

Investigation of the Factors Affecting Telecommunication Technology Proliferation Using International Comparisons and LRSA (Linear Response Surface Analysis)

(Work In Progress Paper)

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Abstract— A lot of research has been done to analyse the relationships between telecommunication technology proliferation and other social, economic and telecommunication indicators such as Gross Domestic Product per Capita (GDP), Financial Freedom, etc. According to some researchers, there is a need to carry out a reassessment of the connection between telecommunications, economic growth and other factors. In our research we are empirically investigating the factors affecting telecommunication technology proliferation using international comparisons. The methodology that is employed to make these comparisons is Linear Response Surface Analysis (LRSA) based on multiple regression analyses

Some of the relationships investigated are aimed at empirically testing the perception that mobile phone technology can help developing countries to overcome the lack of fixed line infrastructure (Substitution effect). A dimension that is also explored in this work concerns the overall ability of a country to access and use new ICT methodologies. The index that measures this (DAI), launched in 2003 by the Market, Economics and Finance Unit of the ITU, is considered as a response variable and factors influencing this DAI in 160 countries are investigated.

Index Terms— Telecommunications Infrastructure, technology proliferation, LRSA, Economic Growth

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I. BACKGROUND

A number of researchers have carried out empirical investigations to look at the extent to which telecommunications infrastructure affects economic growth and they have discovered a positive relationship between the two. Among other developments, they have discovered that an investment in ICT infrastructure provides benefits to the economy.

The first to discover this relationship based on data from 45 countries was [1]. In the US [13] used data from the state of Pennsylvania to show that an investment in telecommunications affects economic activity and vice versa.

Researchers such as [5], used data from OECD (Organisation for Economic Co-operation and Development) countries to prove the reverse causality between telecom infrastructure and economic growth while [6] based on data from 45 developing countries, have also found evidence that telecom infrastructure and economic growth are positively related.

Also [4] investigated this relationship in Africa with similar results.

A study of information networks and their effect on business transaction costs, information dissemination and organizational efficiency was done by [16] and their results were positive.

More research was done by [11] who empirically investigated the role of telecommunications infrastructure on economic growth with a dataset from China.

A difficult question regarding proliferation of telecommunications infrastructure and economic growth is the chicken and egg effect (which comes first and causes the other). In this paper the view was taken that economic welfare and other factors support telecommunications proliferation.

Other researchers have also empirically investigated the

substitution effect between mobile phones and fixed line and they claim that there is evidence (but to a lesser extent) on the substitution of fixed telephones with mobile telephones. Work done by [9] proved that there is a substantial substitution effect between fixed line and mobile telephony using a telecommunications panel dataset of 56 countries. Similar research in Korea was also investigated by [8].

II. EMPIRICAL EXPERIMENTS

Substitution hypothesis

The research done by [9] involved analyzing a dataset of 56 countries and they found indications of a substitution effect between the fixed line infrastructure and mobile telephony. The empirical investigation considered here comprised data from 160 countries with an initial 22 factors per country. This data included cases from African countries (48) and a hypothetical linear function of the form:

$$MSPT = f(\text{Popu, GDPT, GDPC, TTS, MCC, FC})$$

was fitted to the data. The acronyms have the following meaning:

MSPT: Mobile Subscribers per Thousand

Popu: Population

GDPT: Gross Domestic Product Total

GDPC: Gross Domestic Product Per Capita

TTS: Total Telephone Subscribers

MCC: Mobile Cellular Cost per 3mins in US\$

FC: Freedom from Corruption

A reasonably good fit was obtained (adjusted R-squared of 95.6 %)

The characteristics of this linear function were explored using Linear Response Surface Analysis techniques. This technique originally proposed by Bruwer and Hattingh [15] considers the behaviour of the response function over the convex hull of the data points and produces graphs that can highlight the dependence of the response variable on specific factors. Such a graph showing the behaviour of MSPT for various levels of TTS is given below:

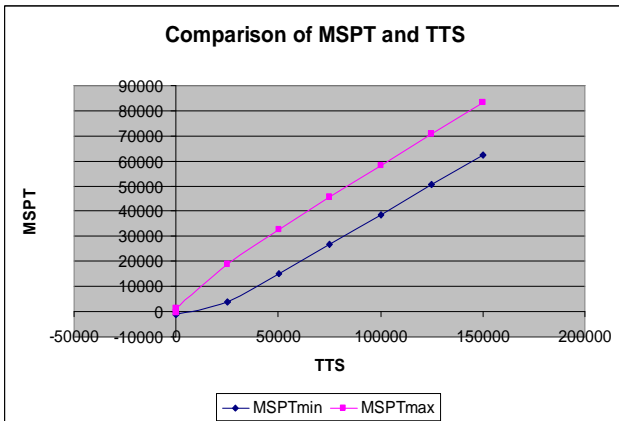


Fig 1. Comparison of MSPT and TTS

The graph shows a marked positive effect of TTS on MSPT. The distance between the max and min graph is small

indicating that other factors (apart from TTS) do not seem to be very important.

Models for Digital Access Index (DAI)

Exploratory models that relate DAI as a response variable to factors like Trade Freedom, Fiscal Freedom, Gross Domestic Product per Capita and others have been investigated using the same database of 160 countries.

A linear function of the form:

$DAI = f(\text{TF, FF, GDPC, MCC, AFFO})$ was fitted where the independent variable set is

defined by:

TF: Trade Freedom

FF: Fiscal Freedom

GDPC: Gross Domestic Product Per Capita

MCC: Mobile Cellular Cost per 3mins in US\$

AFFO: Affordability

A good fit was obtained with an R-squared adjusted value of 0.933.

Application of LRSA techniques was done and the following graph is given as an example of the influence of GDPC on DAI.

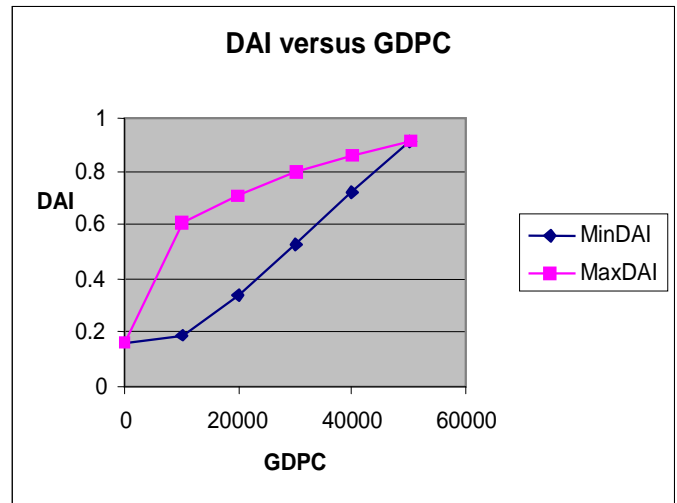


Fig 2: Comparison of DAI and GDPC

TABLE 1

MaxDAI	0.16	0.61	0.71	0.8	0.86	0.91
GDPC	51	1000	2000	3000	4000	5000
TF	74.6	78.77	81.4	81.4	81.4	81.4
FF	74.2	59.34	44.73	32.69	45.76	58.83
MCC	0.53	0.2	0	0.03	0.19	0.34
AFFO	0	0.97	0.98	0.99	0.99	0.99

TABLE 2

MinDAI	0.16	0.19	0.34	0.53	0.72	0.91
GDPC	51	10000	20000	30000	40000	50000
TF	81.4	81.4	70.3	73.91	77.52	81.13
FF	58.83	58.83	79.59	73.15	66.71	60.28
MCC	0.34	0.34	0.04	0.14	0.24	0.34
AFFO	0.99	0.99	0.1	0.39	0.68	0.97

Interpretation of the findings

The graph shows a marked positive effect of GDPC on DAI. Countries with high GDPC almost invariably have high values of DAI. The graph differences are narrow for high GDPC values. For lower GDPC values the graph differences are larger showing that relatively poorer countries attain higher DAI values by optimizing other factors like MCC (See table values above)

Data Sources

World Bank (06 World Development Indicators, 07 The little Data book)

ITU Country data by region, ICT Statistics Database
: <http://www.itu.int/ITU-D/ict/statistics/>

Data and Statistics: <http://www.imf.org/external/data.htm>

2008 Index of Economic Freedom:

<http://www.heritage.org/Index/>

III. CONCLUSION

So far we have found no evidence to support the substitution effect between fixed line and mobile telephone proliferation with the global dataset that was used. The effects which are reported in literature regarding the relationship between DAI and the other factors are generally supported by this empirical study. It seems as if there is a multifactor dependence of DAI and not only economic welfare of a country. This is observed for the less affluent countries.

IV. FUTURE WORK

The empirical exploration of these relationships will continue with one of the main objectives being the determination of critical success factors for telecommunication infrastructure that supports general welfare in a country.

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