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e-Commerce and Economic Development in European Countries: Hierarchical Clusters Analysis Using Eurostat Official Data

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Introduction

E-Commerce provides much advancement:

- **sellers** can offer lower prices
- **buyers** can overcome geographical and time barriers with the support of ICT

Elements which impact the e-Commerce utilization by enterprises in (European) countries are:

- **Economic and ICT development level indicators,**
- **measurements of the expansion and measurements of the barriers (obstacles) variables of usage regarding:**
    - ***perceived quality,***
    - ***trust in enterprises,***
    - ***accessibility,***
    - ***Security, role of government, …***

Introduction

Our work is focused on **three research contributions**:

1. To illustrate **resemblances among European countries** in relation to their **level of e-Commerce utilization by enterprises**

2. To examine:

- the possible positive connection between the level of e-Commerce utilization and economic development level indicators, and

- what is the possible role of perceived **barriers, called obstacles in e-Commerce utilization by enterprises** in that relationship

3. To recognize the position of the Western Balkan countries (and SEE) compared to the rest of the countries under investigation

Data and Methods

In order to investigate **the variables of e-Commerce usage by enterprises,** as well as perceived **barriers/obstacles** related to e-Commerce adoption, and **related economic and ICT development level variables**, we used:

1. **Eurostat database (**DIGITAL AGENDA KEY INDICATORS) **and the World bank data (GDP) for 29 European countries (***EU-28 countries,* ***excluding*** *Luxembourg data* ***plus*** *Norway and FYR of Macedonia).*
2. **Data for enterprises** (including all enterprises, without financial sector (10 persons employed or more)), **according to enterprises' practice of e-Commerce utilization and related variables**
3. **2016**
4. **Identified clusters of countries are evaluated** by the **central tendency (median) level of economic development measured in terms** of **GDP per capita** and **GDP change in 2016/2015**, as well as by the **level of perceived e-Commerce barriers, called obstacles.**

Methodology

The following **measurements of the expansion indicators of e-Commerce in selected European countries** are used **for enterprises** (note: all enterprises, without financial sector), with 10 persons employed or more: (DIGITAL AGENDA KEY INDICATORS)

- **ECOM1 - Received orders via any online channel**
- **ECOM2 - Selling online (at least 1% of turnover)**
- **ECOM3 - Selling via a website or apps - B2C**
- **ECOM4 - Selling via a website or apps - B2B&B2G**
- **ECOM5 - B2C web sales are 10%+ of web sales**
- **ECOM6 - B2C web sales are 1%+ of the web sales**
- **ECOM7 - Receiving orders via a website or apps**
- **ECOM8 - Receiving orders via EDI** (*Electronic Data Interchange*) **-type messages**

Methodology

The following **measurements of the barriers (obstacles) of e-Commerce in selected European countries** are studied **for enterprises** (note: all enterprises, without financial sector, with 10 persons employed or more):

Perceptions:

- **OBST1-The enterprise's goods or services are not suitable**
- **OBST2-Problems related to logistics (shipping of goods or delivery of services)**
- **OBST3-Problems related to payments**
- **OBST4-Problems related to ICT security or data protection**
- **OBST5-Problems related to the legal framework**
- **OBST6-The costs of introducing web sales too high compared to the benefits**

Methodology

- **Hierarchical cluster analysis** with the goal of identification of **five homogenous clusters of selected European countries** according to their **usage of e-Commerce**, for the year **2016**, using the **Ward linkage method and the Squared Euclidean Distance.**

- In the second phase, we apply the **non-parametric Kruskal- Wallis test** to study clusters identified in the first phase according to
- **(i)** their **GDPpc & GDP change in % 2016/2015**, and
- **(ii)** their **perceptions regarding the barriers (obstacles) in e-Commerce**.

Table 1.

Descriptive statistics for the e-Commerce utilisation by enterprises expansion indicators and barriers/obstacles for selected European countries in 2016

Variables	Statistics						
	Mean	St. dev.	Median	Min	Max	Kurtosis	Skewness
E-Commerce Expansion Indicators							
ECOM1	19.2	7.0	20.0	7.0	30.0	-1.04	-0.19
ECOM2	16.9	7.4	17.0	3.0	30.0	-0.79	0.044
ECOM3	12.2	4.3	12.0	4.0	22.0	-0.23	0.06
ECOM4	11.0	4.2	11.0	4.0	18.0	-1.05	-0.04
ECOM5	10.6	4.6	10.0	2.0	22.0	0.15	0.37
ECOM6	11.6	4.2	11.0	4.0	22.0	0.12	0.26
ECOM7	15.8	5.5	16.0	6.0	25.0	-1.01	-0.13
ECOM8	6.1	3.2	6.0	1.0	15.0	0.83	0.79
E-Commerce Barriers/Obstacles							
OBST1	3.2	2.0	3.0	1.0	8.0	-0.05	0.87
OBST2	2.0	1.2	2.0	0.0	4.0	-1.08	0.45
OBST3	1.9	1.0	2.0	1.0	4.0	-0.60	0.71
OBST4	1.3	0.8	1.0	0.0	3.0	0.23	0.44
OBST5	1.2	0.8	1.0	0.0	3.0	0.01	0.43
OBST6	2.1	1.4	2.0	0.0	5.0	-0.43	0.61

Position of the Western Balkan (and SEE) countries

Position of Western Balkan (WB) countries is focused, as well:

- **WB countries** included in this analysis are the **SSE countries**:
  - The EU countries: **Bulgaria, Romania, Greece, Cyprus, with Croatia plus Slovenia**, and
  - The EU candidate: the **FYR of Macedonia**

- **WB countries are compared** according to the e-commerce **expansion indicators** and **obstacles** related **to the e-commerce indicators** (**Figure** 1 and **Figure 2**).
- The highest **e-commerce expansion indicator appeared to be ECOM1** (*„Received orders via any online channel"***)**, with an average of **12.71%** for the **WB countries**, and **21.23%** for the **EU+Norway countries**.

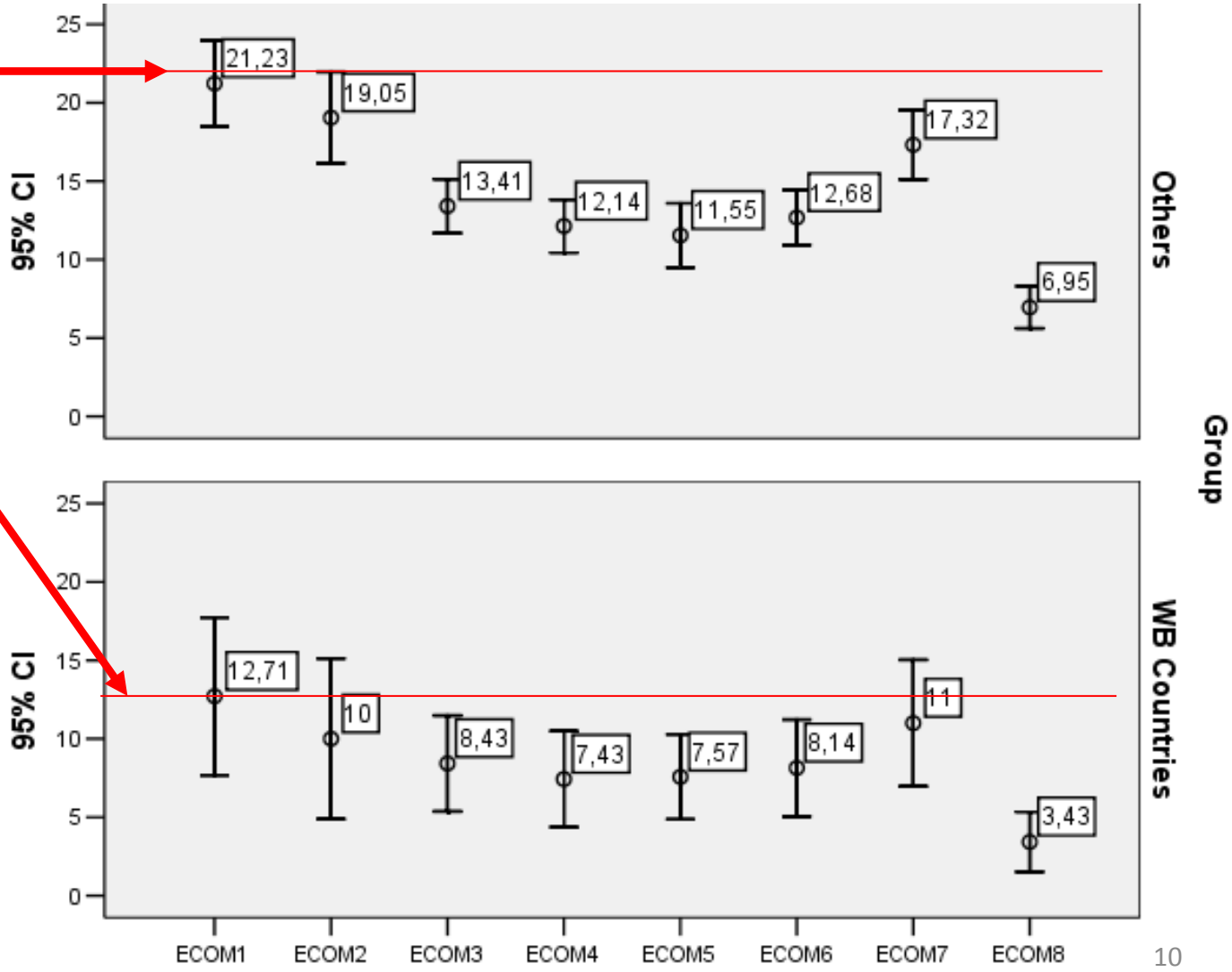
- **The same direction is noticed for other indicators** of both e-Commerce usage **expansion** and perceived **obstacles** related to e-Commerce in two observed groups of countries.

Results

Figure 1.

Means and 95% CI of the e-Commerce expansion indicators; 2016

ECOM1= *„Received orders via any online channel”*



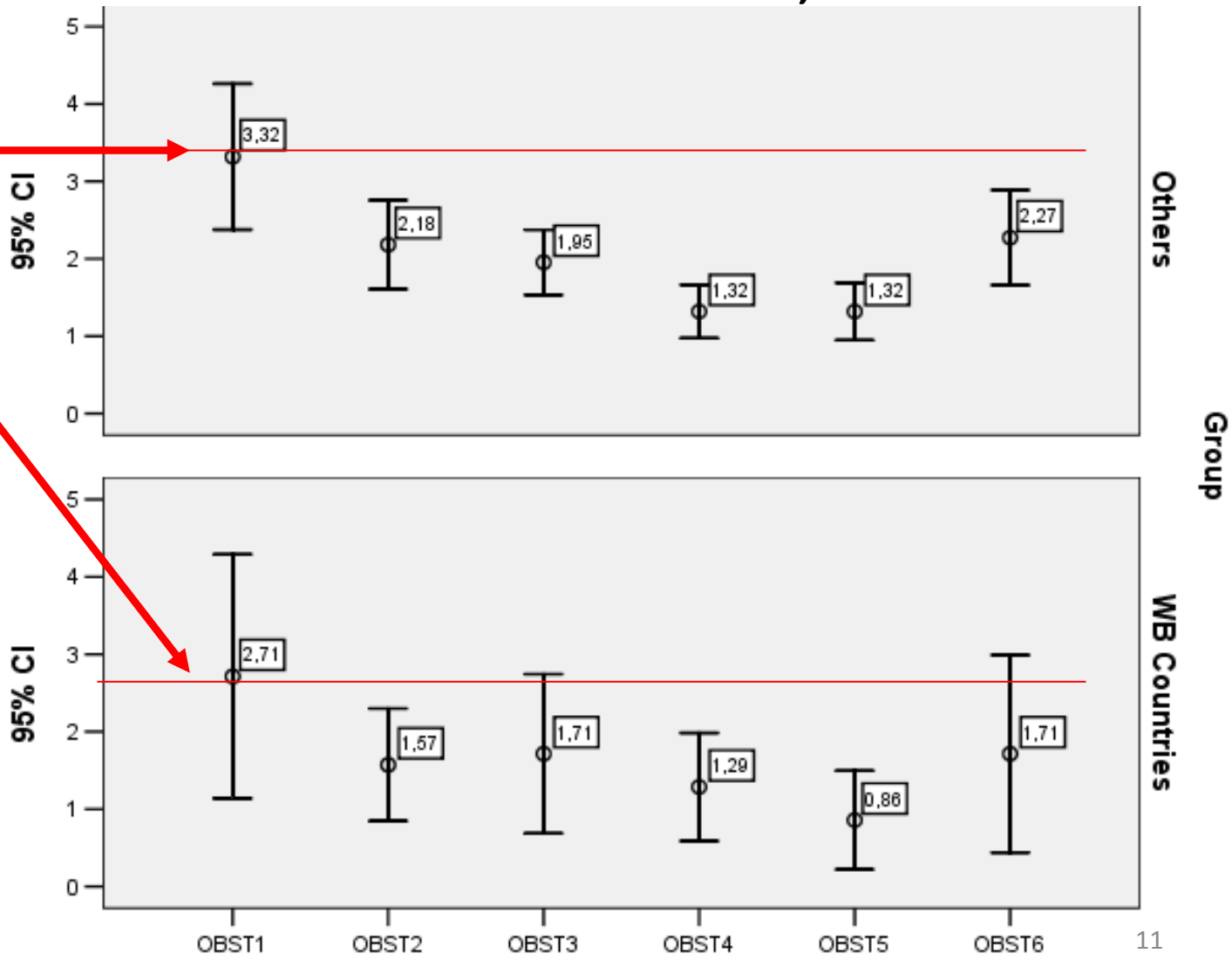
WB countries **ECOM1** average is **12.71%**, and **21.23%** in **Others** (EU+Norway) countries.

Results

Figure 2.

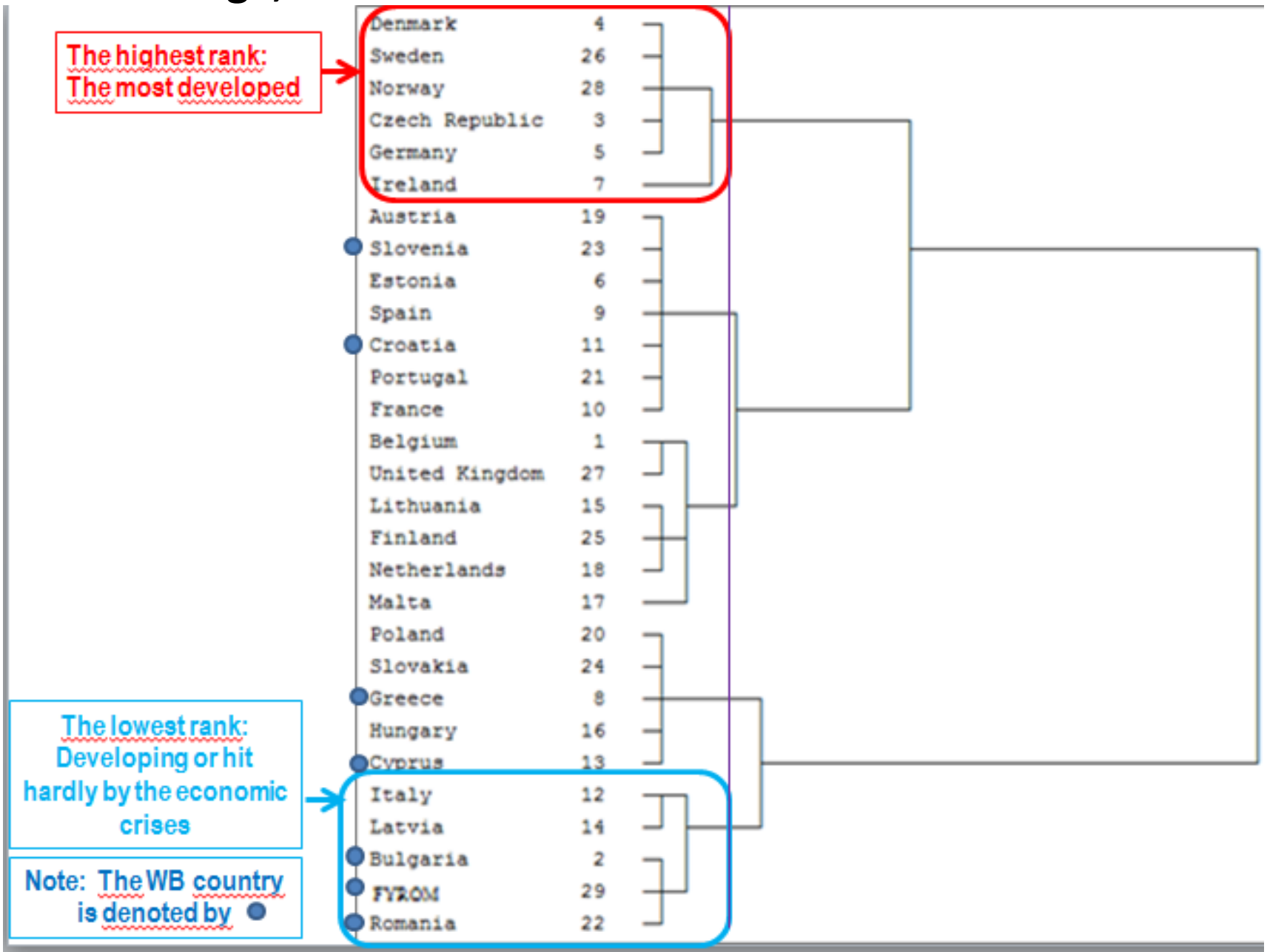
- **Means and 95% CI of the e-Commerce obstacles; 2016**

OBST1=*„The enterprise's goods or services are not suitable”*



WB countries **OBST1** average is **2.71%,** and **3.32%** in **Others** (EU+Norway)countries.

Figure 3. Clusters of European countries regarding different forms of e-Commerce usage; 2016



Results: Clusters of countries

Table 2. Clusters of European countries according different forms of e-Commerce usage; 2016

Cluster	Rank	European countries
C1	2 Highly developed	Belgium, Finland, Lithuania, Malta, Netherlands, UK
C2	5 Developing or hit hardly by the economic crises	Bulgaria, Italy, Latvia, FYR of Macedonia, Romania
C3	1 The most developed	Czech Republic, Denmark, Germany, Ireland, Norway, Sweden
C4	3 Mixed developing and highly developed	Austria, Croatia, Estonia, France, Portugal, Slovenia, Spain
C5	4 Developing, ecovered after the economic crisis	Cyprus, Greece, Hungary, Poland, Slovakia

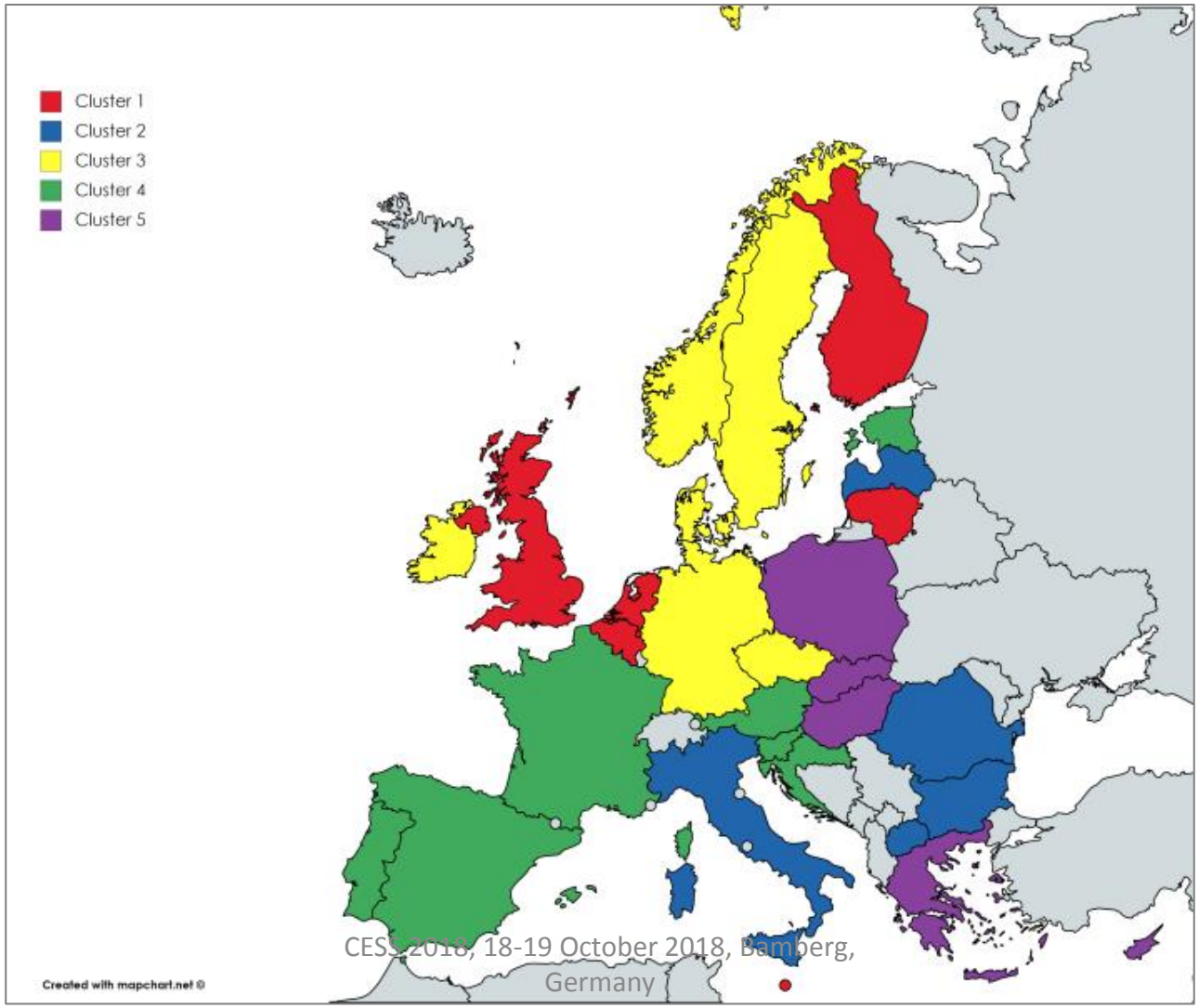
Results: Descriptive statistics for ECOM

Table 3. Descriptive statistics of the e-Commerce usage expansion indicators across clusters (% of enterprises)

Variable	Statistics	Cluster				
		Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
ECOM1	Mean	23.0	8.8	28.3	19.6	13.4
	(St. dev.)	(2.2)	(1.8)	(1.0)	(1.1)	(1.5)
ECOM2	Mean	19.3	6.2	27.5	17.0	11.6
	(St. dev.)	(2.7)	(2.2)	(1.4)	(2.1)	(1.1)
ECOM3	Mean	15.3	5.8	17.2	11.4	10.0
	(St. dev.)	(1.9)	(1.3)	(2.6)	(0.8)	(1.6)
ECOM4	Mean	14.2	5.0	16.0	10.6	7.8
	(St. dev.)	(1.6)	(1.2)	(1.8)	(1.3)	(0.8)
ECOM5	Mean	12.2	5.4	16.5	10.4	7.0
	(St. dev.)	(3.7)	(1.3)	(3.1)	(0.5)	(3.0)
ECOM6	Mean	13.8	5.4	17.0	11.0	9.4
	(St. dev.)	(2.5)	(1.3)	(2.6)	(0.6)	(1.1)
ECOM7	Mean	19.5	7.6	22.8	15.4	11.6
	(St. dev.)	(1.4)	(1.3)	(1.7)	(1.0)	(1.1)
ECOM8	Mean	6.2	2.4	10.5	6.6	3.8
	(St. dev.)	(1.8)	(0.9)	(2.7)	(1.0)	(1.5)

Results: Map with clusters of countries

Figure 4. European map according to the countries grouped into specific clusters based on forms of e-Commerce usage; 2016



Results:
Relation of e-Commerce usage by enterprises and economic development level

- In order to evaluate the connection between **e-Commerce usage by enterprises** and the **level of economic development** of investigated European countries in 2016, we calculated the central tendency measures of ***GDP per capita in EUR*** and the ***GDP change in % in 2016 in comparison with 2015*** (Table 4).

- **There exists positive connection between the level of economic development and level of e-Commerce usage in the observed European countries**

Results for OBST and GDP

- In order to evaluate the **connection between the e-Commerce usage barriers / obstacles towards e-Commerce** of selected European countries in 2016, we calculated the average values for the barriers in e-Commerce of each cluster are displayed in Table 5.

- **K-W** test revealed that **differences among clusters medians** are statistically significant for the following **barriers**:
  - (i) and indicators ***OBST1***, ***OBST2***, ***OBST3*** and ***GDPpc*** are statistically significant at 1%.
  - (ii) ***OBST6*** is statistically significant at 5%,
  - (iII) ***OBST5*** *and* ***GDP change*** *are* statistically significant at 10%,

Results:

Descriptive statistics for GDPpc in 2016 and GDP change 2016/2015 accross the clusters

Table 4. Average values of economic development indicators across clusters and Kruskal- Wallis test value

	Cluster					Kruskal-Wallis H (p-value) df=4
	Cluster 1	**Cluster 2**	**Cluster 3**	**Cluster 4**	**Cluster 5**	
Economic Development Indicator						
GDPpc 2016 (in 000 EUR)	34.9 (12.1)	**13.3** (10.2)	**49.6** (18.2)	25.5 (11.3)	16.6 (4.5)	15.612 (0.004***)
GDP change %	1.0 (5.2)	**4.8** (2.6)	0.9 (3.1)	2.7 (1.2)	1.0 (1.7)	8.814 **(0.085*)**

Results for OBST

Table 5. Average values of perceived e-commerce obstacles across clusters and Kruskal- Wallis test value

Obstacle	Cluster					Kruskal-Wallis H (p-value), df=4
	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	
Obstacles for e-Commerce						
OBST1	4.5 (1.4)	1.4 (0.9)	5.0 (2.3)	2.6 (1.7)	2.0 (0.7)	15.345 (0.004***)
OBST2	3.3 (0.8)	1.0 (0.1)	3.0 (0.9)	1.4 (0.8)	1.2 (0.8)	19.057 (0.001***)
OBST3	2.5 (0.8)	1.0 (0.1)	2.7 (0.8)	1.7 (1.1)	1.4 (0.5)	13.482 (0.009***)
OBST4	1.8 (1.0)	1.0 (0.7)	1.7 (0.5)	1.1 (0.7)	0.8 (0.4)	7.330 **(0.119)**
OBST5	1.8 (1.0)	0.6 (0.5)	1.5 (0.5)	0.9 (0.7)	1.2 (0.8)	7.851 (0.097*)
OBST6	3.2 (1.2)	1.0 (0.7)	3.0 (1.5)	2.0 (1.2)	1.2 (0.8)	12.110 (0.017**)

OBST4-"Problems related to ICT security or data protection"

Conclusions

- **The goals of our research were:**
  - (i) to investigate **homogenous clusters of** European countries regarding the **e-Commerce utilization** by hierarchical **cluster analysis**;
  - (ii) to investigate if there is a **relationship between e-Commerce utilization by enterprises and the level of economic development, and barriers towards the e-Commerce.**
- In order to attain these goals, we used the data on e-Commerce utilization and barriers and GDPpc in EUR and GDP change in % for year 2016 from Eurostat database, for countries:
  - (i) **EU28 countries, excluding Luxembourg;**
  - (ii) **non-EU countries: Norway and the FYR of Macedonia.**

Conclusions

- **Five clusters of European countries, based on the level of e-Commerce utilization,** using hierarchical cluster analysis with the application of Ward-method are recognized

- **Clusters were compared according the their level of economic development**

- Result revealed that **differences among clusters are statistically significant** for **GDP per capita, GDP change % in 2016/2015**

- **Conclusion:**
- **the level of the e-Commerce utilization in European countries is related to their level of the economic development, thus reinforcing already present digital divide.**

Conclusions

- **Five clusters** of European countries were **compared according to their level of perceived e-Commerce barriers.**
- **Clusters that have higher level of e-Commerce utilization in the same time encounter the high level of e-Commerce barriers**, with statistically significant K-W test statistic.
- Therefore, barriers emerge for those countries that are strongly pursuing e-Commerce as a venue towards competitiveness.
- **Future research should focus to new trends in e-Commerce**, such as social media, and new phenomenon such as group-buying websites.

Conclusions

- It could be expected that those clusters that are leading in the utilization of e-Commerce would have the lowest perception of the importance of e-Commerce obstacles among their enterprises, and vice versa.

- **But, in contrary, the results indicate that the highest average values of obstacles OBST1 and OBST3 are present in the Cluster 3 (**Czech Republic, Denmark, Germany, Ireland, Norway, Sweden**), which is also leading in the e-Commerce utilization.**

- **The highest average values of other obstacles *OBST2*, *OBST4*, *OBST5* and *OBST6* are present in the Cluster 1 (**Belgium, Finland, Lithuania, Malta, Netherlands, UK**), which was the second best according to e-Commerce utilization.**

Conclusions

Kruskal-Wallis test revealed that differences among clusters' medians are statistically significant for the following barriers and economic development indicators:

- (i) and indicators ***OBST1***, ***OBST2***, ***OBST3*** and ***GDPpc*** are statistically significant at **1%.**
  - **OBST1-** *The enterprise's goods or services are not suitable*
  - **OBST2-** *Problems related to logistics (shipping of goods or delivery of services)*
  - **OBST3-** *Problems related to payments*

- (iIi) *OBST6* is statistically significant at **5%**
  - **OBST6-** *The costs of introducing web sales too high compared to the benefits*

- (i) ***OBST5*** is statistically significant at **10%,**
  - **OBST5-** *Problems related to the legal framework*

- Note: **OBST4**- *Problems related to ICT security or data protection* **was not** statistically significant

Thank you for your attention!

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