Telecommunications and Economic Development:

Empirical Evidence from Southern Africa

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"... telecommunications policies affect not only telecommunications..., but also the economic development... and social, cultural and political growth."
Pekka Tarjanne[1]

1 Executive Summary[2]

Many countries in the developing world must decide how to best allocate scarce resources for improved economic development. An ITU study of telecommunications and development, *The Missing Link,* concluded that "telecommunications can increase the efficiency of economic, commercial, and administrative activities, improve the effectiveness of social and emergency services and distribute the social, cultural and economic benefits of the process of development more equitably throughout the country." Although it is recognized as an essential catalyst for growth, however, improved telecommunications generally has not been a central investment focus for developing countries[3].

The Southern African Development Countries (SADC) and the Republic of South Africa (RSA)[4] are among the least developed countries,[5] both economically and in their use of telecommunications. A wide range of studies indicate that expanded telecommunications investment is essential, not only for growth, but also to remain competitive within the increasingly information-oriented global economy. Failure to develop telecommunications systems will only increase the development gap between the SADC and RSA and the industrial countries.

There are basically two distinct research methodologies to study the effects of telecommunications on economic development. One uses the macroeconomic or top-down approach. The other uses the microeconomic or bottom-up approach. Both have their advantages and disadvantages. Macroeconomic analysis, which is based on national aggregate statistical data, provides an overview of the basic economic indicators, but cannot explain causal relationships. Microeconomic analysis can substantiate the positive effects of telecommunications in a specific situation, industrial sector or region, but is dependent on the small sample size analyzed and cannot be expanded to a larger universe.

This paper reviews the macroeconomic statistical approach, and suggests a methodology for relating telecommunications and economic development within the SADC and RSA. It is recommended that more detailed studies be developed for each country to confirm these initial assessments. The question of the cause-and-effect relationship between economic development and telecommunications is always present.

The focus of the paper will be on the telecommunications sector of SADC and RSA, but the policy options and recommendations can be applied to other sectors of the Southern African economies, particularly the utility infrastructure.

The authors used a variety of data sources in developing the profile of the Southern African countries under study. One general characteristic to note is that South Africa skews the data. Its level of development is much higher than

the other countries. This is deceptive, however, because the data reflects primarily the white South African economy only.

1.1 Methodology / Economic Analysis

Extensive studies from the 1960s to the present have documented a strong correlation between GDP per capita and telephone density indicators. The data for all countries generally fall within a small band along a straight line on a logarithmic chart. Recent statistical tests for the direction of causality by Hardy (1980), DRI/McGraw-Hill (1991) and Norton (1992) show that the growth of telecommunications investment or penetration is a statistically significant predictor of economic growth, and vice-versa: indicators of economic growth are significant predictors of telecommunications investment. Telecommunications is thus considered to be both a cause and a consequence of economic growth. According to Norton (1992), "The data in this study...are consistent with the proposition that telephones provide substantial growth- and investment-enhancing activity and thus facilitate economic growth."

Input-output studies of the economic impact of telecommunications also show that it makes substantial contributions to the efficiency of the economy. A quantitative study of the U.S. during the years 1963-1982 estimated efficiency gains of nearly US$ 80 billion for the 1982 economy.

1.2 Reasons for Under-Investment in the Telecommunications Sector

If telecommunications is a driver of economic development, why isn't more investment directed to this area? The answer is multi-faceted, but revolves around issues of control and ownership. Telecommunications authorities are state enterprises in most countries. As such, they are subject to standard governmental budget practices. Telecommunications must compete for budget allocations from the state along with all other bureaucracies. Funds are not allocated on the basis of economic criteria, as they would be if the telecommunications entities were competing in the market for the funds. In other words, the gains associated with telecommunications investment are ignored, underestimated, or simply unknown.

Returns may be underestimated because:

1. the externalities associated with an expanded telecommunications infrastructure are not recognized;

2. the government may view the telephone as a "toy for the rich," and believe that it has better things to do with its money;

3. the government, with more sinister purposes, believes that better communications will undermine its own position;

4. the government has many other social/political motives, objectives or goals with little or no economic foundation.

1.3 Conclusions

The conclusions reached by the authors from their review of the literature, the study results and their experience in developing countries:

- A positive relationship exists between economic development and infrastructure investment, including telecommunications in particular.

- Even with a strong positive correlation between telecommunications investment, it alone is not sufficient to ensure economic growth. However, lack of telecommunication investment can prohibit or significantly constrain economic development .

- Investment in telecommunications infrastructure can not only increase general business efficiency but increase the impact of other infrastructure investments.

- Investments in new types of telecommunications infrastructure can result in greater benefits than marginal improvements to existing infrastructure.

- Maintenance of the telecommunications infrastructure is necessary to obtain the full economic development benefits.

- A macro economic approach indicates telecommunications investment to promote economic development within SADC.

- Lack of telecommunications infrastructure clearly inhibits economic development in SADC countries but other economic, political and social factors also inhibit economic development.

2 Overview

2.1 Introduction

The world is rapidly moving toward an economic system based on the continuous and ubiquitous availability of information. Recent advances in telecommunications technology have been an important vehicle in permitting information exchange to develop as a valuable commodity. Countries and sectors equipped with the requisite telecommunications systems have been rapidly moving into post-industrial, information-based economy growth. For the developing world, a modern telecommunications infrastructure is not only essential for domestic economic growth, but a prerequisite for participation in increasingly competitive world markets and for attracting new investments. In the advanced industrial countries of Europe and North America, universal telecommunications services have penetrated every sector of society. In many developing countries the limited availability of service is constraining economic growth. This is particularly true of the SADC countries and the RSA, a region containing both the lowest level of telecommunications density and economic development in the world.

Economic development policies in the industrial countries increasingly include telecommunications as an essential component of the economic infrastructure.[6] This realization has been initiated by industry's demand for advanced telecommunications equipment for competitive reasons. The lesser developed countries have begun to recognize that inadequate telecommunications services will be a disincentive to new investment and place existing industry at a competitive disadvantage. This is valid for a range of activities including: improved farm production, animal husbandry, export marketing for the mining industry, bank transfers and tourist arrangements, all vital sectors of the SADC and RSA.

The primary economic benefit of improved telecommunications is improved efficiencies in other productive sectors. Over 80% of the telephones in the lesser developed countries are connected to businesses or to government agencies. Few domestic businesses and no international activities could operate competitively without modern telecommunications. The primary benefits include reduced transport costs, reduced transaction costs, improved marketing information and increased efficiency of industrial production. In all economic sectors--agriculture, manufacturing and services--advanced telecommunications systems are becoming an integral part of business operations. The lesser developed countries must accelerate their application of telecommunications technology or fall further behind in economic competitiveness.

The gap in telephone penetration between developed and developing countries is increasing. The challenges in reducing this gap are significant. The SADC and RSA have a total population of 115 million inhabitants, the size of Germany and France combined. Yet, they contain

only half a million telephones. Providing expanded telecommunications service for this region is a daunting task.

2.2 Purpose of this Paper

The objective of this paper is designed to provide a framework to analyze the potential impact of telecommunications investment on the SADC and RSA region's economic development.

The paper includes a review of the methodology, models and data requirements utilized in similar studies on the relationship between economic development and telecommunications in other regions of the world. Economic techniques make possible a more precise definition of the relationship between telecommunications and economic development by using both quantitative and qualitative indicators to analyze the impact of equipment cost, calling price, tariff levels, and other factors. The available procedures will be reviewed to determine their potential applications to the SADC and RSA, and suggest the most appropriate methodology for further analysis of each country within the region.

This paper critiques and analyzes data on telecommunications services in the SADC and RSA; and estimates the evidence for, and consequences of, the inadequacy of these services. The object is to provide an overview of the telecommunications effects on the economies of SADC and RSA. Policy alternatives and options will be explored in the conclusions.

3 Methodology

Economic analysis is used to help a country, firm or individual allocate scarce resources in order to optimize efficiency. Telecommunications have been considered an essential factor of production for the output of a country, and both a catalyst and product of economic growth. There are two distinct analytical approaches for reviewing the impact of telecommunications on economic development. One is *macro-economics* in orientation and the other is *micro-economics* in orientation. Both approaches have distinct advantages and disadvantages and can be used in complementary ways. Macro-economics studies are designed to present an overview of the economy based on national statistical data. Micro-economics studies are designed to evaluate the economic impact of telecommunications applications on a detailed sector or unit of production within the economy based on a specific sample.

3.1 Literature Review

Governments and public agencies in most countries, both developed and less developed, spend large sums of money on infrastructure. The purpose of infrastructure investment is to positively influence economic activity in terms of employment, value added, productivity, capital formation and income. Infrastructure investment also were help with the social and political integration of a region.

Investments in physical infrastructure generally fall into four broad categories: utilities; communications; transportation and land development.[7]

Most of these investments have certain characteristic in common. They tend to have some attributes of public goods in that they require a high initial investment with a relatively low marginal cost once the investment is in place. The provision of service from these industries also provides benefits to a large percentage of businesses and households of a region and typically has some form of external economies.

Most infrastructure investment can positively affect the economy in three ways. First, it can reduce the cost of production. Second, it can increase revenues. Third, it can increase employment through both direct and indirect effects.

Most analysts show a positive correlation between infrastructure investment and economic development.[8] Three different methods ordinarily are used to estimate the effect of infrastructure investment on economic development: production functions; factor movements; and trade flows.[9]

The idea that infrastructure investment is correlated with economic development is appealing and intuitive. To imagine an economically developed country without a substantial infrastructure is difficult. However, to state a precise relationship between the two is difficult. For example, Balabkins points out that investment in infrastructure must

occur before what economists call final demand.[10] Others, such as Hirshman, state that development may cause the investment in infrastructure.[11]

Another example is provided in a study by Ford and Poret. They examined the relationship of decreases in total factor productivity to changes in the level of infrastructure investment for 11 countries. They found that in half the countries investment in infrastructure increased and in half it decreased while total factor productivity decreased in all countries.[12]

Although these, and other studies, are seemingly contradictory, they were indicate that the relationship between infrastructure investment and economic development is complex.

A number of researchers point out that infrastructure by itself is not a sufficient condition for economic growth. It is a necessary condition but it will not by itself ensure economic growth. Other factors must be in place. It must have a favorable existing potential for new development. Infrastructure is essential for economic development. A country or region cannot develop without it but the degree to which it will spur growth is ambiguous.[13]

Two other factors may complicate the relationship between infrastructure and growth. First, there may be decreasing returns to infrastructure investment. The contribution of infrastructure to growth may depend more upon the uniqueness of the investment than an increase in the ubiquity of the investment. For example, the addition of a traffic lane to the roads of a country with a highly developed highway system will have less of an effect than building roads in a region that does not have any.

Second, the ability of infrastructure to exert a strong influence on economic development requires that the infrastructure investment be maintained once it is in place. A road that deteriorates to the point where it is difficult to traverse does not exert as much economic stimulus as one in good repair that can be traveled easily and does not cause excessive maintenance on cars and trucks. Nicholas Balabkins attributed the inadequacy of Nigeria's economic development in large part to its inadequate electric power system. He states that as a strategic input to economic development, electric power supply must be regular and must increase with demand from industry and agriculture.[14]

Telephone service is a category of infrastructure investment. The previous discussion of the relationship between infrastructure investment and economic development generally applies to telephone service as a category of infrastructure investment. Some developing countries invest as much as 0.61 percent of their gross domestic product (GDP) in telecommunications. In the 1970s the average was 0.25 percent (developed countries average 0.8 percent of GDP during the same period). At least one group studying the issue suggested that developing countries invest not less than 0.5 percent of GDP in telecommunications infrastructure.[15]

Investment in telecommunications presents its own set of conditions. Because of the nature of telecommunications services and the benefits derived from them, measuring the benefits or placing economic values on the benefits may be more difficult with telecommunications investments than other infrastructure investments.

Telecommunication investments affects economic development in the same general way as other infrastructure investment. It can reduce the cost of production. It can increase revenues. Finally, it can increase employment through both direct and indirect effects. Telecommunications, however, will affect revenues and costs in more indirect ways than many other types of infrastructure investment. The reason is that much of the benefits of increased telephone service are derived from increases in information and knowledge. For example, industrial development requires cooperation and coordination of a series of operations. Increases in information and knowledge result in more efficient cooperation and coordination. Commerce is essentially an information processing activity. Effective buying, selling and brokerage rely on access to current information on the availability and price of goods and services. Telecommunications increases the available information thereby, increases the efficiency of commercial activity.

This section reviews several studies which analyze the relationship between economic growth and telecommunications. The reviews are limited to macroeconomic statistical models[16,17].

3.1.1 Macroeconomic statistical studies

One indication of the benefits of telecommunications investment is the strong correlation between telecommunications development and overall economic development. A long series of studies, initiated first by Jipp (1963), demonstrated the positive relationship between measures of GNP or GDP per capita and telephone density indicators, including DEL or lines per 100 inhabitants. The data for all countries, from the least developed to the most industrialized, generally fall within a small band along a straight line on a logarithmic chart. The telephone density is assumed to be related to GDP per capita by the following relationship:

$$D_{i,t} = \alpha Y^{\beta}_{i,t}, \text{or}$$

$$ln D_{i,t} = \alpha + \beta ln Y_{i,t}$$

$D_{i,t}$ is the telephone density in DEL/100 and $Y_{i,t}$ is the GDP for the country in year t, respectively. Where α is the intercept and β is the slope, an indication of the relationship between telephone density relative to GDP. The available time series data since 1955 suggests that as GDP increases telephone density increases at a faster rate. The basic ITU data for a large number of countries indicated that a consistent pattern emerged with a strong positive correlation.

The high correlation coefficients obtained [0.91 to 0.96] confirm a strong cross country relationship between the variables. The regression lines have consistent and similar slopes (parameter β), suggesting that the rate at which telephone density varied with GDP remained relatively constant, with small improvements due to higher average income levels, over the time frame examined for the collective countries. A more detailed analysis indicates that the rate at which telephone density increases relative to GDP is higher among the more developed countries, and lower among the lesser developed countries. The conclusion is that the more developed a country becomes, the faster telephone service consumption grows relative to the rest of the economy.

In the Results Section (below), we examined this relationship with respect to the Southern African countries for which we had sufficient data. This showed that telephone investment is a cause of GDP growth and telephone usage (both proxied by DELs) is driven by GDP growth. The authors rejects the notion that telecommunications is the sole driver of GDP, but that it is a **necessary** condition for growth.

Several explanations for the correlation between telephone penetration and GDP have been advanced. Telephones can be seen as a stimulant of economic growth; that is, consumption of telephone service actually *causes* increases in GDP. It is also possible that as economies become more highly developed they need more communications relative to less developed economies. In other words, development makes the economy more "information and communication-intensive," requiring a disproportionate increases in telecommunications infrastructure and usage.

Telecommunications can also reduce transactions costs, widening the scope of markets and thereby increasing competition and efficiency. Another possible interpretation is that the growth in telecommunications is simply a passive consequence of development. The advanced nations have more telephones because they are able to afford them. In this view, telephones are a consumption item like televisions and radios; growth in penetration will only follow, and cannot precede, the attainment of higher levels of wealth.

Recent research addresses this relationship and has come up with some fairly conclusive findings.

A study by Andrew Hardy[18] was one of the first to attempt to test for causality. Hardy analyzed the correlation between GDP and number of telephones per capita using data from 45 countries for the period 1960-1973. Time-lagged offsets of one year were used in order to see whether increases in telephone penetration predicted GDP growth, or whether GDP growth predicted telephone penetration. His study found that "causality" ran in *both* directions at statistically significant levels. That is, telephone

penetration was both a cause and a consequence of GDP growth. Hardy's evidence, however, showed diminishing returns. The size of the effect of telephone penetration was inversely related to the prior level of telephone development. The strongest two-way correlation occurred in the least-developed economies, and the weakest effects occurred in the economies which already had a high level of telephone development.

A subsequent study by DRI/McGraw-Hill (1991) conducted a more detailed test of the causal relationship between telecommunications and GNP. The study was limited to data from the United States during the years 1958 to 1988. The DRI/McGraw-Hill study departed from earlier research by taking as its relevant variable telecommunications *investment* rather than telephone penetration levels (DEL). The investment variable was derived from total domestic consumption of telecommunications equipment (SIC code 3661) as reported by the Bureau of Economic Affairs. The use of an "investment" variable is an important difference, because in developed countries such as the U.S.A., changes in telephone penetration are minimal; the telephone has already saturated the consumer market. Furthermore, a significant part of a developed country's telecommunications investment growth is in areas that would not be reflected in telephone penetration statistics (for example, computer networks, intraoffice LANs and PBXs, or video conferencing). This may also be true of developing countries. For example, investing in additional trunk lines and central office equipment may make the existing telephone system more efficient and reliable without necessarily increasing penetration. Using investment as a variable is thus a more thorough approach to the study of telecommunications and development.

The DRI/McGraw-Hill study used a two-year lag to offset the two variables. Two standard statistical tests for the direction of causality were used: the Granger test, and the modified Sims test.

The results were again positive in *both* directions. The inclusion of GNP or total industrial output variables in a specification for telecommunications improved the prediction for the time process of telecommunications investment. Conversely, the inclusion of telecommunications investment variables in a specification for GNP or output improved the prediction for the time process of GNP or output. The authors conclude that the results "suggest a feedback process in which telecommunications investment enhances economic activity and growth while economic activity and growth stimulate demands for telecommunications infrastructure investment."[19]

In another approach to relate telephone infrastructure to economic development, one study statistically analyzed the relationship between telephone density and per capita GDP for ten Latin American countries. The study showed a strong correlation between these variables, suggesting a strong relationship

between investment in telecommunications infrastructure and economic development. The study, however, pointed out that correlation is not causation. It is possible that the use of telecommunications merely reflects economic growth.[20]

The most recent published evidence is by Norton (October, 1992) shows that, statistically, telecommunications investments causes growth in the financial sector and, hence, GDP growth.[21] He assumes transactions cost play a significant role in the economy and applies a model developed by Hirshleifer in which the transaction costs are considered explicitly. Based on this model, Norton developed a theoretical framework to estimate telecommunications role in financial markets and growth.

Clearly, telecommunications and the economy interact in a complex manner. Its the authors' view that, as demonstrated in this document, telecommunications is a powerful driver of development[22]

3.1.2 Policy Implications

The existence of a positive, reciprocal correlation between telecommunications investment or penetration on the one hand and economic growth on the other seems fairly well established. What implications does this have for development policy? "Causality" in this type of test simply means that one variable is statistically a good predictor of the other variable. It does *not* mean that any investment in telecommunications will automatically *cause* growth. As one of the authors of the DRI study wrote, "...simply going on a telecommunications equipment spending spree would not be sufficient to cause future economic growth. We must assume that the agents involved are rational actors, calculating, to the best of their ability, cost effective means of realizing economic ends."[23] In other words, the investments must be responding to actual or potential demand, and must be targeted to provide telecommunication service when and where it is most needed.

Perhaps the best way to describe the relationship is in negative terms: if there are inadequate telecommunications facilities then it is likely that economic growth will be stunted. But this does not necessarily mean that spending more on telecommunications will automatically increase growth. This conclusion is supported further by studies of telecommunications and economic development conducted at the micro level. In these more concrete case studies, we can see that telecommunications does not promote economic growth in and of itself: rather, the economic impact of new investment is strongest when the absence or inadequacy of existing telecommunications facilities acts as a *barrier* or *bottleneck* to private economic activities.

From a development perspective, the key issue is not merely the correlation between telecommunications and growth, but the institutional mechanisms which determine how and when investments in telecommunications are made. The DRI/McGraw-Hill study is based on time series data drawn from the United

States, a developed country with a regulated market economy in equipment and services, and telephone companies which are long-established, private, profit-motivated firms. For part of the period covered by the study (1978-1988), U.S. telephone companies were subjected to competition from other suppliers. Private firms also have a considerable amount of freedom to invest in their own telecommunications facilities. Thus, investments in telecommunications in the U.S. were steered by market prices, competition, and other external forces ensuring that they were, on balance, cost-effective and responsive to demand. Under these circumstances, telecommunications investment is correlated with economic growth.

In developing countries, on the other hand, the institutional context of infrastructure investments is radically different. Often the PTT management consists of political appointees who are concerned more about patronage or with the control of communications for military and political purposes than with meeting business demand. Even if the management is dedicated and professional, the Telecommunications Authority must compete with other government departments for scarce capital, in a political arena in which economic efficiency considerations may be unknown or unrecognized due to the absence of well-organized capital markets and investment information services. Furthermore, in an atmosphere of political instability, even the best of capital investment plans are futile if they are constantly deferred or altered by unstable local and national politics. The existence of the telecommunications/economic growth correlation does not address these institutional considerations.

Making generalizations about the relationship between telecommunications infrastructure investment and economic investment is problematic. However, some themes seem to stand out.

Almost all of the discussions, both theoretical and empirical, depict a positive relationship between these variables. But, the strength of that relationship appears to vary widely. The conclusion that can be drawn that arguments about the existence of a positive relationship are moot. The important issues pertain to describing the relationship and delineating the reasons for variations in the strength of the relationship.

As stated earlier, neither investment in infrastructure generally nor investment in telecommunications infrastructure is sufficient for economic growth. Other conditions must be present. The region must have the human and capital resources as well as other infrastructure investments to obtain greater benefits from telecommunications infrastructure investment. The timing of the investment and the type of telecommunications investment relative to other modernization factors may well be of great importance. Also, installing new equipment that can provide a broader array of services will have a greater impact than marginal

expansion of an existing network, providing that preconditions for modernization of other sectors of the economy are present.

Quality of service is an important variable in determining the strength of the relationship between investment and growth. Quality of service includes minimizing outages and blockages as well as the ability to expand to meet new demands.

4 Data

4.1 Data Deficiencies for Southern Africa

The results generated by economic models and analyses are only as valid as the initial data. An effective economic model requires a valid, reproducible and accurate statistical time series over a significant period of time. This statistical series may not be available for many countries within the SADC and RSA. The SADC and RSA contains countries at the lower range of the development spectrum. Over the past decades the region has moved through turbulent economic and political times. This has produced periods of economic regression and decline that can reduce the validity and confidence levels of statistical indicators. Over the past decade, the level of telephone density has remained stagnant for most countries in the SADC and RSA, except Botswana (Figure 3-1 to 3-9). A World Bank survey of Sub-Saharan Africa found extensive problems with data collection and measurement procedures, particularly with historical records for even basic macroeconomic planning indicators. The survey indicated a higher level of manual data collection efforts than normal, negating the improved quality of computer software and hardware available within these countries.

The authors used a variety of data sources in developing the profile of the Southern African countries under study. One general characteristic to note is that South Africa skews the data. Its level of development is much higher than the other countries. This is deceptive, however, because the data reflects primarily the white South African economy only.

The authors has work extensively with the published and electronic version of the data available on the Southern African countries. Sever data deficiencies were found. As noted above, the authors found several areas where the data series did not agree with one another. The electronic version of the ITU data did not always agree with its published version of the data base. Several of the data items are not reported for specific countries and, in some cases the country did not paper for some or all the years. Appendix A reports on the various data sources available. An electronic version of the data is available from PNR & Associates. The authors used it best judgment when it found discrepancies in the data between two data sources or interpolated or extrapolated, as the case warranted and it was possible, to estimate missing data points .

Data deficiencies could not be overcome within the context of this study. The following suggestions, however, will help others to define what kind of data collection should be undertaken and how to go about it. The ITU should verify the accuracy and completeness of the data it receives from the PTTs and telephone operating authorities. Two tests of the validity could be used:

a. Examine the internal consistency of the data. Statistical analysis could be performed on the series based on all the countries in the data base, to set the bounds of reasonableness for the data.

b. Compare the country's data submission against the previous year's submission. This obviously has not been done in the past, and was the area were the authors detected the most data discrepancies.

4.2 Data Problems

The data available included the United Nations population projections, the International Monetary Fund's International Financial Statistics, United Nations national income accounts, and World Bank Development Reports. Telecommunications specific data is available from the International Telecommunications Union by country and region. (See the Appendix A, Data Sources in the Southern African Scoping Study.)

Certainly, data limitations are likely to exist in some areas. In areas where forecasts are unavailable, economic forecasts are made based upon regional forecasts and the characteristics of that country. Further, in instances where data limitations are present, such as the unmet demand for telecommunications, secondary data sources are examined. It is also recognized that the quality of data from many developing country source is often less than robust. In all cases country source data were thoroughly examined for inconsistencies and attempts made to adjust the data to reality or find alternative data sources. This is especially true of wait list data which often may not reflect unmet demand.

4.3 Limited data

Although limited economic and demographic data of each country and region are available, the project built a database using the relevant data available. The database contains output by sector, population by age group, urban population, and international financial statistics. Telecommunications data are available for each country from the International Telecommunications Union. This limited data on the economic activities in the South African countries limits the quality of the estimates of the estimate excess demand: however, it is sufficient to estimate a **qualified** excess demand.

5 Results

An initial assessment of the quantitative relationship between telecommunications development and economic growth was derived from the available data for the Southern African countries. Because of the difference in the size of the countries, the analyzes utilized the growth rate of GDP and telephones. As can be seen from Figure 5-1 and Table 5-1, the relationship between the rate of growth of DEL per capita and growth in per capita GDP for the Southern African counties is positive.[24]

Figure 5-1
Telephone per Capita vs. GDP Growth Rate
(1983-1989)

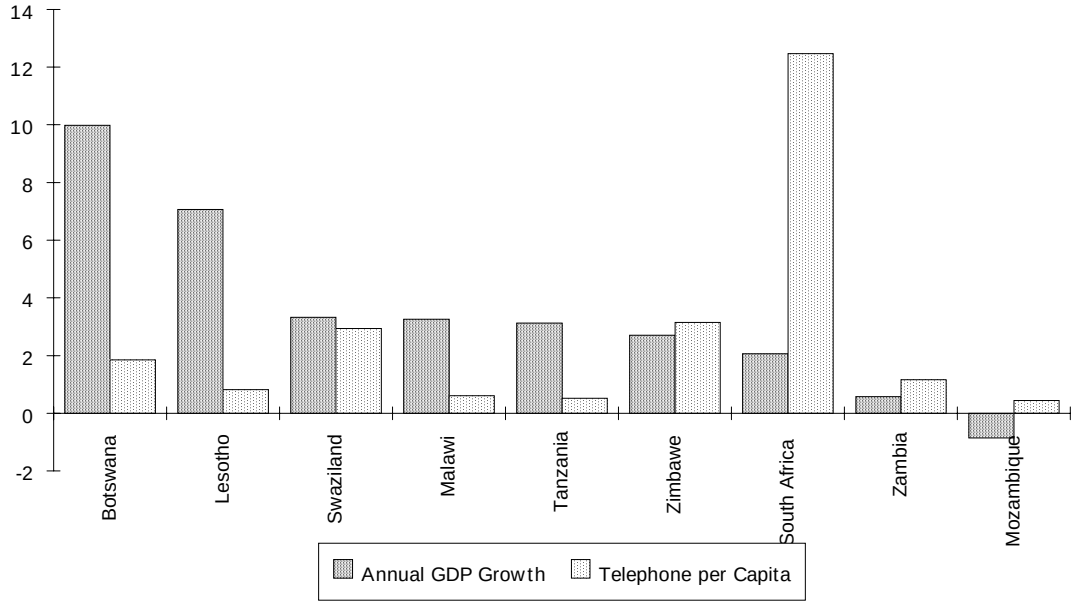

Table 5-1
Telephone per Capita vs. GDP Growth Rate
(1983-1989)

	Annual Growth GDP	Annual Growth Telephone per Capita
Botswana	9.98	1.85
Lesotho	7.07	0.82
Swaziland	3.33	2.94
Malawi	3.26	0.61
Tanzania	3.13	0.52
Zimbabwe	2.71	3.15
South Africa	2.06	12.47
Zambia	0.58	1.16
Mozambique	-0.86	0.44

5.1 GDP and Telephone penetration

We have move beyond the analysis of the simple regression analyses of the past.

Two models were estimated with the available data:

$ln(GDP) = \alpha + \beta\ ln\ (DEL_{-1})$ (1)

$ln\ (DEL) = \alpha + \beta\ ln(GDP)$ (2)

The first model analyzes the growth rates of GDP with telephone penetration lagged one period. The working hypotheses is that DELs represent a proxy for investment in telecommunications and will take one period to manifest this impact; i.e., if telecommunications investment has an impact on the growth of GDP, this will most likely occur with a lag.

The second model is in the current period and has no lags; i.e. growth in GDP should have an instantaneous impact on telephone penetration, if population and other exogenous variables are held constant.

The results of this two equation system are indicated in Table 5-2. The results confirm the hypothesis that telecommunications investment drives growth and , conversely, GDP growth drives telecommunications lines.[25]

Table 5-2
Model of Elasticity for Telephones versus GDP

Country	Model 1 Elasticity	R^2	Model 2 Elasticity	R^2
Botswana	0.75*	0.89	1.21*	0.94

Lesotho	0.25*	0.81	3.11*	0.62
Malawi	0.47*	0.95	1.91*	0.94
Mozambique	0.20	0.10	-0.15	0.05
South Africa	0.31*	0.85	2.99*	0.84
Swaziland	0.55*	0.79	1.39*	0.53
Tanzania	0.49*	0.98	2.18*	0.96
Zambia	0.06*	0.89	13.98	0.53
Zimbabwe	0.77*	0.84	1.22*	0.92

* Indicates significant at the 95 % level.

The primary assumption is that new telecommunications investments are a necessary but not sufficient condition for economic growth. Many factors other than telephone investment are critical to growth, but the lack of this investment will limit growth no matter what resources are dedicated in other areas of the economy.

The close correlation between telephone density and GDP per capita, as indicated by the numerous correlation studies which have been conducted (see Section 4.1.1) have been upheld by this analysis.

At this stage the results are suggestive, but for these countries in particular, give the extremely low penetration per capita, a much more elaborate analysis is required before one can identify time path of the telephone's relationship with GDP. That is , the countries discussed in the study are on the extreme left side of a traditional saturation curve (S-curve). Consequently, comparisons with countries who are further along the S-curve (more industrial countries) is speculative at best. Nonetheless, these countries by virtue of their position the S-curve are more likely to benefit from any activity which encourages and promotes communications.[26]

If we use the previous correlation analysis to derive an imputed level of telephone development for each Southern African country. The gap between "normal" and actual is indicated in the table below, and on Figure 7. The countries within the SADC and RSA are considerably below the normal telephone density and are considered underdeveloped in telecommunications.

6 Conclusions

Making generalizations about the relationship between telecommunications infrastructure investment and economic investment is problematic. However, some themes seem to stand out.

Almost all of the discussions, both theoretical and empirical, depict a positive relationship between these variables. But, the strength of that relationship appears to vary widely. The conclusion that can be drawn is that arguments about the existence of a positive relationship are moot. The important issues pertain to describing the relationship and delineating the reasons for variations in the strength of the relationship.

As stated earlier, neither investment in infrastructure generally nor investment in telecommunications infrastructure is sufficient for economic growth. Other conditions must be present. The region must have the human and capital resources as well as other infrastructure investments to obtain greater benefits from telecommunications infrastructure investment. The timing of the investment and the type of telecommunications investment relative to other modernization factors may well be of great importance. Also, installing new equipment that can provide a broader array of services will have a greater impact than marginal expansion of an existing network, providing that preconditions for modernization of other sectors of the economy are present.

Quality of service is an important variable in determining the strength of the relationship between investment and growth. Quality of service includes minimizing outages and blockages as well as the ability to expand to meet new demands.

A critical constraint is the enormous investment requirements needed to provide the population with adequate telephone communications. Another constraint is a shortage of adequately trained technical and managerial personnel.

A primary objective of this review is to formally define the interaction between telecommunications and economic growth, and apply the most appropriate methodology for the SADC and RSA. The macroeconomic statistical methods was investigated for telecommunications. The generic models available, however, cannot be easily transferred to specific regions, countries or sectors. The microeconomic approach can produce significant results, particularly by displaying the influence of telecommunications on specific projects in the transportation and service sectors of the economy. However, a microeconomic analysis of telecommunications within the SADC and RSA is fatally flawed by the fact that valid and reproducible data of the sort required for an effective analysis is not available for the SADC and RSA countries.

The macroeconomic approach indicates the impact of telecommunication on the economy in general. Procedures can include: correlation, cost/benefit, decision modeling or econometric modeling techniques. Although effective telecommunications econometric models have been developed for other regions, their application would not be appropriate for the countries in SADC and RSA due to the deficiencies in data. Perhaps a more effective approach is a simple correlative model for determining the potential gap between projected demand

and supply for telecommunication services. A decision model would support this approach by providing an indication of the potential costs and benefits for each country expanding telecommunications operations.

After reviewing the various methodologies available to measure the potential impact of telecommunications on economic growth, and taking into account the data constraints, it is recommended that a direct macroeconomic correlation model be defined for each country in conjunction with the decision model. The macro-model will assist in determining the appropriate growth potential for telecommunications for each country, and the impact on economic growth. The decision model is designed to duplicate the judgment of an entrepreneur, viewing the Southern African countries in an independent, unbiased manner and suggesting a hierarchical ranking of investment beneficiaries for each country within the region. This is similar to the process used by investment banks in defining the comparative risk of a project. Substantial data development would be required for each country to effectively utilize more complex modeling procedures. However it is recommended that one or two countries within the region be selected to serve as a laboratory for more detailed analysis and data base development.

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