



# Government Studies Programme

**The economic benefits  
of improved telephone services  
to rural areas  
: phase I  
: report submitted to  
Dept. of Communications**

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# GOVERNMENT STUDIES PROGRAMME

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DALHOUSIE UNIVERSITY  
HALIFAX, NOVA SCOTIA

## THE ECONOMIC BENEFITS OF IMPROVED TELEPHONE SERVICES TO RURAL AREAS

Phase I Report  
Atlantic Region Special Project  
Rural Communications Program

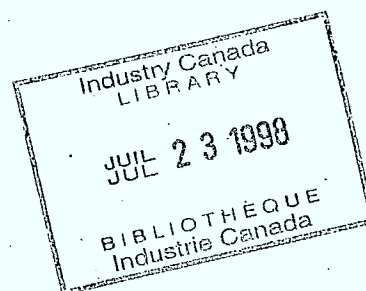
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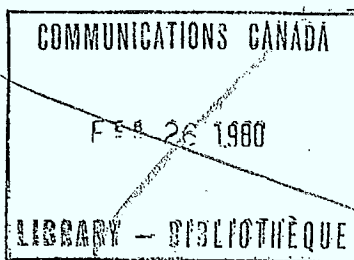
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## I. Introduction

In undertaking the development of a methodology for estimating the potential economic benefits of improved rural telephone services, it is first necessary to place the problem in context by defining the meaning of key terms.

The term "economic benefits" has two possible interpretations. On the one hand, assessment of the economic benefits of public projects, such as a program of improved rural telephone services, has traditionally focused on determining the net increase in the value of the total production possibilities and consumption opportunities made possible by such projects. Although this definition ultimately would be the most desirable one to measure if one were attempting to justify a case for improving rural telephone service, for purposes of this report a second and more modest definition of economic benefits is adopted. By economic benefits we mean simply the net impact of improved rural telephone services on certain basic economic phenomena such as employment, productivity, and income. Of course, determining the benefits as defined according to the second view is a prerequisite for the determination of benefits as defined according to the first view.

"Improved telephone service" is a phrase which similarly has different possible meanings. The possible benefits resulting from gaining first time access to the telephone network may be quite different from the benefits of effecting improvements in the quality of telephone services. Similarly, within the latter category, there may be substantial differences in benefits resulting from different types of quality improvements. For example, the possible benefits resulting from the introduction of dial

service may be quite different from the benefits that could result from a reduction of rural line fills, i.e., the number of parties to a line. For purposes of this report, attention will focus primarily on quality improvements in existing service given that there is now virtually universal accessibility to the telephone system in Canada in all but the most remote areas of the country. Little attempt will be made, moreover, to distinguish between the potentially different effects of different types of quality improvements. Although it is recognized that this could be important, its explicit consideration must be left for future work.

The term "rural" is also one which poses certain definitional problems. This report assumes that the definition of rural to be used will be that of Statistics Canada, namely, any community of less than 1000 people or area of less than 1000 people per square mile.

Finally, it is important to emphasize the definition of telephone service that is adopted. For purposes of this report telephone service will be defined as voice communications between at least two persons using the telephone system. The report will not be concerned with non-voice uses of the telephone, such as data transmission or video hook-ups, nor will it make any attempt to assess the broader area of telecommunications service, which would encompass broadcasting, telegraph and telex, closed-circuit television, etc.

Two further comments need to be made. First, it will be presumed that the policy goal prompting the consideration of the economic benefits of improving rural telephone service is the desire to promote rural economic development. To this end, as noted above, the report will focus on a discussion of the impact on the rural economy of improving rural telephone



service. It needs to be emphasized, however, that an improved rural telephone network has the potential to confer benefits outside the rural area. For example, if an improved telephone system allowed for more centralization of industry which is quite possible especially in terms of a distribution network, rural economies might lose firms and, hence, employment opportunities while the overall economy benefitted from increased economic efficiency in resource allocation and use. The welfare of the rural economy itself would not be enhanced in the same way as it would if new firms were induced to locate in rural areas through an improvement in telephone service.

Second, this report will concern itself entirely with the question of benefits and will not treat the question of the costs of the improvements in rural telephone service. This bears mention because although the benefits are theoretically separate from costs and can be identified as such, in practice cost, or more particularly the incidence of cost, may influence benefits. For example, if the cost of improving rural telephone service is to be borne entirely by the individual subscribers in the rural area, the benefits from the improved service may be quite different than if the cost of the improvements were to be underwritten by the government. Firms deciding whether or not to locate in a rural area might well decide not to locate there if they must bear the full cost of bringing the telephone system up to the level of their needs. If the location of new industry in rural areas is considered to be one of the possible benefits of improving rural telephone service, then the ability to realize the benefits may be influenced by the incidence of the cost of the improvements.

## II Identification and Categorization of Benefits

The improvement of telephone service in rural areas is not a goal in and of itself. Rather, it is a possible instrument or tool to be used in realizing the goal of rural economic development. In this regard, in order to evaluate and justify any planned expenditures for the improvement of rural telephone service, it becomes important to have some understanding of the nature of, and magnitude of, the effects on the rural area of any such improvements in the telephone system.

Telephones serve a number of functions in today's society, both to the individual and to business firms and government. The telephone serves a "security" function; it serves a "social" function; and it serves a "business" function.

The "security" function of the telephone refers to the use of a telephone for emergency purposes. The telephone represents the quickest way of obtaining police, fire, or medical assistance. It provides relatively instant communication and is thus vastly superior to other means of communication in this context. On a somewhat different level, the telephone has given rise to a variety of "help line" programmes -- places to call for psychiatric counselling or other counselling services and it offers the "security" of simply being able to call a friend and talk if you are feeling lonely or despondent. By definition, a rural community or rural area is one which has a small number of people spread over a large area. Essential services such as police, fire, or medical services, are usually quite distant. The ability to communicate quickly in an emergency is thus extremely crucial.

The "social" function of the telephone refers to the use of a telephone by subscribers for "social" purposes -- the calling of a

neighbour to chat or the calling of a relative, etc. In this sense, the telephone may increase the degree of social contact within an area and between one area and another. It serves as a substitute for face-to-face meetings or for other means of communication such as the mail. Distance from neighbours in rural areas may mean less social interaction in rural communities and the presence of a good telephone system may allow for greater social interaction by reducing the time required to maintain contact and/or by increasing the number of contacts that can be made. Further, through the provision of long-distance service, the telephone allows for increased contact with people outside the immediate community. For the rural area, this not only allows contact to be maintained with relatives and friends in distant places but also potentially allows rural residents to become involved in activities outside of their local area which might otherwise be impossible.

The "business" function of the telephone is, for the purposes of the present report, potentially more important than the other two. It refers to the use of the telephone for business reasons, either to satisfy the internal communication needs of a business enterprise or the external needs relating to contact with suppliers, customers, and employees.

The fact that business firms rely on, and make extensive use of, the telephone is not evidence that the availability of a telephone system of a certain quality, in itself, is of any influence in the location of the firm in the first place. A high observed correlation between the availability of telephone services of a certain quality and the use of the phone system by business or the availability of the telephone and the concentration of business activity does not necessarily imply anything of causality. Hence to isolate the possible influences on business firms



of improvements in the telephone system in rural areas, it is necessary to begin at a more conceptual level to consider the potential sources of benefits from an improved telephone system.

The available literature on the benefits of an improved telephone system is extremely sparse. There is, however, work that has been done on the role of telecommunications in developing countries and there are also references to be found in the regional economics literature generally, and in the literature dealing specifically with the role of infrastructure in area development. In the following paragraphs we consider briefly the major points made in this literature and their implications for the problem of estimating the economic benefits of improved telephone services to rural areas.

The Role of Telecommunications in LDC's. A 1972 report on World Bank Activities made the following comment on the benefits of a telephone system in developing countries:

It is not surprising to find that the economic return on investment in expansion of telecommunication services, when measured by willingness of users to pay for installation and for use, can approximate 50% in some cases. .... These high returns are consistent, however, with what one would expect to be the expanding communication needs of a growing economy: for efficient administration of government and industry, for effective competition in business, for orderly marketing and the national movement of goods, for reduction of industrial and business inventories, for tourism, etc. Also, where literacy is low, telephone conversations are more suitable than mail for settling transactions which require checking and bargaining. Telephones provide amenities which some would regard as of questionable priority in poor countries; these amenities are a by-product of the important economic service provided by a good telecommunication system. Telephone facilities in developing countries are useful mainly for government, business, and professional purposes.<sup>1</sup>

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<sup>1</sup>International Bank for Reconstruction and Development, World Bank Operations, Sectoral Programmes and Policies (Baltimore: Johns Hopkins Press, 1972). p. 198.

In another 1972 paper, Bjorn Wellenius has argued that, for telecommunication services, "There is almost no objective knowledge on the probable effect of the provision of services on the economy or, rather, on society and environment in general."<sup>2</sup> But he goes on to argue that there is a need for economic planners to be in a position to rationally assess the resource commitment being made to telecommunications<sup>3</sup> and further, that the basis for such planning "is the quantitative evaluation of the effects of the telecommunication services on the consumer units."<sup>4</sup>

A 1976 paper by Peter Shapiro begins with the following statement:

A nation's industrial development is related to the scope and quality of its telecommunications system. This relationship has been demonstrated many times statistically on a world-wide basis, with per capita income or gross domestic product (G.D.P.) used as the measure of industrial development, and telephone density as the measure of telecommunications . . . .

Experience in many countries has been that causality applies in both directions. On one hand, telecommunication provides an important infrastructure for the operations of an industrialized, diversified economy that relies on interchange of information among mutually dependent participants. Telecommunication is needed for efficient administration of government and business, for effective operations of business from the stage of procuring supplies to that of marketing products, and for the performance of medical, legal, and other professional functions. On the other hand, an advanced stage of industrial development provides an economic base for telecommunication growth in terms of capital, technical expertise, and growth.<sup>5</sup>

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<sup>2</sup>Bjorn Wellenius, "On the Role of Telecommunications in the Development of Nations", IEEE Transactions on Communications, Vol. COM-20, No. 1, February, 1972, p. 3.

<sup>3</sup>Ibid., p. 5.

<sup>4</sup>Ibid., p. 5.

<sup>5</sup>Peter D. Shapiro, "Telecommunications and Industrial Development", IEEE Transactions on Communications, Vol. COM-24, No. 3, March 1976, pp. 305-306.

Shapiro goes on to assert:

However, there is no escaping the fundamental nature of telecommunications as an infrastructure for economic growth. Its true value for industrial development is tied inevitably to the ability of any one user to call any other user with whom there may be an economic relationship. To attain full value as a factor of industrial development, the telecommunication system must achieve a "critical mass" in density that is realized only when a substantial proportion of businesses and residences are accessible via the network.<sup>6</sup>

There are other references in the literature<sup>7</sup> which also deal with the role of telecommunications in developing countries all of which argue along essentially the same lines as those which have just been quoted. Although all of these writings present strong arguments in favour of more study of the benefits of telecommunications for the economic development of a country and point out something of the nature of these benefits, there are a number of problems in applying any of these results to the problem at hand, namely, the assessment of the economic benefits of an improved rural telephone system in Canada.

The first and most obvious problem is that the major focus of any discussion of telephone service in developing countries is a concern with accessibility, i.e., the provision of first time service. Shapiro, in the above quotation from his paper, speaks of a "critical mass" in density" that is realized only when "a substantial portion of businesses and

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<sup>6</sup>Ibid., p. 307.

<sup>7</sup>See, for example, E. L. Bebee and E.J.W. Gelling, "Telecommunications and Economic Development: A Model for Planning and Policy Making", Telecommunications Journal, 43, 8, 1976; D. Marsh, "Telecommunications as a Factor in the Economic Development of a Country", IEEE Transactions on Communications, Vol. COM-24, No. 7, July 1976; International Telecommunications Union, Memorandum on Project 9-GLO-76-001 (unpublished).

residences are accessible via the network".<sup>8</sup> To be sure, accessibility is not unrelated to quality, as is pointed out in the World Bank view of the problem,

In deciding on the components of any program, the first priority is to provide a satisfactory level of local and long distance service . . .

The capacity of the system must . . . be adequate to meet the peak traffic. Inadequate capacity results in congestion, rapid deterioration of service, and failure of calls.<sup>9</sup>

But the major point is that in Canada, in urban and rural areas, there is already a very high level of accessibility to the telephone network.<sup>10</sup> The question in Canada is then not only one of accessibility but also one of the effect of further improvements in the telephone system -- reduction of rural line fills, etc. -- and it is not clear that the benefits of improvements beyond the provision of first time network access are the same as the benefits of that first time access.

A second problem in attempting to apply any of the above studies on developing countries to the case of rural areas in Canada is that the major statistical evidence cited in support of the relationship between economic development and telephone development is the observable fact that countries with the highest levels of economic development are also the countries with the most highly developed telephone networks. But there is

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<sup>8</sup>Shapiro, op. cit.

<sup>9</sup>International Bank for Reconstruction and Development, op. cit., p. 202.

<sup>10</sup>As of 1970 Canada ranked fourth in the world in number of telephones per 100 population. Ibid., p. 212.

nothing in this statistical evidence to show that a telephone network is a precondition to economic development versus a condition for sustained economic development. It is the former issue, i.e., whether a telephone system is a precondition to growth which is at the heart of the consideration of improving the quality of the telephone network in rural Canada.

Telecommunications and Regional Development. The studies quoted above are all concerned with national economic development and do not consider a distinction between urban and rural development. As soon as this distinction is introduced, the problem moves more into the realm of regional economics and the issue of the spatial distribution of economic activity. But very little of the literature of regional economics or spatial distribution places any weight on the telephone network. There is general agreement that communications facilities are important to industrialization and growth:

. . . a quick acting communication system is implied by modern production techniques;<sup>11</sup>

but there is little agreement that telephones affect the spatial distribution of economic activity to any significant degree. Consider, for example, the following comment by Edgar Hoover:

Much has been made, in some speculations about the urban future, of the idea that with improved facilities for transport and particularly communication, distance means less and less, and people's contacts and access cease to be closely associated with space or location. It is clear that the typical household and business has had and will find it increasingly easy to develop and maintain ties with households and firms in other regions, and that such contacts will continue to increase. It is less clear, however, that

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<sup>11</sup>Richard L. Meier, A Communication Theory of Urban Growth (Cambridge: MIT Press (for the Joint Center for Urban Studies), 1962), p. 164.



this really has much bearing on the future of intra-urban spatial patterns with which we are concerned. A more likely presumption is that these growing, external contacts are simply in addition to, and not substitutes for, local contacts, which are likewise becoming more numerous, convenient, and multifarious. And there is no reason to expect a radical change in space relations unless and until some essentially distance-free communication obviates the necessity for existing important access desires that do depend on distance. The telephone did not do away with either the business office or the shopping trip, and it is doubtful that it diminished social travel. It is not easy to envisage any other device doing so in the foreseeable future.<sup>12</sup>

Consider also this comment by A. Losch:

It would disrupt logical geometrical development if one were to suppose that cheapness, rapidity, frequency, and extent of communications over long distances could create a special locational advantage that would result in more industries being established than would otherwise be the case . . .<sup>13</sup>;

or the following statement by Lithwick:

The urban content for development is made necessary by the demands of modern technology, particularly the requirements of large-scale production and hence mass markets, industrial specialization and hence close inter-industrial linkages, and large and specialized labour and capital resources. Because all these can occur only in large dense centers, cities are the sine qua non for industrialization and economic development.<sup>14</sup>

There is in fact a lot of support for this latter view as expressed by Lithwick which is referred to as the economies of agglomeration principle and has, in turn, influenced the growth center concept of regional development.

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<sup>12</sup>Edgar Hoover, "The Evolving Form and Organization of the Metropolis" in Harvey Perloff and Lowden Wingo (eds.), Issues in Urban Economics, Baltimore: The Johns Hopkins Press, 1968), pp. 273-274.

<sup>13</sup>A. Losch, The Economics of Location (New York: Wiley, 1953), reprinted by Yale University Press, 1967, pp. 131-132.

<sup>14</sup>N. H. Lithwick, Urban Canada, Problems and Prospects (Ottawa: Central Mortgage and Housing Corporation, 1970), pp. 15-16.

In a 1973 paper by D. Clark,<sup>15</sup> a study was made of trunk telephone call patterns in Wales in order to assess the impact of the telephone system on spatial organization. The major conclusion of the study was that,

Rather than invert existing patterns, telecommunications at present are reinforcing, not revolutionizing, traditional frameworks of spatial organization.<sup>16</sup>

Clark does note, however, the following:

This limited impact may reflect the speed with which telecommunications services were introduced in Wales. For some time, the size of the telecommunication system has been supply rather than demand determined. Certainly the availability of plant and switching equipment during the study period fell consistently short of consumer requirements. Hence, telecommunications were forced to adopt a lag rather than a lead role in determining spatial form. Rather than substitute new organizational structures, telecommunications have supplemented the existing patterns of information exchange.<sup>17</sup>

This last comment by Clark is important because it suggests that the telephone system, or more generally telecommunications, may be a pre-condition for affecting the spatial distribution of economic activity. This is an important notion because it suggests that the relevant way to look at improvements in the telephone system and their impact on rural economic development, is to consider telephones in the same manner as some recent work has considered the general role of infrastructure, of which the telephone system would be a component, in regional economic development.

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<sup>15</sup>D. Clark, "Communications and the Urban Future: A Study of Trunk Telephone Call Patterns in Wales", Regional Studies, 7, No. 3, 1973, pp. 315-321.

<sup>16</sup>Ibid., p. 320.

<sup>17</sup>Ibid., p. 321.

The Role of Intrastructure in Area Development. A 1973 paper by Walter Buhr<sup>18</sup> provides a very good discussion of the role of infrastructure in regional economic development. Buhr notes at the outset of his paper that:

It has been realized for some time that infrastructure plays an important part in regional economic development. The role of infrastructure in development can be characterized by the interrelationships between its effects and its determinants over time. Regarding the determinants of infrastructure, we must deal with the changing influences of economic, demographic and social variables on the growth of infrastructure capacities. With regard to the dependence of economic development on infrastructure, we are concerned with the effects of infrastructure. These effects deserve special attention since they have largely been neglected in the literature and in the practice of regional planning. The manifold interrelationships between economic development and the growth of infrastructure make infrastructure an important reference point for regional development policy.<sup>19</sup>

Buhr goes on to sketch out an infrastructure model at a conceptual level. In doing this, he makes two points which are particularly important in the present context. First he argues that, for development purposes, it is infrastructure as a whole, rather than any one of its constituent parts, which may be important:

These tests strongly support the notion of complementarity, typifying reactions of locators to the existence of infrastructure facilities in toto. Accordingly, we shall attempt to substantiate the hypothesis that infrastructure elements may have a significant development impact only if they are provided in sufficiently attractive bundles.<sup>20</sup>

In other words firms and households may require a number of infrastructure components either because each is so important that it cannot

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<sup>18</sup>Walter Buhr, "Toward the Design of Intraregional Infrastructure Policy", Papers of the Regional Science Association, 31, 1973.

<sup>19</sup>Ibid., p. 213.

<sup>20</sup>Ibid., p. 214

be foregone, regardless of what else is available, or because one infrastructure component may require the presence of some other(s) before its own usefulness can be maximized, i.e., the infrastructure components may be interdependent.

Second, Buhr argues that the cost-benefit analysis usually employed in evaluating infrastructure investments neglects the impact of these investments on development.

In other words a firm may require a number of infrastructure components either because each is so important that the firm cannot do without it, regardless of what else it has, or because one infrastructure component may require the presence of some other(s) before its own usefulness can be maximized, i.e., the infrastructure components may be interdependent.

Second, Buhr argues that the cost-benefit analysis usually employed in evaluating infrastructure investments neglects the impact of these investments on development.

One basic weakness of most benefit cost analyses lies in the estimation of future project benefits. These benefit-cost studies usually neglect the impact issue. It is often assumed that the project to be evaluated has no effects whatsoever, i.e., future demand is viewed as exogenously given . . . . The supposedly given incremental changes of growth factors are not analyzed in terms of location decisions made by households, firms, and government units. These studies also assume that other types of infrastructure services (more or less complementary to the services provided by the project in question) will be supplied without difficulty in the future. In these cases, infrastructure facilities do not emit effects; they merely provide services. In a different class of cases, in which infrastructure investment does induce effects on intraregional population and employment, these effects are assumed to be of such magnitude and direction that the underlying demand projections will be fulfilled. Studies of this kind assume that the necessary complementary infrastructure investments will exist and that their potentiality effects and those of the project will interact to attract locators. It is thereby assumed that the local infrastructure bundle

will simultaneously create sufficient incentive effects to locate and to stay. All of these conditions seem to be plausible only under the overall assumption of permanent economic growth . . . If on the one hand, growth should turn out to be unexpectedly high, shortages of infrastructure services and commodities may arise long before the investment planning horizon is reached . . . On the other hand, if the predicted growth does not materialize in the future, there will be substantial excess capacities in the infrastructure . . . It is obvious therefore that a more differentiated and elaborate approach to benefit estimation (which considers the effects of infrastructure) will be needed for future project appraisal.<sup>21</sup>

In a 1971 study done for the Telecommission established by the federal government, one of the principal conclusions reached was the following:

Telecommunications are an integral part of economic infrastructure and are essentially vital for a region of slow economic growth.<sup>22</sup>

The study supports this conclusion on the following basis:

While telecommunications may not have been either a prime cause or constraint to economic development they have been a very important catalyst for development and a vital part of the economic infrastructure. There are several indications of this:

- a) Regions of high economic development . . . invariably make more use of telephone communications than do regions of low development . . .
- b) Telephone development (expressed by telephones per 100 population) is higher in areas of high development than in areas of low development . . .
- c) Business telephone users generate higher calling rates than do residential users and this implies that a high level of business development is accompanied by a relatively high level of telephone usage.
- d) Telecommunications is, in a sense, a substitute for presence. Its availability in an underdeveloped area allows the user to overcome some of the disadvantages of distance . . . telecommunications can substitute for travel with an associated

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<sup>21</sup>Ibid., pp. 227-228.

<sup>22</sup>Department of Communications, Telecommission Study 2(d): Telecommunications and Regional Development, (Ottawa: Information Canada, 1971), p. 48.



saving in time, cost, and personnel. As a substitute for the mails, telecommunications can act to save time and to speed up a decision making process. As a means of access to information, telecommunications can allow quick and frequent access, by managers and others in a remote area, to the pools of information and talented advisors found in large population centers . . .<sup>23</sup>

A number of conclusions emerge from this brief literature review.

One of the major conclusions is a negative one. It is that no one really understands how the telephone system exerts its influence on national or regional development, nor the extent to which the telephone system exerts an influence on national or regional development. The simple fact seems to be that nobody has rigorously studied the problem. Almost without exception all the above references are based on casual observation. For example, the fact that regions with the highest level of economic development possess the highest telephone densities, as reported by the Telecommission study,<sup>24</sup> does not by itself support the conclusion that increasing telephone density, in a given region, will promote economic development in that region. To the contrary, it is very plausible to argue that increasing telephone density in, say, rural areas will promote economic development in urban areas because it allows firms to take advantage of the benefits of centralization of production and distribution facilities while still having quick and easy access to rural markets via the telephone. In other words, the "evidence" which the Telecommission study cites may not prove that the telephone has been an important instrument in regional economic development but rather that the telephone is an important instrument for creating and for maintaining regional disparities. Either conclusion is possible from the evidence cited; the detailed investigation

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<sup>23</sup>Ibid., pp. 24-25.

<sup>24</sup>Ibid.

necessary to prove one conclusion or the other is simply not there. Clearly, a strong case exists for doing the studies necessary to arrive at an empirical measure of the development impact of the telephone system and of improvements in the telephone system.

A second major conclusion is that the telephone system is universally regarded as a basic component of the social infrastructure, and it appears that the most promising avenue for pursuing the study of the economic benefits of improved rural telephone service is in terms of a model of the effects of infrastructure on development, as suggested by Buhr,<sup>25</sup> with emphasis on (1) the role of the telephone as an independent component of an infrastructure bundle and (2) the degree of complementarity between the telephone network and other components of the infrastructure bundle.

In this regard, any final conclusions on the impact of an improved telephone system would depend on the empirical analysis generated from this infrastructure model, but at a conceptual level various possible benefits can be pointed out.

First, the telephone, as has been suggested in some of the literature reviewed above, may provide a substitute for travel, thus reducing the influence of distance on location of firms. At the same time, however, it is possible that an improved telephone system could stimulate travel in either of two ways, as suggested in a 1971 article by Alex Reid:<sup>26</sup>

First, better long-distance electronic communication may permit firms to spread their sales (and other) operations more widely. This could mean more travel by the staff. Telecommunications would have stimulated travel, rather than reduced it . . .

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<sup>25</sup>Walter Buhr, op. cit.

<sup>26</sup>Alex Reid, "What Telecommunication Implies", New Society, 30, December 1971.

There is a second way in which improved telecommunication may increase business travel. At present, the businessman who leaves his office on a business trip is largely cut off while he is away. This prevents him from using his time fully, and presumably discourages travel . . . ways will surely be found before too long, to provide some portable means of allowing businessmen to maintain communication while in transit and at their destination.<sup>27</sup>

The main points to be made here are that the telephone network may substitute for travel, thus affecting location decisions and hence rural development and, at the same time (because the options are not mutually exclusive) may stimulate travel, thus underlining the interdependence or complementarity between the telephone network and the transportation network. The latter would be further evidenced in the fact that the telephone may allow for communication with distant suppliers and customers but a transportation network would still be important for the physical transport of supplies and finished products.

Second, the telephone may affect employment in rural areas. To the extent that the telephone affects location decisions of firms positively for rural areas, employment in rural areas will be correspondingly enhanced. Beyond this, however, the telephone may increase employment through facilitating contact between employees and employers. To take a hypothetical example, a fish plant in Nova Scotia might have a highly uncertain or unpredictable demand for workers depending on the timing of boat landings and /or the size of catches. The availability of a telephone network which permits quick contact with employees could significantly affect the number of workers accessible to the plant and hence the number of workers

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<sup>27</sup> Ibid., p. 1285.

employed by the plant.

Third, an improved rural telephone network could affect business productivity. The ability to communicate with employees, as noted above, would be one such influence. The ability to contact suppliers, quickly and at reasonable cost via the telephone could be another influence insofar as this could reduce the inventory requirements of firms in rural areas. This point again underlines the possible complementarity between the telephone network and the transportation network. Similarly, as another possible influence, the telephone has now acquired the potential to be used in education with the result that it can be used to significantly augment the quality of education in rural areas. The possible implication of this complementarity between the telephone system and the education system is that it could lead to a better trained work force in rural areas, with consequent implications for business productivity, and to an enhanced attractiveness of rural areas to trained workers with consequent implications for both productivity and overall employment.

Fourth, an improved rural telephone network could enhance and/or facilitate contact between firms and their customers which in turn could lead to increased production of goods and services. For rural areas, characterized as they are by low population densities, the ability of residential units, in particular, to obtain information from firms, and/or to place orders by telephone could affect the size of the firm's operations and indeed its ability to exist. Especially for service sector firms, it may only be through the enlarged market made available by the telephone that local operations within rural areas can be maintained.

The above enumeration of possible benefits to rural areas from an improved telephone network is not intended to be an exhaustive listing. Rather it is a suggestive listing that points out that, conceptually, benefits for rural economic development are possible. It is only through empirical investigation of the impact of telephone service that the actuality of these benefits and others can be demonstrated.

As a final point to be made, it must be emphasized that improving rural telephone service may create benefits which do not get reflected in increased rural economic development but rather in increased urban economic development. One of the outstanding and unique features of the telephone lies in the fact that it is a two way communication device. This means that putting more phones, or better phones, into a rural area not only gives those rural residents and firms a greater ability to communicate with one another and with residents and firms in other areas but also gives residents and firms in other areas a greater ability to communicate with the rural area in question. The potential calling capability of every subscriber in the total telephone system is enhanced when any part of the system is expanded. Also, the two way nature of the telephone means that benefits get derived not only by persons making calls but also by persons receiving calls. In more formal terms, what this means is that the telephone is characterized by the presence of externalities, benefits which accrue to persons other than the immediate subscriber.<sup>28</sup>

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<sup>28</sup>For a discussion of the externalities of telephone service see R. Artle and C. Averous, "The Telephone System as a Public Good: Static and Dynamic Aspects", The Bell Journal of Economics and Management Science, Vol. 4, No. 1, 1973, pp. 89-100; L. Squire, "Some Aspects of Optimal Pricing for Telecommunications", The Bell Journal of Economics and Management Science, Vol. 4, No. 2, 1973, pp. 515-525; and Jeffrey Rohlfs,



In terms of the concern of this report, the implication of the presence of these externalities is that the benefits potentially derived from improving the rural telephone system may be realized by economic units outside the rural area and, at the very least, will be shared by the rural area and other areas. Thus, for example, the telephone, in influencing business productivity, or location decisions, may confer the major benefits in this regard on urban firms by allowing for greater centralization of distribution facilities and/or production facilities with a simultaneous use of the telephone network to provide quick response to market demands from rural areas. In analogous fashion, the telephone may affect employment in rural areas, not by creating employment directly in rural communities but through improving the access of rural inhabitants to urban labour markets and/or, given the possible location effect just cited, rural inhabitants might actually be motivated to migrate to urban areas.

What this suggests is that in considering the economic benefits of improved rural telephone service, it is not sufficient to consider only the direct effect on the volume of economic activity originating in rural areas. To do so would mean ignoring a potentially important source of benefits and also would mean ignoring the distributional aspects of the problem, which could prove highly significant depending on the policy goals which lie behind the improvement of the rural telephone network. For if the goal is to promote rural economic development, improving the telephone system could well, in some instances, produce a negative effect. Alternatively, if the goal is to maximize the total benefits from the telephone system,

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"A Theory of Interdependent Demand for a Communications Service", *The Bell Journal of Economics and Management Science*, Vol. 6, No. 1, pp. 16-37.

regardless of how those benefits are distributed, then it will not be important where the benefits fall. In either case, the estimation of benefits to both rural and non-rural areas will be important.

### III. Quantitative Analysis of the Relation Between Telephone Development and Rural Development

This section outlines a method for analyzing statistically the aggregate relation between improvements in the level of telephone facilities and services and the level of economic development achieved in rural areas.

Evaluating the impact of telephone development on regional economic development is no easy task. That there is a relation between telephone development and regional development is a proposition that has never been subjected to even the most cursory empirical testing. There are probably several reasons for this. First, economists do not have a general theory capable of explaining how regional development occurs. Instead, there are only hypotheses regarding specific aspects of regional development such as growth center, export base, and sector theories.<sup>29</sup> Second, although it may seem easy to make the distinction between economically advanced regions and underdeveloped regions, the measurement of the level of development of an area is very difficult. Third, as pointed out in the preceding section almost no consideration has been given in the economic literature to the possible role played by telephones in area development. The proposal which follows is necessarily conditioned by all of these facts.

Three matters are taken up: (1) the conceptual approach adopted, (2) the problem of measuring the various aspects of development, and

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<sup>29</sup>For a review of existing hypotheses see Harvey S. Perloff et al., Regions, Resources and Economic Growth (Baltimore: Johns Hopkins, 1960), Chaps. 4-9 and J. P. Francis and N. G. Pillai, "Regional Development: Some Issues and Conceptual Problems", in Regional Poverty and Change (Ottawa: Canadian Council on Rural Development, 1976).

(3) the choice of statistical technique.

#### THE CONCEPTUAL APPROACH

What role does telecommunications play in area development? As the preceding section has noted, telecommunications planners, as well as specialists in both regional and development economics, regard telecommunications' major function to be that of a basic element of material infrastructure. As such, telecommunications investment is seen to be a catalyst in the development process and may be expected to contribute positively to the economic development of rural areas.

Viewing telecommunications as infrastructure suggests that the ideal approach to developing a conceptual framework for measuring the benefits of improved telephone services and facilities is to formulate a systematic model quantifying the structural relationships between infrastructure's effects on development on the one hand and the determinants of infrastructure on the other hand. Unfortunately, no such comprehensive model, which would enable planners to simulate and predict the impact of telecommunications investment on the development of rural economies, yet exists. It is known that economic development depends, in part, on improvements in the social infrastructure. It is also generally recognized that such improvements depend, in turn, on economic progress. But the difficult task of disentangling the causal relationships has not been solved. As the preceding section's discussion indicated, work in this field is at an embryonic stage.<sup>30</sup>

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<sup>30</sup> See, for example, Walter Buhr, *op. cit.*; Donald R. Glover and Julian L. Simon, "The Effect of Population Density on Infrastructure: The Case of

While the development of a general infrastructure model may be feasible, and would obviously be very desirable, its consideration is beyond the scope of the present report. Instead, the goal of the research proposed here is a more modest one, but one that is nevertheless just as essential to rational planning given the paucity of objective information that exists concerning the relation between telephone development and economic development. The goal is to develop an accurate and detailed picture of the aggregate statistical pattern between telephone development and the various other dimensions of rural development. To accomplish this, economic theory will be used to select and construct relevant multidimensional measures of rural development, including measures of the components of material infrastructure available in rural areas. Numerous studies, varying widely in quality and employing a variety of statistical techniques from relatively simple ones to relatively sophisticated ones, have used a similar approach to document the importance to development of factors other than telecommunications, including even political, social and cultural, as well as economic, ones. There is no reason why the relation of telephone development to economic development could not be similarly explored.

It is true that a few efforts have been directed specifically at relating telephone facility growth and economic growth, but these have amounted to no more than attempts to correlate telephone density and

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Road Building", Economic Development and Cultural Change, 23 (April 1975), pp. 453-468; L. H. Klaassen, Social Amenities in Area Economic Growth (Paris: OECD, 1968).

per capita national income.<sup>31</sup> While it may be said that the analysis we envision differs more in degree than in kind from these simplistic correlations between telephone density and per capita GNP, the indexes we would employ bear a stronger theoretical relation to the multi-dimensional concept of economic development and are therefore more satisfactory. Furthermore, we can employ a multidimensional index of telephone facility development instead of the unidimensional index which simply takes number of telephones per capita as the sole measure.

#### MEASURING ECONOMIC DEVELOPMENT

Economic development is a multifaceted concept. As a process, development occurs as a complex set of interrelated social and economic changes. The idea that there is a single measure which can adequately capture the degree of development is not tenable. This section indicates the nature of the information required to measure development and some of its various dimensions, including material infrastructure. It will be convenient to discuss these measures under three separate headings: (1) primary economic indicators, (2) secondary economic indicators, and (3) measures of infrastructure.

Primary Economic Indicators. There have been a number of studies which have sought to analyze the sources and extent of regional disparities in Canada.<sup>32</sup> Most often, the focus has been on comparing the inequality

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<sup>31</sup>Peter D. Shapiro, op. cit., and Donald J. Marsh, op. cit.

<sup>32</sup>Representative studies are Frank Denton, 'An Analysis of Interregional Differences in Manpower Utilization and Earnings, Economic Council of Canada, Staff Study No. 15 (Ottawa: Queen's Printer, 1966); J.P. Francis and N.G. Pillai, "Regional Economic Disparities and Federal Regional Development Policies in Canada", and John Heads, "Inter-Regional Disparities in Canada: A Statistical Analysis", both in Regional Poverty and Change, op. cit.; C.D. Burke and



that exists among the five major regions, vis., the Atlantic, Quebec, Ontario, and Prairies, and British Columbia. There have been none which have looked at the problem of the existence of inequalities among the nation's rural areas, and only a few have considered the disparities between rural Canada and urban Canada.

The standard methodology employed in these studies is simple and frequently amounts to nothing more than tabulating, for a variety of primary economic indicators, the per cent by which an indicator's value for a given region exceeds or falls short of its national average value. Nevertheless, these exercises have provided many insights into the sources of regional disparities in Canada and similar tabulations for rural areas would undoubtedly also prove revealing.

At the subnational level, the key primary economic indicator used to measure development is per capita personal income. More than any other single indicator, this comes closest to measuring the personal welfare of residents of an area. However, for our purposes, pure income figures will be misleading in two respects. First, in comparing the level of well-being of rural inhabitants across a nation as geographically dispersed as Canada, account would need to be taken of the differences that exist in the cost

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D.J. Ireland, "Growth Centres in Atlantic Canada", Paper prepared for a Conference on Growth Centres and Development Policy, Halifax, Nova Scotia, April, 1975; Economic Council of Canada, Options for Growth, Twelfth Annual Review (Ottawa: Information Canada, 1975), Chap. 2; Canadian Council on Rural Development, Rural Canada 1970: Prospects and Problems, Third Report and Review (Ottawa: Information Canada, 1970), Chap. 1; Organisation for Economic Co-operation and Development, Regional Problems and Policies in OECD Countries (Paris: OECD, 1976), Chap. IX.

of living and an appropriate adjustment would have to be made to the income data to correct for this. Second, and more difficult, would be the desirability of taking account of the high proportion of rural economic activity which is of an extra-market character, such as production of food and other consumables at home. We do not know at this time the extent to which this may be feasible, but some work on this has been done by others.<sup>33</sup>

In order to understand the sources of regional income disparities, it is important to decompose personal income into that portion which is earned as a result of economic activity taking place within the region and other income received. Earned income disparities are closely tied to disparities in a number of other primary economic indicators. One set of such indicators relates to employment opportunities. Whenever a region's percentage of population employed is below average, earned income per capita in that region will be lowered. Three factors affect the percentage of population employed. (1) the fraction of the population which is of working age, (2) the labor force participation rate, and (3) the percentage of the labor force employed.

A second indicator closely related to earned income per capita is productivity, since production and income are two sides of the same coin.

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<sup>33</sup>Frances M. Magrabi, et al., "An Index of the Economic Welfare of Rural Families", Journal of Consumer Research, 2 (December 1975), pp. 178-187 and Nancy M. Rudd and Kristin L. Kline, "Money Value of Consumption and Income of Rural Families: Two measures of Economic Status", Social Indicators Research, 3 (September 1976), pp. 217-236.

Productivity, in turn, depends on a host of factors, including the amount and quality of capital and natural resources per worker, on the scale of production, and on the quantity and quality of available human resources. Figure 1 lists the primary economic indicators essential to characterizing the level of area economic development.

Secondary Economic Indicators. According to the major theoretical hypotheses of regional economics, certain basic structural characteristics promote area development. However, unlike the situation concerning the relation between average incomes and the other primary economic indicators listed in Figure 1, there is often no real clear understanding of the nature of the links presumed to exist between these structural characteristics emphasized by the theory and increases in per capita income.

One structural aspect generally regarded as essential in promoting regional development is the industrial composition of an area. Industry mix affects development in several ways. First, a diversified mix enables a region to more easily shift resources from one use to another in response to fluctuations in market conditions, thereby helping to maintain the stability of income. A second way in which industry mix affects development is through productivity differences among industries. A region in which employment is concentrated in high productivity industries will have a high average level of productivity. The close tie between average productivity levels and average income levels has already been noted. Industrial composition, and especially the distribution of employment among the primary (agriculture, forestry, fishing, mining), secondary (manufacturing, construction), and tertiary (transportation, communications, trade, finance, insurance, real estate, public administration) activities

## FIGURE 1

## PRIMARY INDICATORS OF REGIONAL DISPARITIES

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Area real personal income per capita as a per cent of the national average.

Area real earned income per capita as a per cent of the national average

Area unemployment rate as a per cent of the national average.

Area labor force participation rate as per cent of the national average.

Area proportion of population that is of working age as a per cent of national proportion.

Area value added per employee as per cent of national average.

Total private investment per employee as per cent of national average.

Total public investment per capita as per cent of national average.

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is also stressed by the sector theory of economic growth, as well as by the proponents of the notion that regional development depends on the ability of an area to attract so-called growth industries.

Another structural characteristic thought to be important insofar as the generation of income and employment are concerned is the size of the export base and of the residentiary sector. The basic proposition is that the growth process is initiated through an increase in exports in response to an increase in demand from outside the region. This results in a further expansion of economic activity, through a multiplier effect, particularly in the production of goods and services for local consumption. Hence, studies of regional development have often tried to divide regional activity into that portion which represents the production of goods and services for export (the "basic" activities) and that portion which represents the production of goods and services for local consumption ("nonbasic" or "residentiary" activities).

These structural aspects upon which the existing regional development hypotheses focus are complex characteristics. Despite the lack of a clear understanding of how they impact on regional development, these characteristics are so widely regarded as important determinants of regional development that it would seem imperative for us, in assessing the state of development of rural areas, to attempt to develop indexes measuring some of these concepts. For each concept, this would require collapsing several interrelated variables into a single index. Possible candidates would include an index of basic activity, an index of residentiary activity, an index of employment in growth industries, and a measure of the degree of employment diversification.

Some work on this problem has been attempted,<sup>34</sup> but much more is needed before we could properly define the component variables that would go into constructing the various measures.

Measures of Infrastructure. As has been noted several times already any consideration of the role of telecommunications as an element of infrastructure contributing to the economic development of rural areas must take account of the complementary nature of infrastructure elements. Individual infrastructure elements may have a significant development impact only if they are provided as part of a more complete bundle of facilities. It seems safe to say that, by itself, telephone facility improvement is likely to have its greatest marginal impact on development in areas where certain other infrastructure elements are already in place. This demands that we construct indexes of the availability of all of the basic elements of material infrastructure, including health, education, housing, transportation, and telephones in order to determine which have the greatest degree of complementarity with telephone facilities in promoting rural development.

Inclusion in the present study of the measurement of these other components of infrastructure, and particularly of health, education, and housing, is important for another reason as well. It is now widely recognized that economic development means more than just the achievement of high levels of production, employment, and income. Indeed, it has become fashionable to speak of the "quality of life". Three major determinants of the overall

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<sup>34</sup> See U.S. Department of Commerce, Economic Development Administration, Developing Methodologies for Evaluating the Impact of EDA Programs (Washington, D.C.: January, 1972).



level of living of citizens are the quantity and quality of health facilities, education, and housing. Their importance is underscored by the fact that, today, access to adequate health, education, and housing are regarded as a matter of individual rights. Measurement of these benefits of development is, therefore, essential to a proper assessment of the welfare of rural residents.

The measurement of material infrastructure can best be described by providing a preliminary list of the data components required to follow through with the analysis. In doing so, we have recognized that the absence of certain facilities in rural areas may not necessarily imply a lack of adequate access to these facilities.

(1) Telephone facilities

- (a) Percent residences  
without telephones  
with single party service  
with two party service  
with four party service  
with more than four party service
- (b) Rural areas where one and two party service is not available
- (c) Number of public telephones
- (d) Repair delay statistics
- (e) Number of telephones which can be called free of long distance charge
- (f) Degree of line congestion at peak times
- (g) Availability of automatic dial
- (h) Availability of direct distance dialing

(2) Health facilities

- (a) Hospital beds/capita
- (b) Nurses/capita

- (c) Doctors/capita
  - (d) Dentists/capita
  - (e) Pharmacists/capita
  - (f) Distance from hospital or emergency facilities.
- (3) Transportation facilities
- (a) Miles of paved road/square mile of land
  - (b) Miles of unpaved road/square mile of land
  - (c) Proximity to major highways
  - (d) Proximity to airport
  - (e) Proximity to railroad
- (4) Education
- (a) Expenditures per pupil
  - (b) Teacher/pupil ratios for elementary, secondary, etc.
  - (c) Numbers and types of curricula per school district (business, vocational, university preparatory).
- (5) Housing<sup>35</sup>
- (a) Persons/room
  - (b) (Rental value/room) as per cent of income
- (6) Energy, water and sewage
- Availability of adequately serviced land for commercial and industrial purposes.

#### STATISTICAL TECHNIQUES

The preceding section dealt with data requirements. This section deals with the choice of statistical techniques.

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<sup>35</sup>See Economic Council of Canada, Economic Targets and Social Indicators, Eleventh Annual Review (Ottawa: Information Canada, 1974), Appendix A.

One possible approach to the problem of relating telephone development to regional development would be to try to "explain" one or more of the various primary economic indicators of development by multiple regression, using as independent variables measures of the structural features identified by theory as being essential to development, plus a variable measuring telephone development. However, at our present level of understanding nothing would be gained by taking this line. The interrelationships that exist between the various aspects of economic activity and the development of an area are exceedingly complex and not well understood. Until a testable causal model can be properly specified, a multiple regression approach is unlikely to yield useful results. The recent study by Debertain and Bradford<sup>36</sup> illustrates this perfectly.

Recognizing the problems inherent in using multiple regression analysis to explain the role of telecommunications in regional development has led to consideration of alternative techniques for studying the aggregate statistical pattern that exists between telephone development and rural development. Several techniques are available but two, in particular, stand out as being the most promising. These are cluster analysis and factor analysis. Both have been utilized in previous studies by investigators interested in the problem of the quantitative analysis of development. Particularly interesting for our purposes are the studies

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<sup>36</sup>D. L. Debertain and G. L. Bradford, "Conceptualizing and Quantifying Factors Influencing Growth and Development of Rural Economies", The Annals of Regional Science, Vol. X, No. 1, March 1976.

by Harbison, et al., Ewusi, Stone, and Barrows and Shaffer.<sup>37</sup>

The first three studies mentioned employ a type of cluster analysis in studying disparities in levels of development. Harbison, et al., applies the technique to a large cross-section of present-day nations. Stone uses it to analyze the structure of regional development in England. Ewusi uses it to analyze regional development in Ghana. The technique used in these particular studies is based on the Euclidean distance measure. It is straightforward and readily understood. As applied by these authors, the principal object of the analysis is to group regions into subsets whose elements are homogeneous in terms of selected characteristics of development, and to measure the extent to which the subsets differ from one another. The Euclidean distance measure is also applied to the prior problem of deriving the necessary composite indexes of development as well as to determining the extent to which a region is underdeveloped in comparison to some actual or hypothetical ideal region.

Figure 2, reproduced from the study by Ewusi, illustrates the type of information which it is possible to derive. The first column, labelled "pattern of development" represents a percentage scale of development and is derived from the pattern of development simply by calculating the ratio of the pattern of development to the "critical distance", where the

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<sup>37</sup> Frederick H. Harbison, et al., Quantitative Analysis of Modernization and Development (Princeton: Industrial Relations Section, 1970); Kodwo Ewusi, "Disparities in Levels of Regional Development in Ghana", Social Indicators Research, 3 (June 1976), pp. 75-100; Richard Stone, "A Comparison of the Economic Structure of Regions Based on the Concept of Distance", Journal of Regional Science, 2 (Fall 1960), pp. 1-20; Richard L. Barrows and Ron E. Shaffer, "Indicators of Development in Wisconsin Counties", Social Indicators Research, 2 (December 1975), pp. 333-360.

FIGURE 2

PATTERN OF DEVELOPMENT AND MEASURE OF DEVELOPMENT FOR  
REGIONS IN GHANA

Region	Pattern of Development	Measure of Development
Greater Accra	10.729	1.159
Western Region	4.205	0.454
Central Region	4.264	0.461
Eastern Region	3.804	0.441
Ashanti Region	3.648	0.394
Brong Ahafo Region	2.838	0.307
Volta Region	3.283	0.355
Northern Region	1.182	0.128
Upper Region	0.755	0.082

Source: Kodwo Ewusi, "Disparities in Levels of Regional Development in Ghana", Social Indicators Research, 3 (June 1976), Table II.

critical distance is the mean plus twice the standard deviation of the pattern of development. In this example, the pattern of development is derived from a single composite indicator based on the following ten socio-economic variables: (1) crude participation rate, (2) per capita energy consumption, (3) proportion of population employed in non-agricultural occupations, (4) rate of urbanization, (5) literacy rate, (6) population density per square mile, (7) earnings per worker, (8) doctors per 1000 persons, (9) hospital beds per 1000 persons, (10) an "accessibility" index. In the more thorough analysis of Harbison, et al., pattern of development and measure of development tables are calculated for each of several composite indexes, including an index of economic development, an index of cultural development, an index of health development, an index of educational effort, an index of high level manpower, a demographic index, and a composite index similar to the one computed by Ewusi.

One of the important drawbacks of the Euclidean distance method used by Harbison, et al. and Ewusi is that all variables entering into the construction of a given measure of development are equally weighted. Factor analysis is a technique which does not have this weakness.<sup>38</sup> A very interesting application of factor analysis is the study, already mentioned, by Barrows and Shaffer which uses this technique as a way of constructing several related composite indicators of development for county areas

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<sup>38</sup> A brief but excellent explanation of factor analysis may be found in Pan A. Yotopoulos and Jeffrey B. Nugent, Economics of Development, Empirical Investigations (New York: Harper and Row, 1976), pp. 32-33. Stone, op. cit., shows the relations between factor analysis and the type of cluster analysis employed by Harbison, et al., op. cit., and Ewusi, op. cit.



in Wisconsin.

Barrows and Shaffer constructed seven different indexes of development: (1) an economic base index, (2) an economic growth index, (3) a personal economic opportunity index, (4) a health facilities index, (5) a health status index, (6) an education input index, and (7) an educational attainment index.

It is interesting, and typical of all of the research we reviewed, that telecommunication facilities are not recognized as sufficiently important for county development to have been included in the study. While we would not necessarily choose to construct the same set of development indicators as that selected by Barrows and Shaffer, and while we do not necessarily agree with their choice of variables used in the construction of the composite indicators they have selected, this study would nevertheless serve as one of our principal models.

One of the important but not surprising conclusions to emerge from their analysis is the importance of urbanization to both the economic and social aspects of area development. Generally, counties located in the more urbanized portions of the state enjoyed the highest values for the economic base, economic growth, and personal economic opportunity index. However, while high values of the health facilities index showed no such geographic pattern, the health status index still showed the same general pattern as the economic indexes, confirming that the mere availability of a particular component of infrastructure is not sufficient to guarantee that the desired result will be forthcoming. Clearly, factors other than availability of health facilities are just as important to the determination of health quality.

#### IV. Summary and Recommendations

In this section we summarize the major conclusions of our investigation and make recommendations for future research.

##### Summary of Conclusions

The preceding sections reached a number of conclusions. These are:

a) There is strong support in parts of the economic development literature for the hypothesis that telephone development (and more broadly, telecommunications) is important for national economic development. The meager evidence offered in support of this hypothesis does not, however, necessarily apply to the issue of telephone development and economic development in rural Canada.

b) There is no consensus within the regional economics literature as to the impact of telephones on regional development. Most of the literature in this field does not even consider the role of communications. The mainstream adherence to the growth centre concept, agglomeration benefits, and the general role of urban centres in area development as well as the export base and sector theories do not suggest a strong relationship. A few writers, however, have suggested that telephones may indeed compensate for distance and be a factor in location decisions.

c) There is a growing awareness in the literature of the role of infrastructure on development. This appears to be the most profitable avenue for exploring the impact of improved telephone service on rural areas, as the telephone is part of the material infrastructure of a region.

Multiple regression analysis does not suggest itself as a particularly useful technique for isolating the impact of telephones on development without a conceptual framework in place which gives the regression equations

a priori meaning. At the same time, it is only through the development of a conceptual model and its subsequent testing and validation that a predication could be made of the likely impact of further telephone development on rural area development.

e) Some form of factor analysis, to construct indexes measuring various aspects of rural development, and some form of cluster analysis, to group areas which are similar in terms of various measured characteristics of development, are the most promising exploratory techniques to utilize if the aggregate statistical relationship between telephone development and rural economic development is to be analyzed prior to the development of a suitable conceptual framework.

The above conclusions lead naturally to several recommendations for future work on the identification and measurement of the economic benefits of improved rural telephone service.

#### Recommendations

a) It is recommended that any attempt to empirically verify the existence of an aggregate relationship between telephone development and rural economic development proceed as outlined in Section III by using economic theory in combination with appropriate statistical methods to develop a comprehensive set of indicators for measuring rural development, including the availability in rural areas of the various components of the social and material infrastructure of which telephones comprise one element. As indicated in Section III, this would entail a considerable amount of work both in defining and constructing the relevant measures and in determining their interrelationships. As a result, however, a

detailed profile of the economic status of rural areas would emerge.

This would be of immense value to telecommunications planners, especially insofar as pinpointing rural areas where priority should be given to the further improvement in telephone facilities and services. A considerable amount of the raw data for this exercise has already been collected by the demographic study component of Phase I, which this report accompanies.

b) There is a clear need to develop an adequate conceptual framework for predicting the likely economic impact and benefits of improved rural telephone service. Meaningful prediction of potential benefits can only proceed from a solid a priori base, which such a model would provide. In addition to the construction of the macroeconomic indicators of rural development and welfare the conceptual framework would need to comprise:

- (i) A microeconomic model which accounts for the role of telephones in the location, production, and consumption decisions of firms and households, by considering the general role in these decisions of material infrastructure and the specific role of telephones as an infrastructure component. As by-products of this modelling exercise, it will be possible to determine the minimum quantity and type of infrastructure investment necessary to realize the attractiveness to firms and households of rural areas with development potential as well as to determine the degree of complementarity and/or substitutability between telephones and other infrastructure components.
- (ii) Explicit specification of the linkages translating location decisions at the micro level into the impact of these decisions on the macroeconomic indicators developed as a result of carrying out recommendation (a) above. In this regard it needs to be

stressed that the selection and construction of the macro-economic indicators, the development of the microeconomic model detailing the role of infrastructure in location decisions, and the specification of the relationships linking the locational decisions to the aggregate measures can and should proceed simultaneously in order to ensure their compatibility with one another.

Figure 3 illustrates each of the above components and their linkages. With each of the above components in place, it would be possible to quantitatively assess the impact of upgraded rural telephone service by postulating such a change, seeing the immediate impact of this in the microeconomic model and translating this into its macroeconomic implications through the linkage model.

c) To provide a complete view of the benefits of rural telephone development, it would be necessary to consider also the externalities of telephone service. As was pointed out in Section II, the two way nature of telephone service and the externalities which are thus associated with the telephone create the possibility that at least part of the development impact of improved rural telephone service will be felt outside the rural area. Figure 4 illustrates the overall flow of information through the various components of the model, including those externality effects, which would translate a given change in rural telephone service into a measure of its net total economic benefit.

d) Finally, as was noted in the introductory section, the incidence of the cost of improving rural telephone service may affect the ability to realize the benefits of such improvements. The potential importance of

Figure 3

Principal Components for the Quantitative Assessment  
of the  
Economic Benefits of Improved Rural Telephone Service

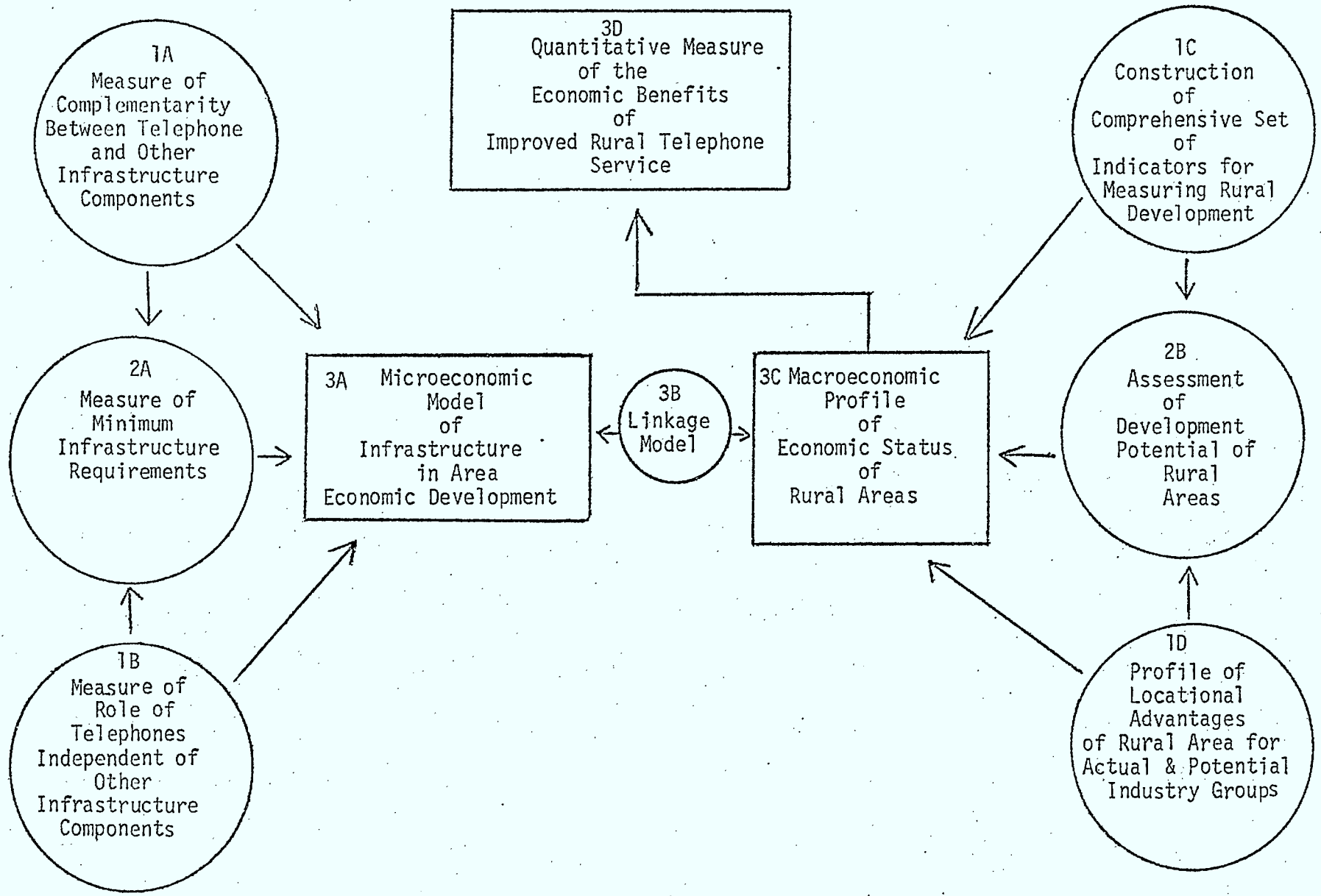
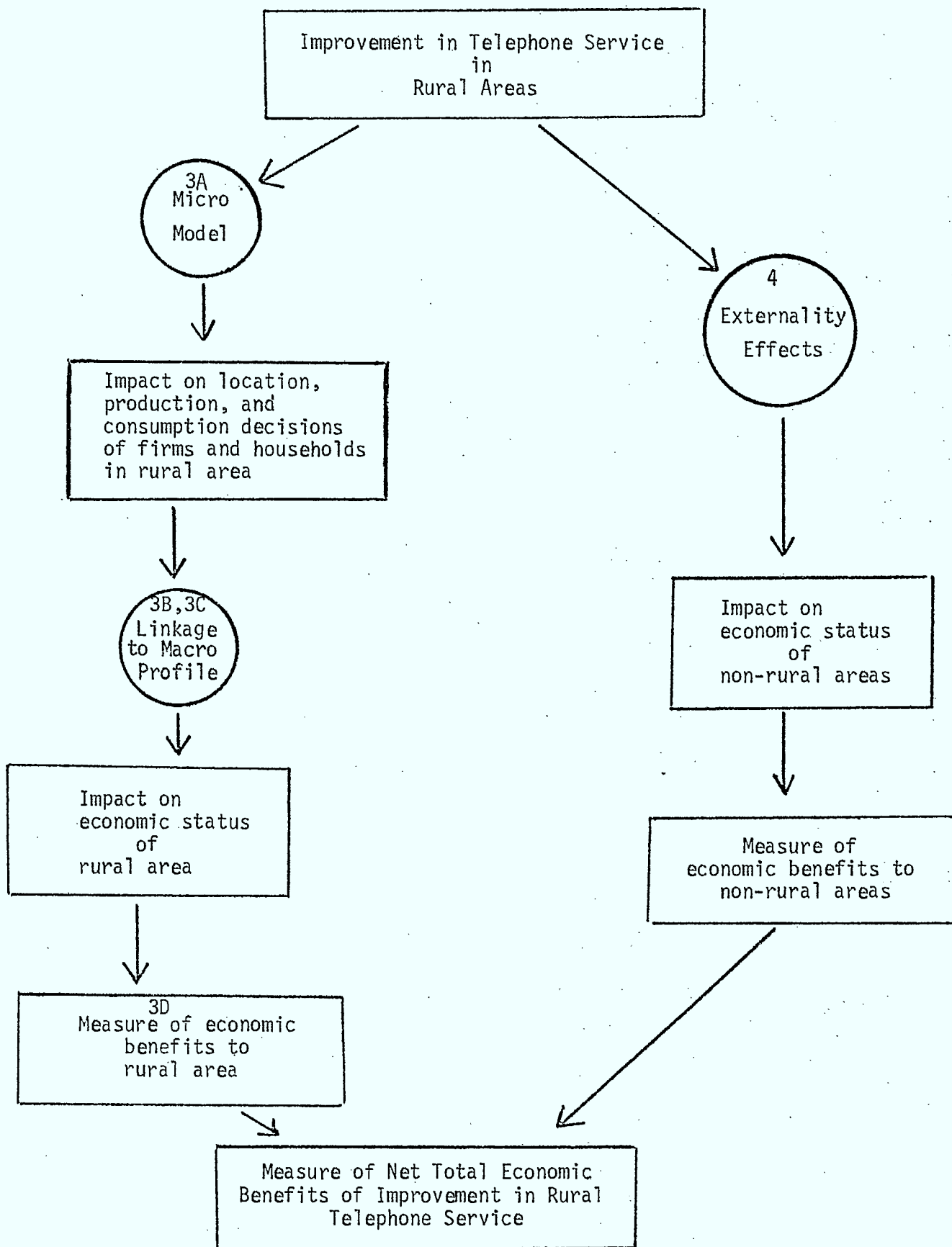




Figure 4

Information Flow Through Model Components



this consideration cannot be judged at this time but should be investigated in conjunction with the above tasks.

The sequence of steps through which this further work might best proceed is indicated by the labelling of Figures 3 and 4. Phase 1 would include steps 1A, 1B, 1C, and 1D, and Phases 2, 3, and 4 would follow as indicated. Phase 5, not shown, would conclude the project with a consideration of the impact of alternative cost-sharing arrangements on the realization of the potential benefits of improving rural telephone service derived from the first four phases.

In the time available for this special task, we have been unable to assess with confidence a realistic time schedule for completion of all of the phases described. However, within each phase, important information and conclusions relevant to the planning of telecommunications development in Canada, will be produced. Hence, the lack of a time schedule for the entire multi-phased study is not viewed as an obstacle to a start on Phase 1.



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