Determinants of Fixed broadband diffusion: An International Study

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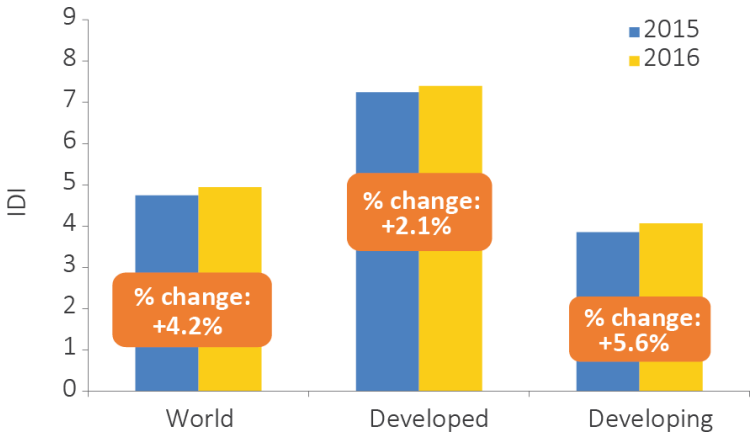
1.1 Introduction

The virtues of broadband for economic and societal development are well documented. It is no surprise then, due to the critical importance of broadband networks, that many countries have designed efforts in order to facilitate the adoption of broadband. For example, the European Commission, published in 2010 the Digital Agenda for Europe[1] that sets a seven-pillar strategy and a set of objectives to be achieved till 2020 by EU countries. It has been long recognized, the importance for policymakers, as well as private organizations to be aware of the factors that influence broadband uptake, so to design appropriate policies that would facilitate its' diffusion.

However, the experiences that each country has concerning the proliferation of broadband, differs substantially. For instance, broadband adoption differs considerably between developed, developing and least developed countries. The ICT Development Index (IDI) published by the International Telecommunications Union (ITU), which is a measure of the development of Information Communications Technologies (ICT) (IDI uses for its' construction a variety of infrastructure, access and skills measures that impact the proliferation of ICT), is considerably lower for least developed and developing countries (ITU 2016). For instance, for the year 2016 the IDI index takes a value of 7.25, 3.85

Figure 1- IDI index for Developed and Developing countries for years 2015,2016.



Source: International Telecommunications Society (2016)

and 1.91 for developed, developing and least developed countries respectively (ITU, 2016). Thus, a digital divide exists between advanced and less developed economies which reinforces the developmental gap between them. Therefore, in order for this digital divide to narrow, it is important

[1] See European Commission, (2010).

that policies should be constructed by taking into account differences in the broader socioeconomical environment between these countries.
This study hopes to contribute to this discussion, by not only attempting to discern factors that influence broadband worldwide, but also, by investigating any differences in their impact in countries with significant developmental variation.

The remaining portion of this chapter is organized as follows. Section 1.2 discusses the relevant literature for the determinants of broadband[2] adoption. Section 1.3 discusses the dataset and relevant variables, section 1.4 presents the results from regression analysis and finally section 2.5 provides a discussion and conclusions derived, based on the main findings.

1.2 Related Literature.

There is considerable empirical literature investigating the determinants of broadband adoption. These empirical studies have focused on either cross country or within a country dataset. Due to the scope of this study we will focus on cross country studies that examine a wider range of factors, comparing to studies that concentrate on the effect of a particular variable (such as regulatory policy).

One of the first studies to explore broadband deployment in a cross-country setting, considering a variety of socioeconomic and industry related variables, is that of Murrillo-Garcia (2005). The author concludes that income per capita and population size increases the probability of subscribers in a country having access to broadband services. Furthermore, among industry factors, the author shows that market competition and internet content positively affect the percentage of internet users to subscribe to a broadband service. Concerning regulatory policy, such as Local Loop Unbundling (LLU) she finds inconclusive results, where broadband penetration is positively affected in one specification (using a logit model) while it does not have a significant effect on another (using OLS).
Cava-Ferreruela et al. (2006), together with regulatory policies, examined a variety of socioeconomic factors that potentially affect cable modem and DSL coverage for 30 OECD countries during a sample time period from 2000 to 2002. Their main conclusion is that broadband infrastructure development in a country is primarily explained by its economic level. Also, competition between different access platforms drive broadband deployment. They did not find evidence that market competition, internet content or local loop unbundling significantly affects broadband infrastructure. Regarding demographic variables, they argue that the percentage of urban population and household density have a positive

[2] For the remaining of this paper, when we refer to broadband, we mean fixed broadband.

relationship to Cable and DSL coverage, while education was not found to be significant.

One of the studies that employs a large sample of international countries is that of Lee (2008). The author employed a sample of 107 countries for a period from 2002 to 2005 and examined an extensive set of various socioeconomic and industry factors. He concludes that the unbundling of the local loop, platform competition, lower cost of fixed broadband, higher mobile price, political freedom, bandwidth, and the percentage of internet users, positively contribute to broadband diffusion.

Lee et al. (2011), in a following study, focused on the determinants of broadband diffusion for 30 OECD countries for a period between 2001 to 2008. They concluded that income, inter-platform competition, education and a lower cost of broadband are important drivers of broadband diffusion.

Another study that employs a large set of countries in the sample is that of Andres et al (2010). Using data from 214 countries for a period between 1990 and 2004, concluded that GDP per capita, computers per capita and previous internet users contribute to internet users' uptake.

A more recent study is that of Lin and Wu (2013), which focuses on the impact of factors on broadband penetration in each stage of the diffusion process. They used data from 1997 to 2009 from 34 OECD countries. They found that income, lower price, inter-platform competition, internet content and previous broadband penetration are key drivers for broadband deployment and that education facilitates diffusion on its' initial stages.

Finally, Ovington et al (2017) using a dataset for 27 European countries for a period of 2004 to 2011 they conclude that unbundling, income, inter-platform competition, education, previous broadband penetration and population density have a significant effect on broadband adoption.

From the above presentation of studies occurs that earlier studies included a relatively small number of countries focusing on either OECD countries or a subset of European countries. This is probably due to data limitations. First because broadband diffusion in many studies mostly was at its' earlier stages and secondly data were more likely to be available from major organizations such as the OECD or the European Commission. In summary, among the factors that were identified by the relevant literature that influences broadband diffusion include market competition, competition between access technologies, local loop unbundling, income, internet content, cost, population density, population size, political freedom, education, bandwidth and mobile price.

This study uses a similar approach but attempts to complement the relative literature by including a large set of countries in the analysis than most studies that examine the determinants of broadband diffusion (the exceptions being Lee, 2008 and possibly Andres et al 2010 as their scope of analysis was in

internet diffusion rather than broadband). This provides the advantage of being able to conduct an analysis for countries at different levels of development.

1.3 Empirical Model and Data.

1.3.1 Empirical Model.

Equation (1) describes the linear relationship between the independent and dependent variables of the model examined in this study. It includes both demand side and supply side variables. In order to prevent problems of positive skewness that may affect the analysis, some variables[3] were transformed to their natural logarithms.

$$\begin{aligned} &ln\,(Broadband\ penetration)_{it} = b_0 + b_1(ln\ Fixed\ Broadband\ price)_{it} + b_2(Liberalization\ Part\ Comp)_{it} \\ &+ b_3(Liberalization\ Full\ Comp.)_{it} + b_4(Education)_{it} + b_5(Economic\ Freedom)_{it} + b_6(ln\ Income)_{it} \\ &+ b_7(ln\ Content)_{it} + b_8(ln\ Bandwidth)_{it} + b_9(ln\ E\text{-}Services)_{it} + b_{10}(Urban\ Population)_{it} + b_{11}(Privatization)_{it} \\ &+ b_{12}(LLU)_{it} + b_{13}(Age)_{it} + b_{14}(Trend)_t + \alpha_{it} + \varepsilon_{it} \end{aligned} \quad (1)$$

The terms α_{it} refers to the specific unobservable country effects that are not included as variables and ε_{it} is the standard error term. The covariates were primarily selected according to the findings of the relevant literature and data availability. The dependent variable is defined as *Broadband penetration* and its measurement is total fixed broadband subscriptions per 100 inhabitants. This includes subscriptions from several fixed broadband technologies such as DSL, Cable, Fibre to the Home/Building and others[4]. The independent variables include overall fourteen factors which are the following: i) *Fixed Broadband price*, ii) *Liberalization Part Comp*., iii) *Liberalization Full Comp.,* iv) *Education*, v) *Economic Freedom*, vi) *Income*, vii) *Content*, viii) *Bandwidth*, ix) *E-services*, x) *Urban Population*, xi) *Privatization,* xii) *Local Loop Unbundling* (LLU), xiii) *Age* and xiv) a linear time *Trend*, which are further elaborated below.

1.3.2 The Data and Variables.

The dataset involves a panel data set of 140 international countries for a period, from 2008 to 2015[5]. The panel data set is unbalanced[6] and the time frame is yearly. The main portion of the data comes

[3] Except the *Liberalization*, Privatization and *LLU* variables which are binary, as well as the *Economic freedom* and *Education* variables which are indexes, and the urban population and age covariates which are percentages.
[4] Others, include Ethernet Lan, and broadband over powerline communications.
[5] See Table A.5 in Appendix A, for a list of countries included in this study.
[6]. For the dependent variable broadband penetration there are missing observations for Côte d'Ivoire for years 2010;2011, for Guatemala for 2011, for Honduras for 2008;2009 and for Philippines for 2010. For the variable fixed broadband price, for Bahamas for 2008, for Belarus for 2008, for Brunei Darussalam for 2008, for Burundi for 2008 to 2012, for Ecuador for 2008, for Gabon for 2008 to 2011, for Gambia for 2012, for Georgia for 2010, for Honduras

from the "ITU World Telecommunication/ICT Indicators (WTI)" database and the "The World Bank World Development Indicators (WDI)" database. Table 1 summarizes the type of variable, its' measurement and its' data source.

1.3.2.1 Fixed Broadband Price.

Fixed broadband price as demand theory predicts, is expected to have an inverse relationship with broadband diffusion. For instance, higher prices of broadband plans offered (ceteris paribus), are expected to hinder the adoption of broadband services and vice versa. Several studies have showed that lower cost of broadband services increases demand for them (Distaso et al., 2006; Lee S., 2008; Lee et al., 2011a; Lin et al., 2013, among others).

1.3.2.2 Liberalization Part Comp. and Liberalization Full Comp.

Liberalization is a category variable which refers to, if the regulator restricts licenses to one monopoly operator serving all subscribers in a country, or partial competition when licenses are restricted to few operators or full competition when the issuing of licenses is completely unrestricted. The covariate *Liberalization Part Comp*. takes the value of 1 when licenses are restricted to few operators, while the covariate *Liberalization Part Comp.* takes the value of 1 when there are no restrictions. Note, that in order to avoid the dummy variable trap we do not include in the model the reference case when licensees are restricted to a single operator. The liberalization variables can also be thought of as a proxy for the level of competition that exists in the market. If entry in the market is restricted, this is going to directly impact the number of firms that can offer broadband services. Thus, liberalization allows for the introduction of competition which increases allocative efficiency, leads to lower prices, and thus is

for 2008;2009, for Israel for 2008, for Kazakhstan for 2008; for Kyrgyzstan for 2008;2012, for Mongolia for 2008, for Suriname for 2008 and for Turkey for 2008. For the variables Liberalization Partial Comp. and Liberalization Full Comp, for Lesotho 2009;2015, and for Venezuela for 2012 to 2014. For the variable Education, for Bhutan for2008;2009, for St. Lucia for 2008, and for St. Vincent and the Grenadines for 2008.) For the variable economic freedom, for Bhutan for 2008, for Brunei Darussalam for 2008 to 2013, for Comoros for 2008, for Maldives for 2008, for Montenegro for 2008, for Serbia for 2008, for Seychelles for 2008, for St. Lucia 2008, for St. Vincent and the Grenadines for 2008, and for Vanuatu for 2008. For the variable income, for Venezuela for 2015. For the variable Content, for Montenegro for 2008, and for Serbia for 2008. For the variable Bandwidth, for Guatemala for 2011, for Seychelles 2009 and for Suriname for 2011. For the variable e-services, for Bhutan for 2008, for Comoros for 2014;2015, for Lesotho for 2011;2012, for Montenegro for 2008, for Oman for 2009, for Serbia for 2009, and for United Kingdom for 2009. For the variable Privatization for Armenia for 2013, for Belize for 2013, for Canada 2013, for Gambia for 2013, for Georgia for 2013, for Hong Kong, China for 2008 to 2013, for Iceland for 2013, for Iran for 2013, for Israel for 2013, for Italy for 2013, for Jamaica for 2013, for Jordan for 2013., for Malaysia for 2013, for Montenegro for 2013, for Netherlands for 2013, for Niger for 2013, for Poland for 2013, for Rwanda for 2013;2015, for Vanuatu for 2013 and for Zambia for 2013. For the variable local loop unbundling, for Fiji for 2008 to 2010, and for Kazakhstan for 2008;2009.

Table 1 Variables, Measurement and data sources.

Variable	Measurement	Source
Broadband penetration	Total Fixed broadband Internet subscriptions per 100 inhabitants.	ITU World Telecommunication/ICT Indicators (WTI) database.
Fixed Broadband price	Fixed broadband Internet monthly subscription charge (US$).	ITU World. Telecommunication/ICT Indicators (WTI) database.
Liberalization Partial Comp.	A binary variable, whereas takes the value of 1 if the market of fixed line telephony is restricted to a few licenses (partial competition) or 0, if the market is restricted to one license (monopoly) or there are no restrictions (full competition).	ITU ICT/Eye Regulatory database and The Little Data Book on Information and Communication Technology Reports (2010-2017).
Liberalization Full Comp.	A binary variable, whereas takes the value of 1 if the market of fixed line telephony is not restricted (Full competition) or 0 otherwise.	ITU ICT/Eye Regulatory database and The Little Data Book on Information and Communication Technology Reports (2012-2017).
Education	UNDP Education Index. It takes theoretically values from 0 to 100, with higher values signifying a higher level of education.	UNDP Human Development Reports (2010-2016).
Income	GDP per capita (constant 2011) (US PPP $).	The World Bank World Development Indicators database.
Economic Freedom	Index of economic freedom. It takes theoretically, values from 0 to 100, with higher values signifying higher economic freedom.	Heritage Foundation.
Content	Number of Internet hosts per 100 people.	Internet System Consortium, Internet Domain Survey.
Bandwidth	International Internet Bandwidth per internet user; in bit/s.	ITU World Telecommunication/ICT Indicators (WTI) database. Internet Systems Consortium (2017).
E-Services	Number of secure online servers per 100 people.	The World Bank World Development Indicators database.
Urban Population	Percentage of Urban population to total population.	The World Bank World Development Indicators database.
Privatization	A binary variable, it takes the value 1 if the main fixed telecommunications operator is fully privatized or 0 otherwise.	The Little Data Book on Information and Communication Technology Reports (2010-2017).
LLU	A binary variable, it takes the value 1 if the local loop unbundling is obligatory in a country at a particular year or 0 otherwise.	ITU ICT/Eye Regulatory database.
Age	Percentage of population between 15-64 years old.	The World Bank World Development Indicators database.

expected to facilitate broadband diffusion. However, it is noteworthy to mention that although when licenses are restricted to a dominant monopoly, then the *Market liberalization* variable is a perfect proxy for the competitive forces (or lack of) that exist in the market, in contrast it is an imperfect proxy in the case of partial or full competition. In other words, the allowance of additional entry in the mobile market with no restrictions in granting of additional licenses, does not necessarily mean that entry will occur, or fully captures the market structure of at a particular country.

1.3.2.3 Education.

The *Education* variable is measured by the education index published each year by the United Nations Development Program. It is a proxy for the level of development of human capital that exists in a country. The education index is calculated by combining two indices (UNDP, 2016). One from expected years of schooling (that is number of years a child of school entrance age can expect to spend in a given level of education), and the other from mean years of schooling (that is average number of completed years of education of the population above 25 years of age). The inclusion of education in the model as a possible determinant may be relevant, because people with higher education are more likely to have the skills required for using information technologies (Murrillo-Garcia M., 2005). Moreover, people who are more educated are likely to demand a higher amount of services to be made available through the internet (van Dijk, J., 2005).

1.3.2.4 Income.

As the level of income constraints consumption of products and services of potential subscribers, it is expected that higher income shifts upwards the demand curve for broadband services and thus facilitates broadband diffusion. Several studies have showed that the level of income has a significant positive effect on broadband adoption (for example, Murrillo-Garcia M., 2005; Cava-Ferreruela et al., 2006; Bouckaert, et al., 2010; Lee et al., 2011a; Lin and Wu, 2013; Ovington et al., 2017).

1.3.2.5 Economic Freedom.

The variable *Economic Freedom* is measured by the economic freedom index published yearly by the Heritage Foundation (The Heritage Foundation, 2018). The index is consisted of four sub-indexes which are respectively i) rule of law, ii) government size, iii) regulation efficiency and iv) market openness. It is a measure of several distinct freedoms such as namely, property rights, judicial effectiveness, government integrity, tax burden, government spending, fiscal health, business freedom, labor freedom, monetary freedom, trade freedom, investment freedom and financial freedom. Lee, (2008) explored the relationship between broadband penetration and economic freedom but did not find evidence of correlation.

1.3.2.6 Content.

Content relates to internet content, and is measured by the number of internet hosts per 100 people. Internet hosts are used as a proxy for internet content. An Internet host can be a machine or an application connected to the Internet that has an Internet Protocol address (IP address) and can provide several services such as email, web server, websites etc. The main motivation for adopting broadband

services is access to internet content. In the early days of broadband emergence, the Director of the Cable and satellite Broadcasting Association of Asia (CASBAA) stated that users' willingness to pay for high speed networks is dependent on their ability to access specialized applications and entertaining content (Wilhelm and Bickers, 2000). Although each internet user can access the internet globally, internet hosts located in a specific country is a proxy measure for the internet content relevant to this country internet users. This is because of language, relevant websites content etc. Therefore, internet content may be related to the diffusion of broadband. *Content* is expected to have a positive relationship to broadband adoption as it increases the value of the service for broadband subscribers. Murrillo-Garcia M. (2005) and Lin and Wu (2013) found that internet content is a significant driver of broadband adoption, while Cava-Ferreruela et al. (2006) did not find an association.

1.3.2.7 Bandwidth.

Bandwidth is measured by international Internet bandwidth per internet user in Kbit/s. It refers to as the maximum quantity of data transmission from a country to the rest of the world per internet user. *Bandwidth* may be a relative factor for the diffusion of broadband, because bottlenecks may exist for internet traffic, between a specific country and the rest of the world. Moreover, bandwidth capacity is an indicator of the overall performance of the telecommunications sector in each country (Fransman, 2006).

1.3.2.8 E-Services.

The *E-services* variable is measured as the number of secure on-line servers in each country. Secure online servers are used in order to implement secure transactions between parties. It is thus a proxy, on the supply side, of the development of e-services such as e-commerce, e-government, e-health services or e- banking in a country. Better development of e-services enhances the utility of potential and existing subscribers for broadband services and thus are expected to incite broadband adoption.

1.3.2.9 Urban Population.

Urban population is a proxy of the cost of deployment of networks infrastructure in order to service a fixed amount of the population. Cava-Ferreruela and Alabau-Munoz (2006) argue, "that in urban areas where house household and population density is high, operators can take the maximum benefit for the infrastructure deployment cost as the number of possible customers is also high". Therefore, operators can supply more potential subscribers with same level of investment. In contrast, in areas of low urbanization and population density, the investment required to service the same number of subscribers is higher.

1.3.2.10 Privatization.

Private firms are for-profit organizations and therefore have a greater incentive to be more efficient in their allocation of resources in order to increase productivity and increase profits. Moreover, are less vulnerable comparing to public firms, to political interference, that can have a negative impact on the performance of the firm.

1.3.2.11 LLU.

LLU (Local loop Unbundling) refers to the regulatory policy of permitting competitive telecommunications operators' access to the local loop of the incumbent operator in order to provide services to customers. This policy was implemented by regulators in many countries in order to facilitate entry of competitive operators in the telecoms market. In this study, the *LLU* covariate is a dummy variable which takes the value of 1 if local loop unbundling is mandatory for a country in each time period and zero otherwise.

1.3.2.12 Age and Trend.

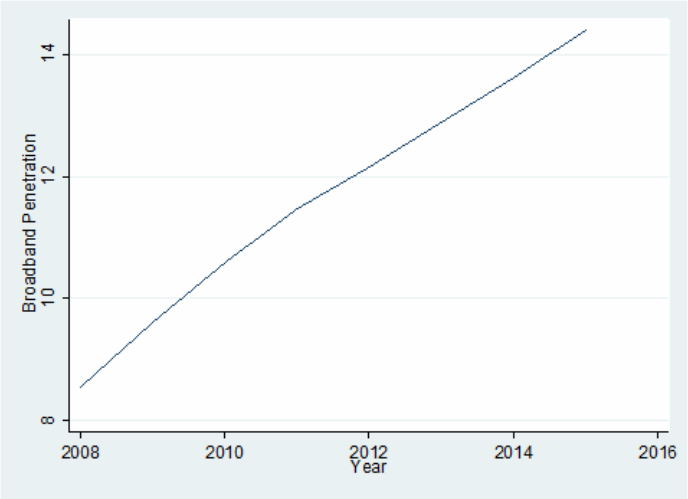
The *Age* variable corresponds to the percentage of the population that are between 15-64 years old. It measures the percentage of the population in a country that are more likely to seek internet content and to have the necessary e-skills. Moreover, as this age range approximates the working population age in many countries which uses internet services for job-related purposes. Thus, it is expected that this percentage of the population is more willing to pay for the consumption of broadband services. The *Trend* variable is a linear time trend. It is added to the model as to capture the rapid technological innovation that the telecom industry exhibits. Constant technological innovation reduces costs of deployment and improves the quality of broadband services.

1.4 Results and Analysis.

Table 2 presents the descriptive statistics of the untransformed variables. From Graph 1 we can observe that broadband penetration exhibits an upward trend typical of a technological diffusion process before it reaches its' mature stages. The estimators utilized in order to infer the model, are fixed effects (FE), fixed effects with instrumental variables and the two-stage least squares estimator (FEIV-2SLS) and fixed effects with instrumental variables and the two-stage general method of moments estimator (FEIV-GMM2s). The FEIV-GMM2s estimator is considered a general case of the FEIV-2SLS estimator and in the presence of heteroscedasticity, when the model is over-identified and the and the number of observations is large, as in this study, GMM is more efficient than the 2SLS estimator (Baum, 2014, Dkhil, 2014).

Following, Section 1.4.1 tests for cross sectional dependence. Section 1.4.2 discusses the test for unit roots, section 1.4.3 tests for multi-collinearity and finally section 1.4.4 presents the results.

Graph 1- Broadband Penetration for all countries



Source: ITU World Telecommunication/ICT Indicators (WTI) database. Calculated.

Table 2 Descriptive statistics of the untransformed variables.

Variables	Observations	Mean	Standard dev.	Min	Max
Broadband Penetration	1114	11.66492	11.92927	0.0017924	45.10761
Fixed Broadband Price	1096	35.16401	50.50739	0.9234297	635.0171
Liberalization Partial Comp.	1115	0.1363229	0.3432851	0	1
Liberalization Full Comp	1115	0.6538117	0.4759676	0	1
Education	1116	66.06576	16.2581	16.53911	93.9
Income	1119	19799.56	19638.18	748.4153	129349.9
Economic Freedom	1105	62.82054	9.350938	34.3	90.1
Content	1118	12.78174	22.99816	0.0001343	175.205
Bandwidth	1117	91211.19	451189.6	82.24581	7186378
E-services	1111	0.0289166	0.0563639	3.61e-06	0.3406738
Urban Population	1120	59.98663	22.38125	8.445	100
Privatization	1094	0.2239488	0.4170788	0	1
LLU	1115	0.5596413	0.4966529	0	1
Age	1120	64.81578	6.573721	47.24444	85.8724

1.4.1 Cross Sectional Dependence.

One of the problems of having panel data in contrast to the case of pure time series is the probability that the variables or the random disturbances are correlated across the panels (Halkos and Polemis, 2017). Early literature on unit root tests assumed that no cross-sectional dependence was present, whereas when it exists, the power and size of the tests can be distorted (Halkos and Polemis, 2017). In order to test for the presence of cross-sectional dependence we apply the test proposed by Pesaran

(2004) and Pesaran (2015). Results are presented in Table 3. The test strongly rejects the null hypothesis of cross-sectional independence or weak cross-sectional dependence (P-values close to zero) for all variables, except the dummy variables *Liberalization Partial Comp., Liberalization Full Comp.* and *LLU.*

Table 3 Cross sectional Dependence Test.

Variables	CD Test	P-Value	Correlation	Absolute (correlation)
Broadband Penetration	232.852***	0.000	0.84	0.87
Fixed Broadband Price	55.421***	0.000	0.20	0.50
Liberalization Partial Comp.	0.329	0.742	0.00	0.01
Liberalization Full Comp	0.971	0.332	0.00	0.02
Education	181.406***	0.000	0.65	0.74
Income	106.935***	0.000	0.38	0.67
Economic Freedom	3.969***	0.000	0.01	0.48
Content	149.349***	0.000	0.54	0.68
Bandwidth	198.791***	0.000	0.71	0.77
E-services	205.803***	0.000	0.74	0.80
Urban Population	142.766***	0.000	0.51	0.92
Privatization	3.083***	0.002	0.002	0.02
LLU	0.863	0.388	0.00	0.01
Age	20.32***	0.000	0.01	0.02

Under the null hypothesis of cross sectional independence / weak cross sectional dependence, the CD-statistic is distributed as a standard normal ~ N(0,1). ***, significant at 1%.

Table 4 Unit Root test of Maddala and Wu.

Variables	Statistics			
	P	Z	L*	Pm
Broadband Penetration	2216.7031*** (0.0000)	-22.7204*** (0.0000)	-46.3869*** (0.0000)	81.8406*** (0.0000)
Fixed Broadband Price	817.7828*** (0.0000)	-8.2581*** (0.0000)	-13.2015*** (0.0000)	22.7255*** (0.0000)
Education	520.0684*** (0.0000)	-5.6498*** (0.0000)	-7.3250*** (0.0000)	10.1447*** (0.0000)
Income	778.1664*** (0.0000)	-2.6123** (0.0045)	-22.1819*** (0.0000)	45.1006*** (0.0000)
Economic Freedom	634.6024*** (0.0000)	-4.9087*** (0.0000)	-7.7540*** (0.0000)	15.1233*** (0.0000)
Content	951.7567*** (0.0000)	-10.3143*** (0.0000)	-16.4539*** (0.0000)	28.3869*** (0.0000)
Bandwidth	1262.9875*** (0.0000)	-9.5955*** (0.0000)	-21.1865*** (0.0000)	41.5388*** (0.0000)
E-services	506.2362*** (0.0000)	0.0723 (0.5288)	-2.1250 ** (0.0170)	9.5602*** (0.0000)
Urban Population	4201.4988*** (0.0000)	-49.3586*** (0.0000)	-109.7658*** (0.0000)	165.7136*** (0.0000)
Age	667.7375*** (0.0000)	5.9918 (1.0000)	1.1652 (0.8778)	16.3849*** (0.0000)

The null hypothesis assumes that the variable contains a unit root. The Phillips-Perron test is used which is robust in the presence of unspecified homoscedasticity and autocorrelation. The number of lags has been set to two and panels of variables that have cross-section dependence have been demeaned. The statistics are the following: P is the inverse chi-squared statistic, Z is the inverse normal statistic an L* denotes the inverse logit statistic, while Pm stands for the modified inversed chi-squared statistic. P-values in parenthesis. *** denotes significant at a 1% level.

1.4.2 Unit Roots.

If potential non-stationarity of the variables is not accounted for in the analysis, the results can be severely biased. The presence of a unit root in the dependent and independent variables in the model can result in the problem of spurious regression, where statistically significant relationships are inferred when actually do not exist (due to, for example, a third unaccounted factor that influences the variables). If it is unaccounted for it can result to very misleading findings. In order to test if the variables in our model are stationary, we perform a Fisher test as proposed by Maddala and Wu (1999). This test does not require a balanced panel data set and explicitly considers cross sectional dependencies (Halkos and Polemis, 2017). Table 4 presents the results of the test. The test assumes that all series are non-stationary under the null hypothesis. We can observe that the null hypothesis is rejected for all variables and all statistics, except for the variable *E-services* where statistics report contradictory results.

However, for samples with large number of panels, as is the case in this study, the Pm statistic is preferred (Choi, 2001). Therefore, we can conclude that all variables in the model are stationary.

Table 5 Multi-collinearity Diagnostics.

Variables	VIF	VIF-Squared	Tolerance	R-Squared
Fixed Broadband Price	1.50	1.23	0.6647	0.3353
Liberalization Partial Comp.	1.61	1.27	0.6207	0.3793
Liberalization Full Comp.	1.90	1.38	0.5250	0.4750
Education	5.50	2.34	0.1819	0.8181
Income	8.19	2.86	0.1220	0.8780
Economic Freedom	2.27	1.51	0.4402	0.5598
Content	3.53	1.88	0.2834	0.7166
Bandwidth	3.41	1.85	0.2931	0.7069
E-services	8.32	2.88	0.1202	0.8798
Urban Population	2.51	1.59	0.3978	0.6022
Privatization	1.24	1.11	0.8056	0.1944
Age	2.67	1.64	0.3740	0.6260
LLU	1.46	1.21	0.6845	0.3155
Trend	1.42	1.19	0.7032	0.2968
Mean VIF	**3.25**			

1.4.3 Multi-collinearity.

In order to investigate the presence of multi-collinearity in the variables used in the model a variable inflation factor (VIF) for each variable was calculated. As we observe from table 5 none of the variables exhibited a value of VIF greater than 10 and the overall model has a mean VIF value of considerably less than 6. However, we test if the coefficients and significance levels change considerably when each three variables with the highest VIF are excluded. Table A.1 in the Appendix A presents the results. The coefficients and significance levels for the (3) and (4) specifications do not change considerably except in

the (2) specification where the variable *E-services* is excluded, the variables *Trend* and *Income* become significant, while the variables *Privatization* and *Economic Freedom* become insignificant. However, we do not remove the covariate from the model as the exclusion of *E-services* could result in bias due to the omission of a relevant factor.

1.4.4 Empirical Results.

Table 6 presents the results of the regression model using different estimators, for comparison reasons. A robust Hausman test is conducted as to choose between fixed and random effects. The test shows that FE is the appropriate estimator. In the instrumental variables' estimation one of the endogenous variables is considered *Fixed Broadband price* because price affects broadband penetration, however simultaneously telecom operators set their price according to demand for broadband services. Moreover, there is an issue of reverse causality between income and broadband penetration, as broadband incites economic growth in a country. The same applies for industry factors such as internet content, international bandwidth and e- services. While these factors may impact broadband adoption, they also in turn are affected by the level of broadband adoption, presenting again an issue of reverse causality. For example, the supply of e-services or internet content is tied to the development of the telecommunications infrastructure in a country. The more developed it is, the more likely is governments or businesses to offer such services as there is a larger customer base to consume them. Therefore, all these factors are considered endogenous in this study. Moreover, in both instrumental variables estimators the Sargan-Hansen test of over-identifying restrictions fails to reject the null that the instruments are jointly valid. Lastly, the Difference-in-J endogeneity test justifies our choice to use instrumental variables methods.

1.4.4.1 Empirical Results of regression analysis for all countries.

The variable *Fixed Broadband price* is significant and with the appropriate sign, for all estimators. Concerning the variables *Liberalization Partial Comp*. and *Liberalization Full Comp.* are both significant and positive. This result indicates that countries which have liberalized the market of fixed local telephony and issued additional licenses have significantly higher broadband penetration than countries which did not allow for the introduction of competition (the reference category).

We do not find evidence that education impacts broadband adoption as the variable *Education* is not significant. Our finding matches that of Lee, (2008) but in contrast to other studies that have examined the impact of education (for instance, Lee, 2011a; Lin and Wu, 2013; Ovington et al., 2017). Similarly, we do not find that the level of income impacts the level of broadband adoption as is evident by the

insignificance of the *Income* variable for the FE-IV regressions. A surprising result is that the covariate *Economic Freedom* has the opposite sign from the one expected and is significant.

In order to investigate further, we estimated a model (results are presented on Table A.2 on the Appendix A.) including an interaction term between the *Economic freedom* variable and the time trend in order to examine if the marginal effect of economic freedom on broadband penetration is dependent on the time dimension. We find that the interaction term is negative and significant. Moreover, from Graph 2 we can observe that the negative effect of economic freedom on broadband penetration becomes stronger with time, as the slopes of the marginal effect becomes steeper. The variables *Content* and *E-services* are both positive and significant indicating that the level of internet content and supply of e-services play a positive role in the diffusion of broadband. This finding corresponds to that of studies such as Murrillo-Garcia (2005) and Lin and Wu (2013). The covariate *E-services* is positive and significant, highlighting the importance of e-services in inciting demand for broadband. The covariates *Urban population* and *Bandwidth* have both the expected sign and are significant for the FE-GMM2s regression. However, caution is warranted in interpreting the results since the covariates are only insignificant for the FE-2SLS regression. The dummy variable *Privatization* is positive and significant suggesting that in countries where the main fixed telecoms operator is privatized, have significant higher levels of broadband penetration than those countries which did not. We do not find evidence that countries which have implemented mandatory local loop unbundling significantly differ in their levels of broadband penetration comparing to countries which have not. This result is similar to the studies

Graph 2- Marginal Effects of Economic Freedom on Broadband Penetration

(for various values of Economic Freedom and Years=2010 to 2015).

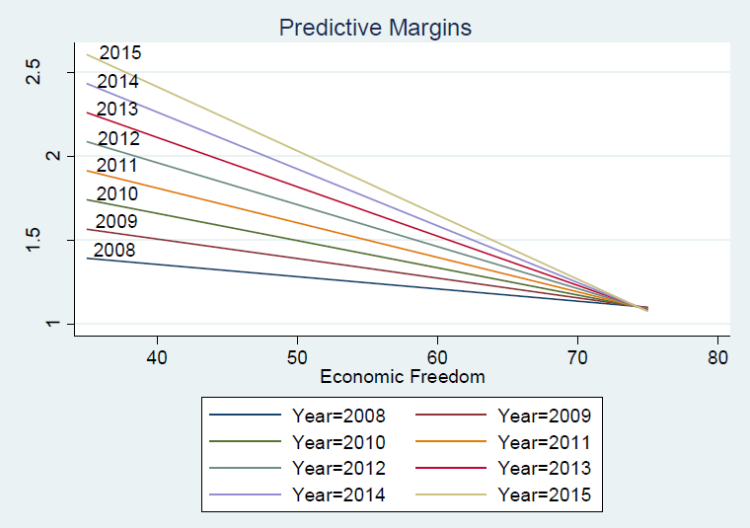


Table 6	Results of Regression Analysis for the determinants of Broadband Penetration		
Dependent Variable Broadband Penetration.			
Independent Variables	FE	FEIV-2SLS	FEIV-GMM2s
Fixed Broadband price.	**-0.291***** (-3.14)	**-0.273***** (-3.02)	**-0.192***** (-3.34)
Liberalization Partial Comp.	0.229 (1.65)	**0.259*** (1.75)	**0.231*** (1.86)
Liberalization Full Comp.	**0.260**** (2.10)	**0.263**** (2.19)	**0.250**** (2.26)
Education	-0.009 (-0.59)	-0.011 (-0.67)	-0.007 (-0.63)
Income	**0.839*** (1.71)	0.570 (1.31)	0.425 (1.56)
Economic Freedom	**-0.023*** (-1.71)	**-0.025*** (-1.84)	**-0.022**** (-2.27)
Content	**0.102**** (2.17)	**0.140***** (2.60)	**0.155***** (2.37)
Bandwidth	0.093 (1.60)	0.059 (1.04)	**0.069*** (1.73)
E-Services	**0.142*** (1.71	**0.280***** (2.95)	**0.292***** (4.00)
Urban Population	0.052 (1.45)	0.047 (1.28)	**0.049*** (1.80)
Privatization	0.128 (1.44)	**0.157*** (1.70)	**0.143**** (2.04)
LLU	-0.098 (-1.04)	-0.103 (-1.13)	-0.106 (-1.38)
Age	**0.129***** (3.19)	**0.129***** (3.18)	**0.128***** (4.64)
Trend	**0.041*** (1.75)	0.028 (1.19)	0.025 (1.41)
Hausman test robust (P-value)		26.998 (0.0193)	
Sargan-Hansen test (P-value)		2.808 (0.2457)	2.843 (0.2414)
Difference-in-J Endogeneity test (P-Value)		27.653 (0.0000)	41.305 (0.0000)
Modified Wald test (P-value)		6.0e+05 (0.0000)	
Lagram-Multiplier test (P-value)		62.887 (0.0000)	
F test (P- value)	26.67 (0.0000)	28.53 (0.0000)	53.30 (0.0000)
R^2	0.5921	0.5841	0.5792
Numb. of observations	1032	1032	1032

(i) *,** and *** denote significance at the 10%, 5% and 1%, respectively.
(ii) t-statistic is denoted in parenthesis.
(iii) Robust standard errors to arbitrary heteroscedasticity and autocorrelation.

of Cava-Ferreruela et al. (2006) and Nardatto et al., (2014) where they did not find a significant relationship between local loop unbundling and broadband penetration but contrary to studies that have concluded that local loop unbundling has either a positive relationship (Garcia-Murillo, 2005;

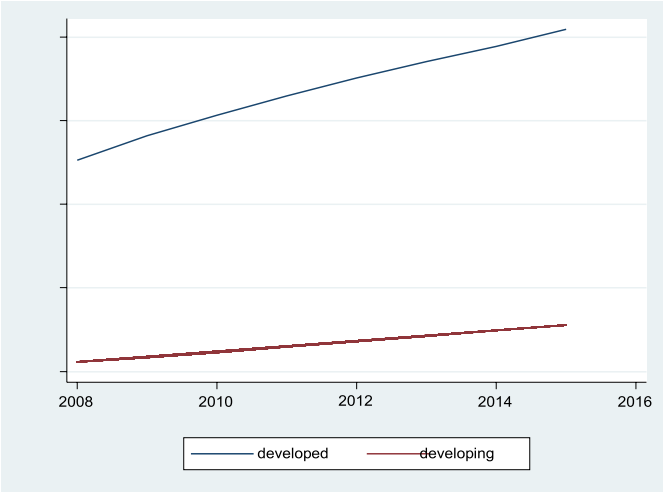
Grosso, 2006; Gruber and Koutroumpis, 2012; Ovington et al., 2017) or negative one (for instance, Crandall et al., 2013) to broadband penetration. Lastly, the variable *Age* is significant and positive indicating that countries with a greater percentage of population between 15 to 64 years old have significantly higher broadband diffusion.

1.4.4.2 Empirical Results of regression analysis for developed and developing countries.

The countries in the sample are separated to different groups, according to their level of income, in developed and developing countries, in order to investigate if there are significant differences in the factors that impact broadband penetration. The separation of the countries into the two groups was done according to the classification of the World Bank. The World Bank separates the countries into four groups, low, lower-middle, upper-middle, and high-income countries[7]. Developed countries are those that generally have achieved a higher level of industrialization and have higher GDP per capital. According to the World Bank developed countries are those that are classified as high and upper-middle income and developing are those of lower-middle and lower income (The World Bank, 2017). Graph 3 presents broadband penetration through the sample period for developed and developing countries, respectively. As we can observe, broadband penetration for both groups exhibit an upward trend, but the level of penetration for developing countries is considerably lower.

Table 7 presents our findings. *Fixed Broadband price* has the expected negative sign for both developed and developing countries, however we only find to be significant for the developing countries group. The price elasticity was expected to be more elastic (larger negative coefficient) for countries with lower

Graph 3- Broadband Penetration for Developed and Developing countries.



Source: ITU World Telecommunication/ICT Indicators (WTI) database. Calculated.

[7] The classification was made according to the fiscal year 2014, in order to match the sample period of this study.

Table 7 Results of Regression analysis for Developed and Developing countries.

Dependent Variable Broadband Penetration.	FEIV-2SLS		FEIV-GMM2s	
Independent Variables	Developed	Developing	Developed	Developing
Fixed Broadband price	-0.058 (-0.59)	**-0.287**** (-2.38)	-0.047 (-0.62)	**-0.191**** (-2.17)
Liberalization Partial Comp.	0.308 (1.39)	0.398 (1.36)	**0.342*** (1.78)	0.347 (1.42)
Liberalization Full Comp.	0.024 (0.22)	**0.430*** (1.95)	0.029 (0.32)	**0.419**** (1.96)
Education	-0.002 (-0.13)	0.003 (0.08)	0.002 (0.18)	0.009 (0.38)
Income	-0.059 (-0.15)	0.768 (0.77)	-0.154 (-0.52)	0.392 (0.65)
Economic Freedom	**-0.019*** (-1.74)	-0.012 (-0.40)	**-0.018**** (-2.22)	-0.002 (-0.08)
Content	**0.477***** (2.80)	**0.113*** (1.77)	**0.529**** (3.47)	**0.124*** (1.66)
Bandwidth	0.088 (1.39)	0.100 (0.92)	**0.086*** (1.67)	0.112 (1.54)
E-Services	**0.291**** (2.57)	-0.063 (-0.51)	**0.260***** (2.93)	-0.078 (-0.81)
Urban	0.049 (1.18)	-0.034 (-0.44)	0.045 (1.60)	-0.043 (-0.77)
Privatization	**0.175***** (3.61)	0.148 (0.54)	**0.183***** (4.03)	0.089 (0.42)
LLU	-0.090 (-0.89)	-0.086 (-0.44)	-0.077 (-1.07)	-0.091 (-0.59)
Age	**0.104***** (3.57)	0.076 (0.67)	**0.099***** (4.57)	0.071 (0.92)
Trend	-0.023 (-1.38)	**0.159***** (2.77)	**-0.025*** (-1.75)	**0.176***** (4.14)
Sargan-Hansen test (P-value)	1.437 (0.4874)	3.984 (0.1364)	1.821 (0.4023)	3.640 (0.1620)
F test (P- value)	21.54 (0.0000)	24.25 (0.0000)	34.82 (0.0000)	33.07 (0.0000)
R^2	0.5271	0.6283	0.4935	0.6220
Numb. of observations	682	350	682	350

(i) *,** and *** denote significance at the 10%, 5% and 1%, respectively.
(ii) t-statistic is denoted in parenthesis.
(ii) Robust standard errors to arbitrary heteroscedasticity and autocorrelation.

income where potential subscribers have tighter budgetary constraints, however the insignificance of the covariate for developed countries is somewhat unexpected. The Liberalization of the telecoms market differs significantly only for the case were additional licensees are partially restricted, for developed countries (and only for the FE-GMM2s estimator, as signified by the variable *Liberalization Partial Comp.)* comparing to the reference case where only a monopoly operator is licensed. In contrast the variable *Liberalization Full Comp,* which indicates the case where licensees are completely unrestricted significantly differs from the reference case only for developing countries. Moreover, the

Economic freedom variable is negative and significant only for the developed countries group. The variable *Content* is significant and positive for both groups. However, the coefficient is significantly higher for developed countries (approximately 0.5 versus 0.12) suggesting that internet content has higher impact for countries that have higher income. *Bandwidth* is significant and positive only for developed countries and only for the FE-GMM2s specification. Finally, the variables *E-services*, *Privatization* and *Age* have significantly positively association to broadband penetration only for developed countries.

1.5 Discussion and Conclusions.

This study attempts to identify the factors that determine broadband penetration for a large sample of international countries. Moreover, it separates these countries according to developed and developing countries groups, in order to identify possible differences in the factors that affect broadband diffusion in countries with different income characteristics.

The study highlights the importance of e-services for the proliferation of broadband. It is important for policymakers to encourage the development of e-services. For instance, governments should make high priority the development of e-government or e-health services, as it increases the value of broadband services for subscribers.

Furthermore, it is imperative for regulators to issue additional licenses as liberalization of the fixed telecoms market and allowance for the market to be more competitive has provided benefits to broadband diffusion that allowed for the introduction of competition.

Privatization of the main fixed telecoms operator has enhanced broadband proliferation and thus governments should resist vested interests and public pressure that wants retainment of public ownership. However, we also find that there are some differences between country groups separated by their level of development. We do not find e-services to have significant impact on broadband diffusion in the case of developing countries. It may be that a country must have reached a level of industrial development before e-services impact broadband adoption. A possible explanation, is that the quality of e-services tends to be typically higher for higher income countries and this may be the reason why it only affects developed countries. If this is the reason, then developing countries must improve the quality and usefulness of such e-services in order to incite broadband adoption. We find that privatization of the main fixed telecoms operator again benefits broadband diffusion only for developed countries. In general, institutions in developing countries do not function as well as in developed ones, and phenomena like regulatory capture or the collusion of private interests with governments against

the public interest are more common. Thus, this may be the reason why privatization has not resulted in the benefits that ensued in developed countries.

Finally, the unrestricted issue of licenses positively impacts broadband adoption only for developing countries. The reason for the fact that we do not find evidence of significant association for developed countries could be monopolies are more "efficient" and more likely to pass some of their surplus to consumers in developed countries, due to the quality of regulation.

The supply of relevant internet content is an important factor for the diffusion of broadband for both developed and developing countries. It increases the value of broadband to subscribers as the "consumption" of relevant internet content is the primary motivation for the subscription of broadband services.

Finally, this study finds that economic freedom is negatively correlated to broadband diffusion and that the effect becomes stronger for the later years in our sample. This may be due to the strong role that government plays in some country's economies. Because of the significant role of broadband in economic growth and for reasons of equity because in some peripheral regions of a country broadband may be less economically viable, government often chooses to use public funds to subsidize broadband services. However, further research is required for this association to be firmly established.

Appendix A.

Table A.1 Results of Regression analysis with different specifications.

Dependent Variable Broadband Penetration				
Independent Variables	(1)	(2)	(3)	(4)
Fixed Broadband price	**-0.192*****	**-0.238*****	**-0.190****	**-0.195*****
	(-3.34)	(-3.85)	(-3.31)	(-3.36)
Liberalization Partial Comp.	**0.231***	**0.227***	**0.231***	**0.246***
	(1.86)	(1.81)	(1.86)	(1.95)
Liberalization Full Comp.	**0.250****	**0.237****	**0.248****	**0.259****
	(2.26)	(2.05)	(2.23)	(2.33)
Education	-0.007	-0.001	-	-0.007
	(-0.63)	(-0.08)		(-0.59)
Income	0.425	**0.534***	0.438	-
	(1.56)	(1.97)	(1.63)	
Economic Freedom	**-0.022****	-0.012	**-0.022****	**-0.019****
	(-2.27)	(-1.21)	(-2.32)	(-2.04)
Content	**0.155*****	**0.163*****	**0.155****	**0.150****
	(2.37)	(2.41)	(2.38)	(2.25)
Bandwidth	**0.069***	**0.070***	**0.066***	**0.071***
	(1.73)	(1.75)	(1.66)	(1.77)
E-Services	**0.292*****	-	**0.290*****	**0.304*****
	(4.00)		(3.98)	(4.14)
Urban Population	**0.049***	**0.053***	**0.047***	**0.054****
	(1.80)	(1.93)	(1.82)	(2.01)
Privatization	**0.143****	0.107	**0.146****	**0.149****
	(2.04)	(1.59)	(2.10)	(2.12)
LLU	-0.106	-0.089	-0.107	-0.110
	(-1.38)	(-1.13)	(-1.38)	(-1.42)
Age	**0.128*****	**0.126*****	**0.129*****	**0.128*****
	(4.64)	(4.52)	(4.75)	(4.54)
Trend	0.025	**0.066*****	0.022	0.028
	(1.41)	(4.59)	(1.34)	(1.50)
Sargan-Hansen test	2.843	2.284	2.904	2.643
(P-value)	(0.2414)	(0.4037)	(0.2341)	(0.2668)
F test	53.30	51.33	56.43	56.58
(P- value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2	0.5792	0.5800	0.5802	0.5747
Numb. of observations	1032	1039	1033	1033

(i) *,** and *** denote significance at the 10%, 5% and 1%, respectively.
(ii) t-statistic is denoted in parenthesis.
(iii) Robust standard errors to arbitrary heteroscedasticity and autocorrelation.
(iv) The (1) specification is the original while the (2), (3), (4) specifications are without the e-services, education and income covariates respectively.
(v) All specifications are inferred using the FEIV-GMM2s estimator.

Table A.2 Results of Regression analysis with interaction term.

Dependent Variable Broadband Penetration.		
Independent Variables	Coefficients	t-statistic
Fixed Broadband price	**-0.226*****	(-2.65)
Liberalization Partial Comp.	**0.265****	(1.96)
Liberalization Full Comp.	**0.271****	(2.42)
Education	-0.012	(-0.80)
Income	0.526	(1.26)
Economic Freedom	**-0.023***	(-1.74)
Content	**0.109****	(2.10)
Bandwidth	0.080	(1.44)
E-Services	**0.256****	(2.28)
Urban	0.016	(0.43)
Privatization	0.140	(1.49)
LLU	-0.079	(-0.92)
Age	**0.101****	(2.55)
Trend	**0.050***	(1.83)
Economic Freedom*Trend	**-3.39*****	(-3.02)
Sargan-Hansen test (P-value)	3.025 (0.2204)	
F test (P- value)	28.69 (0.0000)	
R^2	0.6056	
Numb. of observations	1,032	

(i) *,** and *** denote significance at the 10%, 5% and 1%, respectively.
(ii) t-statistic is denoted in parenthesis.
(iii) Robust standard errors to arbitrary heteroscedasticity and autocorrelation.
(iv) Inferred using the FE-2SLS estimator.
(v) The variables Economic Freedom and Trend are centered on their mean.

Table A.3 Descriptive statistics of the untransformed variables for developed countries.

Variables	Observations	Mean	Standard dev.	Min	Max
Broadband Penetration	736	16.8036	11.57516	.0151602	45.10761
Fixed Broadband Price	724	27.74599	16.47371	2.852522	163.1275
Liberalization Partial Comp.	733	0.1200546	0.3252473	0	1
Liberalization Full Comp	733	0.744884	0.436224	0	1
Education	734	74.3174	10.30281	41.04011	93.9
Income	735	27917.95	19785.63	5895.114	129349.9
Economic Freedom	724	65.97735	9.459534	34.3	90.1
Content	734	18.87442	26.33502	.0012344	175.205
Bandwidth	734	132178.8	552044.9	775.1528	7186378
E-services	732	0.0289166	0.0563639	3.61e-06	0.3406738
Urban Population	736	70.12555	22.38125	8.445	100
Privatization	718	0.2239488	0.449965	0	1
LLU	731	0.6990424	0.4589884	0	1
Age	736	67.45434	4.808577	50.29085	85.8724

Table A.4 Descriptive statistics of the untransformed variables for developing countries.

Variables	Observations	Mean	Standard dev.	Min	Max
Broadband Penetration	378	1.659455	2.643097	.0017924	15.54902
Fixed Broadband Price	372	49.60122	81.75557	.9234297	635.0171
Liberalization Partial Comp.	382	0.1675393	0.3739464	0	1
Liberalization Full Comp	382	0.4790576	0.5002164	0	1
Education	382	50.2105	13.64226	16.53911	80.3
Income	384	4260.455	2636.161	748.4153	11411.94
Economic Freedom	381	56.82178	5.358827	43.3	73
Content	384	1.135836	2.850182	.0001343	23.90917
Bandwidth	383	12698.87	23404.7	82.24581	162429.4
E-services	379	0.0009461	0.0023364	3.61e-06	.0223259
Urban Population	384	40.55371	16.08208	10.118	72.04
Privatization	376	0.1143617	0.3186741	0	1
LLU	384	0.2942708	0.4563088	0	1
Age	384	59.75853	6.546913	47.24444	74.33752

Table A.5 Countries in the sample

Albania	Croatia	Indonesia[a]	Mongolia[a]	Singapore
Algeria	Cyprus	Iran, Islamic Rep.	Montenegro	Slovak Republic
Angola	Czech Republic	Ireland	Morocco[a]	Slovenia
Argentina	Denmark	Israel	Mozambique[a]	South Africa
Armenia[a]	Djibouti[a]	Italy	Namibia	Spain
Australia	Dominican Republic	Japan	Netherlands	Sri Lanka[a]
Austria	Ecuador	Jordan	New Zealand	Suriname
Azerbaijan	Egypt[a]	Kazakhstan	Nicaragua[a]	Sweden
Bahrain	El Salvador[a]	Kenya[a]	Norway	Switzerland
Bangladesh[a]	Estonia	Korea, Rep.	Oman	TFYR Macedonia
Belarus	Ethiopia[a]	Kyrgyz Republic[a]	Pakistan[a]	Tanzania[a]
Belgium	Fiji	Lao PDR[a]	Panama	Togo[a]
Bhutan[a]	Finland	Latvia	Paraguay[a]	Tunisia
Bolivia[a]	France	Lebanon	Peru	Turkey
Bosnia and Herzegovina	Gabon	Lithuania	Poland	Uganda[a]
Brazil	Georgia[a]	Luxembourg	Portugal	Ukraine[a]
Brunei Darussalam	Germany	Madagascar[a]	Qatar	United Arab Emirates
Bulgaria	Ghana[a]	Malawi[a]	Romania	United Kingdom
Burkina Faso[a]	Greece	Malaysia	Russian Federation	United States
Cambodia[a]	Guatemala[a]	Maldives	Rwanda[a]	Uruguay
Cameroon[a]	Honduras[a]	Mali[a]	Sao Tome and Principe[a]	Uzbekistan[a]
Canada	Hong Kong, China	Malta	Saudi Arabia	Vanuatu[a]
Chile	Hungary	Mauritius	Senegal[a]	Vietnam[a]
China	Iceland	Mexico	Serbia	Yemen, Rep.[a]
Colombia	India[a]	Moldova[a]	Seychelles	

[a] signifies that a country belongs to the developing country group.

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