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Measurement of the Intersectoral Digital Divide with the Gini Coefficients: Case Study Turkey and Lithuania

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The digital divide, which arises from the usage differences of the information systems and appears as a new inequality is a concept which affects negatively the business processes. This concept which is in general scrutinized personally, regionally and globally and which is neglected by the sectors and the enterprises is one of the major factors affecting the sectoral and economic structure. Thus, determining the inequality level which results from the intensifying digital divide along with developing technology gains importance. In general the computer and internet usage rates are used as indexes for determination of the digital divide levels and the analyses are carried out with statistical methods according to the demographic variables. Gini method, one of the standard tools of inequality measurement, is rarely encountered in the digital divide studies. The purpose of this study is to determine the intersectoral digital divide by Gini method.
The usage differences of the Turkish and Lithuanian sectoral information systems were analyzed in order to determine the digital divide by Gini method. The data was obtained from the reports published by Tuik and Eurostat between 2010 and 2013 based on the studies of the usage of the information systems by the enterprises. Gini values, which show the sectoral digital divide, were calculated using the data regarding the computer, internet, social media usages, having web page and selling over web which belong to the sectors classified according to the Nace Rev.2 system. The analysis revealed that both Turkey and Lithuania have low levels of sectoral digital divide. The highest level of digital divide was observed in the case of the selling over web and an increasing trend of the sectoral differences has been identified. Although Lithuania had high rates of information systems usage, it has been determined that the intersectoral differences are more than those in Turkey, in terms of usage of the information systems.

Keywords: *Information Systems, Sectoral Differences, Inequality Measurement, Digital Divide, Lorenz Curve, Gini Coefficients.*

Introduction

The information systems which went beyond the academic environments and started to be used in the social fields late in the twentieth century, took the center stage of the commercial enterprises. The enterprises which have a continuous development strategy paid a great attention to the informatics in order to make their business processes and sectoral relations more efficient (Akın, 2005). At the beginning many were arguing that the information systems have no contribution to the efficiency (Solow, 1987) and production outputs (Loveman, 1988) and that the marginal benefits of the informatics investments were lower than the marginal costs (Morrison & Berndt, 1991). However, the realistic contributions of the information technologies to the production, management, control and sectoral relations changed, by time, these opinions. Currently it is widely acknowledged among the researchers that computer and internet based systems are influencing the social and economic structure leading to cost decrease and increase in labor productivity (Grabara *et al.*, 2014; Comptia, 2015), thus ensuring competitiveness (Clemons, 1986; Mata et al., 1995) and sectoral shifts by transforming of the organizational functions and business processes (Laan *et al.*, 2005; Dolata, 2009; Drucker, 2010; Kraftova *et al.*, 2011).

The sectoral differences arising based on the social, regional, political, technological and economic grounds, are among the major factors affecting the economic structure (Kraftova *et al.*, 2011). Indicators such as the sectoral production figures, employment, wages, national income shares, export rates and R&D expenditures are used to reveal such differences (Klevorick *et al.*, 1995; Ferguson & Galbraith, 1999; Stewart, 2011). Recently and in parallel with the technological developments, the technology usage levels took their place too among these indicators (Castellacci, 2007). According to Cohen and Levin, due to the structural factor, the technological implementation and development is easier for some sectors, thereby causing intersectoral technological differences (Cohen & Levin, 1989). Also the sector size, the information density, the competition level and sectoral restrictions affect the levels of the organizational investments to the information systems (Porter and Millar, 1985; Palmer & Griffith, 1998; Love *et al.*, 2005). Some sectors have higher information system usage levels resulting in differences in the usage of the information systems and thus in the intersectoral inequalities.

The differences in the usage level of the information systems lead to a new inequality denoted as digital divide which is, in fact, a diversity of the distribution of the information technologies. Digital divide is a complex concept which includes both the access and usage

inequalities. The concept itself considered as an issue which increases the social inequalities (Attewell, 2001), is described by OECD as benefit differences caused by the lack of information (OECD, 2001). The digital divide which is caused by the geographical, social and economic factors has personal, organizational, regional, national and global sizes and it is generally analyzed in terms of internet and computer usage (Brousseau & Curien 2007; Srinuan & Bohlin, 2011). On the other hand, indicators such as wage, investment, income, employment and size are used in the studies revealing the sectoral differences (Galbraith & Hale, 2007) but the digital divide concept is ignored. *The novelty of the study* is to focus on the measuring of the intersectoral digital divide with Gini coefficients.

Although the rapid technologic changes bring a dynamic structure to the information technologies, the following of these by all the environments and their efficient usage becomes difficult. There are no literature agreements on how the digital divide should be measured due to the miscellaneous factors such as different disciplinary approaches, wide parameter range, technological diversity, economic differences and geographic conditions (Sciadas, 2005). The studies are employing different scales, indexes and parameters. The data obtained with the questionnaire method are analyzed with the conventional statistical methods. *The main scientific problem is that* the lack of a standard measuring method implies an issue at the point of identifying the digital divide level and making efficient comparisons. On the other hand the Gini method is considered one of the most appropriate tools used for the measuring of the inequalities (MacLachlan & Sawada 1997). Considering the inequality in the distribution of the digital divide, employing the Gini method which is used for the inequalities of the income distribution for the measurement of the digital divide level would be a proper approach. *The purpose of the study* is to suggest that sectoral differences among the usage levels of the information systems may be determined by Gini coefficients.

The object of the study is to research according to the Turkish and Lithuanian data the computer, internet, social media usages, having web page and selling over web differences occurring between the sectors according to the Nace Rev.2 sectoral classification. Turkish Statistical Institute (Tuik) who started to use the Nace classification as of 2010 published the Turkish sectoral company numbers till 2013. Thus this study comprises the usage data of the information systems by the enterprises published by Tuik and Eurostat between 2010 and 2013 of twelve sectors included in Nace Rev.2 classification. *The method of the study* is Gini approach used for the measurement of the inequalities. Thereby the intersectoral digital divide levels are numerically calculated with the data obtained from Tuik and Eurostat so that the comparison of sectoral digital divide of Turkey and Lithuania may be carried out more efficiently.

Information System, Enterprises, Sectoral Differences

The effects of the opportunities provided the developments from information technologies on the enterprises and business process are increasing day by day. The technological developments which are the core of the information society lead to structural changes in the enterprises (Melnikas, 2011). Effects such as the efficiency, competitive advantage, process controls, profitability, organizational flexibility, market value increases as well as the reduction of the cost and quality differences may be observed both in the public and private sector organizations which are keeping in step with the technological changes (Love *et al.*, 2005; Moriones & Lopez, 2007). Considering the studies which analyzed on a large scale the information systems adaptations of the enterprises, the predominance of the personal, technological, organizational and environmental factors is observed, (Davis, 1989; Tornatsky & Fleischer, 1990; Ajzen, 1991; Rogers, 1995;Thong & Yap, 1995; Thong, 1999; Oliveira & Martins, 2011) and the sector is considered as an environmental factor (Palmer & Griffith, 1998; Goode & Stevens, 2000; Moriones & Lopez, 2007; Teo, 2007).

The sectors which are defined by enterprises operating in certain areas are a grouping of the organizations according to their productions of goods and services. In general each sector is evaluated according to the characteristic structures of its enterprises (Kraftova *et al.*, 2011).The information systems considered as a strategic tools affecting the properties and functions of the organizations (Currie, 1996), affects the factors shaping the activities and lead to changes in the sectoral structure (Porter ve Millar, 1985). Akmanligil and Palvia, who asserted that the sectoral structure is shaped by the competition, emphasize that the main reason of the usage of the information systems is the competition (Akmanligil and Palvia, 2004). According to Love et al., information systems affect the sectoral structure and there are intersectoral usage differences, while the reason of this difference is the variation of the investments per sectors (Love *et al.*, 2005). The information systems are widely used in the sectors where the information usage level is higher such as banking or health (King & Gribbins, 2002), thus resulting in higher investments. The sectoral structure is associated with the usage of the information systems and the differences occur due to the data processing intensity, sectoral activities and uncertainties (Moriones & Lopez, 2007). Akman and Mishra who emphasized that the usage of information systems varies according to the public and private sectors, determined that the private sector employees use more internet than the others (Akman & Mishra, 2010). Also the sectoral differences affect the implementation process of the new technologies by the companies leading to the increase of the current differences (Edmondson *et al.*, 2001). In a study which analyzed the upgrading of the companies to World Wide Web (www) technologies, it was determined that the sectoral structure is one of the factors affecting the usage of www technologies (Goode & Stevens, 2000). Another study on the web usages determined that web is mostly used in the retail and tourism sectors (Cheung & Huang, 2002). Haller and Siedschlag who emphasized that the usage of information technologies is associated with the sector determined that having web site of the company from the same sector is higher than other companies operating in the same field (Haller & Siedschlag, 2011).

The developments of the information technologies reveal personal, regional, organization and national changes and increase the social, political and economical

interactions. These interactions called as synergy effect makes the information systems to be perceived among the top priorities (Melnikas, 2011). This situation requires business processes to be integrated with information technologies and increases available interactions within sector and between sectors (King & Gribbins, 2002). The companies starting to use the information systems are inducing the others and a positive spreading effect appears among the companies (Haller & Siedschlag, 2011). The companies which have their order systems in the electronic environment made mandatory the transition to information systems of the others. This process which is shown as an example of the intersectoral interaction leads to the high investments by the other logistics sector companies in order to be integrated to the order management system. Thus the usage levels of the information systems in the sector and accordingly the sectoral efficiency increased (Grabara *et al.*, 2014). On the other hand globalization requires organizational activities in worldwide too. Having distant organizational departments imposes the usage of the information systems for the structural functionality. Especially the global structure of the electronics, computer and pharmaceutics sectors causes to increase the usages of information systems in these sectors (Akmanligil &Palvia, 2004).

Turkish and Lithuanian Sectoral Distribution and Informatics Trends

The technological developments are among the main factors which lead to the changes in the social and economical life. The most radical changes seen throughout the history are those starting with the twentieth century (Drucker, 2010). The low unemployment and high growth rates especially in USA draw the researchers' attention and the information systems were pointed out as the cause of this performance (Stiroh, 1999). Similar effects were also seen between the sectors and the economies encountered sectoral shifts (Kraftova *et al.*, 2011). These developments which are driving the structural change are affecting the sectors at different levels, depending on their transformation capacities (Dolata, 2009). The most of the economies are focused on the service sector and information based sectors such as informatics, communication and education grew larger than the others (Laan *et al.*, 2005). The Lithuanian and Turkish economical structures which are similar in terms of sectoral shift are focusing on the service sector. Some of the basic economic indicators of 2014 regarding both of the countries are given at Table 1.

The per capita income and unemployment level of Lithuania which is a smaller economy in terms of population and national income according to the data from Table 1 is higher than Turkey. The sectoral structures of the countries which have similar growth rates are similar too. Both Turkish and Lithuanian economies have a sectoral focus on the service sector. The highest share of the countries within their GDPs is in the service sector and the lowest in the agriculture.

Table 1

Basic Economic Indicators of 2014

Indicators	Turkey	Lithuania
Population (million person)	77,695	2,9
GDP (billion $)	800	48
Share of Agriculture sector (%)	7,1	4,3
Share of Industry sector (%)	24,1	27,6
Share of Service sector (%)	57,7	68
Per capita income ($)	10 404	26 484
Growth (%)	2,9	2,9
Unemployment (%)	9,9	15,4

Source: Turkish Statistical Institute, Turkish Economy Ministry and Economist Intelligence Unit

The Nace (Nomenclature of Economic Activities) system developed as of 1970 by European Community Statistical Office (Eurostat) in order to classify the economic activities and to bring a standard, started to be used in 1990. Nace of which different versions were created with some updates was named as Nace Rev.2 with the revisions brought in 2008 and started to be used for the sectoral researches of EU. The purpose of this classification system is to gain an international platform to the determination of the economic business fields and to ensure inter-country comparisons (Eurostat, 2008). Eurostat carries out detailed analyses which include the 21 general sectors created with Nace Rev.2 including the all EU countries. Turkey is included among these countries in the Eurostat reports. However, there are no sufficient data regarding Turkey for the analyses. The sectoral studies in Turkey are performed by Tuik which published for the first time in 2005 the statistics of usage of the information systems in the enterprises, uses Nace Rev.2 system as of 2010. Twelve of the sectors created with Nace Rev.2 are used in the studies regarding the usage of the information systems by the enterprises performed both by Tuik and Eurostat. These sectors are provided in Table 2.

Table 2

Sectors

Sector Sections	Sector Descriptions
C	Manufacturing
D	Electricity, gas, steam, air conditioning and water supply
E	Water supply, sewerage, waste management and remediation
F	Construction
G	Wholesale and retail trade, repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food service activities
J	Information and communication
L	Real estate activities
M	Professional, scientific, technical activities
N	Administrative and support service activities
S	Other service activities

Source: Eurostat, 2008

Table 3

Sectoral Numbers of the Enterprises

Sektor	2010		2011		2012		2013	
	TR	LT	TR	LT	TR	LT	TR	LT
C	299928	13058	333288	14107	336893	15583	340413	16424
D-E	3271	783	3851	892	4377	2229	4705	1687
F	105030	13794	126841	18328	143047	21864	157679	23313
G	939479	51685	1056195	52939	1067241	56741	1074575	57967
H	411801	7251	424321	7418	421574	10179	421770	11121
I	193876	4384	228256	4562	233010	4985	232738	5238
J	26936	2718	28924	2759	29616	3385	31785	3700
L	19573	7373	22972	8184	24141	9018	24490	9066
M	123348	14495	140032	16527	147344	18545	154456	20576
N	20940	4054	22552	4809	25797	5459	29026	5805
S	127598	9833	146376	11005	151849	12899	154200	14408
Total	2271780	129428	2533608	141530	2584889	160887	2625837	169305

Source: Tuik and Eurostat, TR: Turkey, LT: Lithuania

Table 3 prepared based on the sectors included in the Table 2 shows the Turkish and Lithuanian enterprise numbers and their sectoral distribution per years. The table includes 2010–2013 years since the data after 2013 in the reports published by Tuik regarding the Turkish enterprise numbers are not included. According to the table the sectoral focus is in the wholesale and retail trade (G) sector both for Turkey and Lithuania. In terms of the enterprise numbers in Turkey, the second sector is transportation and storage (H) and the third one is the production (C). The second sector of Lithuania is construction (F) and the third sector is the professional, scientific and technical activities (M).

Table 4

Sectoral Percentages of the Enterprises (%)

Sektor	2010		2011		2012		2013	
	TR	LT	TR	LT	TR	LT	TR	LT
C	12,9	9,3	12,9	9,1	12,7	8,8	12,6	8,7
D-E	0,1	0,6	0,1	0,6	0,2	1,3	0,2	0,9
F	4,5	9,9	4,9	11,8	5,4	12,3	5,9	12,3
G	40,5	37,0	40,8	34,2	40,3	31,9	39,9	30,6
H	17,7	5,2	16,4	4,8	15,9	5,7	15,6	5,9
I	8,3	3,1	8,8	2,9	8,8	2,8	8,6	2,8
J	1,2	1,9	1,1	1,8	1,1	1,9	1,2	2,0
L	0,8	5,3	0,9	5,3	0,9	5,1	0,9	4,8
M	5,3	10,4	5,4	10,7	5,6	10,4	5,7	10,9
N	0,9	2,9	0,9	3,1	1,0	3,1	1,1	3,1
S	5,5	7,0	5,6	7,1	5,7	7,2	5,7	7,6

The sectoral distribution is provided more clearly in the Table 4 where the enterprise rates are submitted in percentages. According to Table 4 minimum number of enterprises in the both countries is in the electricity, gas, steam, ventilation systems and water supply, sewerage, waste management (D, E).

In general the usage of information systems by the enterprises is evaluated by miscellaneous variables such as computer, internet, social media, customer relations management (CRM), enterprise resource planning (ERP) software usage, internet access types, internet access speed, electronic data interchange (EDI), purposes of internet usage, having web page, selling over web etc. In the reports published by Tuik regarding the information systems of the enterprises, rates of computer, internet, social media, CRM, ERP usages, having web page and selling over web are included. In Lithuania the usages of information systems by the enterprises started to be studied according to Nace Rev.2 in 2010. The variables used by the studies carried out by Eurostat are more than those used by Tuik. However, in the Eurostat and Tuik studies the usage of variables regarding some information systems such as RFID, wireless network, CRM, ERP is not continuous. The collection of data regarding the usage of the social media by the enterprises started in 2013. The continuous data included in the reports regarding the both countries were provided at Table 5 and Table 6.

Table 5

Percentages of the Information Systems Usage by the Enterprises in Turkey per Sectors

Sectors	Computer usage (%)				Internet usage (%)				Having web (%)				Selling over web (%)				Social media usage (%)
	2010	2011	2012	2013	2010	2011	2012	2013	2010	2011	2012	2013	2010	2011	2012	2013	2013
TR	92,3	94,0	93,5	92,0	90,9	92,4	92,5	90,8	52,5	55,4	58,0	53,8	15,6	17,9	11,1	10,1	26,7
C	92,5	94,7	94,4	90,0	91,4	92,9	93,3	88,4	60,9	63,2	67,2	56,4	13,7	15,2	12,6	10,3	25,1
D-E	98,5	98,9	97,8	95,8	98,2	97,8	97,8	93,6	63,2	62,7	68,0	62,2	8,8	15,1	4,2	4,6	24,5
F	88,7	92,1	89,0	91,4	87,1	90,1	88,0	90,3	44,8	46,8	46,8	49,2	9,2	13,3	5,2	3,7	20,8
G	94,9	96,1	95,5	96,3	92,9	94,9	94,6	95,7	46,7	52,2	56,0	55,5	16,2	17,9	13,2	12,7	28,4
H	93,7	91,3	93,1	90,5	92,7	90,2	92,0	89,7	45,1	46,6	51,1	43,7	16,9	15,3	7,2	6,4	22,0
I	81,2	82,2	87,2	84,7	80,3	80,5	85,0	83,4	49,2	49,9	53,4	54,4	36,5	54,5	16,5	18,5	36,4
J	98,6	98,5	99,3	98,1	98,6	98,2	98,9	97,0	77,1	79,8	81,8	78,5	19,9	22,0	16,3	20,0	58,7
L	91,1	93,8	95,9	94,4	91,1	93,8	95,9	91,8	60,7	75,1	60,6	49,3	4,8	13,2	3,5	3,5	25,5
M	98,6	98,4	98,1	93,0	98,6	97,8	97,6	91,1	62,8	58,9	63,6	57,3	7,2	8,9	9,6	7,5	31,8
N	87,4	93,0	91,9	89,5	87,3	91,1	91,4	87,8	47,4	53,9	49,0	44,5	25,4	16,7	5,8	7,3	26,9
S	97,7	100	100	97,3	97,7	98,2	100	97,3	76,9	82,1	82,7	73,0	17,9	26,6	26,7	24,3	40,4

Source: Tuik

Table 6

Percentages of the Information Systems Usage by the Enterprises in Lithuania per Sectors

Sectors	Computer usage (%)				Internet usage (%)				Having web (%)				Selling over web (%)				Social media usage (%)
	2010	2011	2012	2013	2010	2011	2012	2013	2010	2011	2012	2013	2010	2011	2012	2013	2013
LT	97	98	100	100	96	98	100	100	65	68	71	75	22	21	15	20	31
C	98	99	100	99	97	99	100	99	69	68	73	78	25	21	16	20	26
D-E	100	100	100	100	100	100	100	100	62	73	81	87	12	9	2	8	15
F	98	99	100	100	96	99	100	100	56	68	68	73	9	10	8	10	22
G	97	97	100	100	96	97	100	100	65	65	71	74	24	22	18	25	36
H	93	97	99	100	93	97	99	100	47	55	55	64	25	27	15	19	24
I	97	100	100	100	97	100	100	100	97	92	96	93	65	65	70	81	72
J	100	100	100	100	100	100	100	100	91	94	96	94	34	31	36	35	64
L	100	100	99	99	100	100	99	99	68	63	73	72	15	9	9	9	21
M	100	100	100	100	99	100	100	100	87	79	83	86	18	18	4	8	31
N	96	98	98	100	96	98	98	100	76	76	80	86	25	27	14	21	42
S	100	100	100	100	100	100	100	100	97	96	98	95	36	32	34	32	53

Source: Eurostat

Table 5 and Table 6 show that the Lithuanian usages of the information systems are higher than these in Turkey. Especially in Lithuania almost all the enterprises are using the computer and internet. However, the usages of having web page, selling over web and social media usage by the enterprises of the both countries are at the lower levels.

According to the data included in the tables the lowest usage rates for all sectors is the selling over web. As of 2013 the lowest level in Turkey is in the L sector and in Lithuania in the D-E and M sectors. The selling over web for which a decreasing trend was observed in the both countries, is most in Turkey in the S sector with 24 % and in Lithuania in I sector with 81 %.

Digital Divide

Definition of Digital Divide

The digital divide which appears together with the spreading of the computer technologies and which became a social issue is in general defined as an inequality between those using and not using the information systems (NTIA, 1999; NTIA, 2000; Selwyn, 2004; Wei & Hindman, 2011). The concept which was first known in 90's in order to emphasize the ownership of telephone line (Brousseau ve Curien, 2007) started to be used in the expression of differences of computer usage and later the internet access rates together with the development of the information systems. At the beginning the studies were limited with the OECD countries but today this becomes a global issue interesting all the countries.

Baker which regarded the digital divide as an inequality evaluates the concepts as imbalance in the distribution of the resources (Baker, 2001). Riggins and Dewan express it as the differences among these who have and have not access to the information and communication technologies (Riggins & Dewan, 2005). The definitions included in the studies are in general classified per those who do and do not have the information systems. However, it is stated in some studies that the term does not only relate to the access but digital divide could be discussed even after having information systems (Belanger & Carter, 2006; Hargittai, 2002; Sedimo *et al.*, 2011). The concept in the studies which adopts this approach is defined as the differences encounters in the access to and usage of the information technologies in the persons, household, business and geographic areas (OECD, 2001). This definition which is used as a reference in the most of the studies emphasizes that the digital divide is associated with the efficient usages as well as physical access.

Types of the Digital Divide

There are two types of digital divide: horizontal and vertical divide. The differences between those using and not using the information technologies is expressed by vertical divide and the differences between those using as horizontal divide (Sedimo *et al.*, 2011; Wei & Hindman, 2011). The vertical divide is defined also as first level digital divide because it is an issue encountered at the beginning of the usage of the information technologies (Attewell, 2001) and it is evaluated with the physical ownership (VanDijk & Hacker, 2003).

The horizontal divide called also as second level digital divide is related to the usage differences (Attewell, 2001). The efficient usage which includes the qualified personnel and training as well as the economic and regional factors has wider social effects since it is an approach more complex than the physical ownership. These effects increased rapidly especially after the spreading of the internet within the social life and thus a conceptual shift from physical access to the efficient usage occurred (Selwyn, 2004). Thereby it is important in terms of digital divide that in the future academic studies on the second level divide to be carried out and the public policies to be implemented accordingly (Wei & Hindman, 2011).

Studies on the Measurement of the Digital Divide

The studies regarding the digital divide are performed in general to determine the social, regional or global divide levels. Organizations such as World Bank, United Nations and OECD are dealing with the global extent of the digital divide and offer solution recommendations. The studies in which different indexes, parameters and analyses are used emphasizes that the digital divide is a global issue. Digital Opportunity Index (DOI), Digital Access Index (DAI), ICT Development Index (IDI), Networked Readiness Index (NRI) and Digital Evolution Index (DEI) are the main indexes used by these institutions and include in general the indicators such

as the computer ownership, internet access and mobile device usages (NTIA, 1995; UNDP, 1999; OECD, 2001). These international researchs are reporting that in general the digital divide between the countries is increasing.

The digital divide which is widely examined by the academicians as well as the global institutions is still up to date. The literature shows that the studies starting as of 90s accelerated as of 2000s. The concept is analyzed by different disciplines because it has psychological, sociologic, economic and technologic perspectives. Most of the studies aim to determine the divide levels and these levels are tried to be determined by comparison of usage levels among different groups. The differences are evaluated with conventional statistical methods according to the demographic variables such as age, gender, educational background, ethnicity, location and income. The studies analyze the digital differences from the computer and internet usages within a personal, regional and global context (Dewan & Kraemer, 2000; Bonfadelli, 2002; Chakraborty & Bosman, 2002; Cheung & Huang, 2002; Rice & Katz, 2003; Dewan *et al.*, 2005; Teo, 2007; Stern *et al.*, 2009; Sedimo vd., 2011; Wei & Hindman, 2011; Sharma & Gupta, 2014).

Measurement of Digital divide with Gini Coefficients

Gini Coefficients

The inequalities occur in the distribution according to the economics view built on the principle of scarce resources leads to imbalances in economic system. The unequal sharing of the resources leads to the different well-being levels and thus the decrease of the social welfare. Thereby it is important for the economies to measure the levels of the inequality which are denoted as situations in which the distributions are different from each other (Karoly, 1992). Although there are numerous measurement tools, Gini coefficients is the best method to be employed for the measurement of the inequalities (Maclachlan and Sawada, 1997). This method developed in 1912 by the Italian statistician Corrado Gini, provides the opportunity to denote numerically the inequality caused by the different income distributions (Ceriani & Verme, 2012).

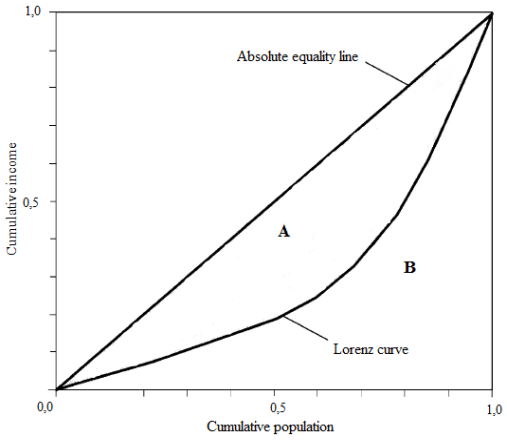


Figure 1. Lorenz Curve

The Gini coefficient is obtained by taking as basis the Lorenz curve developed in 1905 by Max Otto Lorenz which is the graphical display of the income inequality. The Lorenz curve depicts graphically the ratio of share received by the individuals from the total produced income (Kakwani, 1977). The population is divided by the determined income levels and the incomes of each segment are cumulatively determined (Chakraborty & Bosman, 2005). Figure 1 demonstrates the Lorenz curve which shows the income distribution inequalities within the population segments.

The inequality is defined by the A area between the diagonal called as absolute equality line and Lorenz curve. If A area is larger it means that the distribution inequality is higher and vice versa. On the other hand in case of full inequality in which the total income is gathered under a single segment or individual the Lorenz curve will be comprised of diagonals and the A are will equal the area of the right triangle (Maclachlan & Sawada, 1997).

Although Lorenz curve is a powerful tool for the graphical evaluation of the inequalities, it is insufficient for the comparison and interpretation of the inequalities. This insufficiency may be exceeded with the proportioning of the areas created with the Lorenz curve. The share within the triangle of the A area gives the numerical size of the inequality. The numerical calculation of the inequality levels will provide accurate information on the size of the inequality and ensure more efficient comparisons.

The Gini approach, one of the indexes used in order to denote numerically the inequalities is a method based on the total of the differences (Goodman & Kruskal, 1959). It is used in the sociology, economics, geography, biology, health and education working fields in order to determine the numerical levels of the distribution difference. Gini coefficient which is called also as Gini concentration ratio or Gini index, is the most appropriate method used for the measurement of the inequalities (Chakraborty & Bosman, 2005). The ratio of the area between the Lorenz curve and the absolute equality line (A) to the right triangle located under the absolute equality line (A+B), as provided at Figure 1 is denoted as Gini coefficient and is obtained with equation (1).

$$\mathrm{G} = \frac{\mathrm{A}}{\mathrm{A+B}} \qquad (1)$$

$$G = \frac{1}{n}\left(n + 1 - 2\frac{\sum_{i=1}^{n}(n+1-i)y_i}{\sum_{i=1}^{n} y_i}\right) \qquad (2)$$

$$G = \sum_{i=1}^{n} \mid X_i Y_{i+1} - X_{i+1} Y_i \mid \qquad (3)$$

In cases in which the intergroup's population sizes are equal the Gini coefficient may be calculated with equation (2). Each of the n group in the equation is denoted as i and Y_i shows the cumulative percentage of the income (Shankar & Shah, 2003). The equation in which the Gini value is calculated without including the population data may be used under the assumption of the population distribution is evened. However, in the analysis of the regions with different population sizes, weighting the calculations according to the population will give healthier results. In this case the equation (3) shall be used for the calculation of the Gini coefficients. The n shows the region number, X_i the

cumulative population ratio and Y_i the cumulative income ratio of region i. It is emphasized that an ascending sort of the income groups is needed before the calculation to be made by using this equation (Maclachlan and Sawada, 1997).

The G value resulting from the ratio is between 0 and 1. If A area increases (becomes distant from the certain equality line of Lorenz curve) G value approaches to 1 and this means that the inequality increases. If A area decreases (approaches to the certain equality line of Lorenz curve) G value approaches to 0 and inequality decreases.

Studies on the Measuring of Digital Divide by Gini Coefficients

The publications on the digital divide show that the studies are generally focused on its reasons, levels, compounds and effects. The determination of the divide level includes the statistical methods. However, the studies employing methods such as the Lorenz curve and Gini coefficients used for the measurement of the inequalities beyond the conventional method are rare.

The study of Riccardini and Fazio determined the digital difference levels between the countries, companies and persons with the Gini coefficients. According to the study it was determined that the highest digital divide observed between the countries is related to the server density and the digital divide between the individuals is related to the internet based applications. The researchers, who studied the digital divide between the companies according to the geographic location and company size, determined that according to the company size the digital divide is higher (Riccardini & Fazio, 2002). In the study of Chakraborty and Bosman with Gini coefficients, the digital differences between the USA states were analyzed. The study used ethnicity and computer ownership data to perform the analyses of the regions with different population intensities within the frame of income group. The study mapped the regional distribution differences and determined that there is a digital divide between the blacks and whites in each region of USA (Chakraborty & Bosman, 2005). Howard et al., who analyzed with Gini the digital divide levels according to the education and income groups using the USA and Canada internet access rates, determined that education has significant effects on the digital divide of the both countries. Also the study shows that the Canadian Gini coefficients were relative lower and American ones both in terms of income and education (Howard *et al.*, 2010). According to the Jin and Cheong who analyzed the digital divide between the individuals taking into consideration the demographic variables such as age, gender, education background and income level, it was determined that there was not a significant relation between the internet access and internet usage and that the Gini coefficient calculated for the internet access is higher than the internet usage (Jin & Cheong, 2008).

Research Findings

The sectoral digital divide levels were determined with Gini in the study which used the Table 3, 5 and 6 which include the Turkey and Lithuania data. The calculation method of the Gini coefficient is given in Table 7. While creating the table in which the Gini value which shows the digital divide level between the sectors regarding the Turkish computer usage, initially the number of the enterprises from the sectors which are using computers were determined. According to these sizes, the rates of the sectoral enterprise number within the total enterprise number x_i and the rates of the sectoral computer using enterprise number within the total computer using enterprise number y_i was calculated and located in Table 7. The ascending sort according to the income levels made in the other studies before the calculation of the cumulative values was made in this study according to the number of the computer using companies. Equation (3) was used to weight according to the number of the companies and the Gini value was calculated as 0,013.

Table 7

Calculation of Gini Coefficients

Sectors	Prop. of Computer Usage (y_i)	Propor. of Enterprises (x_i)	Cumulative Propor. of Computer Usage (Y_i)	Cumulative Propor. of Enterprises (X_i)	
D,E	0,001521	0,00144	0,001521	0,00144	9,83E-07
L	0,008418	0,008616	0,009939	0,010056	4,74E-06
N	0,008639	0,009217	0,018578	0,019273	2,14E-05
J	0,012538	0,011857	0,031116	0,03113	6,98E-05
F	0,043969	0,046232	0,075085	0,077362	0,000364
M	0,057405	0,054296	0,13249	0,131658	0,000306
S	0,058844	0,056167	0,191334	0,187825	0,00236
I	0,074373	0,085341	0,265708	0,273166	0,000699
C	0,130977	0,132023	0,396685	0,405189	0,001919
H	0,182199	0,181268	0,578885	0,586457	0,007572
G	0,421115	0,413543	1	1	0
				Total = 0,013316	

The Gini value calculated in the Table 7 shows that as of 2010 there are no different levels of intersectoral computer usage in Turkey. The computer usage percentages from Table 5 although create the perception that there is an intersectoral digital divide regarding the computer usage, the calculated Gini value which is very close to zero shows that the intersectoral computer usages are close to the equal distribution. This may be explained as a non-significant digital difference regarding the Turkish intersectoral computer usage as of 2010. Using the method given in Table 7 the Gini values regarding the computer, internet, social media usages, having web page and selling over web between 2010 and 2013 of Turkey and Lithuania were calculated and provided at Table 8.

Table 8

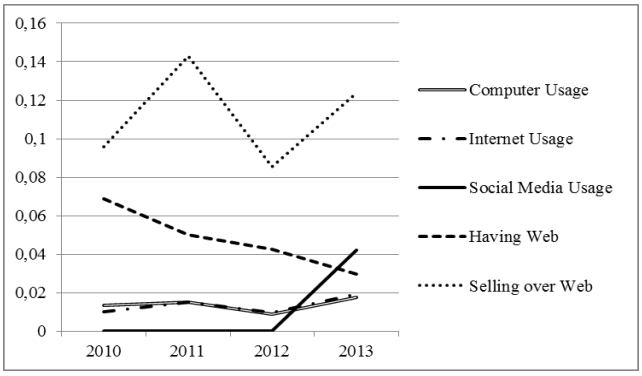
Gini Values of Information Systems Usages

Country	Information system	2010	2011	2012	2013
TR	Computer usage	0,0133	0,0150	0,0088	0,0176
	Internet usage	0,0100	0,0153	0,0096	0,0194
	Social media usage	-	-	-	0,0423
	Having web	0,0689	0,0501	0,0424	0,0298
	Selling over web	0,0957	0,1430	0,0856	0,1237
LT	Computer usage	0,0055	0,0065	0,0015	0,0012
	Internet usage	0,0069	0,0065	0,0015	0,0012
	Social media usage	-	-	-	0,0869
	Having web	0,0668	0,0544	0,0451	0,0401
	Selling over web	0,0734	0,0838	0,1694	0,1803

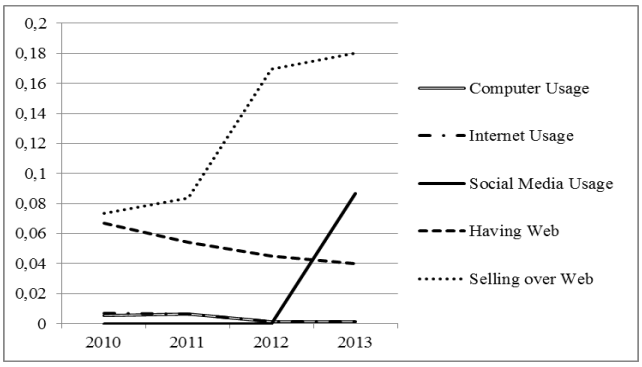
The Gini values from Table 8 show that intersectoral digital divide level is quite low. Especially there is no digital divide regarding the computer and internet usages. Having even smaller Gini values indicates that Lithuania has a better position. Moreover the descending Gini coefficients show that the computer and internet usage differences decreased gradually over years.

Studies on the levels and aims of the social media usage levels of the enterprises were started to be included in the Tuik and Eurostat reports as of 2013. According to the data the Turkish social media usages are at a lower level than those of Lithuania. Gini values which show the intersectoral digital divide levels reveals that the sectoral differences regarding the social media usages are lower in Turkey.

Considering the values from Table 5 and 6, the highest ratios of having web page and selling over web as well as in the other information systems are observed to be in Lithuania. However, according to Table 8 the Gini values showing the Lithuanian intersectoral digital divide both in terms of having web page and selling over web are higher. The Figure 2 which includes the graphical intersectoral digital divide shows that especially the sectoral differences from selling over web have a higher increase trend over the years when compared with the other information systems. On the other hand the sectoral differences on selling over web in Turkey have a descending trend unlike the Lithuania.



a)Turkey



b)Lithuania

Figure 2. Gini Values

Comparing Results

Most of the studies on digital divide are concerned with measuring the differences in usage of information systems (Vicente & Lopez, 2011). Various methodological approaches and statistical techniques are applied to determine the level of digital divide. There are two approaches for measuring the concept in previous studies. Some of them use composite structures which consist of some selected indicators and the others use each variable separately.

The major indexes composed of some indicators carried out by international organizations and those are called E-Readiness, IDI and NRI. Each of the indexes consists of varied indicators which are weighted differently to calculate index scores (EIU, 2010; ITU, 2014; WEF, 2013). E-Readiness, IDI and NRI scores and ranks of some European countries and Turkey are given in Table 9.

Table 9

Scores and Ranks of European Countries

Country	E-Readiness (2010)		IDI (2013)		NRI (2013)	
	Score	Rank	Score	Rank	Score	Rank
Sweden	8,49	1	8,67	3	5,91	3
Denmark	8,41	2	8,86	1	5,58	8
Finland	8,36	4	8,31	8	5,98	1
Greece	6,20	33	6,85	39	3,93	64
Lithuania	6,14	34	6,74	40	4,72	32
Bulgaria	5,05	47	6,31	49	3,87	71
Romania	5,04	48	5,83	58	3,86	75
Turkey	5,24	43	5,29	68	4,22	45

Source: EIU, WEF and ITU reports

The indexes provide a general assessment of the level of using information systems (Corrocher and Ordanini, 2002). So they are far from measuring the digital divide. In these reports, the digital divide among countries is determined by pairwise comparison of index scores. Table 9 shows that Denmark is the first country according to IDI and eighth according to NRI in the world's rank. In a smilar way, Greece's rank is 39th in IDI and 64th in NRI. Also, the values of all indexes show that Lithuania has better position than Turkey. The scores of indexes and ranks of countries cause confusion and they are queried in the context of healthy measuring tools. Applying variety indicators and using different weighted variables for calculation of scores reveal methodological complexity among indexes (Vicente & Lopez, 2011). On the other hand, indexes are aimed to get information about technological capacities of countries. Therefore, indexes do not provide micro outlook on digital divide (Corrocher & Ordanini, 2002). Using basic actors such as individuals and businesses will be proper methodology for measuring the digital divide (WEF, 2013).

Another approach for measuring digital divide is to examine the components of information systems (e.g. computer, internet usage, having web site etc.) one by one. The determinants of the digital divide are investigated by statistical analysis to determine the relations with demographic and economic variables (Bonfadelli, 2002; Dewan *et al.*, 2005; Vehovar *et al.*, 2006; Vicente & Lopez, 2011; Viard & Economides, 2014). Several researches which applied Gini explored the issue with grouping by gender, ethnicity, education and income at individual and regional level (Chakraborty & Bosman, 2005; Jin & Cheong, 2008; Howard *et al.*, 2010). Some papers related to digital divide in Europe show that Lithuania has an average level of use of information systems among European

countries (Kyriakidou *et al.*, 2011; Vicente & Lopez, 2011; Cruz-Jesus *et al.*, 2012). According to a study which aimed to classify the European countries based on the usage of information systems, Turkey and Lithuania are located in the same group (Cilan *et al.*, 2009). Meaning of the finding is that, Turkey and Lithuania have same level in the use of information systems.

The methodological approach for measuring digital divide in this paper differs from other studies in several ways. First of all, our study focused on to measure digital divide by using each variable of information technology separately instead of using composition of indicators. It will eliminate the unstable results of the indexes. E-Readiness, IDI and NRI scores claim that Lithuania has better position than Turkey. In our analysis, Gini coefficients demonstrate that Lithuania has low differences in using computer and internet, but the digital divide in other information systems is higher than Turkey in sectoral structure. Results of the analysis determine that Lithuania has higher digital divide, in spite of high percentage of using information systems. Our findings show that using composition of indicators is seen as an improper approach to identify the level of digital divide.

Secondly, evaluating the digital divide with demographic variables reveals the determinants of the digital divide. For this reason, analysis of descriptive statistics, factor, correlation and regression are applied to determine the relationships (Corrocher ve Ordanini, 2002; Cilan *et al.*, 2009; Vicente ve Lopez, 2011; Bach *et al.*, 2013). These approaches usually applied for individuals and firms identify factors affecting the digital divide instead of measuring the degree of digital divide (Grimes *et al.*, 2012). This study shows that Gini method which builds a common ground for quantitative measure of income inequalities is also applied to the digital divide without using demographic variables.

Lastly, studies dealing with digital divide among firms, organizations and sectors are rare. The digital divide among manufacturing firms and SMEs has been investigated by several researches with the statistical analysis mentioned above (Bach *et al.*, 2013). This study has a leading role to determine sectoral digital divide with Gini method. The paper's methodological approach demonstrates how Gini method can be applied to measure sectoral digital divide by only using sectoral number of firms and usage of information systems.

Conclusions

The information system infrastructures of the enterprises operating in the sectors which have an important role in the economy increase both the intra and intersectoral interactions. Such interactions become mandatory due to the network externality which is a concept closely associated the information systems. The information systems increase the organizational and sectoral efficiency in the business processes but lead to the sectoral imbalances due to the inequalities between the users and non users. Thus the efficient operations of the sectors are directly associated with the digital divide.

Gini method used for the measurement of the differences between the income levels became a standard. This method creates a common ground for the comparison of the income imbalances. On the other hand the different methods and indexes used for the measurement of the digital divide, lead to the complexity of the methods and difficulties in the comparison of the results. If it is thought that digital divide is an inequality in distribution of resources Gini will be the best approach for measurement of digital divide. This approach will end the method complexity regarding the measurement of the digital divide level and will create the common ground.

Most of the studies aim to determine the individual, regional or global digital divide and sectoral approaches are infrequent. The usage of the Gini coefficients in the studies instead of the basic statistical methods will reveal healthier results. The differences observed in the usages of the information systems in some studies which employed the Gini coefficients, are analyzed based upon the income levels on an individual basis. In this study the sectoral digital divide levels were determined by Gini coefficients. The method was applied to the Turkish and Lithuanian computer, internet, social media usages, having web page and selling over web and sectoral digital divide levels as of 2010–2013 were determined. Thereby the comparison of the intersectoral information systems usage differences in Turkey and Lithuania was enabled.

The research data show that the Turkish and Lithuanian sectors have an increasing trend of information systems. Especially Lithuania has a good level of sectoral usages of computer and internet. The Turkish and Lithuanian computer and internet usages are higher than the other information systems. The digital divide levels decreased over years in the computer and internet usages which had the lowest sectoral digital divide level. The highest digital divide among the information systems is observed at the selling over web. This determination reveals that the sectoral transition to new technologies takes time and thus in case of new technologies the digital divide level is higher.

The web page ownership rate of the enterprises operating in Turkey which is 53,8 % in 2013 is 75 % in Lithuania. The Gini values show that 2013 year sectoral digital divide level is 0,029 for Turkey and 0,04 for Lithuania. A similar case is observed in the selling over web and social media usage values. Although Lithuania has higher rates regarding the social media usages, having web page hosting and selling over web, the Gini values determined that the intersectoral usage differences of these technologies are higher than those in Turkey. In this context it may be stated that higher information systems usage rates does not mean that the digital divide is lower.

The systems which are important for the enterprises such as mobile applications, cloud technologies, CRM or ERP among the information systems usages of the enterprises are included in the Eurostat and Tuik reports. While Tuik has not included the cloud technologies, Eurostat is not studying the CRM and ERP systems usage levels. However, the developing technologies require these systems to be included in the researches. Thereby the studies on the digital divide will be able to be analyzed within a largest context and detailed determinations regarding the social and economic structure may be realized.

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