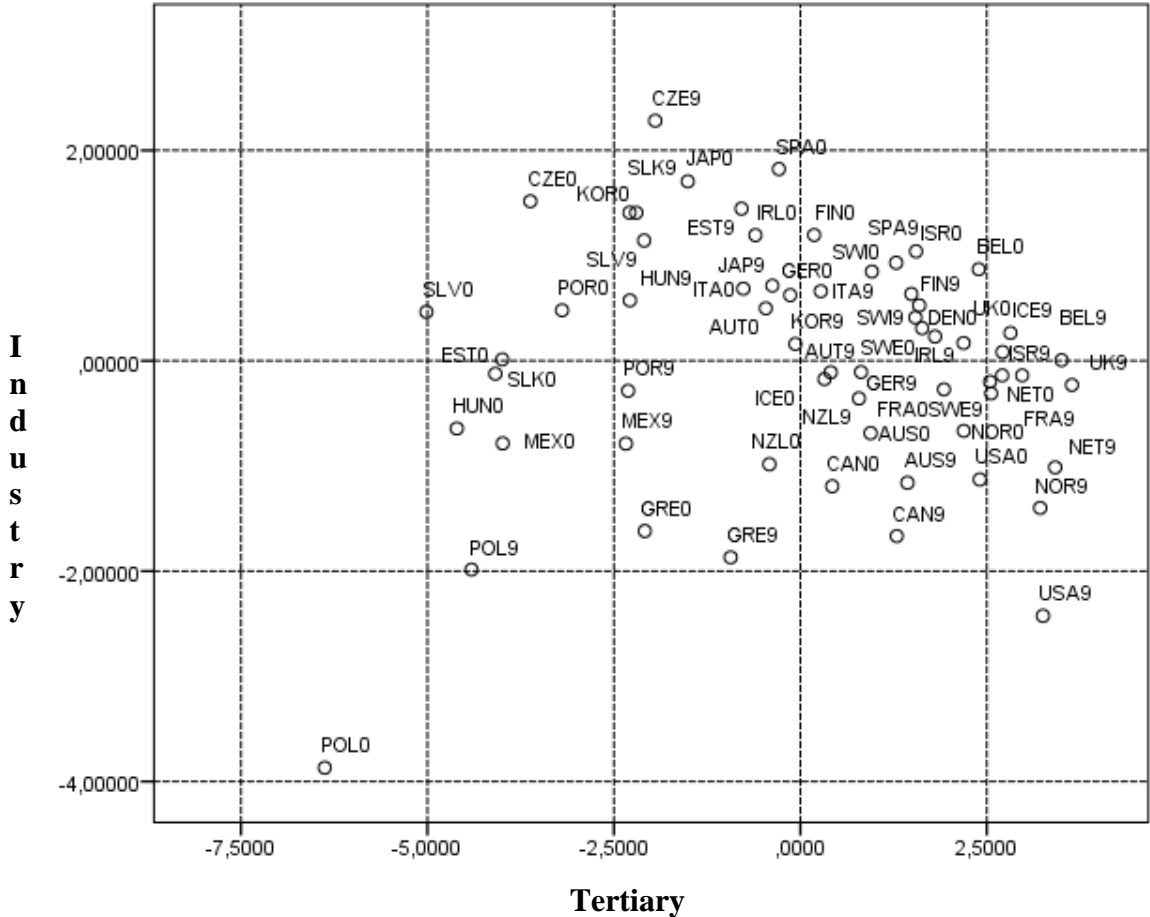


Figure 4 illustrates that the most industrialized country by employment structure is the Czech Republic. Transition economies have generally shifted further in both dimensions, increasing both tertiary and industry DFs. However, in several trade and ser-



vice oriented economies the industrial employment has reduced as the service sector has gained employment.

**Figure 4.** Location of countries in a “tertiary” and “industry” discriminant plane.



Discriminant analysis also provides a remarkable opportunity to calculate **the probability for of one or another country for being in a particular cluster**. If this probability is significantly less than one, then the country also has substantial similarities with other clusters. Interestingly, the lack of clarity in the distribution of countries has increased over the years. In 2000, there were only three countries with uncertain positioning (Table 8). Iceland and Switzerland were still industrialized countries by two-thirds of probability, whereas one-third of probability of belonging to the service cluster already indicated the development towards the service economy structure. In contrast, Austria with two-thirds of probability for being in an industrial cluster also had one third of probability for being in a trading cluster.

**Table 8** Probabilities of countries belonging to the clusters

	2000				2009			
	Production economy	Industrial	Trading	Service economy	Production economy	Industrial	Trading	Service economy
AUS		0.06	0.80	0.14		0.04	0.07	0.90
AUT		<b>0.65</b>	<b>0.34</b>	0.01		<b>0.46</b>	<b>0.39</b>	<b>0.15</b>
BEL		0.02		0.98				1.00
CAN		0.04	0.93	0.04		0.03	0.21	0.76
CZE	0.95	0.05			0.01	0.99		
DEN		0.13	0.01	0.86				1.00
EST	1.00					1.00		
FIN		0.94		0.06		0.09		0.91
FRA		0.01		0.99				1.00
GER		<b>0.95</b>	0.01	0.04		<b>0.35</b>		<b>0.64</b>
GRE			1.00				1.00	
HUN	1.00				0.18	0.81	0.01	
ICE		<b>0.69</b>	0.04	<b>0.27</b>				1.00
IRL		0.93	0.07			0.06	0.01	0.93
ISR		0.17		0.83				1.00
ITA		0.98	0.01	0.01		0.87	0.01	0.13
JAP		0.10	0.90			0.08	0.92	
KOR			1.00			0.14	0.86	0.01
MEX	0.80	0.01	0.19				1.00	
NET				1.00				1.00
NZL		0.01	0.99			0.03	0.95	0.02
NOR				0.99				1.00
POL	1.00				1.00			
POR	0.81	0.18	0.01		0.02	0.22	0.76	
SLK	1.00				0.01	0.87	0.12	
SLV	1.00				0.14	0.86		
SPA		<b>0.88</b>	0.11			<b>0.25</b>	<b>0.51</b>	<b>0.24</b>
SWE		0.05		0.95				1.00
SWI		<b>0.58</b>	0.11	<b>0.32</b>		0.21	0.02	0.77
UK		0.02	0.02	0.96				1.00
USA				1.00				1.00

Source: OECD, author's calculations

In 2009, the number of countries with uncertain placement in clusters has doubled compared to 2000. According to the probabilities, the position of Austria, Germany and Spain was the most blurred. For Austria the probability for being in an industrial cluster is less than 0.5, however it is still higher compared to the corresponding probabilities for other clusters. The probability of being in a trading cluster was left un-

changed, but contrarily to 2000 there is 15% of probability for belonging to a service cluster. In Spain, the initial orientation towards industrial cluster has dispersed, but unlike many other countries, in favour of trading. However, there is also a certain shift towards a service economy. In 2000, Germany was still an industrial country by our definition, but by 2009 the probability for belonging to industrial cluster has decreased to 35%, because with 64% of probability the country belonged to the service cluster.

Estonia demonstrates a rapid transition from production economy cluster to industrial cluster. In 2009 Estonia can be considered the most genuine or authentic representative of the cluster. In 2000 Hungary, Poland, Slovakia and Slovenia could be also considered as pure production economy countries. However the Czech Republic already had some signs of an industrial country. In 2009 only Poland with strong agrarian sector remained in the production economy cluster. All the others have had transferred to the industrial cluster – Czech Republic with 99% probability, the remaining with 81-87% probability. In addition to Estonia and Poland also Greece (trading), and the US and the Netherlands (financial services) could be considered as the 'genuine' representatives of their clusters in both 2000 and 2009.

The values of discriminant functions are instrumental in **analyzing the overall dynamics of structural shifts** (Table 9). Remarkably, the dynamics of all of the DF values over the period 2000-2009 confirm the general shift of employment structure towards a modern service economy with dominant business and public service sectors (BUS + SOC). If in 2000 the mean value for service orientation was below the average, then in 2009 it is already higher than the average: the value has increased by 1.42 units. This is the result of the significantly decreased mean values of discriminant functions of “trade” and “industry”, which also confirms the assertion above.

The descriptive statistics of discriminant functions also refer to a **beta-convergence**. The standard deviation of the first function has decreased from 2.57 to 2.20 during the period observed. This indicates the diminishing transnational discrepancies. The convergence of branch structure is also seen in the trade and industrial aspect, but in a smaller scale.

**Table 9.** Descriptive statistics of discriminant functions.

	2000.a.			2009.a.		
	1. Tertiary	2. Trade	3. Industry	1. Tertiary	2. Trade	3. Industry
Mean	-0,71	0,02	0,10	0,71	-0,02	-0,10
Standard deviation	2,57	1,69	1,17	2,20	1,53	1,08

Source: OECD, author's calculations

The theory suggests that service-economy like employment structure refers to the overall development level of the country. Hence, it is interesting to identify the **relations of DF values and income levels of respective countries** (Table 10). We use gross domestic product (GDP) per capita (pc) in purchasing power parity as a base measure for income levels. In 2009 the correlation of the linear relationship between GDP and the first DF (tertiary function) is as high as 0.75, the correlation for the second DF – trade function – is -0.22 and -0.24 for the third, industry function. A statistically significant correlation exists only between the tertiary DF function and income levels. The increasing share of trade and manufacturing employment, is more likely related to some, albeit statistically insignificant loss in national welfare. The latter is explained in particular by the fact that a larger share of employment in manufacturing industry (mainly in the transition countries) is generally associated with lower level of productivity.

**Table 10.** The values of discriminant functions and income levels in OECD countries, 2009.

Country	Tertiary	Trade	Industry	GDP	Prediction	Difference
AUS	1,44	0,64	-1,16	42702	40574	2128
AUT	0,41	0,79	-0,11	47526	34677	12849
BEL	3,50	-1,42	0,01	44997	52405	-7408
CAN	1,29	0,94	-1,67	40764	39757	1007
CZE	-1,95	-1,36	2,28	19699	21214	-1515
DEN	2,56	-0,03	-0,31	57896	46997	10899
EST	-0,79	-0,92	1,45	14717	27835	-13118
FIN	1,59	-1,22	0,53	47104	41478	5626
FRA	2,97	-1,43	-0,14	41631	49382	-7751
GER	0,81	-0,82	-0,11	41669	37009	4660
GRE	-0,93	3,23	-1,87	29484	27000	2484
HUN	-2,29	-0,69	0,57	12907	19264	-6357

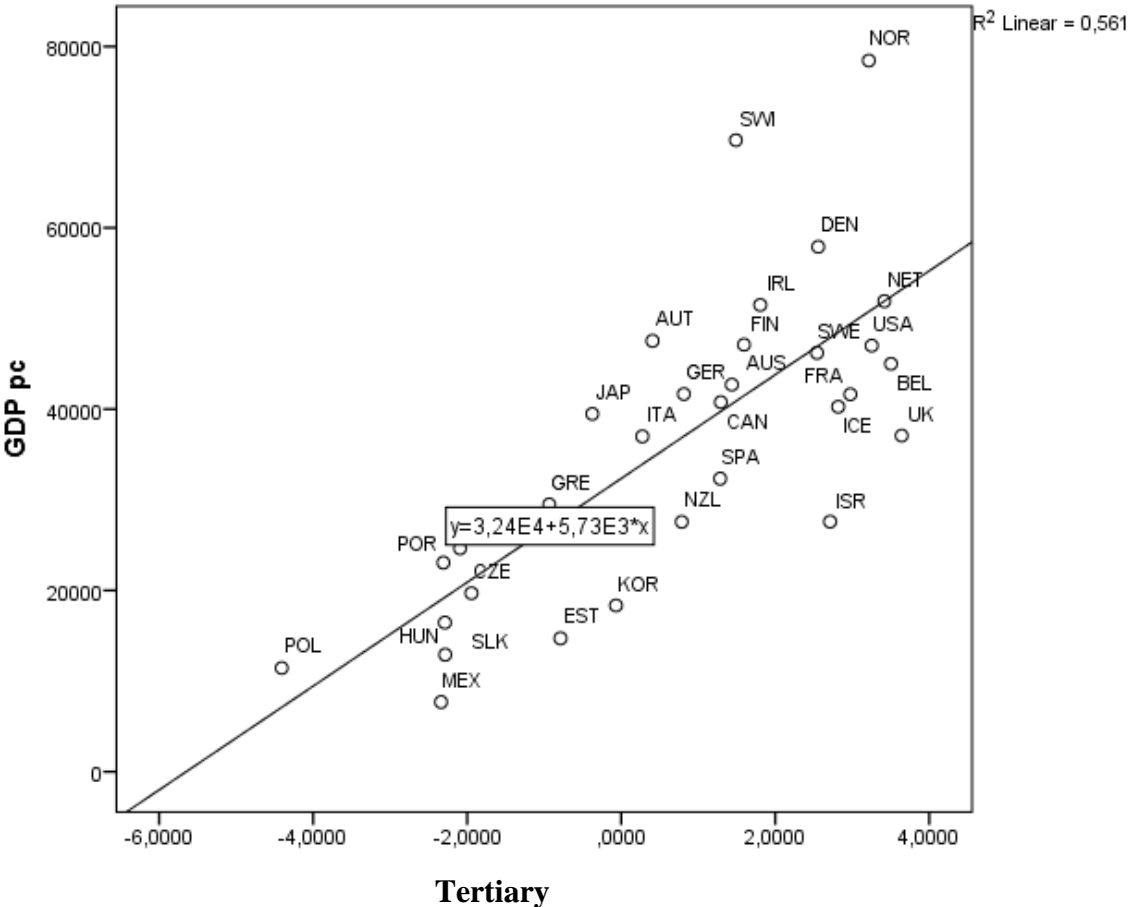
ICE	2,82	-1,57	0,26	40263	48484	-8221
IRL	1,81	0,35	0,23	51494	42690	8804
ISR	2,71	-1,03	0,08	27583	47878	-20295
ITA	0,27	-0,73	0,66	36993	33923	3070
JAP	-0,38	2,16	0,71	39473	30200	9273
KOR	-0,07	1,67	0,16	18339	31963	-13624
MEX	-2,34	3,18	-0,79	7690	18958	-11268
NET	3,42	-0,46	-1,01	51907	51913	-6
NZL	0,79	2,12	-0,36	27562	36849	-9287
NOR	3,22	-1,77	-1,40	78457	50763	27694
POL	-4,41	-2,17	-1,99	11441	7111	4330
POR	-2,31	1,22	-0,29	23063	19125	3938
SLK	-2,29	0,72	1,41	16455	19242	-2787
SLV	-2,09	-1,84	1,14	24634	20362	4272
SPA	1,29	1,61	0,93	32332	39709	-7377
SWE	2,54	-2,36	-0,20	46207	46907	-700
SWI	1,49	0,32	0,64	69669	40878	28791
UK	3,64	0,54	-0,23	37076	53202	-16126
USA	3,25	-0,20	-2,43	47001	50975	-3974

Source: OECD, author's calculations

According to the previous calculations, the regression equation describing the relation between the income level (GDP) and tertiary function at DF1 is as follows  $GDP = 32351 + 5726DF1$ . The regression equation describes 56% of the variation of the income levels (see Figure 5).

There is also a tendency that the higher is the tertiarization level of the country, the more the actual income level differs from the predicted value of the GDP. For example, Estonia, Korea and Israel represent a group of countries where the actual levels of income and productivity do not yet meet the opportunities that should result from the sectoral structure of the employment. The largest positive deviations from the predicted income levels are particularly significant for Norway and Switzerland.

**Figure 5** The relationship between the level of tertiarization of employment structure and the GDP



Source: OECD, author's calculations

**Conclusion**

In this paper, we analyzed the changes at the sectoral structure of the economy, primarily the tertiarization of OECD countries during the previous decade (2000-2009). The main focus was identifying the typology of countries by comparing both developed and developing OECD member states, which can be considered a novel approach in the literature, especially in empirical papers.

With regard to the common trends in OECD countries, tertiarization clearly continues. Economic sectors as business and public services are constantly increasing the share in both employment and value added. The employment share of trade, transport and communication employment have not changed significantly, but their share in value added has declined. As expected, the percentage of people employed in manufacturing and in primary sector has decreased. Altogether, during the years

2000-2009, there was a structural shift of 5 percentage points towards the service economy (mostly on account of the manufacturing industry).

The analysis of differences between countries in the extent and dynamics of tertiarization provided interesting results. We first applied cluster analysis to identify the groups of countries with similar employment structure. Four clusters were identified:

1. The first cluster is distinct from the rest with high share of employment in agriculture, energy and other extractive industries. It is a cluster of production economy, with employment structure most distinct from service economy.
2. The second cluster is characterized by a large share of people employed in manufacturing. Employment in agriculture is smaller compared to the previous cluster and somewhat larger share is employed in the business services industry and in the public sector. In accordance with the theory, countries in this cluster represent a more developed employment structure.
3. The third cluster is characterized by the dominant trade sector as the share of manufacturing is already lower compared to the previous cluster. That kind of employment structure could be considered as a predecessor of the service economy.
4. The fourth cluster represents the relatively well established service-economy as the share of employment in manufacturing is even smaller, but the business services and the provision of public services is significantly more relevant compared to the rest of the clusters

Interesting trends emerge while analyzing the dynamics of the countries from one cluster to another during the years 2000-2009. In theory, the nature of the evolution of employment structure should be from agrarian-economy towards a service economy. According to the results of this analysis, around half of the countries (16 out of 31) have remained in the same cluster, with 9 of them already in service-economy cluster in 2000. The general shift for the rest was towards a service economy, however specific trajectories illustrate the role of path dependency.

For presenting more generalized picture and increasing the clarity of the results of the cluster analysis, the discriminant analysis was applied as the method that replaces the initial intensities of the sectors with a discriminant function (DF). Using four cluster, the discriminant analysis provide three DF-s:

The first DF that describes 73% of the initial variation directly reflects **the level of modern tertiarization** as the share of business and public services have the strongest positive correlations with the function and contrarily, the share of agriculture and manufacturing the strongest negative correlations.

The second DF distinguishes **trade oriented** economies from the countries, whose economies are more energy and transport-oriented.

The third DF helps to distinguish countries with large share of employment in **manufacturing industry**. This is considered as an industry function.

The values of discriminant functions further indicate:

- **The probability of the country for being in a particular cluster.** If this probability is less than one, the country also has strong commonalities with other clusters. Interestingly, this lack of clarity in the distribution of countries has increased over the years. In 2000 there were only three countries with uncertain cluster. In 2009 the countries with blurred employment structure has doubled.
- **General trends of tertiarization.** The average values of tertiarization function, illustrating the overall economic balance of the service and manufacturing branches in the country, have increased over the observed decade. This could be considered as the evidence for **beta-convergence**. The standard deviation of the first DF decreased significantly over the period. Thus, transnational discrepancies in tertiarization are generally decreasing. The trends are not so obvious among the other DFs and the specificity of the countries is maintained.
- **The values of DF were also compared with the respective national income levels**, using gross domestic product (GDP) per capita (pc) as the proxy. The results show statistically significant correlations between the levels of income and tertiarization in 2009. Increased employment in trade and industry, however, is more closely related to some, albeit statistically insignificant loss in welfare. Apparently, the increased trade and manufacturing employment is generally associated with lower productivity.

However, tertiarization explains more than half of the variation in income levels between countries, but significant fluctuations around the expected income levels appear.



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