Sepp, Jüri; Kaldaru, Helje; Joamets, Jürgen

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The characteristics and position of the economic structures of Estonia and Korea among the OECD countries

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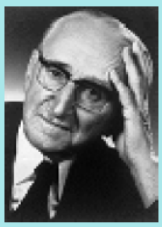



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Discourse 2014 – 4

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Abstract

The present study is a follow up to a previous paper by the same authors that aimed to systematize the similarities and differences of the economic structures of the countries of the European Union. This errand has been expanded to include the countries of the OECD. The starting point of the study is the share of employment in the 14 sectors of the economy as well as that of the 10 branches of manufacturing on the basis of which 3-4 latent principal components will be synthesized. These components will be used to explain the typology of the countries. The first two components are a repeat of those found in the EU study and differentiate three groups of countries – evolved service based economies, tourism based economies, and manufacturing based transition economies. The following two components on the other hand are new and present a differentiation based on the proportion of employment in the public and private sectors. The connection between the principal components and the sectors' relative productivities (in relation to national averages) will also be examined and a primarily inverse relation with share of employment is determined (structural burden). In addition to the above, the present study takes an in depth look at the positions of two specific countries – Estonia and Korea – among the developed countries of the world. It appears that in some ways the two are similar but in others they are polar opposites.

Keywords: Comparative economics, sectoral structure, productivity, employment, tertiarization, principel component analysis, latent variables

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Jüri Sepp, Helje Kaldaru and Jürgen Joamets
University of Tartu
Faculty of Economics and Business Administration
Narva Rd 4, 51009 Tartu, Estonia
juri.sepp@ut.ee, helje.kaldaru@ut.ee, jyrgenjoamets@gmail.com

Jüri Sepp, Helje Kaldaru and Jürgen Joamets

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Introduction

Prior research has shown that when it comes to time and regional variation, the behaviour of the various industries of the economy tends to be contingent upon each other.[1] The variance of their relative importance is linked regardless. This in turn allows us to pose the question of not only an overarching trend of structural change but also one of economic typology and to study the placement and movement of countries within the said typology. The topic of varying economic structure between countries was brought up by Wacziarg, Imbs (2000) and from a convergence viewpoint by Wacziarg (2001) specifically. Unfortunately, not many in-depth studies on the subject have been done to date. Studies on structural convergence include Höhenberger, Schmiedeberg (2008) and Melihovs, Kasjanovs (2011). The latter have also attempted to find a structural typology among European countries by utilising cluster analyses. Paas *et al.* (2009) and Sepp (2009) have combined factor and cluster analyses to show that European countries may be divided into certain groups which can be characterised by specific traits:

* The service-based welfare states of Western and Northern Europe with a strong but small core of high value-added industries,
* The countries of Southern Europe where in addition to manufacturing, tourism is in a prominent position. These countries have a small but high value social sector as well.
* The transition states of Eastern and Central Europe with a sizable but low value-added manufacturing presence. Both the business and private services sectors in

[1] Fisher (1935), Clark (1940), Fourastié (1949), Kaldor (1961), Baumol (1967), Fuchs (1968), Kuznets (1971) and Madisson (1980) are the classics in this sphere. See the overview by Jorgenson, Timmer (2011).

these countries are on the rise. In addition, these countries have remarkable returns on mediation activities.

Similar conclusions have been drawn by Janger *et al.* (2011: 17), however, their typology is based on more than just the structure of the economy:

- Higher-income countries with a specialisation in knowledge-intensive sectors, including Austria, Belgium, Denmark, Finland, France, Germany, Ireland, the Netherlands, Sweden and the United Kingdom.
- Higher-income countries with a specialisation in less knowledge-intensive sectors, including Cyprus, Greece, Italy, Luxembourg, Portugal and Spain.
- Lower-income countries with a trade specialisation in technologically-progressive sectors including the Czech Republic, Hungary, Malta, Poland, Slovakia and Slovenia.
- Lower-income countries with a specialisation in less knowledge-intensive sectors, including Bulgaria, Estonia, Latvia, Lithuania and Romania.

The typology of the various economic structures may seem hidden at first glance and as such is also an intriguing subject outside of the European Union. The current article will look at the OECD countries while paying special attention to finding the positions of Estonia and Korea within this conglomeration of countries. For generalisation purposes, we will use principal component analysis while relying on the STAN database for data on employment structure in OECD countries in 2006. The following 14 sectors will be under examination:

1. Agriculture, hunting, forestry and fishing
2. Mining and quarrying
3. Manufacturing
4. Electricity, gas and water supply
5. Construction
6. Wholesale and retail trade – repairs
7. Hotels and restaurants
8. Transport, storage and communication
9. Financial intermediation
10. Real estate, renting and business activities
11. Public administration and defence – compulsory social security
12. Education
13. Health and social work
14. Other communal, social and personal services

1. Sectoral Structure of Employment

Excluding the quarrying industry, for which no data was available, our component analysis reached a structure that could be described with three or four components (the corresponding eigenvalues were greater than one). It is remarkable that the first two components were not at all dependent on the specification of the following two, which speaks volumes about their robust and objective nature (Table 1). The density of correlations between first components found from two different models reached 0.99.

When interpreting the first two components (Table 1) we can see some overlapping with the components found with European Union data (Sepp 2009). Firstly, the **tertiarisation component** (F13 and F14), which has a significant positive relation to finance and business services and social and healthcare sector employment and a negative relation to the agriculture, manufacturing and energy sectors. The second component of employment structure (F24 and F23), however, is strongly connected to the transport and communication sector as well as the manufacturing and energy sectors. All of these industries share an aptitude for technology. On the other hand, a negative relation can be seen with the housing, catering and wholesale industries, and in the case of three components (F23), other personal and social services which can all be summarised as the leisure industry. This component can be called the **technology component** in accordance with its positive relation.

Table 1. The hidden components of employment structure (factor loadings in the case of a 3 or 4 dimensional specification)

	Components of the 4-dimensional model				Components of the 3-dimensional model		
Industry	F14	F24	F34	F44	F13	F23	F33
1 AGR	-0.786				-0.823		
3 MAN	-0.736	0.351			-0.718	0.397	
4 ELE	-0.586	0.647			-0.551	0.684	
5 CON			0.451	0.595			0.760
6 WHO		-0.684				-0.679	
7 HOT		-0.708	0.540			-0.767	0.484
8 TRA		0.853				0.834	
9 FIN	0.579			0.656	0.579		0.479
10 REA	0.886				0.866		
11 PUB			-0.705				-0.646
12 EDU				-0.735			-0.488
13 HEA	0.745				0.744		
14 OTH			0.787			-0.435	0.408

Note: The first three letters of the name of the economic sector will be used as an acronym. Only statistically significant factor weights are listed.
Source: Authors' calculations based on OECD STAN data.

The above interpretation is also confirmed when looking at the allocation of the countries on the level of factor scores (Figure 1). It is worth noting that Estonia is an outlier – it has the largest technology component. This also sets it apart from other transitional economies which without it form a cluster of six countries. One may say that Estonia is clearly the most technologically advanced out of them. On the other hand, Japan alongside Korea seems to be moving closer to the economic structure of the tourism-based countries of Southern Europe. Despite this, Korea and Japan still belong to the cluster of advanced western service-based economies, although with relatively extensive deindustrialisation (the score of the first factor is slightly negative). Their counterparts among the developed countries are Northern European countries, where the traditional retail and communal services sectors do not employ as many individuals.

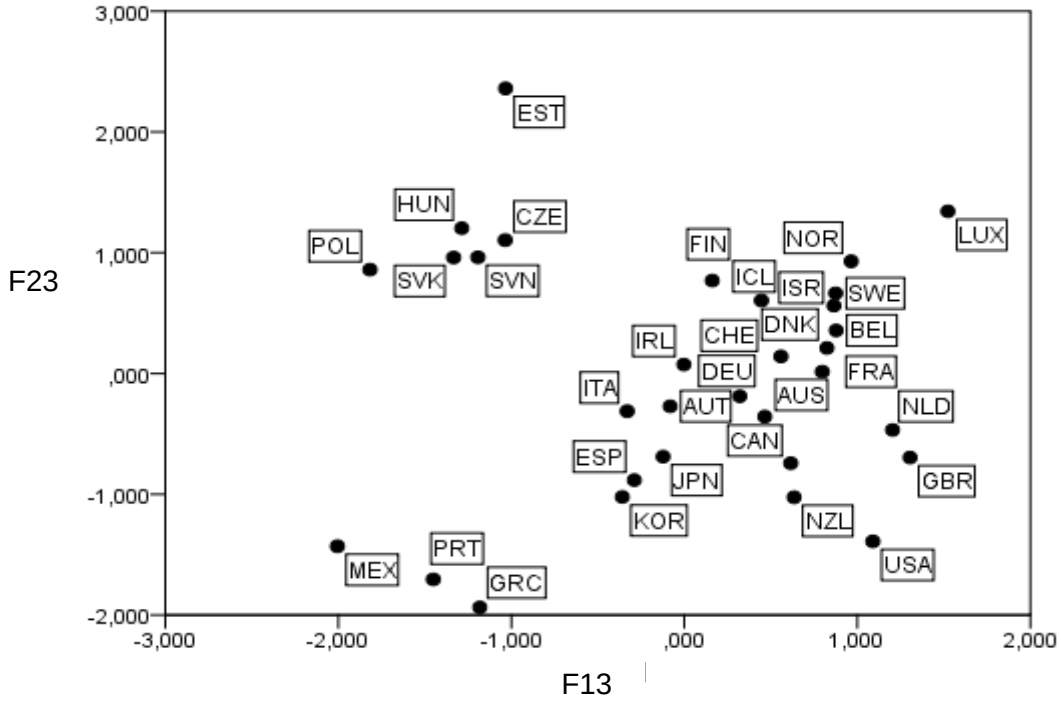

Figure 1. The OECD countries according to the first two latent variables of employment in 2006 (factor scores).
Source: Authors' calculations based on OECD STAN data.

The largest contribution of the current study is the forming of a third (and fourth) component (Figure 2). These components are described by a relatively modest public sector, especially in the public services and education sense. This void in employment is filled by construction and multiple private sector services.

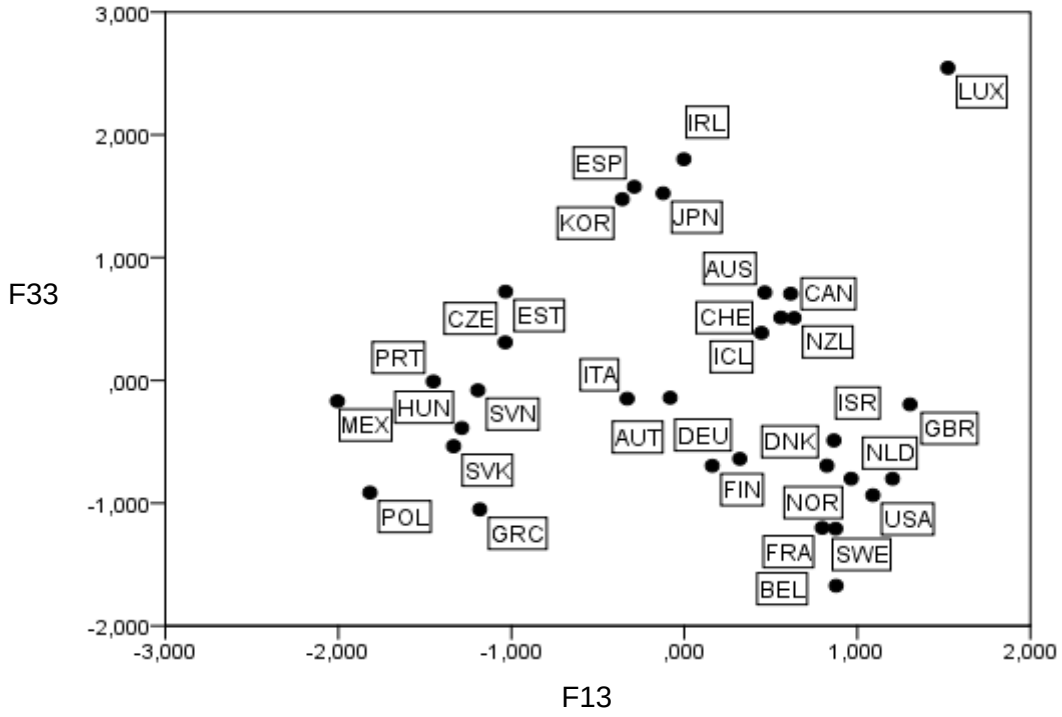

Figure 2. The OECD countries according to the first and third latent variables of employment in 2006 (factor scores).
Source: Authors' calculations based on the OECD STAN data.

Broadly speaking, the last two components separate large and small public sectors regarding employment. In the three dimensional model the component analysis integrates the last two components of the four dimensional model. In this case, the countries where employment in education and public services is relatively low (Japan, Korea, Ireland and Spain) have the largest positive factor scores, with the largest outlier being Luxembourg. The latter can be explained by the opportunity of using the public infrastructure, especially education systems, of its larger neighbouring countries. In place of the public sector, these countries have a large proportion of employment in construction, housing, financial services and other social and personal services in the private sector. This affinity is shared by the smaller Anglo-American countries (Australia, Canada and New Zealand), as well as Switzerland and Iceland, with the only transition state being Estonia. Larger economies like the UK and the US may not be able to afford a small public sector. Countries inclined toward a large public sector include the state-centred France and Belgium and also a majority of the Northern countries. Examples from less wealthy countries also include Poland and Greece. All in all, this component can be referred to as the **private economy component**.

Of course, in a four-dimensional world, the third and fourth components do not align. When looking at them separately (Figure 3), one can see that Luxembourg makes up the fourth component, or the **minimal education system**, almost all on its own. The opposite can be seen with Sweden and Israel. The other countries are relatively similar in this case.

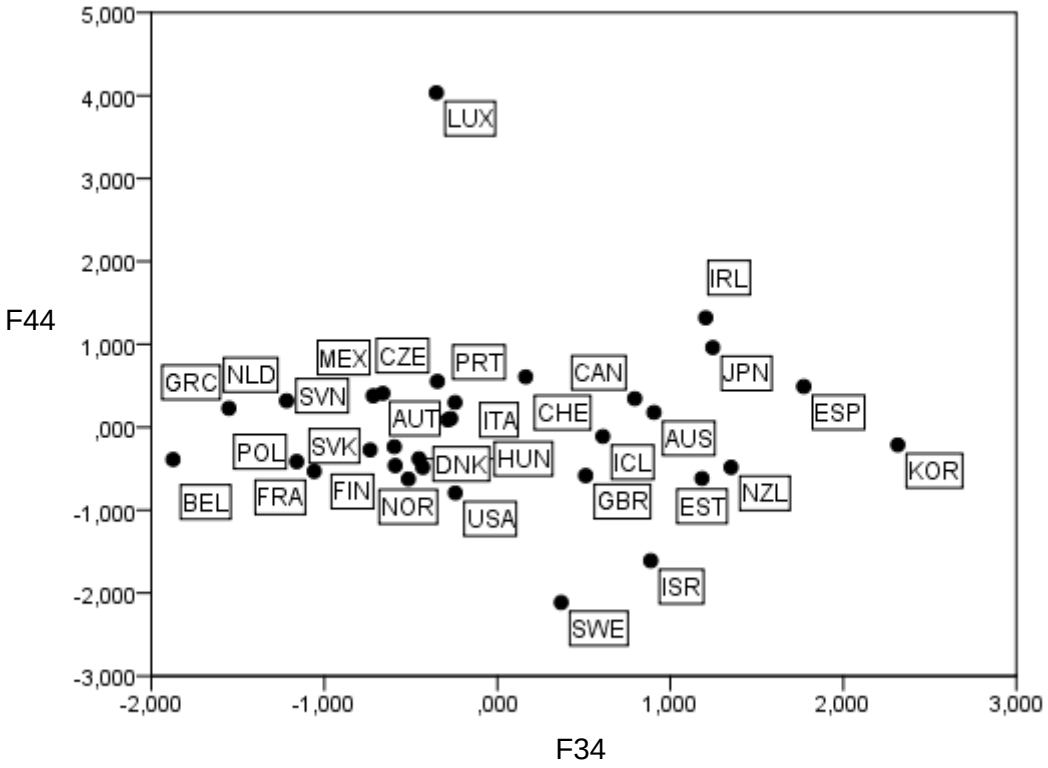

Figure 3. The OECD countries according to the third and fourth latent variables of employment in 2006 (factor scores).
Source: Authors' calculations based on the OECD STAN data.

On the contrary, Korea seems to be the most frugal when it comes to public administration employment including social protection. The scores of this component exceed one in Spain, Japan, Ireland and the Netherlands. Estonia is not far behind. The countries with the largest public administration employment are Belgium and Greece, which could be related to servicing their large national debts.

Finally, the factors are cross-checked among each other and various socio-economic indicators (Table 2).

Table 2. The relations of the latent variables of the employment structure with the proportion of budgetary income in the GDP of the state and national income per capita (excluding Luxembourg)

	F14	**F24**	**F34**	**F44**	**F13**	**F23**	**F33**	**Ratio of state budget to GDP**
Ratio of state budget to GDP	0.45	0.34	-0.27	-0.33	0.44	0.35	-0.40	1.00
GNI per capita	**0.83**	-0.08	0.00	-0.08	**0.82**	-0.12	-0.12	0.36

Source: Authors' calculations based on the OECD STAN data

As expected, financial well-being (GNI per capita) is mostly and essentially only connected to the first so-called tertiarisation components of both specifications (F14 and F13). The other components do not describe well-being. The components are, however, moderately related to a country's monetary "thickness" (the state's proportion in GDP) – the tertiarisation and technology components have a positive relation and the private sector components a negative.

2. Relationship between Employment Structure and Relative Productivity

The latent components of employment are also connected to the relative productivity – that is to say in relation to the country's average productivity – of the various industries to a noteworthy extent (Table 3). In addition to this, we can see that the correlation between the proportion of employment and relative productivity is inverse in a number of industries. For example, in service-based economies relative productivity is lower in the service sector than in their manufacturing-based counterparts. The opposite is true when looking at the manufacturing sector. It is worth noting that the comparatively higher productivity of the service sector in less wealthy manufacturing-based countries is rather widespread, encompassing industries that do not define the first component in employment structure.

Table 3. The links between employment components and the relative productivity of industries

Industry	F13: Services *versus* Manufacturing		F23: Technology *versus* Tourism		F33: Private *versus* public sector	
	Employment	Productivity	Employment	Productivity	Employment	Productivity
AGR	-0.82					
MAN	-0.72	0.29	0.40			
ENE	-0.55		0.68	-0.61		
FIN	0.58	-0.49			0.48	0.29
HEA	0.74	-0.42		-0.51		
REA	0.87	-0.66				
TRA		-0.48	0.83	-0.48		
HOT		-0.37	-0.77		0.48	
WHO		-0.45	-0.68	0.37		-0.31
OTH		-0.29	-0.43	0.31	0.41	-0.50
CON					0.76	
PUB					-0.65	0.36
EDU				-0.49	-0.49	0.27

Source: Authors' calculations based on the OECD STAN data.

A similar inverse relation between employment and relative productivity repeats itself in the case of the other components as well. The second component differentiated between countries with a higher proportion of employment in technological industries (manufacturing, energy and water management, transport and communication) and tourism-based states with a higher proportion of employment in housing, catering, retail and other personal services. Table 3 shows that employment and relative productivity are inversely related to the second component. Housing and catering is an exception in that higher employment in the sector is not coupled with lower productivity. The same can be said about the manufacturing sector. No significant differences between countries can be seen in employment in the education sector but better funding has brought with it higher productivity within the sector in the tourism-based countries.

The third component is predominantly characterised by its inverse relation with employment and productivity. This is mainly seen in education, public administration and private services. An outstanding confluent relation can be seen with both productivity and employment and financial services. No palpable difference in productivity can be seen as far as countries with a small government having a significant percentage of people employed in construction, housing and catering go.

In summary, we have confirmed the conclusion reached through the deconstruction of Estonia and Korea's average productivity (Sepp, Varblane 2014) stating that a rise in a sector's employment brings about a dip in its productivity. We have confirmed the structural burden hypothesis. This relation is, however, not univocal. One can only assume the extent of the influence of international competition on open sectors of the economy. Globalisation forces the labour force in wealthier countries out of low value-added industries. This entails a higher proportion of employment in the service sector at a lower value-added because international competition has a lower effect. This does not, of course, mean a lower level of absolute productivity.

3. Employment Structure of the Manufacturing Industry

The following will take a detailed look at the employment structure of the OECD countries using the aforementioned principal component method. We are interested in whether the latent components that define it (Table 4) have any relation to the previously explained components of the general structure of the economy. All analysis will be based on the data of 10 industry sectors in the OECD countries in 2006.[2] In addition to this, aggregate data of low, medium, and high-technology manufacturing is included. The variants presented in the table show that the first principal component is robust regardless of the model used. For the main part, this can also be seen in the case of the second principal component. Their interpretation is aided by the aforementioned classification of low, medium, and high-tech industries. One can clearly see that the first principal component (G12 and G13) describes, or generalises, **employment in high and medium-tech sectors** and the second (G22 and G23) describes **employment in the low-tech sector.**

Low-tech manufacturing is based on textile, forestry, partially metal and food industry as well as other industries. High-tech manufacturing includes the manufacture of various machines and gadgets as well as chemistry and a large portion of metalwork. The role of the third component (G33) is to describe the paper, cellulose and printing industries first and foremost. These industries cannot be completely categorised un-

[2] Food products, beverages and tobacco; Textiles and textile, leather, leather products and footwear; Wood and products of wood and cork; Pulp, paper, paper products, printing and publishing; Chemical, rubber, plastics and fuel products; Other non-metallic mineral products; Basic metals and fabricated metal products; Machinery and electrical and optical equipment; Transport equipment; Manufacturing n.e.c. and recycling.

der a certain technological level and are not influenced by the spatial variation of other subindustries (related to Finland, Sweden and Canada's specialisation).

Table 4. The hidden components of employment structure in the manufacturing sector in the OECD countries in 2006 in the case of a 3 or 4 dimensional specification

Sector	3-dimensional model			2-dimensional model	
	G13	G23	G33	G12	G22
Food and textile industry			0.534		0.572
Textile, clothing and leather industry		0.789			0.885
Forestry		0.895			0.760
Paper and printing industry			-0.906		
Chemical and fuel industry	0.830			0.818	
Manufacturing of non-metal minerals		0.555	0.520		0.703
Metal industry	0.734			0.743	0.432
Machinery	0.930			0.935	
Transport equipment	0.617			0.618	
Manufacturing n.e.c.		0.849			0.813
Low-tech industry		0.957			0.959
Medium-tech and high-tech industry	0.938			0.940	

Source: Authors' calculations based on the OECD STAN data.

This interpretation is also seen when looking at the allocation of countries at the component level. We will only look at two dimensions simultaneously (Figure 4). Manufacturing-based states are clearly set apart from the other by both general employment and level of technology. Manufacturing states are the countries where the factor score of at least one component is positive. The level of technology is determined by which factor score is greater. All transition states as well as some Southern European countries have specialised in low-tech manufacturing. Estonia and Portugal are forefront performers (the score of the second component exceeds two). Most other transition states are also represented in high-tech manufacturing, performing around the average (the Czech Republic, Slovenia, Slovakia and Hungary). Italy is not far behind. Highly advanced high-tech countries are mainly represented by Germany and Korea, the latter of which we are very interested in. A similar industrial trend can also be seen in Finland, Switzerland, Sweden and Japan, although to a much lesser extent. In conclusion, it can be said that Estonia and Korea are polar opposites as far as the internal structure of industrial employment goes.

When looking at how the first two components of industrial employment are related to the third component of the general economy we can see that the only statistically

significant relation is between the low-tech and the tertiarisation components. As expected, this relation is negative. It is somewhat unexpected that the tertiarisation component is also inversely related to the medium-tech and high-tech component. This can be somewhat explained by the negative correlation between industrial employment and national income per capita. The low-tech industry stands at -0.70 and the medium-tech and high-tech industry at -0.35. One can assume that the main reason is the negative relation between employment and relative productivity.

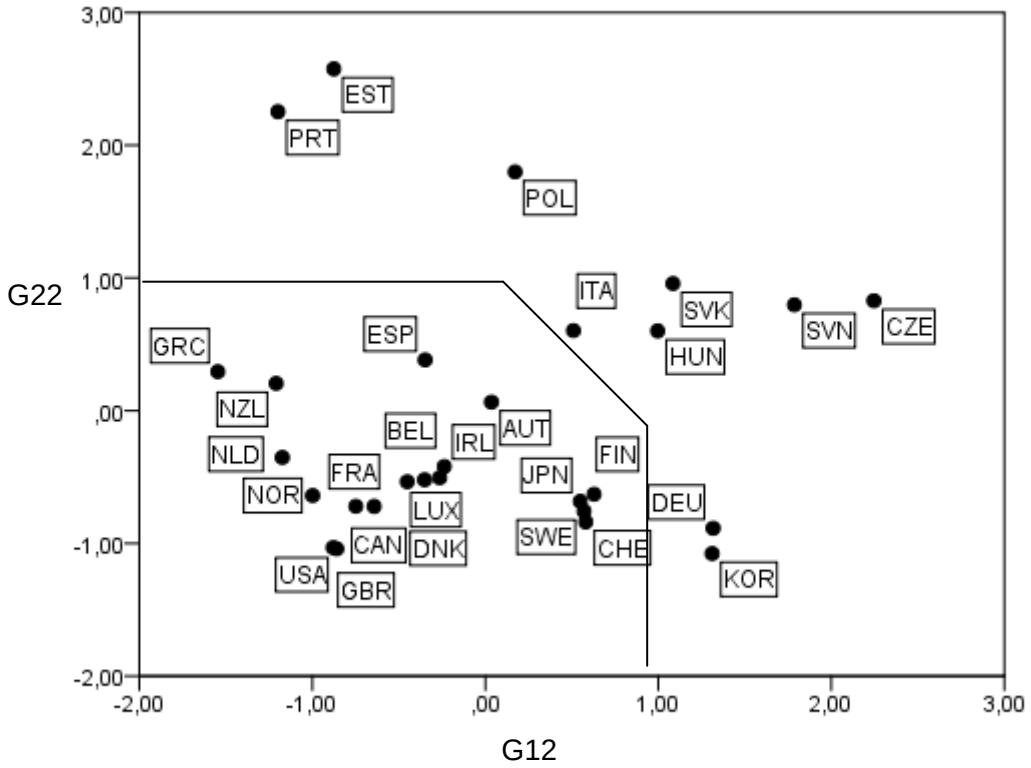

Figure 4. The OECD countries based on the first two latent components of industrial employment structure in 2006 (factor scores).
Source: Authors' calculations based on the OECD STAN data.

Table 5. The relationship of manufacturing and general employment components in the economic structure

	G12: Medium- and high-tech industry	**G22:** Low-tech industry
F13: Tertiarisation	-0.37	**-0.79**
F23: Technology	0.39	0.27
F33: Private sector	0.05	-0.03

Source: Authors' calculations based on the OECD STAN data.

The aforementioned relations can be seen in Figures 5 and 6. Low-tech manufacturing is once again represented by the transition states, headed by Estonia and Portu-

gal. An intermediate group is made up of other Southern European countries. Medium and high-tech manufacturing employment is slightly more complicated (Figure 6). The transition states are more clearly separated. The Czech Republic, Slovenia, Slovakia and Hungary are grouped with Korea and Germany. Estonia, along with Portugal and Greece, is left behind even by countries that are in essence already service based.

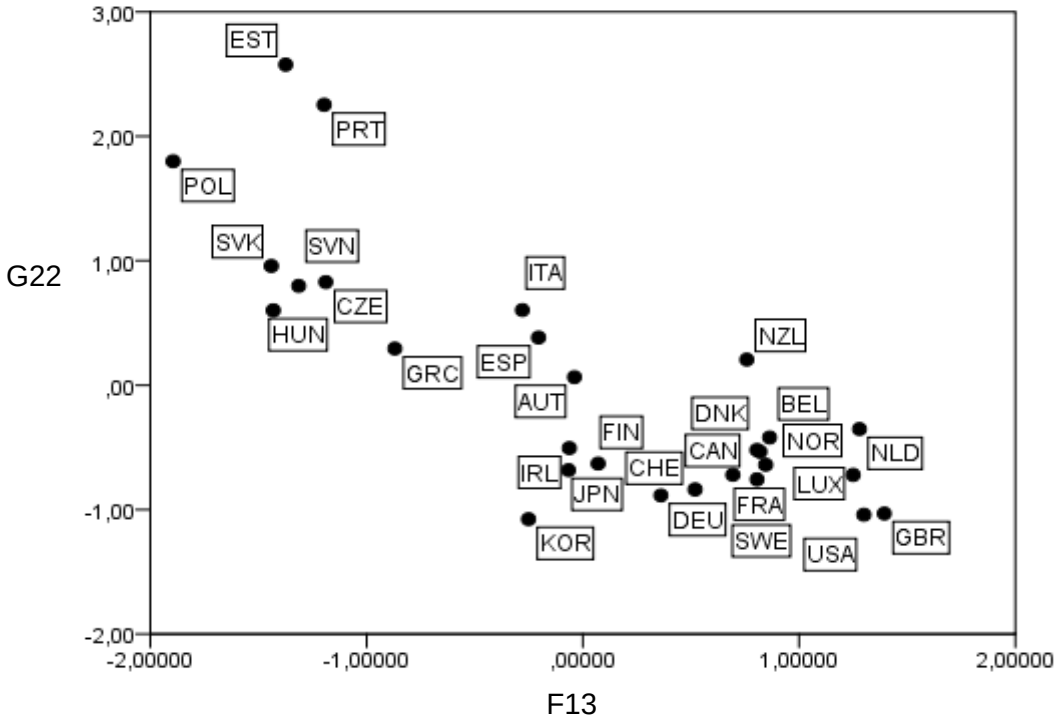

Figure 5. The relation of the tertiarisation and low-tech industry employment components. Source: Authors' calculations based on the OECD STAN data

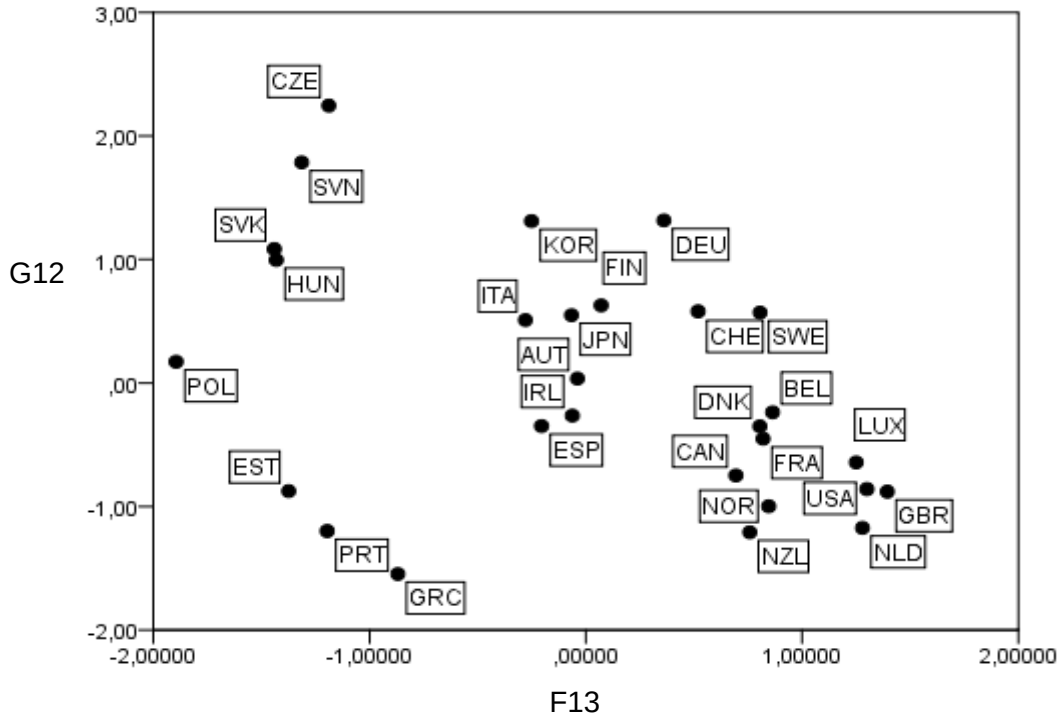

Figure 6. The relation of the tertiarisation and medium-tech and high-tech industry employment components.
Source: Authors' calculations based on the OECD STAN data.

Summary

1. The regional variations of the OECD countries and the European Union have relatively similar latent components. A clear difference can be seen starting at the third component.
2. The main trend of the evolution is explained by the **tertiarisation component** which expresses the outstanding growth of the service sector relative to the two first (primary and secondary) sectors. At the same, this is either accompanied or preceded by an important rise in relative productivity in manufacturing and a dip in the service sector (compared to the averages of the economy). The strongest inverse relation between the proportion of employment and relative productivity and the first structural component can be seen in the real estate sector: 0.87 and -0.66 respectively. Korea's overall lead over Estonia in the tertiarisation process is not very large (the deviation of its factor score is below one) and Korea is still around the average.
3. On the other hand, according to the second sectoral structure component, Estonia and Korea are polar opposites. Estonia is at the forefront of **technologi-**

cal employment, which means a relatively large proportion of employment in sectors such as transport, communication and energy. However, Korea (as well as Japan) tends to be a part of the contrasting tourism-based countries' group, where a large portion of the workforce is employed in housing, catering and retail, akin to Mediterranean countries. Unfortunately, it must be repeated that a rise in employment entails a relatively lower level or productivity, especially in the technology sector. For instance, the second principal component's relation to employment and productivity in the energy sector is 0.68 and -0.61 respectively.

4. The present study could, for the first time, interpret the following components in a meaningful way. Both the third and fourth component had a strong relation with differences in the **institutional sectoral structure**. In essence, countries with large and small employment in the public sector could be differentiated. Both Estonia and Korea, especially the latter, are countries with low employment in the public sector. Employment in public administration and social protection is especially minute in Korea. Countries such as these have a large portion of employment in private services and especially construction to make up for their smaller public sector. The opposite can be seen in countries like France, Belgium, the Nordic countries, Poland and Greece. A reference to structural barriers must be made, meaning that the component has an inverse relation to both employment and productivity. This can be seen mainly in public administration, at -0.65 and 0.36 respectively. This means that a public sector with low employment may not necessarily be low on funding.

5. An even clearer picture was seen in the structural **typology of the manufacturing**. Two principal components were found, which were based on a dominant technological level. The STAN database divides the various industries into low, medium and high-tech manufacturing and as such pre-aggregated data could be added into the component analysis. The factor score of medium and high-tech manufacturing in the first component turned out to be 0.94. The factor score of low-tech manufacturing in the second component reached 0.96. The content of the components is confirmed by the loadings of the various industries. The first component encompasses primarily machinery and the chemistry and fuel industries, while the second includes the textile, clothing and leather industries as well as forestry and manufacturing n.e.c. The third

component is characterised by strong loadings in the paper and printing industry.

6. **Korea and Estonia** can both be considered manufacturing states because the factor score of at least one component exceeds one. Unfortunately, the different manufacturing specialisation of the two countries is clear as well. Estonia as well as Portugal is one of the low-tech manufacturing countries, while Korea is one of the high-tech manufacturing countries alongside Germany. Both Estonia and Korea have a very low representation of the other's level of technology (the factor score is negative). The largest industrial countries seem to be the transition states of Central Europe where industries of both technological levels are strongly represented.
7. As expected, the relation between the **tertiarisation and industrialisation** components is negative. General tertiarisation means deindustrialisation in employment in both the low and medium to high-tech sectors, albeit with varying intensity (-0.79 and -0.37 respectively). The difference in association coefficients hints at an inverse relation with relative productivity. Employment in manufacturing converges toward industries with higher relative productivity in times of economic upswing.

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Herausgeber:

Prof. Dr. Stefan Kolev - Erfurt
PD Dr. habil. Bernhard Seliger – Seoul
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