Macroeconomic ICT Facts and Mobile Telecom Operators via Social Networks and Web Pages

Sadi Evren Seker and Atik Kulakli

***Abstract*—This study has three major outcomes, the first major outcome of the research is the comparison of countries in Balkan region by some characteristic differences between the mobile phone users, market structures and profitability of mobile operators.**

The second major outcome is the normalization of mobile operator actions and comparing different operators from different countries with respect to their normalized success.

The third major outcome of study is first time collecting the web and social network activeness of companies and building a internet activeness model like number of Facebook shares, number of tweets mentioning operator, number of followers in linked-in, number of unique daily visitors to the web page of operator, number of backlinks from Google, Yahoo or Bing, the Google page rank and so on. We collected all these data and analyzed to build our model of internet activeness from 43 different operators in 13. We believe the analysis are useful for all businesses in these markets, which are related to the internet connection, mobile phone users, telecom operators or e-business. Also a cross-country comparative study can be useful for further market analysis and political and/or macroeconomic studies.

***Index Terms*—Business intelligence, ICT, social network analysis, mobile phone operators, GSM penetration rate.**

I. Introduction

Increases on telecommunication, Internet and mobile phone industry shows the increasing importance of mobile phone operators. For today, all mobile operators have a country wide operation area at least and they are under effect of country based facts like the import/export rates, population, income level or the percentage of information and communication technology (ICT) rate on export/import volume of the country. The [1] and [2] have a variety of statistical research on the subject. Also the relation between macro economic conditions of a country and the mobile phone operators is a two-way relation and both are affected from each other. In other words, macroeconomic facts affect the mobile phone operators while the mobile phone operators are affecting the macroeconomic facts. Furthermore, mobile phone operators can be considered as one of the major players of a country, especially for the ICT macroeconomic facts [3].

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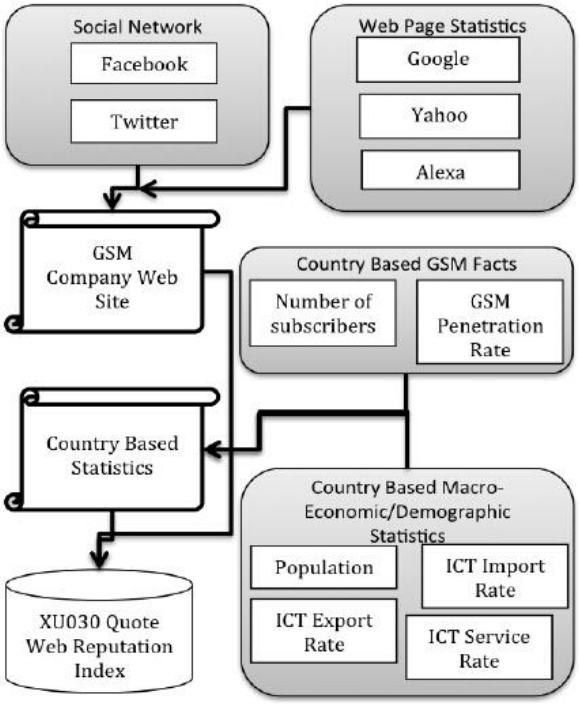

Fig. 1. Data flow diagram of the study.

As demonstrated in Fig. 1, this study, mainly focus on the correlation between country-based economic environment and the customer dynamics of mobile operators. We have proposed an economical model for the correlation and we have applied the model over the Balkan countries.

We have applied a novel approach in order to measure the customer dynamics of mobile operators. In our model the web site traffic of mobile operator and the social network traffic of the mobile operator have a key importance on the measuring customer dynamics of the mobile operator.

We define the social network or web site dynamics of a GSM operator by the activeness of brand on the social network and the activeness of its web site. From the point, if a mobile operator has a more active web site with more visitors or more active social network influence like more likes or shares in Facebook or more mentioning in twitter, we consider the mobile operator as more active. The activeness on the web and social network is a key indicator for us to consider the operator, relatively better than the others.

II. Background

Information and communication technology (ICT) has a great impact on firm specific organizational capability. Despite the increasing capabilities correlated with the ICT, scholars are still trying to model the linkage between ICT

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and financial performance of the firms [4]. Some researches in the MIS area are trying to correlate the statistical ICT data and the performance of the company [5], while some scholars are trying to model the correlation over the ICT and company capabilities, such as financial operations or accounting [6].

Also the ICT implementations and improvements on the company's yields a transformation on the companies, further replacing classical operations with technology. The transformation brings out a paradigm shift in almost all of the firm capabilities [7].

One of the major capability effected with the ICT transformation is the reputation of the firm. The impact of firm related to the ICT operations like social media marketing, electronic communications (e-mails, web forms, social media messaging, etc.) or electronic B2B and B2C operations are considered as a major impact in the reputation [8].

According to [9], it is "the study of web-based content with primarily quantitative methods for social science research goals using techniques that are not specific to one field of study". First example of this measurement is the "Web Impact Factor" (WIF) developed by [5] and defined as "the number of web pages in a web site receiving links from other web sites, divided by the number of web pages published in the site that are accessible to the crawler".

There are five set of tools of web-o-metric research: link analysis, web citation analysis, search engine evaluation, descriptive studies of the web, and the analysis of Web 2.0 phenomena. While link analysis measures the hyperlinks between web pages, web citation analysis counts how often journal articles are cited. Search engines are used to evaluate the extent of the coverage of the web and the accuracy of the reported results. Descriptive studies include various survey methods like the average web page size, average number and type of meta-tags used, the average use of technologies like Java and JavaScript, the number of users, pages and web servers. Last but not least tool is Web 2.0 applications [9].

As the aim of our paper, we use tools of internet activeness, like Google page rank, number of visitors, number of pages linking back to the web page or the number of likes on Facebook, in order to create an Internet activeness index [5]. Our intention is to be as simple and usable as possible [10].

Furthermore we conduct the Internet activeness with other macroeconomic ICT variables, which can affect the success of mobile operator, [11]-[13].

We have selected Balkan region because of very familiar market characteristics and similar companies operating on the region. We believe if we can prove a market indication even in Balkan region, the method we have proposed can be utilized in other cases. The Balkan countries can be considered in two groups. In the first group we consider countries fully in Balkans and in the second group we consider countries partly in Balkans. The countries included into the study are listed in Table I.

We also included the countries partly in Balkans to our research because of their intense influence on the mobile telecom market.

TABLE I: COUNTRIES INCLUDED INTO THE STUDY

Full in Balkans	Partly in Balkans
Albania	Serbia
Bosnia and Herzegovina	Croatia
Bulgaria	Romania
Greece	Turkey
Kosovo	Italy
Macedonia	Slovenia
Montenegro	

III. COLLECTION AND COMPARISON OF INTERNET METRICS

We define a function of Internet activeness, as a comparative function between two mobile telecom operators, operator1 and operator2 with multiple parameters, including social network and web site metrics.

$$f(op1, op2) \leftarrow \begin{cases} SNA(op1, op2) \\ WebA(op1, op2) \end{cases} \quad (1)$$

The Internet metrics can be compared by two sub parameters of social network activeness and web activeness.

Also web activeness is collected from several sources, like web site traffic, Google page rank,daily unique visitors and number of backlinks from Google, Bing or Yahoo.

$$WebA(op1, op2) \leftarrow \begin{cases} Web\ Traffic\ (op1, op2) \\ Google\ Page\ Rank\ (op1, op2) \\ Num\ of\ Backlinks(op1, op2) \end{cases}$$

Similar to the web activeness, we have collected the social network activeness as a function of the number of Facebook shares, number of Facebook likes, number of Twitter messages, mentions, re-tweets or if company has a linked-in page the number of followers in the linked-in.

$$SNA(op1, op2) \leftarrow \begin{cases} Facebook\ Activeness(op1, op2) \\ Twitter\ Activeness(op1, op2) \\ Linked-in\ Activeness(op1, op2) \end{cases}$$

The parameters of Internet metrics (both web and social network) can be explained as below.

Facebook Share Count. Facebook is the leading social network with highest number of members around the world [14]. We have collected the number of share counts for each of the companies. The maximum like count is for Telenor from Serbia.

Linked-in Follower Count. The number of people following company in the Linked-in. There are several companies without linked-in company page and they are considered as 0 followers. In our research, the operator with highest number of followers was T-2 Mobile from Slovenia.

Google Backlinks. Google crawler counts the other web pages linking to a target web page as back link count. The number indicates how a web page is active in the content. For example an empty web page would obviously got no back link while a content rich and well announced and attractive web page gets the highest back link. In our research, SiMobil from Slovenia had the highest number or backlinks.

Daily Unique Visitors is the average number of visitors to the web site of operator per day. The daily visitor number can vary from date to date and we have collected the up to date values during the research time. The maximum visitor is 498744 for Vodafone Italy.

Alexa Ranking is another indicator published by an Amazon owned web site alexa.com. The lesser number means the web page has a higher ranking and the minimum ranking for the web site is 1928 for Vodafone Italy.

Tweets parameter is the count of tweets mentioning about the web site of the company. Again, similar to the Facebook shares, the publicly available tweets are limited. Maximum number of tweets is 364 for Tre-Telecomfrom Italy.

Number of Subscribers is the count of subscribers in the mobile operator network. The number of subscriber parameter is mostly related with the populationof the country, so we also consider the ratio of subscribers to the population as the penetration rate.

IV. Data Set

Besides the data collected for the activeness of the mobile operator on the Internet, we have also collected some macroeconomic parameters, like the percentage of ICT export in whole export, percentage of ICT imports in whole imports, percentage of ICT service volume in whole service industry, the population of country, where the mobile operator is operating and so on. We have calculated penetration rate over the total number of subscribers for each country as demonstrated in equation (4).

$$\text{Penetration Rate} = \frac{\sum \text{Subscribers for each operator}}{\text{Population of Country}} \quad (4)$$

The data set for macroeconomic parameters is presented in Table II.

TABLE II: ICT Facts and Penetration Rates by Countries

Country	Penetration Rate	ICT Service Export	ICT Export	ICT Import
Albania	2.01	10.92	0.39	2.97
Bosnia and Herzegovina	0.87	5.55	0.19	2.68
Bulgaria	1.46	22.80	1.96	6.20
Greece	1.40	7.87	1.68	5.10
Kosovo	0.60	20.74	n/a	n/a
Macedonia	1.11	23.99	0.31	4.01
Montenegro	1.77	7.88	0.44	3.02
Serbia	1.27	42.00	2.11	3.78
Croatia	1.20	14.51	1.89	4.35
Romania	1.29	37.31	4.99	6.77
Turkey	0.94	1.64	1.74	4.18
Italy	1.61	34.87	2.10	6.21
Slovenia	0.42	22.18	1.79	3.57

ICT Exports in Table II, indicates the percentage of information and communication technology related exports within the whole exports of the country, including telecommunications, audio and video, computer and related equipment; electronic components; and others. Similar to ICT Exports, the ICT imports is Information and communication technology goods imports include telecommunications, audio and video, computer and related equipment; electronic components; and other information and communication technology goods. Software is excluded from the ICT imports.

ICT service is, information and communication technology service exports include computer and communications services (telecommunications and postal and courier services).

All the data in Table II is from year 2012 with only exception of Italy, which we have used 2011 data because the data from 2012 was not available during the research.

V. Normalization

All Internet activeness parameters should be considered into its own domain. For example, the daily traffic of the web page of the mobile operator is between 295 and 498744 and page rank of the web page is between 1 and 10 so we can not apply simple operators like summation or average between those variables, instead we have normalized each of the variable within its scope and than applied a simple average over all the parameters. The normalization we have used is Min-Max normalization and can be shown as in equation (5).

$$N_{\text{Min Max}}(x) = \frac{x - \text{Min}}{\text{Max} - \text{Min}} \quad (5)$$

The normalized value is calculated by the subtraction of the minimum value of the series from the sample and dividing the subtraction to the distance between minimum and maximum values of the series.

Another problem in combining multiple parameters into a single metric is the effect of parameters as positive or negative direction. For example the Alexa ranking of a web sitecan be considered as a negative directed effect on the combination, since the better reputation comes from smaller rankings. As a solution we have calculated the inverse of these indicators by multiplying with -1. Which means a subtraction in the final decision in fact.

So the total score is calculated the Internet activeness of operator viaequation (6).

$$\text{IA} = \frac{\sum_0^C N_x - \sum_C^K N_x}{C} \quad (6)$$

The Internet activeness (IA) is calculated with the summation of negative indicators subtracted from the summation of positive indicators divided by the count of positive indicators “C”. The “K” symbol in above formula stands for the total number of indicators which is the summation of positive and negative indicator counts.

Because the summation of positive indicators is always higher than the summation of negative indicators the equation of IA always gets a positive real number between 0 and 1.

VI. Results

This research is important and useful from three aspects.

1) In order to understand the market differences in Balkans region from the mobile telecom companies
2) Proposing a novel market independent model for the mobile telecom companies.
3) It is first time we are proposing an Internet activeness research for the mobile telecom companies.

In this section we will demonstrates the outputs related to each aspect listed above.

The market structure is studied from the macro economic parameters perspective and demonstrated in Fig. 2.

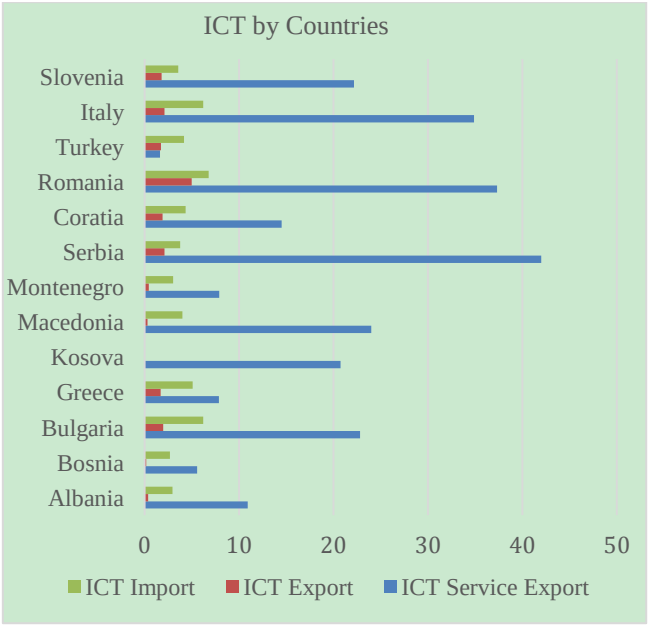

Fig. 2. ICT facts by countries.

Parallel to the ICT parameters per country, we have also calculated the penetration rates for each of the country by simply using the equation (4) and demonstrated in Fig. 3.

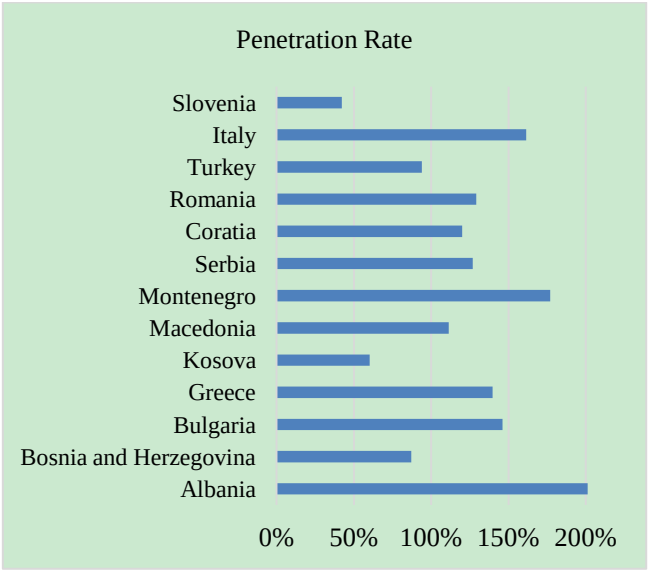

Fig. 3. Penetration rates by countries.

Albania has the highest penetration rate with 201% and Slovenia has lowest with 41%. The meaning of 201% in Albania is, the number of subscribers are double of the population. This doesn't exactly means each subscriber has at least two subscriptions, because of children and old population without using any cellular phones. Also the number indicates the active subscriptions.

Fig. 4 demonstrates the normalized aggregated web statistics of mobile operators for each country. The country mobile operators are aggregated into a single value and results are demonstrated.

We have run several association algorithms and tried to apply the correlation between the macroeconomic values and aggregated mobile web stats.

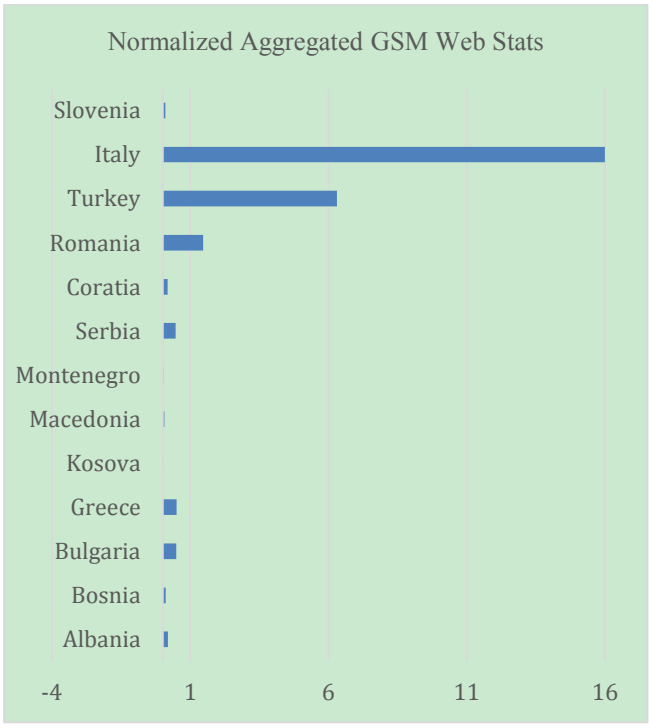

Fig. 4. Normalized aggregated mobile operator internet activeness.

Besides trying several correlation algorithms, the final correlation algorithm we have utilized in this study is Pearson's r function, which can be defined as in equation (7).

$$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2 \sum(y-\bar{y})^2}} \quad (7)$$

in above formula $x \in Array1$ and $y \in Array2$, where Array1 and Array2 can be any data sets like ICT export, import, service, penetration rate or mobile operator internet stats. Also $\bar{x}$ *and* $\bar{y}$ are the mean values of the Array1 and Array2 relatively and can be formalized as in equation (8).

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \quad (8)$$

The correlation matrix, which is demonstrated in Table III, is built on the binary coupling of all arrays and values are calculated by the Pearson's r function as in equation (7).

TABLE III: CORRELATION MATRIX OF VARIABLES

				1.00	Internet Stats
			1.00	0.44	ICT Import
		1.00	0.78	0.19	ICT Export
	1.00	0.59	0.52	0.23	ICT Service
1.00	0.01	-0.10	0.14	0.19	Penetration Rate
Pen. Rate	ICT Service	ICT Export	ICT Import	Internet Stats	

The matrix shows the binary correlation of each array in the column and row. From the correlation matrix, the correlation between ICT Import, export and services can be found as a high correlation, which we consider as out of scope of this study. The highest correlation between the Internet stats is the ICT imports and this high correlation attracts our attention. The correlation graph for each country's mobile operator Internet stats and the ICT imports can be drawn as in Fig. 5.

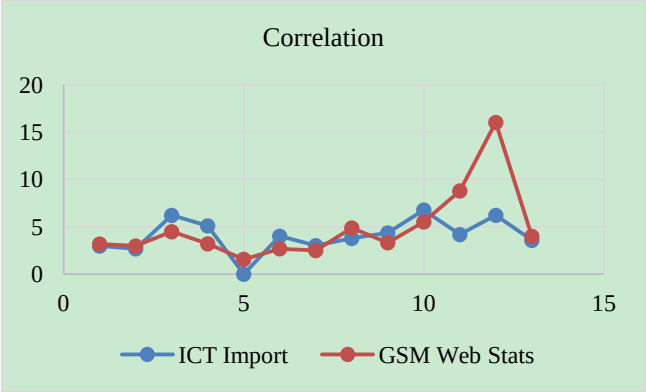

Fig. 5. Correlation between ICT imports and internet activeness of mobile operators.

The Fig. 5 demonstrates the high correlation between Internet stats and ICT imports for 13 countries of this study.

VII. Conclusion

This study aims to find the market structure for mobile telecom operators, also aims to find a market independent success model for the mobile operators and also aims to model an Internet activeness model for the mobile operators and gets this model into action by real life data. For all these three aims, we have collected real life data from Balkan countries, we have studied our statistical model and we have demonstrated a high correlation rate between the ICT import percentage of the country and the internet based activeness of the mobile telecom operator above the correlation between other macroeconomic parameters. We believe this high correlation rate is useful for further analysis on the mobile telecom market structures and mobile telecom company success models.

References

[1] A. S. Bharadwaj, "A resource-based perspective on information technology capability and firm performance: An empirical investigation," vol. 24, no. 1, pp. 169-196, 2000.

[2] M. L. Arslan and S. E. Seker, "Web based reputation index of Turkish universities," *International Journal of e-Education e-Business e-Management and e-Learning (IJEEEE)*, vol. 4, no. 3, pp. 197-203, 2014.

[3] P. Aula, "Social media, reputation risk and ambient publicity management," *Strategy & Leadership*, vol. 38, no. 6, 2010.

[4] Broadband Commision, "ITU BDT advisory board on the smart sustainable development model (SSDM) initiative issued the report: WG on financing, partnerships and business models report," ITU Headquarters, Geneva, Switzerland: International Telecommunication Unit (ITU), 2014.

[5] R. Chun and G. Davies, "E-reputation: The role of mission and vision statements in positioning strategy," *The Journal of Brand Management*, vol. 8, no. 4, pp. 315-333, 2001.

[6] E. Cuvelier and M.-A. Aufaure, "A buzz and e-reputation monitoring tool for twitter based on galois lattices, conceptual structures for discovering knowledge, lecture notes in computer science," *IEEE*, no. 6828, pp. 91-103, 2011.

[7] European Commision. (2013). European commission, trade, policy, countries and regions. [Online]. Available: http://ec.europa.eu/trade/policy/countries-and-regions/countries/turke

[8] J. E. Hunton, "Blending information and communication technology with accounting research," *Accounting Horizons*, vol. 16, no. 1, pp. 55-67, 2002.

[9] P. Ingwersen and T. C. Almind, "The calculation of web impact factors," *Journal of Documentation*, vol. 54, no. 2, pp. 236-243, 1998.

[10] International Telecommunication Unit (ITU), *ICT and Development, ICTs As Enablers of Development: A Microsoft White Paper*. Microsoft Research, 2014.

[11] ITU and UNESCO, "Doubling digital opportunities, enhancing the inclusion of women and girls in the information society," A Report by The Broadband Commission Working Group on Broadband and Gender, 2014.

[12] J. A. Oravec, "The transparent knowledge worker: Weblogs and reputation mechanisms in KM systems," *International Journal of Technology Management*, vol. 28, no. 7, pp. 767-775, 2004.

[13] S. E. Seker and K. Al-Naami, "Sentimental analysis on Turkish blogs via ensemble classifier," in *Proc. the 2013 International Conference on Data Mining*, pp. 10-16, Las Vegas: CSREA Press, 2013.

[14] S. E. Seker, K. Al-Naami, and L. Khan, "Author attribution on streaming data," *IEEE*, pp. 497-503, 2014.

[15] S. E. Seker, C. Mert, K. Al-Naami, U. Ayan, and N. Ozalp, "Ensemble classification over stock market time series and economy news," *IEEE International Conference on Intelligence and Security Informatics (ISI)*, pp. 272-273, Seatle: IEEE, 2013.

[16] M. Thelwall, "Introduction to webometrics: Quantitative web research for the social sciences," *Synthesis Lectures on Information Concepts, Retrieval, and Services*, vol. 1, no. 1, pp. 1-116, 2009.

[17] P. Triggs and P. John, "From transaction to transformation: Information and communication technology, professional development and the formation of communities of practice," *Journal of Computer Assisted Learning*, vol. 20, no. 6, pp. 426-439, 2004.

[18] Z. Whittaker, "Social media 2014 statistics," *Digital Insights*, June 2014.

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