Have ICT changed the game for mobility and migration?

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1. Introduction

Migration is broadly defined as a permanent or semi-permanent relocation of residence, there are no restrictions placed upon the distance or voluntary or involuntary nature of moving (Lee 1966). In fact, few countries today are not affected by international migration (Martin 2014). For many years, the idea of international migration meant disconnecting with one's homeland. This meant the process of communication with friends and family left behind was a slow process, often via hand written letters. However, since the dawn the digital age at the start of the 20th century information and communication technology (ICT) has radically changed the speed and nature of interactions between people worldwide. New ICT such as mobile phones have facilitated instant communication by phone calls, text messages, e-mail, and other social platforms. Cheap international telephone calls function as the 'social glue' binding migrants to their friends and families in their home country by creating constant involvement and engagement in their life (Vetrovec 2004). Castells (2009) argues that the digital age has drastically changed the speed of communication within transnational populations. Since the introduction of the Internet to the masses, it has developed into a globally diverse web of opportunities for gathering information, interacting globally and effectively producing new forms of media and content for consumption. Presently, the digital era has transformed how people live their lives, how they interact with one another and how they learn and gather new information. There is no doubt that ICT have had a monumental impact on the world in which we live, fundamentally changing the way individuals communicate, entertain and learn. With the increase accessibility to ICTs and the existing state of mobility between people around the world, it is easy to envision an existing relationship between increased access to communication and information and the results of migration. Social media developed on the Internet has become one of the most popular channels of communication. These new communication devices created by the Internet and mobile phones are important for migrants who frequently remain in contact with friends of family members in their original locations and might positively affect their decision to migrate. New innovation in digital technologies allows people to thing beyond borders and it is reinforced by both digital and societal developments (Castles 2010).

Furthermore, with the advent of ICT in all components of everyday life, it is important and yet interesting to observe the how the relationship between ICT and migration has developed. However, as (**???**) points out there is little evidence on the effect of ICT on international migration. In this sense, this empirical research seeks to contribute to the literature by analysing if the increase use of technologies such as the Internet and mobile phones impacted the flow of emigration? With the beginning of globalization, we aim to observe the changes in the context of migration around the world. One driving factor increasingly put forward in recent years is the use of technology. According to Hiller and Franz (2004), computer mediated communication has created new possibilities for migrants to maintain strong linkages and ties with their home nations. Not only has new technology improved and heightened communication, it has also bridged cultural gap between countries as it allows people to easily gathering new information and knowledge about other cultures. This of course has made a large impact on people's perception on other cultures and their worldviews. Overall, technology has changed the landscape for communicating, and gathering knowledge and information. These revolutions that have transformed society are making travel and telecommunications cheaper and easier than ever. Moreover, Technology has enhanced the aspects of interaction as it is transforming the way individuals communicate.

As such, this paper will be organized as follows. Section 2 will provide a theoretical foundation for the analysis, as to set the scene for subsequent discussion. Section 3 will be a literature review to identify the converging ideas and understand contemporary studies on the topic. Section 4 will provide the basis for our empirical analysis, by explaining the data and methodology. Section 5 will provide the results of the analysis, followed by a discussion.

2. Understanding Migration: A Theoretical Foundation

Migration is one of the three main determinants of a country's population development (Lee 1966). Every act of migration involves an origin, a destination and intervening set of obstacles and opportunities. The idea of human mobility is that individuals are always in constant circulation, whether it is a college student returning home every summer, a family permanently moving to another country, or people seeking employment in other foreign countries. In existing literature, the factors that influence an individual's decision to migrate, more specifically to emigrate from their origin country to another location are multifold and are described as a combination of social, ethnic, and politically related factors that can be categorized as either Push or Pull factors that are divided into three categories: Economic and demographic, political, and social and cultural (Gold 2013).

Push factors are reasons that are generally forced and negative. In particular, these factors are associated with the country of origin. When considering the three categories, people are 'pushed' to leave their homeland for a number of varying reasons. Social push factors include discrimination, for example, those facing religious or racial discrimination will be negatively influenced to leave their country of origin to seek a new location that does not have leave them socially oppressed. Also, political push factors play a role as to why people leave. Often people living in countries with on going war, conflict, government instability or corruption are forced to flee to avoid harm. Furthermore, economic push factors play a large role in emigration. Countries with low unemployment, rampant poverty or a high cost of living may force individuals to seek more reasonable and opportunistic locations to settle. Moreover, people will move for more employment opportunities

Pull factors on the other hand are the positive traits that positively affect the movement of people. Often people are drawn to move to places to escape the negative factors pushing them out. To escape the issue of social discrimination, people are pulled to countries with high levels of personal freedom or equality. Migrants seeking alleviation from political push factors will be drawn to locations with well-established individual rights or a well functioning justice system. Moreover, people will move to find more economically stable reasons such as employment opportunities or high standard of living.

Another theory common among the literature is the *Neo-classical theory*, which affirms that the market allocates labor depending on demand and supply. In most cases, the demand of employment will automatically provide a supply of persons willing to do the labor in order for the market to reach equilibrium. The determinants of the individual decision will be based on the wage differentials among two geographical areas. To illustrate, a person will be more willing to move to another for labor and employment if the offering wage is higher and more competitive than in their home market.

Motivations for migration	Push factors	Pull factors
Economic and demographic	Poverty	Prospects of higher wages
	Unemployment	Potential for improved standard of living
	Low wages	Personal or professional development
	High fertility rates	
	Lack of basic health and education	
Political	Conflict, insecurity, violence	Safety and security
	Poor governance	Political freedom
	Corruption	
	Human rights abuses	
Social and cultural	Discrimination based	Family reunification
	on ethnicity, gender,	Ethnic (diaspora migration) homeland
	religion	Freedom from discrimination

Source: The World Bank retrieved from (**???**)

3. ICT as a Determinant

ICT plays an important role in many stages of the migration process. Wood also argues that different modes of communicating information such as news, films and advertisements are important sources of information for people considering migration Wood (2001). Moreover, new ICT may have created the image of wealth and prosperity of more developed countries in those living in developing regions (Hamel 2009). Information is crucial in the final decision making process of migration. However, this information flows both ways. Simultaneously, accessibility to ICT have fostered a negative perception of migrants (Wood 2001). Castells argues that being interconnected through a 'network society' has changed the nature of international migration, ICT has increased the rate at which people gather information and communication trans-nationally (Castles 2010).Additionally, Vetrovec (2004) argued that the reduction of the cost of communication has drastically changed how information is collected and perceived. Similarly, mobile phone technologies have made information and knowledge more readily accessible, thus creating realistic and more informed expectations for potential migrants (Panagakos 2004).

Castells (2009) argues of a new 'network society' where information is made a valuable resource through ICT. Technology allows for information to flow quickly and efficiently, providing opportunities for people to interact with one another (Barney 2004). Migration is increasing in spite of more restricted boarder controls because of the development of "networks of connectivity" between societies through channels like the Internet, which offer opportunities for the an expansion of information (Castles 2010). Being connected online offers perpetual connectivity and allows individuals to foster a 'network' outside and within the borders of their origin country. Information constitutes a core of the social process associated with migration. The circulation of information through networks creates 'strong ties' (Granovetter 1983).

Another relevant theory associated with the focus of this analysis is *Globalization theory*. According to Castles, Haas, and Miller (2014), Globalization can be defined as as the process in which world wide interconnections have not only expanded but have deepened the speed of connectivity, and time of all aspects of social life. This theory suggest that globalization has very inconclusive effects on migration flows. On one hand, globalization has strengthened migration since it has fostered new developments in transport and communications. However, on the other hand, it is argued that these new developments have also changed the way in which people work and interact with each other. For example, it has increased outsourcing, commuting and teleworking. Although it sounds like a positive innovation, this has also made migration to another location less attractive, as all the resources are so readily available.

Research Question:

This paper intends to analyse the following question using emperical methods:

Have ICTs, more specifically Internet and mobile cellphone usage affected the flows of emigration?

4.1 Data Selection

To capture the movement and flow of people data was gathered from The International Migrant Stock produced from the United Nations, which provides estimate for the years 1990, 2000, 2010, and 2013. This data will measure emigration between countries. Two proxy variables collected from World Bank Indicators were used to measure the impact of ICT. First, **Internet users** (per 100 people) captures individuals who have used the Internet (from any location) in the last 12 months, the Internet can be used through a number of mediums via computer, mobile phone, personal tablet, game consoles, digital TV etc.**Mobile cellular subscriptions** (per 100 people) data represent the number of subscriptions

mobile telephone service that has been active in the last 3 months. This proxy indicator applies to all mobile cellular subscriptions that offers voice communications.

Additionally, we gather aggregate data from the World Bank Indicators as there are other determinate of migration that needed to be accounted for. These indicators are used to measure push factors. However, due to the lack of information available in the control variables, we ommitted the year 1990, and we focus on the years 2000, 2010 and 2013.

Fertility rate captures demographic push factors and represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with current age-specific fertility rates.

- **Employment Probability:** Using the Employment Rate indicator from the world bank, we calculated the employment probability by using the following equation.

$$1 - \frac{EmployementRate}{100}$$

  Higher unemployment employment opportunities should motivate individuals to stay in their country of origin, this equation is controlling for the employment opportunities within the country of origin. Countries with high employment probability may keep a large amount of its population inside their borders.

- **Gross Domestic Product (GDP) Per Capita:** Controls for the level of wellness of a country.Simultaneously, the outflow of the population are likely to increase wages in the origin country and immigrant flows are likely to decrease the wages of the destination country. To address the reverse causality and homogeneity, we *lagged* the values of GDP.

- **Political Stability:** Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism. This variable interprets the political push factors that influence migration flows.

4. Descriptive Statistics

Dependent Variable

Figure 1 below shows the distribution of the dependent variable. Since the statistics accounts for the number of emigrants, it can be considered as count variable. In order to account for population differences between countries, emigration is expressed in per capita terms. The shape of the distribution is very rightly skewed, which means that emigration is quite low in a large number of countries.

Figure 2 shows the logaritm of emigration per capita. A jarque-bera test is used in order to evaluate whether the transformed variable follows a normal distribution. The chi-squared is equal to 4.2882629 with a p-value equal to 0.1171698 which means that the null hypothesis of "normality" can not be rejected.[1]

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[1]We use the command `jarque.bera.test` in the package R `tseries` (Trapletti and Hornik 2015)
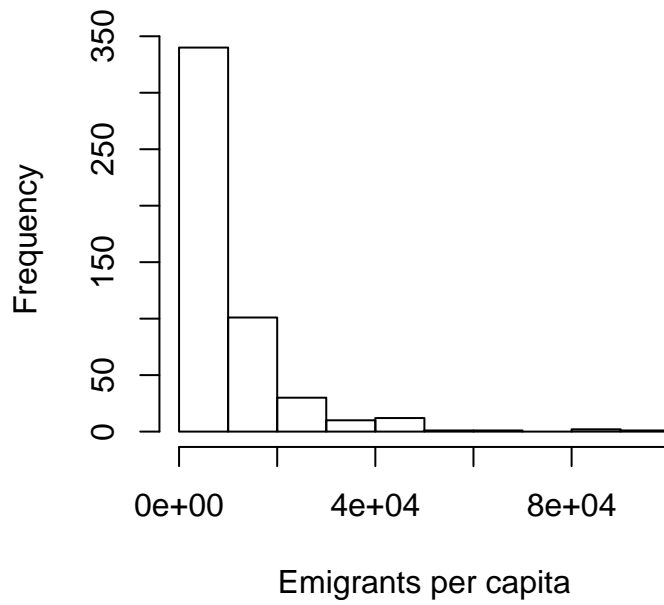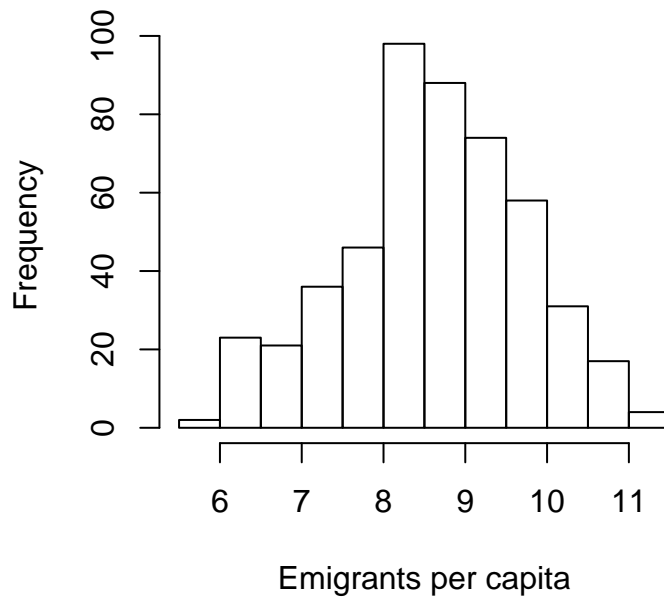
Figure 1. Histogram for Emigrants per cap

Figure 2. Histogram for Emigrants per cap

Among all the years, the country with the largest emigration per capita is the West Bank and Gaza. One can infer that the conflict in this region over time has affected the population movements drastically. The country with the lowest emigration per capita is Western Sahara. Even though there is a strong conflict in the region, free mobility in and out of the country is heavily guarded and limited by a 2,700 kilometer sand wall, also known as the Moroccan Wall. This can account for the lack of emigration throughout the region.

Patterns of Emmigration

The following figures illustrate the evolution of the per capita emigration stock totals for each country in the years 1990, 2000, 2010 and 2013.

Figures 1, 2 and 3 shows important population movements, particularly in Africa. For example, between the years of 2000-2010, Mozambique and Burkina Faso has reduced the number of people exiting the country. Also, Chad has experienced similar pasterns, but not the the extent to which the previous examples faced. When comparing 2010 and 2013, there is not a visually observable difference. This can possibly be attributed to the stabilization of migration patterns.

While Africa has experienced a decrease in emigration, Latin America has the opposite pattern. For example, countries such as Mexico, Colombia, Educator, Peru, Bolivia, and Guatemala have experience a large increase in total emigration during the last decade.

In Europe, the situation is quite mixed since many factors, such as the creation of European Union (EU) and the enlargement of EU over the years could have played a large role the heterogeneity of the migration patterns in the past decade. There is migration movement, but there is no overall pattern of movements within the EU region.

Figure 3. Emigrantion per capita 2000

6.08   11.4

Figure 4. Emigrantion per capita 2010

5.92   11.3
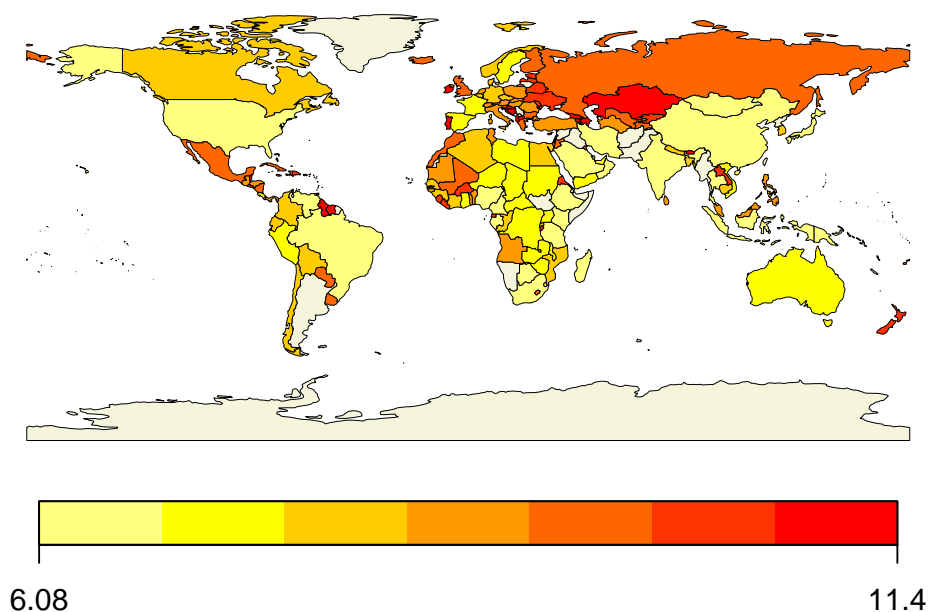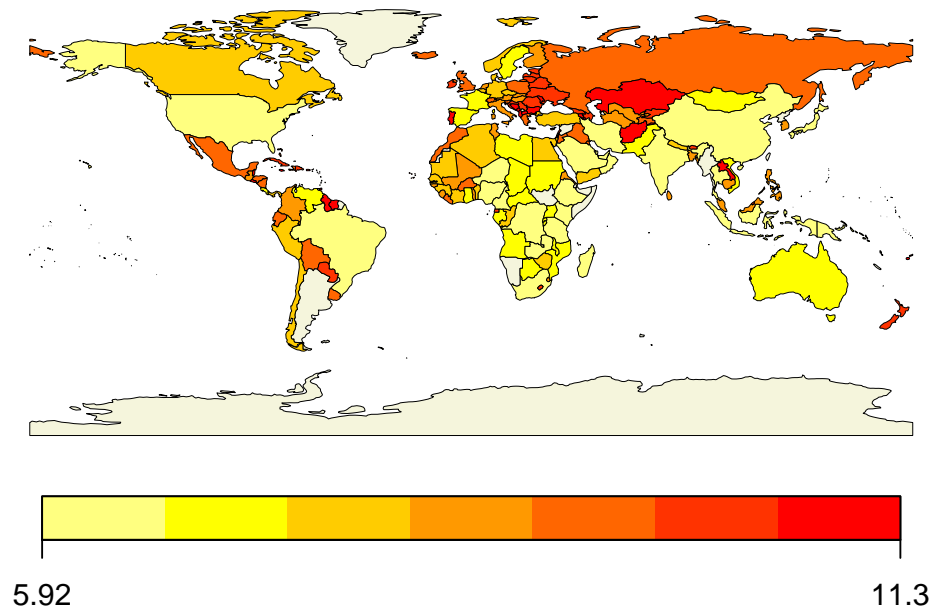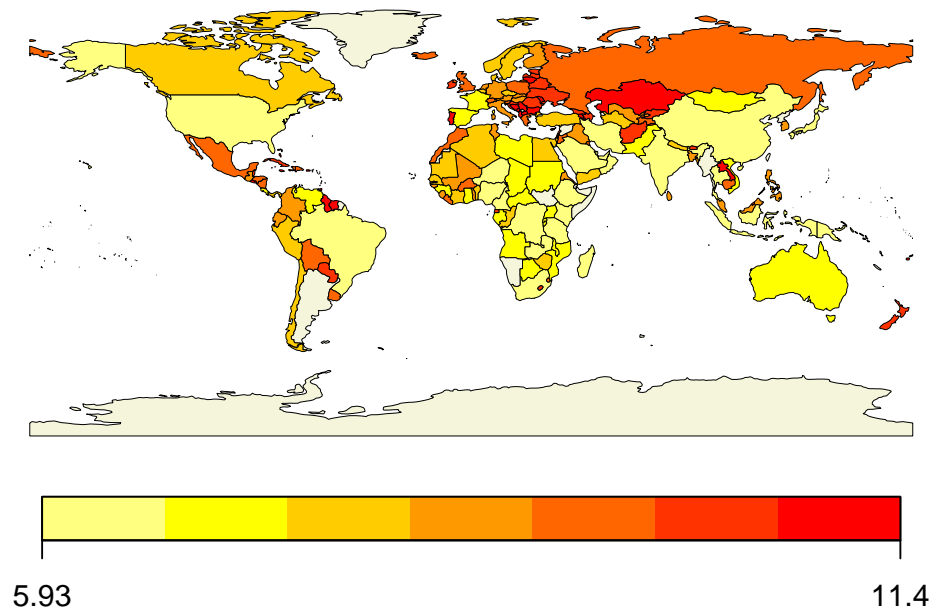
Figure 5. Emigrantion per capita 2013

5.93   11.4

Independent Variables

The following table display relevant descriptive estatistics of the independent variables used in this study.

Table 2: Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Max
Cellphone Subscriptions (per 100 ha)	498	72.07	53.30	0.00	304.08
Internet Users (per 100 ha)	498	28.08	28.37	0.01	96.55
Fertility Rate (percentage)	498	2.99	1.59	0.94	7.72
Political Stability	498	−0.15	0.95	−2.67	1.67
Employment probability	498	0.91	0.06	0.63	1.00
GDP percapita t-1 (log)	497	8.94	1.28	6.09	11.82

5. Emperical Strategy

We conducted a cross panel analysis to examine the hypothesized effect of technology. Our dependent variable of interest (Y) is the total number of Emigrants expressed in per capita terms by country. The independent variable (X) is captured by Internet and mobile cellular subscriptions per country. We used panel data methods to address the research question, this includes panel data regression, fixed effects and random effects. For further discussion of the methodology selected, please refer to Appendix 1.

The following equations show the final estimated models.

Model 1: Cellphone Users (1)

$$I_{\frac{Migration_it}{Poptotal}} = \beta_i + \beta_1 Cell_i t + \beta_2 FertRate_i t + \beta_3 PoliStab_i t + \beta_4 EmployProb_i t + \epsilon_{it}$$

Model 2: Internet Users (2)

$$I_{\frac{Migration_it}{Poptotal}} = \beta_i + \beta_1 Net_i t + \beta_2 FertRate_i t + \beta_3 PoliStab_i t + \beta_4 EmployProb_i t + \epsilon_{it}$$

6. Emperical Results

Table 1. displays the estimation results using a panel regression with fixed effects (Further specifications are shown in the Appendix). Model 1 presents the results using Cellphone subscriptions per 100 inhabitants as an independent variable. Control variables are added in Models (2), (3) and (4). From these estimations we can observe a positive effect of cellphone use in emigration rates. However, the magnitude of these effect is minimal, in which an increase in 100 cellphone subscription increases the number of migrants by 0,11% (per 100,000 individuals). Model 5 includes the logarithm of lagged GDP per capital (PPP-Adjusted) since it has been widely discussed in the literature. However, there is a strong positive relationship between telecommunication penetration and GDP growth (Kathuria, Mahesh, and Manta (2009); Roller and Waverman (2001); Roller and Waverman (1996); Hardy (1980)) since it not only increments information flows, but also reduces transaction costs. In this sense, In order to the identify whether GDP per capita is confounds the relationship between the use of telecommunication on emigration rates, Model 5 display the results when GDP is accounted for. The results show that the share of Cellphone user are still positively related to Emigration but the effect is slightly significant (10% significance level), while GDP is not statistically significant. Model 6 presents the interaction term between these two variables. When GDP is interacted with cellphone users, the effect of cellphone user remain to be positive and significant, while the effect of GDP is non-significant. The interaction negative and barely significant, meaning that countries with higher and high mobile penetration has less emigration rates compared to countries with low GDP and low mobile penetration.

Moreover, fertility rates does not explain international emigration flows, while political stability has a negative relationship with emigration rates. This means unstable political environments is a push determinant of emigration rates. On the other hand, employment probabilities in the country of origin provides incentives for individuals to stay in their home country.

Similar results are found when the number of Internet Users per 100 inhabitants, are used as a proxy of communication technology. Model 1 in Table 2 presents the results using only Internet users as independent variables. Similarly as in table 1, further control variables are added in models (2), (3), (4), (5). When GDP per capita is added, internet user is not significant, however, when the interaction between these variables is included, the number of Internet user has a positive relationship with emigration rates. The interaction, though, has a negative coefficient, meaning that countries with higher and high Internet penetration has less emigration rates compared to countries with low GDP and low Internet penetration

In Table 3, cross sectional regressions are performed by estimating a OLS model for 2000, 20190, 2013 (similarly as the Between model in appendix 1). Models (1), (2) and (3) show that Cellphone penetration explain within country variation in emigration inside and not between country. Contrary, The number of internet Users also explain the differences in emigration between countries for the latest years 2010 and 2013 (See columns (6), (7), (8)). The effect of Internet on emigration is not significant in the 2000's.

Table 3: Panel Regression of emigration rate using Cellphone Users

	Emigration rate per cap (log)					
	logemigrationpercap					
	(1)	(2)	(3)	(4)	(5)	(6)
CellphoneUsers	0.0012***	0.0011***	0.0011***	0.0012***	0.0008*	0.0059***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0004)	(0.0019)
logGDPpp-1					0.0781	0.0576
					(0.0572)	(0.0571)
Fertility Rate				0.0395	0.0451	0.0826**
				(0.0325)	(0.0327)	(0.0352)
Political Stability			−0.0615**	−0.0591**	−0.0698**	−0.0717**
			(0.0288)	(0.0288)	(0.0298)	(0.0296)
Employment prob		1.3560***	1.5410***	1.4784***	1.4353***	1.3306***
		(0.4640)	(0.4696)	(0.4721)	(0.4725)	(0.4695)
CellphoneUsersXlogGDPpp-1						−0.0005***
						(0.0002)
Observations	498	498	498	498	498	498
R^2	0.0989	0.1219	0.1339	0.1379	0.1428	0.1620
Adjusted R^2	0.0652	0.0800	0.0877	0.0900	0.0929	0.1051

Note: *p<0.1; **p<0.05; ***p<0.01

Table 4: Panel Regression of emigration rate using Internet Users

	Emigration rate per cap (log)					
	logemigrationpercap					
	(1)	(2)	(3)	(4)	(5)	(6)
InternetUsers	0.0022***	0.0022***	0.0021***	0.0020***	0.0003	0.0246***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0008)	(0.0065)
logGDPpp-1					0.1555***	0.0941*
					(0.0510)	(0.0525)
Fertility Rate				−0.0102	0.0315	0.0519
				(0.0300)	(0.0326)	(0.0324)
Political Stability			−0.0610**	−0.0615**	−0.0826***	−0.0851***
			(0.0293)	(0.0294)	(0.0298)	(0.0292)
Employment prob		1.8370***	2.0092***	2.0091***	1.5465***	1.5449***
		(0.4620)	(0.4670)	(0.4676)	(0.4860)	(0.4762)
InternetUsersXlogGDPpp-1						−0.0023***
						(0.0006)
Observations	498	498	498	498	498	498
R^2	0.0521	0.0959	0.1077	0.1081	0.1330	0.1701
Adjusted R^2	0.0343	0.0629	0.0705	0.0705	0.0865	0.1103

Note: *p<0.1; **p<0.05; ***p<0.01

Table 5: Yearly OLS Regression of emigration

	Emigration rate per cap (log)					
	logemigrationpercap					
	2000	2010	2013	2000	2010	2013
	(1)	(2)	(3)	(4)	(5)	(6)
CellphoneUsers	0.0108	0.0263	0.0111			
	(0.0857)	(0.0166)	(0.0138)			
InternetUsers				0.1528	0.1069**	0.0758**
				(0.1750)	(0.0424)	(0.0331)
logGDPpp-1	-0.1305	-0.0817	-0.1820	-0.0572	-0.0917	-0.1253
	(0.1415)	(0.1838)	(0.1815)	(0.1320)	(0.1465)	(0.1626)
Fertility Rate	-0.2215***	-0.2732***	-0.3447***	-0.2016***	-0.2029**	-0.2489**
	(0.0783)	(0.0875)	(0.0910)	(0.0771)	(0.0944)	(0.1000)
Political Stability	0.0569	0.1687	0.1619	0.0936	0.2044*	0.2035*
	(0.1272)	(0.1047)	(0.1057)	(0.1286)	(0.1085)	(0.1098)
Employment prob	-1.3258	-3.3622**	-3.8563***	-0.7432	-2.6571*	-3.0844**
	(1.4697)	(1.3842)	(1.3247)	(1.4475)	(1.4255)	(1.3515)
CellphoneUsersXlogGDPpp-1	-0.0012	-0.0026	-0.0010			
	(0.0084)	(0.0017)	(0.0014)			
InternetUsersXlogGDPpp-1				-0.0163	-0.0102**	-0.0071**
				(0.0172)	(0.0041)	(0.0032)
Constant	11.6176***	13.1017***	14.7094***	10.4509***	12.3324***	13.1255***
	(2.0009)	(2.3398)	(2.3239)	(1.9072)	(2.1692)	(2.1946)
Observations	159	169	169	159	169	169
R^2	0.0886	0.1905	0.2020	0.1033	0.2082	0.2239
Adjusted R^2	0.0526	0.1605	0.1725	0.0679	0.1789	0.1952

Note: *p<0.1; **p<0.05; ***p<0.01

7. Conclusions

The increase in the use of technology has had important effect on how people communicate now a days. AS Castles (2009) points out social transformations are tighly related with ICT development. This paper intents to explore the relationship between migration flows and ICT's using the number of cellphone subscription and Internet users as proxies for Information and Communication Technology. We take advantage of both the itme series and cross-country variation in our data set. Our results show that countries with higer Internet Users has on overage higher emigration rates and that this relationship is stronger as Internet use deepens in the latest decade when compared to the 2000's. Moreover, as the use of Cellphone penetrates in the country's inside markets, emigration rates tends to be higher. The diferences in emigration rates between countries, however, are not explained by the number of Cellophone users.

This research had of course many caveats. One of the major limitations on migration studies is the difficulty of accessing good and reliable datasets. The United Nations (UN) have complied a large amount of statistical evidence on the topic of migration, however, the database does not have a large number of year observations. Moreover, this analysis must be interpretated with percussion since it can not identidy how how ICTs had influence people's opinion and experience of migration at the individual level since we use country agregates. For this purpose survey data must be deleveoped.

Nevertheless, as there are many reasons why individuals choose to migration, and communication technologies could make this process much more easy and attractive. It is benificial for countries or governments to undestand the causes and the drivers for migration so that they can futher learn and develop strategies to either retain or atract population in their borders, depending on trends currently happening around the globe. Mobile and internet technology are also resources that governments can exploitto communicate policies and information for people interesting in migrating, making integration process more easy for them.

Appendix

1. Data Collection and analysis process

International Migration Stock, Total

The original data was obtained through the United Nations Population Division, and downloaded through our repository as a Microsoft Excel file. The Excel datasheet had a matrix that described the population outflows and inflows for each country and for several time periods. This analysis focuses four time series; 1990. 2000, 2010 and 2013.

Gather the data using the `import` command from the package `rio` (Chan et al. 2015), afterwards we used a loop to import the file to R Studio. Since this analysis is only interested in emigration, we extracted the migration column from all origin countries in the data set, and created a vector. From each matrix, we selected the years of interest for this analysis. Afterwards we transposed the data to transform it into a more usable and readable format, and then we declared it as a data frame. Using the command `callnames`, we renamed each column appropriately. We ended the loop by assigned each year to a specific data frame. Using the command cbind we combined all the extracted data from above, thus creating combined year in a singular data frame. In order to reshape the new data frame, we used the function `gather` from the package `tidyr` (Wickham 2015). This takes multiple columns and collapses them into key value pairs, this created two new variables called emmigration and year. Finally, we included the corresponding year names to the specific year variables.

Moreover, we create a an unique identifier for each country using the `countrycode` function in the package `countrycode` (Arel-Bundock 2014).

World Bank Indicators

To import the indicators we used `WDI` (Arel-Bundock 2013) and `RJSONIO`packages (Temple Lang 2014). Then, we specified which indicators we wanted to include in our analysis by using the specific codes available on the metadata set of the World Bank. We then properly renamed the variables using the `plyr::rename` function. Once the data was loaded, we used Merged <- merge(emigrationtotal, WDI_indi, by = c('iso2c','year')) to combine the WDI indicators with the International Migration Stock.

The following packages were relevant for our analysis:`CiteR` (R Core Team 2015), `DtaCombine` (Gandrud 2015a), `Formula` (Zeileis and Croissant 2015), `ggplot2` (Wickham and Chang 2015@), `Hmisc` (Harrell 2015), `knitr` (Xie 2015), `maptools` (**???**), `plm` (Croissant and Millo 2013), `Hmisc` (Harrell 2015), `rwoldmap` (South 2013), `stargazer` (Hlavac 2015), `repmis` (Gandrud 2015b).

2. Model selection

To estimate equations (1) and (2) , several models were evaluated since the database has repeated observations for 3 periods of time: 2000, 2010, 2013. Table 6 shows the results of both pooled OLS, the Within and between estimaor and random effects models. Column 1 shows the results from the Pooled OLS regression.

In order to estimate the emigration rate, we must consider time invariant unobservable characteristics such as social cohesion, trust, attidutes toward foreigners and so on. Hence a fixed effect panel model is estimated as shown in Table 6. To test for the existence of this fixed country effects, a join F test is calculated (see Table 6.2 and Table 7.2). According to this test, we reject the null hypothesis that the country fixed effects are equal to zero. This means that Pooled OLS is inefficient and we should

continue with a fixed (or random) effect models. Nonetheless, the fixed effect model only accounts for time invariant effects and as we analyze 3 periods, it is plausible that this unobserved determinants could vary over time. Therefore, a Random Effect Model is also estimated (see Table 6.2 and Table 7.2). In summary,we use the within-estimator for the Fixed Effects Model to estimate equation (1) and (2). The results are presented in Table 6 and 7. And will be used as the baseline for the rest of the paper.

Table 6: 1.Panel Regressions fro cellphoneUsers using all models

	Emigration rate per cap (log)			
	logemigrationpercap			
	Pool OLS	Within	Between	Random
	(1)	(2)	(3)	(4)
CellphoneUsers	0.0078	0.0059***	0.0136	0.0038**
	(0.0069)	(0.0019)	(0.0218)	(0.0018)
logGDPpp-1	−0.2037**	0.0576	−0.1795	0.0908*
	(0.0831)	(0.0571)	(0.1850)	(0.0495)
Fertility Rate	−0.2796***	0.0826**	−0.2955***	0.0025
	(0.0464)	(0.0352)	(0.0862)	(0.0316)
Political Stability	0.1285**	−0.0717**	0.1488	−0.0519*
	(0.0626)	(0.0296)	(0.1158)	(0.0297)
Employment prob	−3.0873***	1.3306***	−3.5051**	0.7886*
	(0.7695)	(0.4695)	(1.4336)	(0.4604)
CellphoneUsersXlogGDPpp-1	−0.0006	−0.0005***	−0.0013	−0.0003*
	(0.0007)	(0.0002)	(0.0022)	(0.0002)
Constant	14.0010***		14.2756***	7.0251***
	(1.0867)		(2.3785)	(0.6063)
Observations	498	498	169	498
R^2	0.1506	0.1620	0.1664	0.1300
Adjusted R^2	0.1485	0.1051	0.1595	0.1282

Note: *p<0.1; **p<0.05; ***p<0.01

Table 6.2. Test results when Cellphone USers is used as a proxy of ICT

	Testing for Fixed Effects	Testing for Random Effects	Hausman Test
	F test	Chi-squared	Chi-squared
Test-Stadistic	87.962911	491.031971	95.9863436913173

Table 8: 1. Panel Regressions for InternetUSers using all models

	Emigration rate per cap (log)			
	logemigrationpercap			
	Pool OLS	Within	Between	Random
	(1)	(2)	(3)	(4)
InternetUsers	0.0722***	0.0246***	0.1073*	0.0236***
	(0.0209)	(0.0065)	(0.0557)	(0.0062)
logGDPpp-1	−0.1538**	0.0941*	−0.1310	0.0934*
	(0.0763)	(0.0525)	(0.1565)	(0.0480)
Fertility Rate	−0.2324***	0.0519	−0.2130**	−0.0067
	(0.0479)	(0.0324)	(0.0959)	(0.0305)
Political Stability	0.1480**	−0.0851***	0.1769	−0.0602**
	(0.0627)	(0.0292)	(0.1221)	(0.0291)
Employment prob	−2.6174***	1.5449***	−2.7278*	0.9200**
	(0.7769)	(0.4762)	(1.4850)	(0.4603)
CellphoneUsersXlogGDPpp-1	−0.0067***	−0.0023***	−0.0101*	−0.0022***
	(0.0020)	(0.0006)	(0.0053)	(0.0006)
Constant	12.9627***		12.7544***	6.9146***
	(1.0725)		(2.2911)	(0.5478)
Observations	498	498	169	498
R^2	0.1666	0.1701	0.1833	0.1444
Adjusted R^2	0.1643	0.1103	0.1757	0.1423

Note: *p<0.1; **p<0.05; ***p<0.01

Table 7.2. Test results when Cellphone USers is used as a proxy of ICT

| | Testing for Fixed Effects | Testing for Random Effects | Hausman Test |
	F test	Chi-squared	Chi-squared
Test-Stadistic	87.1322292	490.1850563	49.0072842722636

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