

Have ICT changed the game for mobility and migration?

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Contents

1. Introduction	2
3. Understanding Migration: A Theoretical Foundation	3
4. ICT as a Determinant	4
5 Method	4
5.1 Data Selection	4
5.2 Emperical Strategy	5
Emperical Results	5
Descriptive Statistics	5
Dependent Variables	5
Summary Statistics	7
Patterns of Emmigration	7
Independent Variables	9
Emperical Results	9
Limitations	14
Appendix	14
References	16

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) few countries today are. 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 or family members in their original locations. New innovation in digital technologies allows people to think 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. This empirical analysis seeks to observe 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.

3. 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. Humans are constantly moving throughout their lives, which could be seen on varying degrees. Whether it is a college student returning home every summer, or a family permanently moving to another country. 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 Unemployment Low wages High fertility rates Lack of basic health and education	Prospects of higher wages Potential for improved standard of living Personal or professional development
Political	Conflict, insecurity, violence Poor governance Corruption Human rights abuses	Safety and security Political freedom
Social and cultural	Discrimination based on ethnicity, gender, religion	Family reunification Ethnic (diaspora migration) homeland Freedom from discrimination

Source: The World Bank retrieved from Mansoon (2007)

4. 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.

5 Method

5.1 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 to a public mobile telephone service that provides access to public switched telephone network (PSTN) technology. 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.

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

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

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

Higher unemployment employment opportunities should motivate individuals to stay in their country of origin, this equation is controlling.

- **Gross Domestic Product Per Capita:** To avoid reverse causality that is likely to bias the estimates towards zero. 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 and expressed them in a *log*.
- **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.

Furthermore, we focus on the years 2000, 2010 and 2013. We committed the year 1990 as a whole since was a lack of information available in the control variables.

5.2 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 immigrants 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.

Model 1: Cellphone Users

$$I_{\frac{Migration_{it}}{Pop_{total}}} = \beta_i + \beta_1 Cell_{it} + \beta_2 FertRate_{it} + \beta_3 PoliStab_{it} + \beta_4 EmployProb_{it} + \epsilon_{it}$$

Model 2: Internet Users

$$I_{\frac{Migration_{it}}{Pop_{total}}} = \beta_i + \beta_1 Net_{it} + \beta_2 FertRate_{it} + \beta_3 PoliStab_{it} + \beta_4 EmployProb_{it} + \epsilon_{it}$$

Emperical Results

Descriptive Statistics

Dependent Variables

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. Histogram for Emigrants per capita

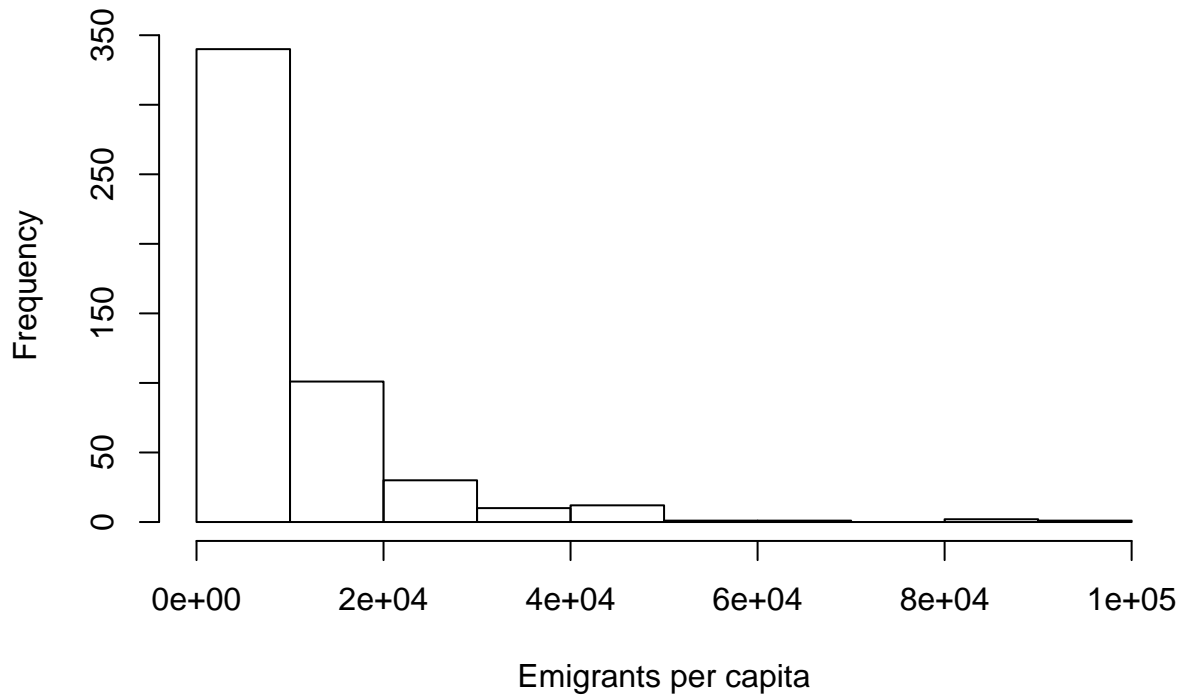
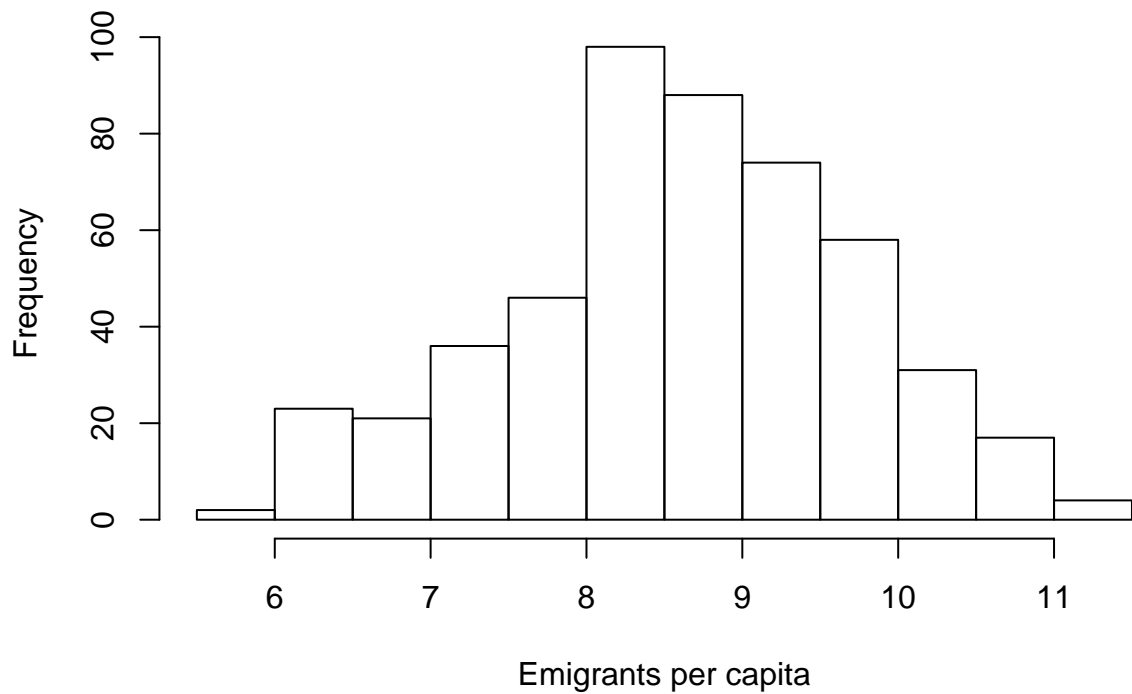


Figure 2. Histogram for Emigrants per capita



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.

Summary Statistics

Patterns of Emigration

Figure 4 Emigration per capita 2000

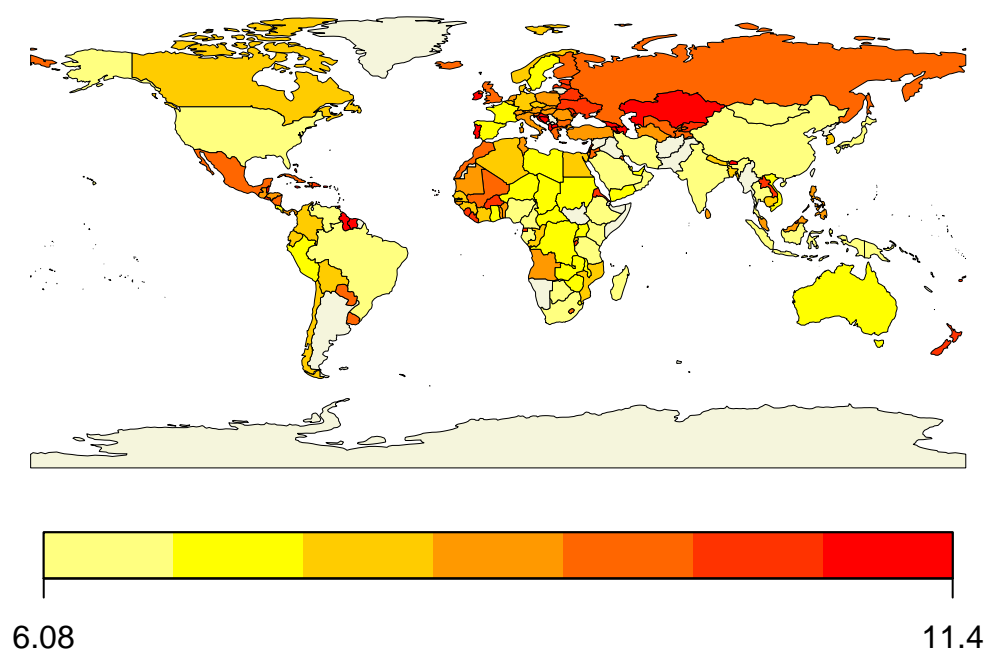


Figure 5. Emigration per capita 2010

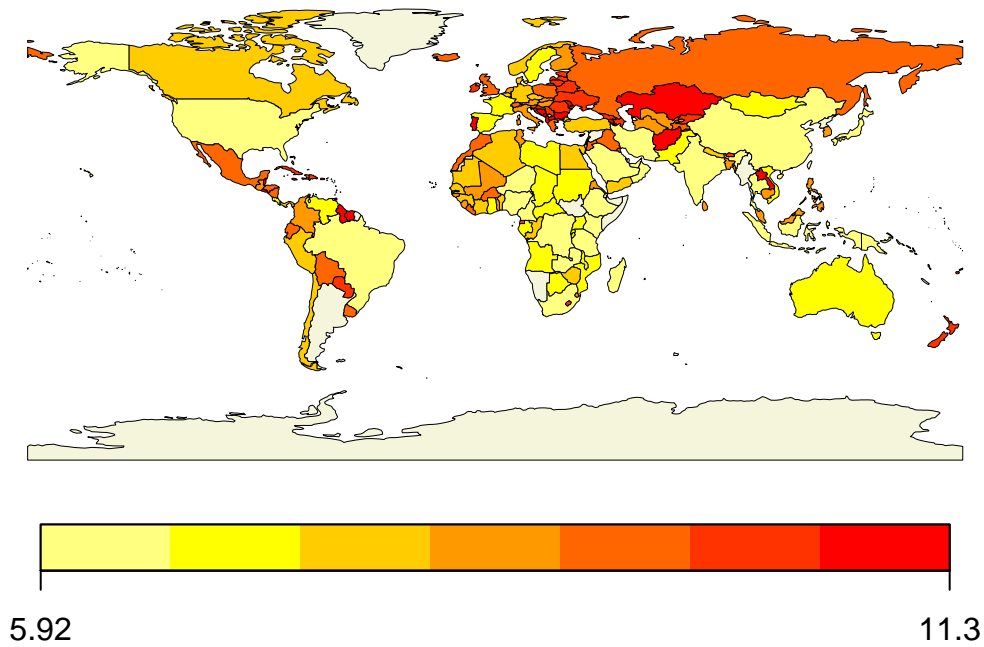


Figure 6. Emigration per capita 2013

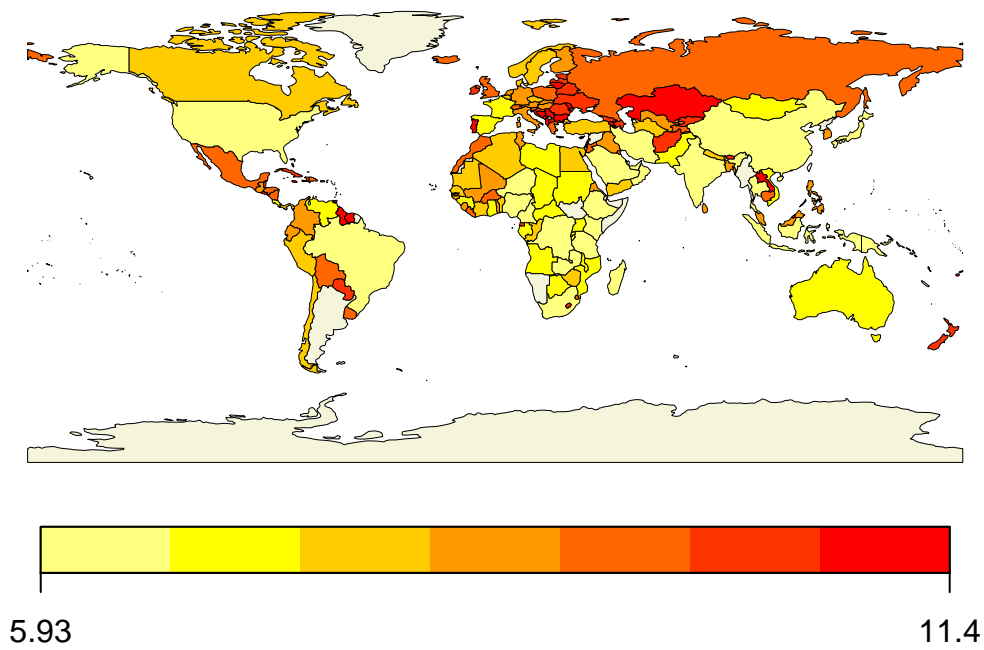


Table 2: Summary Statistics

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

Independent Variables

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 ((???);Roller01;@Roller96; @80) 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 incentivize individuals to stay in their home country.

Similar results are found when the number of Internet Users per 100 habitants, 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,

Table 3: Table 1 Panel Regression of emigration rate using Cellphone Users

	Emigration rate per cap (log)					
	logemigrationpercap					
	(1)	(2)	(3)	(4)	(5)	(6)
CellphoneUsers	0.0012*** (0.0002)	0.0011*** (0.0002)	0.0011*** (0.0002)	0.0012*** (0.0002)	0.0008* (0.0004)	0.0059*** (0.0019)
logGDPpp-1					0.0781 (0.0572)	0.0576 (0.0571)
Fertility Rate				0.0395 (0.0325)	0.0451 (0.0327)	0.0826** (0.0352)
Political Stability			-0.0615** (0.0288)	-0.0591** (0.0288)	-0.0698** (0.0298)	-0.0717** (0.0296)
Employment prob		1.3560*** (0.4640)	1.5410*** (0.4696)	1.4784*** (0.4721)	1.4353*** (0.4725)	1.3306*** (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: Table 2 Panel Regression of emigration rate using Internet Users

	Emigration rate per cap (log)					
	logemigrationpercap					
	(1)	(2)	(3)	(4)	(5)	(6)
InternetUsers	0.0022*** (0.0005)	0.0022*** (0.0005)	0.0021*** (0.0005)	0.0020*** (0.0005)	0.0003 (0.0008)	0.0246*** (0.0065)
logGDPpp-1					0.1555*** (0.0510)	0.0941* (0.0525)
Fertility Rate				-0.0102 (0.0300)	0.0315 (0.0326)	0.0519 (0.0324)
Political Stability			-0.0610** (0.0293)	-0.0615** (0.0294)	-0.0826*** (0.0298)	-0.0851*** (0.0292)
Employment prob		1.8370*** (0.4620)	2.0092*** (0.4670)	2.0091*** (0.4676)	1.5465*** (0.4860)	1.5449*** (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

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.

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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 (0.0857)	0.0263 (0.0166)	0.0111 (0.0138)			
InternetUsers				0.1528 (0.1750)	0.1069** (0.0424)	0.0758** (0.0331)
logGDPpp-1	-0.1305 (0.1415)	-0.0817 (0.1838)	-0.1820 (0.1815)	-0.0572 (0.1320)	-0.0917 (0.1465)	-0.1253 (0.1626)
Fertility Rate	-0.2215*** (0.0783)	-0.2732*** (0.0875)	-0.3447*** (0.0910)	-0.2016*** (0.0771)	-0.2029** (0.0944)	-0.2489** (0.1000)
Political Stability	0.0569 (0.1272)	0.1687 (0.1047)	0.1619 (0.1057)	0.0936 (0.1286)	0.2044* (0.1085)	0.2035* (0.1098)
Employment prob	-1.3258 (1.4697)	-3.3622** (1.3842)	-3.8563*** (1.3247)	-0.7432 (1.4475)	-2.6571* (1.4255)	-3.0844** (1.3515)
CellphoneUsersXlogGDPpp-1	-0.0012 (0.0084)	-0.0026 (0.0017)	-0.0010 (0.0014)			
InternetUsersXlogGDPpp-1				-0.0163 (0.0172)	-0.0102** (0.0041)	-0.0071** (0.0032)
Constant	11.6176*** (2.0009)	13.1017*** (2.3398)	14.7094*** (2.3239)	10.4509*** (1.9072)	12.3324*** (2.1692)	13.1255*** (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

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Limitations

One of the major limitations on migration studies is the difficulty of accessing good and reliable datasets. The United Nations (UN) have compiled a large amount of statistical evidence on the topic of migration, however, the database does not have a large number of year observations. This will limit the research because the results will not yield year to year analysis, which of course will rely mostly on between country effects.

Appendix

Table 6: Panel Regressions fro cellphoneUsers using all models

	Emigration rate per cap (log)			
	Pool OLS	logemigrationpercap		Random
		Within	Between	
	(1)	(2)	(3)	(4)
CellphoneUsers	0.0078 (0.0069)	0.0059*** (0.0019)	0.0136 (0.0218)	0.0038** (0.0018)
logGDPpp-1	-0.2037** (0.0831)	0.0576 (0.0571)	-0.1795 (0.1850)	0.0908* (0.0495)
Fertility Rate	-0.2796*** (0.0464)	0.0826** (0.0352)	-0.2955*** (0.0862)	0.0025 (0.0316)
Political Stability	0.1285** (0.0626)	-0.0717** (0.0296)	0.1488 (0.1158)	-0.0519* (0.0297)
Employment prob	-3.0873*** (0.7695)	1.3306*** (0.4695)	-3.5051** (1.4336)	0.7886* (0.4604)
CellphoneUsersXlogGDPpp-1	-0.0006 (0.0007)	-0.0005*** (0.0002)	-0.0013 (0.0022)	-0.0003* (0.0002)
Constant	14.0010*** (1.0867)		14.2756*** (2.3785)	7.0251*** (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 7: Panel Regressions for InternetUsers using all models

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

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