Closing the Gap in Access to Rural Communications

Chile 1995-2002

Björn Wellenius
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(Continued on the inside back cover)
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Björn Wellenius

The World Bank
Washington, D.C.
## Contents

Foreword ......................................................................................................................... vii  
Acknowledgments ........................................................................................................ viii  
Acronyms ................................................................................................................... lx  
Executive Summary .................................................................................................... 1  
1. Background .......................................................................................................... 3  

2. The Telecommunications Development Fund ...................................................... 5  
   Administration ........................................................................................................ 5  
   Eligible Projects ...................................................................................................... 6  
   Competitive Tenders ............................................................................................... 6  
   Licenses ................................................................................................................. 6  

3. Results, 1995–2002 ................................................................................................. 9  
   Population Coverage ............................................................................................ 9  
   Private Resource Mobilization .......................................................................... 10  
   Utilization and Revenues ................................................................................... 11  
   Operating Companies ......................................................................................... 12  

4. Success Factors ...................................................................................................... 15  
   Reliance on Market Forces .................................................................................. 15  
   Minimal Regulation ............................................................................................. 15  
   Simple and Relatively Fast Processing ............................................................... 16  
   Competence and Leadership ............................................................................. 16  

5. More on Selected Success Factors ......................................................................... 17  
   Competition for the Market ............................................................................ 17  
   Growth-Oriented Business Strategy ................................................................. 18  
   Cost-Reflective Access Charges ...................................................................... 20  

6. Improving the Basic Design .................................................................................. 23  
   Target Population ............................................................................................... 23  
   Selection Bias ...................................................................................................... 24  
   Local Participation ............................................................................................... 25  
   Implementation Delays and Penalties ................................................................. 26  
   Quality of Service and Monitoring .................................................................. 27  
   Administration .................................................................................................... 28
7. Outstanding Questions ........................................................................................................ 31
   Sustainability of Rural Service ......................................................................................... 31
   Remaining Unserved Rural Population .............................................................................. 32
   Low-Income Urban Areas ................................................................................................. 33

8. Beyond Voice .................................................................................................................. 35

9. Conclusion ...................................................................................................................... 39

Annex 1. Cost-Benefit Analysis of Projects ...................................................................... 41
   Private Cost-Benefit Analysis ......................................................................................... 41
     Costs .............................................................................................................................. 41
     Benefits ....................................................................................................................... 42
   Social Cost-Benefit Analysis ........................................................................................... 42
     Costs .............................................................................................................................. 43
     Benefits ....................................................................................................................... 43
   Project Selection ............................................................................................................. 43
   Discussion ......................................................................................................................... 44
     Private Costs and Revenues ......................................................................................... 44
     Impact on Subsidies ....................................................................................................... 45
     Social Costs and Benefits ............................................................................................. 45
     Scope for Improvement ................................................................................................. 46

Annex 2. Setting Access Charges for Rural Telephone Companies .................................. 47
   Background ...................................................................................................................... 47
   Method and Application ................................................................................................. 48
     Investments .................................................................................................................. 48
     Operating Expenses .................................................................................................... 49
     Cost of Capital ............................................................................................................ 49
     Other Parameters ........................................................................................................ 50
     Cost Allocation ........................................................................................................... 50
   Results .............................................................................................................................. 51
   Conclusion ....................................................................................................................... 51

Tables
Table 1. Telecommunications Sector Development in Chile, 1988–2000 ........................................ 3
Table 2. Seven Rounds of Tenders for Rural Telecommunications Projects, 1995–2000 ............... 10
Table 3. Financing of Rural Investment, 1995–2000 (US$ million) ............................................... 10
Table 4. Subsidy Awarded per Locality and per Inhabitant ....................................................... 11
Table 5. Outgoing Payphone Calls per Month, per Inhabitant

Table 6. Companies Providing Rural Services Supported by the Fund, 2001

Table 7. Investments Mobilized by the Fund, 1995–2000

Table 8. Subsidy Bid as Percentage of Available Subsidy

Table 9. Access Charges for Different Companies, 2001

Table 10. Committed and Installed Rural Payphones, 1997–2002

Table 11. Access to Computers, 1998 (% of population)

Table 12. Rural Tariffs, Official Gazette, February 26 1999
Foreword

Three billion people live in rural areas, and most of them have never made a phone call. Although increasing competition and private participation in the telecommunication sector has extended service to new localities and lower-income groups, major segments of the population remain excluded. How can one expect the information revolution to benefit the poor under these circumstances?

Chile is showing how. Building on major sector reforms in the late 1980s, Chile pioneered in the mid-1990s the use of competition for markets and subsidies to mobilize additional private investment in rural telecommunications. Since then, in an effort financed largely by the private sector with only a small contribution of public funds, the proportion of Chileans living in localities without even a payphone has fallen dramatically—from 15 percent in 1994 to a projected 1 percent in 2002. This cost-effective approach to extending services beyond what operating companies are prepared to do on their own has become international best practice and is being replicated in various forms elsewhere in Latin America, Asia, and Africa.

In this study Björn Wellenius documents and reviews the Chilean experience in rural telecommunications. The report focuses on the principles, practical organization, results, improvements on the basic design, outstanding issues, and prospects for extension of the approach to more advanced forms of communication and access to information. We expect that this report will help other developing countries learn from the Chilean experience, adapt it to their own needs and circumstances, and accelerate their efforts to improve basic access to communication.

Mohsen Khalil
Director
Global Information and Communications Technologies Department
The World Bank Group
Acknowledgments

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Acronyms

CNT  Compañía Nacional de Teléfonos S.A.
CTC  Compañía de Telecomunicaciones de Chile S.A.
CTR  Comunicaciones y Telefonía Rural S.A.
ENTEL Empresa Nacional de Telecomunicaciones S.A.
GVT  Global Village Telecommunications S.A.
ITU  International Telecommunication Union
IRR  internal rate of return
NPV  net present value
SUBTEL Subsecretaría de Telecomunicaciones
WLL  wireless local loop
Executive Summary

Although telecommunications reforms in Chile led to rapid development in the 1990s driven by the private sector, rural areas remained largely excluded because of the high cost of providing service, low revenue potential, and lack of strategic interest to the operating companies. In 1994 the government established a Telecommunications Development Fund, financed by the national budget, to catalyze additional private investment in payphone service in rural and urban areas with low income and low telephone density.

The Fund has been very successful. Between 1995 and 2000 it supported the provision of payphone service to more than 6,000 rural localities with about 2.2 million inhabitants, thereby reducing the proportion of Chile’s population living in places without access to basic voice communication from 15 percent in 1994 to 1 percent in 2002. In addition, some 25,000 individual rural telephone lines are being provided. The subsidies awarded cost the government less than 0.3 percent of total telecommunications sector revenue during the funding period, and Fund administration cost about 3 percent of the monies granted.

The Fund’s success was due largely to extensive reliance on market forces to determine and allocate subsidies, minimal regulatory intervention, simple and relatively expeditious processing, and effective government leadership. Competition among existing and new operators for the rural market and subsidies led to substantial reductions in cost to the government compared to earlier public sector investments in similar facilities. Commercial success has hinged on operators using the subsidized payphone infrastructures to also provide individual business and residential telephone lines and, subsequently, add value through new services (including voice mail and internet access in some areas) over this network. Interconnection was the single most important regulatory factor of commercial viability, with access charges in some cases surpassing 40 percent of rural operating revenues.

The design of the Fund proved robust, and remains the leading example of a cost-effective solution to reduce access gaps in basic communication in emerging economies. Some questions remain, however, about whether the services can be sustained in the long term, what to do with the small residual rural population still excluded, and whether anything needs to be done in urban areas. These questions—in addition to limited design improvements suggested by the Fund’s experience, as well as work still in progress on quality standards and monitoring—are relevant to the Fund’s proposed extension into more advanced modes of communication and access to information, as well as to other countries learning from the Chilean experience.
Background

Reforms in Chile led to rapid development in the telecommunications sector in the 1990s. Privatization of state-owned enterprises was completed in 1988, and the remaining legal and regulatory barriers to entry and competition in all market segments were removed by 1994. This resulted in fast growth, new services, technological innovation, high productivity, and prices among the world's lowest. By 2000 the number of fixed and mobile phone connections had multiplied ten-fold, service had become widely available, and more than 70 percent of households had a telephone (Table 1).

Table 1. Telecommunications Sector Development in Chile, 1988–2000

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Telephone main lines (million)</td>
<td>0.6</td>
<td>1.6</td>
<td>3.2</td>
</tr>
<tr>
<td>Mobile customers (million)</td>
<td>0.0</td>
<td>0.1</td>
<td>2.8</td>
</tr>
<tr>
<td>Total connections (million)</td>
<td>0.6</td>
<td>1.7</td>
<td>6.0</td>
</tr>
<tr>
<td>Per 100 inhabitants</td>
<td>5</td>
<td>11</td>
<td>39</td>
</tr>
<tr>
<td>Outstanding applications (years)</td>
<td>7</td>
<td>0.7</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Telephone digitalization (% lines)</td>
<td>38</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Telephone main lines per employee</td>
<td>74</td>
<td>208</td>
<td>223*</td>
</tr>
<tr>
<td>Households with telephone (%)</td>
<td>16</td>
<td>40</td>
<td>74</td>
</tr>
</tbody>
</table>

*ITU figure for 1999. Actual for 2000 is likely to be higher.

Sources: Compiled by the author from data provided by CTC, ITU, and Alfa Centauro. Figures for 2000 are provisional. Figures for households with telephone are estimates.

Significant population groups, however, remained excluded. In 1994 most rural inhabitants, accounting for about 15 percent of all Chileans, lived in localities that did not have even a payphone. Pockets of poor urban dwellers also had no service. The following chapters describe the government's subsequent efforts to narrow this gap through July 2001. This report was completed in May 2001 and reflects the situation in Chile until that date.
The Telecommunications Development Fund

The Fondo de Desarrollo de las Telecomunicaciones (Telecommunications Development Fund) was created by a 1994 amendment to the telecommunications law of 1982.\(^1\) Implementing regulations were issued later the same year by presidential decree.\(^2\) Although the telecommunications law provided for the Fund to close in four years (in 1998), its duration was extended by provisions in the budget laws of 1999 and 2000 as needed to complete a task that proved larger than initially assessed.

The objective of the Fund was to provide payphones in rural and low-income urban areas with low income and low telephone density. To this end, the Fund offered subsidies to private operating companies willing to invest in these services. The subsidies were allocated through competitive tenders and financed by the national budget.

Administration

The Fund was administered by a council of seven members appointed by the president of the Republic. The Council included the ministers of Transport and Telecommunications (chair), Economy, Finance, and Planning (or their representatives), and three telecommunications professionals from different regions. The Council:

- Decided on the annual program and priorities of projects eligible for subsidy
- Awarded the subsidies through public competitive tender
- Published an annual report on the Fund.

The deputy minister of Transport and Telecommunications, the telecommunications sector authority and regulator, was executive secretary to the Council. His office, the Subsecretaría de Telecomunicaciones (SUBTEL), provided the Council’s secretariat and was responsible for all the technical and administrative work of the Fund.

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Eligible Projects

Once a year, SUBTEL collected requests for payphones from regional and local authorities, neighborhood associations, telecommunications companies, and the general public. A simple half-page form was completed by any interested party and conveyed to SUBTEL through regional government offices. SUBTEL grouped these requests into projects, each typically comprising 20–50 localities, according to geographical proximity and technical solutions likely to be cost-effective, and carried out private and social cost-benefit analyses for each project (Annex 1).

Projects deemed desirable from the viewpoint of the economy at large (that is, those with positive social net present value, or NPV) but unlikely to be commercially viable on their own (negative private NPV) were added to the pool of eligible projects. The maximum subsidy to be offered for a project was the amount needed to render it commercially viable (the absolute value of the private NPV). The projects in the pool, including any that remained unallocated from previous rounds, were ranked by social NPV per unit of maximum subsidy.

Competitive Tenders

Public competitive bids were invited for each project in the pool, in rank order down to the limit of available funds assuming the maximum subsidy would be bid for each project. Existing as well as new operating companies, subject only to minimal legal requirements, could bid. Each project was awarded to the bidder requiring the lowest one-time subsidy.

The tender documents specified for each project the localities to be served, conditions of service, maximum price of regional calls with indexing formula, deadlines to complete works and initiate service, and bid evaluation rules. Payphones were required to be available to the public 24 hours a day, every day, for 10 years. Although bids could propose additional services (such as individual business or residential telephone lines), and these were included in the licenses, they were neither taken into account for bid evaluation nor eligible for additional subsidy. Payphone service was required to begin by the dates specified for each project, usually 6–20 months after the license was granted. The subsidy was paid in full once all payphones in the project were certified to be in service.

Licenses

The winning bidder for each project was granted within 60 days a non-exclusive 30-year operating license to provide one payphone in each locality included in the project as well as any additional services included in the bid. Any necessary radio authorizations were processed and granted concurrently at no additional initial cost.\(^3\)

\(^3\) Users of radio frequencies, including those authorized through the Fund, pay annual fees.
Licensees are free to set the retail prices of all services, except for regional call charges from payphones for which maxima were defined in the tender documents for the full 10 years of required service. These maximum charges are subject to a fixed adjustment formula to reflect changes in wholesale prices, cost of labor, foreign exchange, and the corporate tax rate.

Maximum retail prices for regional calls from payphones are equivalent to about US$0.11 per minute (or about US$0.33 for a typical three-minute call) during peak hours to any telephone within the primary service area in which the payphone is located. This usually includes calls to the municipal headquarters town, several other towns and cities, and the regional capital. Operators often charge lower rates per minute for longer calls and during off-peak hours. In comparison, local calls from urban payphones are priced at around US$0.20 for up to five minutes any time of the day.

Calls beyond the primary area are carried by competing long-distance operators for an additional (unregulated) charge. Payphone licensees and long-distance carriers must post at each payphone the call charges they actually charge, and they must inform SUBTEL of any changes.

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4 Chile is divided into 24 primary service areas. Local telephone companies provide services within primary areas. Only separate competing companies can carry calls between primary areas.
Results, 1995–2002

The Fund has succeeded in extending access to basic voice communication service to virtually all Chileans living in rural areas. This has been largely financed by private companies. From 1995 to 2000 the Fund undertook seven rounds of licensing. Total subsidies committed by the Fund are equivalent to about 0.3 percent of total telecommunications sector revenue during this period, placing the Fund among the most cost-effective telecommunications support programs worldwide. Administration of the Fund cost less than 3 percent of the subsidies granted.

Population Coverage

By 2002 a total of 6,093 rural localities with about 2.2 million inhabitants will have been provided with payphones (Table 2). Only some 150,000 inhabitants, or 1 percent of the population, are likely to remain excluded, compared with about 15 percent in 1994 when the Fund was created. Additionally, some 25,000 individual rural telephone lines will have been provided. Over 90 percent of payphones and 80 percent of additional lines were already in service at the end of 2000.

Fund support has been widely distributed across Chile’s rural population. Seventy-four percent of localities subsidized by the Fund are in regions VI to X, the main agricultural zones in central and south-central Chile, which have 75 percent of the country’s rural population. Regions I to III, in the extreme north, and regions XI and XII, in the extreme south, together have 3.9 percent of all subsidized localities and 4.2 percent of the total rural population.


6 These figures are indicative. Precise numbers of initially unserved population are not available, partly due to different definitions and population estimates used by the Fund and the national statistical service.

7 The view of some observers that the Fund was biased in favor of the central and south-central regions is thus not supported. On the contrary, since the cost of service is higher in extreme regions, and localities are more widely scattered, these regions have received a disproportionately large share of Fund money and projects: 26 percent of funds and 22 percent of awarded projects for only 4.2 percent of total rural population.
Table 2. Seven Rounds of Tenders for Rural Telecommunications Projects, 1995–2000

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tendered</td>
<td>1,286</td>
<td>2,463</td>
<td>2,176</td>
<td>1,023</td>
<td>725</td>
<td>177</td>
<td>—</td>
</tr>
<tr>
<td>Bid</td>
<td>1,106</td>
<td>1,632</td>
<td>2,146</td>
<td>858</td>
<td>554</td>
<td>143</td>
<td>6,439</td>
</tr>
<tr>
<td>Awarded</td>
<td>726b</td>
<td>1,632</td>
<td>2,146</td>
<td>858</td>
<td>554</td>
<td>143</td>
<td>6,059</td>
</tr>
<tr>
<td>Population of localities awarded (million)</td>
<td>0.24</td>
<td>0.76</td>
<td>0.77</td>
<td>0.23</td>
<td>0.15</td>
<td>0.04</td>
<td>2.2</td>
</tr>
<tr>
<td>Total subsidies awarded (US$ million)</td>
<td>2.01</td>
<td>0.87</td>
<td>7.28</td>
<td>5.19</td>
<td>4.58</td>
<td>1.82</td>
<td>21.8</td>
</tr>
</tbody>
</table>

a Figures are for two tenders carried out in 1997.

b Bids for eight projects comprising 380 localities with 0.22m inhabitants were not awarded for lack of a rule to resolve ties at zero subsidy. These localities were subsequently connected by one of the bidders (CTC) as extension of its main operating license.


Private Resource Mobilization

The expansion into the rural areas was largely financed by the private operating companies (Table 3). For every dollar of subsidy, the companies invested up to 20 dollars of their own money, averaging over six dollars. Total investment committed by the companies from 1995 to 2000 reached US$161m, of which 86 percent was financed by the companies and 14 percent by the Fund.

Table 3. Financing of Rural Investment, 1995–2000 (US$ million)

<table>
<thead>
<tr>
<th>Service</th>
<th>Private</th>
<th>Subsidy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payphones</td>
<td>30</td>
<td>22</td>
<td>52</td>
</tr>
<tr>
<td>Additional services</td>
<td>109</td>
<td>0</td>
<td>109</td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>22</td>
<td>161</td>
</tr>
</tbody>
</table>

Source: See Table 7.

About US$52m, or one-third of the total investment in rural facilities, was used to install payphones, for which the Fund provided subsidies of US$22m. The average subsidy was US$3,600 per payphone or US$10 per inhabitant. In addition, the companies invested about US$109m to provide other services, mainly individual business and residential telephone connections and value-added services (including electronic mail and access to the Internet in some areas), for which no subsidies were received.

The subsidy per payphone increased substantially as the program extended to smaller, less accessible, and poorer places (Table 4). Reaching roughly the first half of the
excluded population cost the Fund only US$1,220 per locality or US$3 per person living in those localities. Halving again the unserved population tripled the subsidy per locality and per person. By the last round of licensing, which benefited only 2 percent of the initial unserved population (about 40,000 people of a total of 2.2 million), subsidies reached US$12,730 per location or US$45 per inhabitant.

Table 4. Subsidy Awarded per Locality and per Inhabitant

<table>
<thead>
<tr>
<th>Licensing Round</th>
<th>Population without Payphones (%)</th>
<th>Subsidy per Locality (US$)</th>
<th>Subsidy per Inhabitant (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995 and 1996</td>
<td>15/9</td>
<td>1,220</td>
<td>3</td>
</tr>
<tr>
<td>1997 (two rounds)</td>
<td>9/4</td>
<td>3,390</td>
<td>10</td>
</tr>
<tr>
<td>1998</td>
<td>4/2</td>
<td>6,320</td>
<td>23</td>
</tr>
<tr>
<td>1999</td>
<td>2/1.3</td>
<td>8,270</td>
<td>31</td>
</tr>
<tr>
<td>2000</td>
<td>1.3/1</td>
<td>12,730</td>
<td>45</td>
</tr>
<tr>
<td>Total 1995–2000</td>
<td>15/1</td>
<td>3,600</td>
<td>10</td>
</tr>
</tbody>
</table>


Less than one-half of the ten-fold increase in subsidies is likely to be due to (a) the higher cost of extending and maintaining service in places that are farther from the main networks and harder to reach and (b) lower revenues from smaller populations with lower incomes. The maximum available subsidy, which is SUBTEL’s ex-ante estimated present value of private losses during the first ten years of service, was almost four times as high in the last round compared with the first two rounds. The increasing level of subsidy rather seems to have mainly reflected changing company strategies, discussed later.

Utilization and Revenues

On average, payphones supported by the Fund generate about one outgoing call per month per inhabitant. A survey of payphones in 1998 showed that the number of outgoing calls was roughly proportional to population for localities up to about 150 inhabitants but declined considerably for larger places (Table 5). This translates into average outgoing

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8 Actual average investment cost per payphone installed by CTC and CTR was estimated to have been only 20 to 40 percent higher (respectively) in 1998 than in 1995, without clear trends in between. GVT—which used satellite technology, whose costs are insensitive to distance—incurred significant initial fixed investment costs to set up its hub, so investment costs per payphone added declined as more were installed, irrespective of location. Operating costs, on the other hand, especially payphone maintenance and coin collection, probably rose considerably in later rounds, as access became more difficult. Revenue per locality added probably declined, but only about 10 percent overall. During this period, the average population of the locations being connected decreased from about 450 inhabitants to 250. This, however, was almost offset by people in small places actually calling more often than those in larger places.
call revenue per payphone per year of around US$1,400, typically ranging between US$500 for small localities and US$2,000 for larger ones.9

Table 5. Outgoing Payphone Calls per Month, per Inhabitant

<table>
<thead>
<tr>
<th>Population of Locality</th>
<th>Number of Calls</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;150</td>
<td>2.2</td>
</tr>
<tr>
<td>200</td>
<td>1.7</td>
</tr>
<tr>
<td>300</td>
<td>1.2</td>
</tr>
<tr>
<td>400</td>
<td>1.0</td>
</tr>
<tr>
<td>500</td>
<td>0.8</td>
</tr>
<tr>
<td>700</td>
<td>0.6</td>
</tr>
<tr>
<td>1,000</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Source: Universidad de Chile, 1998.

Outgoing payphone calls typically divide rather evenly between regional (i.e., terminated within the same primary area) and long distance (i.e., terminated in a different primary area). About 80 percent of regional calls go to the nearest town or city. Earlier surveys showed that the proportion of comparable long-distance calls from existing payphones had been much lower before long-distance charges dropped with competition. These findings suggest that, contrary to usual assumptions, the rural population has substantial interests well beyond its immediate geographical and administrative vicinity—but this extended community of interest only reflects on payphone traffic once long-distance charges approximate the level of regional payphone call charges.10 In addition to outgoing calls, rural payphones receive a significant number of incoming calls, in some cases as much as one-half of outgoing calls, for which the operating company is paid access charges by the company originating this traffic.11

Operating Companies

Five operating companies provide rural services supported by the Fund (Tables 6 and 7). Compañía de Telecomunicaciones de Chile (CTC, controlled by Telefónica of Spain) is Chile’s largest telephone company. Comunicaciones y Telefonía Rural (CTR, owned by

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9 Assuming three minutes per call and a call charge of US$0.11 per minute.

10 Most long-distance carriers offer a single rate of about US$0.08 per minute countrywide irrespective of distance, which is similar to the local call charges from rural payphones (US$0.11 per minute) although still higher than local call charges from urban lines (about US$0.03 per minute).

11 The local person in charge of the payphone (for example, someone living in the house to the outside of which the payphone is attached) may receive incoming calls and relay messages to the called party, or the called party may set up an appointment to receive a call.
SR Telecom, a Canadian manufacturer of rural radio equipment) and Global Village Telecommunications (GVT, owned by Gilat, an Israeli manufacturer of satellite communication equipment) are new companies established specifically to provide rural services in the context of the Fund program. These three companies account for over 90 percent of all payphones supported by the Fund, divided rather evenly among them. They also have over 98 percent of additional rural lines, of which CRT has three-fourths.\(^{12}\)

Two established companies well positioned to be the lowest bidders for many projects never bid for or won Fund support. ENTEL (Empresa Nacional de Telecomunicaciones S.A.), Chile’s largest long-distance carrier, had a country-wide network and substantial presence in rural areas financed earlier by regional development programs and own funds, which would have given it a competitive advantage to win many projects. Its management, however, did not regard rural service as a strategic business interest and never bid for Fund projects, preferring instead to focus on developing mobile, Internet, wireless local loop\(^{13}\) and other new services. Compañía Nacional de Teléfonos S.A. (CNT, a regional telephone company in southern Chile) already had a thriving rural business developed with own funds as well as supported by local and regional government programs and private cooperatives. It initially bid for but failed to win Fund projects, and later lost interest. Eventually almost 1,000 additional rural payphones were installed in CNT’s territory by other companies with Fund support.

**Table 6. Companies Providing Rural Services Supported by the Fund, 2001**

<table>
<thead>
<tr>
<th>Company</th>
<th>Payphones</th>
<th>All Phone Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTR</td>
<td>32</td>
<td>73</td>
</tr>
<tr>
<td>CTC</td>
<td>31</td>
<td>20</td>
</tr>
<tr>
<td>GVT</td>
<td>29</td>
<td>6</td>
</tr>
<tr>
<td>Megacom</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Geneva</td>
<td>3</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

\(^{a}\) Payphones committed with the Fund to be installed until 2002. Other lines as estimated by the companies by end 2000.

*Sources: SUBTEL, Fondo de Desarrollo de las Telecomunicaciones: Memoria 1999, results announced for 2000, and company information.*

\(^{12}\) The smaller new entrants are still finding their way. Geneva, for example, transferred 120 rural payphones to CTR and 19 payphones to Natrans, a new company. Natrans is developing local voice and data services in several cities without recourse to Fund support.

\(^{13}\) A wireless local loop is a wireless network used, instead of traditional cables and lines, to connect end-user telephones, facsimile, or other equipment to the main telecommunications network.
### Table 7. Investments Mobilized by the Fund, 1995–2000

<table>
<thead>
<tr>
<th>Investments</th>
<th>CTC</th>
<th>CTR</th>
<th>Geneva</th>
<th>GVT</th>
<th>Megacom</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total investment (US$ million)</td>
<td>43</td>
<td>101</td>
<td>2</td>
<td>9.5</td>
<td>5</td>
<td>160.5</td>
</tr>
<tr>
<td>Of which in subsidized payphones (US$ million)</td>
<td>19.1</td>
<td>16.1</td>
<td>2</td>
<td>9.5</td>
<td>5</td>
<td>51.7</td>
</tr>
<tr>
<td>Of which Fund subsidy (US$ million)</td>
<td>5.9</td>
<td>4.9</td>
<td>0.4</td>
<td>7.2</td>
<td>3.4</td>
<td>21.8</td>
</tr>
<tr>
<td>Total lines in operation</td>
<td>6,000</td>
<td>22,500</td>
<td>156</td>
<td>1,737</td>
<td>303</td>
<td>30,696</td>
</tr>
<tr>
<td>Of which subsidized payphones</td>
<td>1,892</td>
<td>1,971</td>
<td>156d</td>
<td>1,737</td>
<td>303</td>
<td>6,059</td>
</tr>
<tr>
<td>Average investment per line (US$)</td>
<td>7,200</td>
<td>4,500</td>
<td>12,800</td>
<td>5,500</td>
<td>16,500</td>
<td>5,300</td>
</tr>
<tr>
<td>Average investment per subsidized payphone (US$)</td>
<td>10,100</td>
<td>8,200</td>
<td>12,800</td>
<td>5,500</td>
<td>16,500</td>
<td>8,200</td>
</tr>
<tr>
<td>Average private investment per US$ of subsidy (US$)</td>
<td>6.2</td>
<td>20</td>
<td>4.0</td>
<td>0.3</td>
<td>0.5</td>
<td>6.4</td>
</tr>
</tbody>
</table>

- **a** CTC and CTR: Universidad de Chile estimates for 1995–98, plus additional payphones committed in 1999 and 2000 times each company’s average investment per payphone in 1995–98. Total investment figures of other companies are fully attributed to payphones.
- **b** Expected by the end of 2000, plus payphones committed to be installed in 2001 and 2002.
- **c** One subsidized payphone per locality. Includes localities to be connected in 2001 and 2002.
- **d** Of which 120 have been sold to CTR and 19 transferred to NATRANS, a new local telephone entrant in La Serena, Quintero, and Peñafior that did not bid for subsidized payphones.

**Note:** Investments and subsidies are in equivalent current US dollars of each year.

**Sources:** SUBTEL, *Fondo de Desarrollo de las Telecomunicaciones: Memoria 1999* and results announced for 2000. Universidad de Chile 1999. Information from companies and consultants.
Success Factors

The Fund’s success can be attributed largely to extensive reliance on market forces, minimal regulation, simple and relatively expeditious processing, and effective government leadership.

Reliance on Market Forces

- **Bottom-up identification of demand.** Localities needing payphones are identified by regional and local authorities, neighborhood associations, other organizations, telecommunications operators, and the public at large. Regional authorities review initial selections before finalizing the list of localities for which bids are to be tendered. Information about the opportunity, timetable, and process to request payphones is disseminated by regional government officials with support from SUBTEL.

- **Competition for the market.** Existing telecommunications companies as well as new entrants meeting minimal eligibility conditions compete for licenses to provide rural services. Competition is fueled by the incumbents’ efforts to defend territories where they have a dominant presence as well as by newcomers trying to gain a foothold in local service that gives them direct access to end customers.

- **Subsidies allocated through the market.** Competitive bidding determines which operators can provide services at the least cost to the state, and how much subsidy is actually required. The Fund uses economic analysis only to select localities for which bids will be tendered in a particular round and the maximum subsidies to be made available for each project, not to decide how much is paid out.

Minimal Regulation

- **Freedom of business and technical choice.** Operators are free to design their business strategies, subject only to the obligation of providing payphone service as specified in the tender documents. They are also free to choose technologies and network designs, subject only to rules applicable to all telecommunications companies.
• **Attractive licenses designed to encourage growth.** Bidders for payphone licenses and subsidies are encouraged to propose unregulated additional services, which would be included in the licenses although they are neither considered for bid evaluation nor eligible for additional subsidy. The licenses also include access to scarce radio frequencies at no additional initial cost.

• **Limited price controls.** Rural operators are free to set all prices for their services, except for payphone call charges within the primary calling area (fixed for 10 years in the license) and for interconnection charges (fixed for 5 years in a separate tariff decree).

• **Cost-reflective access charges.** Rural operators are allowed to levy access charges on incoming calls that are significantly higher than those paid to urban companies, reflecting higher investment and operating costs of rural service.

**Simple and Relatively Fast Processing**

• **One-stop process.** The Fund offers the opportunity to obtain operating licenses and at the same time gain access to scarce radio frequencies, all significantly faster and with less paperwork than the standard procedures. Processing times were roughly halved.14

• **Recurrence.** The Fund held seven consecutive rounds between 1995 and 2000, with the process and rules largely unchanged. This built up experience and trust, and reduced the cost of organizing and participating in successive rounds.

**Competence and Leadership**

• **Leadership.** Effective and sustained leadership was demonstrated by senior government officials who conceived the Fund, shepherded enabling legislation, and oversaw initial implementation until the program was well established.

• **Competence.** Minimal but competent and dedicated staff ran the program day to day. Local consultants helped develop, apply, and update the engineering models and cost-benefit analyses. Consultants from academia undertook an extensive review of the Fund in 1998.

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14 By 2000 standard license and spectrum processing had been improved considerably and this initial advantage of the Fund had largely vanished.
More on Selected Success Factors

Three of these success factors deserve to be described in more detail: competition for the market, growth-oriented business strategy, and cost-reflective access charges.

Competition for the Market

Competition among existing and new operators for the rural market led to substantial reductions in cost for the government. The average subsidy of US$3,600 awarded per payphone was far below US$10,000 to US$20,000 paid by the government under earlier regional development programs to finance limited provision of rural payphones.

Between three and five companies bid for new projects in each round. Rural operators seeking Fund support initially aimed at securing or defending market positions, with limited consideration of actual costs and revenues. Uncertainty regarding who would bid for a particular project kept subsidies down, irrespective of how many companies actually bid. In the first two rounds, 55 percent of all bids were for zero subsidy and most of the rest were at or near the maximum available:

- **CTC**, the dominant local telephone operator in most of the country, typically bid 100 percent of the maximum available subsidy in localities close to its existing network where there were no other established local operating companies, 90 percent where it faced an emerging challenger, and zero in areas with strong presence of other operators.

- **CTR**, which would eventually become the largest of the new rural entrants, bid for zero subsidy for payphones in areas where it believed it could also develop a profitable market of individual business and residential telephone lines, and did not bid elsewhere.

- **GVT**, another new entrant, bid at or near the maximum available subsidy in localities that could only be reached economically using satellite technology (manufactured by its parent company), and bid for zero subsidy in other regions to which it sought to extend the same satellite network but faced competition from companies using lower-cost technology.
Later, as operators consolidated their market presence (largely along regional lines), there were seldom more than two bidders for each individual project, and they bid for a growing proportion of the available subsidy (Table 8). Bids for zero subsidy declined sharply, while the middle ground of less than 90 percent of the maximum available subsidy swelled from 2 percent to 43 percent of lowest bids. By the last round (2000), only one project out of 27 had more than one bidder, and bids averaged 95 percent of available subsidies. This evolving strategy of the operators is likely to have been a major determinant of the trend for subsidies to rise through the life of the Fund beyond what can be explained by higher net costs.

**Table 8. Subsidy Bid as Percentage of Available Subsidy**

<table>
<thead>
<tr>
<th>Licensing Round</th>
<th>Subsidy Available per Allocated Locality (US$)</th>
<th>Subsidy Awarded per Locality (US$)</th>
<th>Subsidy Awarded as % of Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995 and 1996</td>
<td>3,000</td>
<td>1,220</td>
<td>41</td>
</tr>
<tr>
<td>1997 (two rounds)</td>
<td>8,520</td>
<td>3,390</td>
<td>40</td>
</tr>
<tr>
<td>1998</td>
<td>10,150</td>
<td>6,320</td>
<td>62</td>
</tr>
<tr>
<td>1999</td>
<td>10,340</td>
<td>8,270</td>
<td>80</td>
</tr>
<tr>
<td>2000</td>
<td>13,400</td>
<td>12,730</td>
<td>95</td>
</tr>
</tbody>
</table>

*Source: SUBTEL, Fondo de Desarrollo de las Telecomunicaciones: Memoria 1999 and results announced for 2000.*

**Growth-Oriented Business Strategy**

Commercial success has largely hinged on operators using the subsidized payphone infrastructures to also provide individual business and residential telephone lines and, subsequently, add value through new services over this network. The law and the tender documents explicitly allowed for including additional services.

The case of CTR illustrates this strategy. CTR targeted the fairly dense agricultural areas of south-central Chile with potential for marketing individual phone lines in addition to payphone calls. Revenue increased as residential and business customers gained experience using telephones and as new services were introduced. CTR now offers access to three competing long-distance carriers, electronic mail and Web access through a choice of three Internet service providers, and enhanced telephone service (such as call waiting, call forwarding, conference calls, and voice mail). Access charges that reflect the higher cost of rural service result in a positive net settlement revenue from urban companies, accounting for up to 60 percent of operating revenues. Access charges regulated below those charged by mobile companies, and better service coverage and data capability of the fixed network, have given CTR an edge over competing mobile services. The cost of connecting new subscribers is declining with new technologies (e.g., wireless...
local loop for the last mile\textsuperscript{15}) and with economies of network and organizational scale. New customers are being added at an investment cost below US$2,500, resulting in an internal rate of return (IRR) of approximately 16 percent. In rural areas closer to Santiago, the capital city, CTR expects to add customers for less than US$1,000 per line, yielding an IRR in excess of 20 percent. By now CTR has built 70 percent of all phone lines licensed through the Fund countrywide.

Not all operators benefited from the possibility of including additional services in their bids. GVT, for example, bid for and won licenses mostly in isolated or distant localities where VSAT\textsuperscript{16} technology was a cost-effective choice. These localities lack an extended customer base, however, and GVT has had difficulty developing business beyond payphones. This was compounded by initially bidding zero-subsidy in order to gain market share. Once a national hub was established and connected to the main domestic and international networks, GVT’s core facilities arguably could also be used to provide corporate and government VSAT services, but some observers note that in Chile this market is rather small and was already quite crowded.

Prepaid calling cards for rural payphones were only introduced in 2000. Some observers had believed that rural users were too poor to pay for several calls in advance, too illiterate to adopt non-cash solutions, and too few to sustain local card retailing. Collecting coins from coin-operated payphones, however, proved costly and caused service problems, especially in remote localities or where access is virtually impossible during parts of the year. When coin boxes are full, the payphones continue to receive calls but can neither make outgoing paid calls nor report malfunction; this hurts service and revenues, especially in tourist areas during the high season. Many of CTC’s rural payphones are in charge of local administrators who have agreed to empty the coin boxes, but reportedly sometimes fail to remit the coins to the operator. GVT was considering sub-contracting coin collection.

Operators have found that it pays to use the simplest possible payphone. Over one-half of CTR’s payphones are small, table-top, coin-operated phones in semi-enclosed cabins attached to the outside wall of a shop or house. In order to comply with the 24-hour access requirement, the outside gate of the house or shop may not be locked. Other CTR solutions used include standard coin-operated payphones in semi-enclosed stand-alone cabins on pillars or attached outside shops, and fully enclosed stand-alone cabins used in about one-third of all payphones.

\textsuperscript{15} New wireless local loop systems in the 3.4-GHz band allow data transmission from about 64 kilobits per second (Kb/s) up to 2 megabits per second (Mb/s).

\textsuperscript{16} VSAT stands for \textit{very small aperture terminal}—in essence, a small satellite dish. A VSAT network has three components: a central hub (or master earth station), the satellite itself, and a number of VSAT earth stations.
Cost-Reflective Access Charges

Interconnection has proven to be the single most important regulatory factor for the commercial viability of rural services in Chile.\(^{17}\) New rural companies initially had difficulty getting the urban local telephone companies to interconnect. Although technical matters were settled rather quickly, disagreement remained over commercial terms. Prominent among these were access charges—that is, payments that operating companies require from other companies to terminate calls originating in those other companies. All interconnection charges, including access charges, are regulated by SUBTEL. The maximum prices that each company can charge for interconnection are established in the company’s tariff decree and remain constant in real terms for five years, after which a new tariff decree comes into effect.\(^{18}\)

The telecommunications law prescribes in some detail how regulated access charges must be calculated with reference to a hypothetical efficient operating company capable of meeting demand during the five-year period. Since new rural networks were being developed in a competitive environment, access charges were calculated on the basis of data from these real companies (Annex 2). Subsequently the telecommunications industry, following the example of mobile phone service, voluntarily adopted a common access charge for all rural companies.\(^{19}\)

The resulting maximum access charge by rural companies in 1999–2004 is about US$0.19 per minute during peak hours and US$0.09 off-peak. These are above the access charges applicable to other non-rural telephone companies but below those of mobile companies (Table 9). The wide range of access charges tends to reflect the higher cost of providing service in smaller and less densely populated rural areas.\(^{20}\)

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\(^{17}\) Interconnection among operating companies allows customers of one rural company to call, or be called by, customers of other rural or urban companies. Interconnection may also refer to one company using parts of another company’s networks and facilities instead of building its own. The latter issue was not a major one for the Chilean rural companies and is not discussed in this report. For a concise treatment of interconnection regulation and economics, see Hank Intven and others, 2000 *Telecommunications Regulation Handbook*, The World Bank, Washington, D.C., especially Module 3 and Appendix B.

\(^{18}\) This applies to all telecommunications companies, not only rural ones.

\(^{19}\) Initial approvals for three rural companies (CTR, GVT, and Megacom) were within a 15 percent range. The common access charge agreed by the industry was CTR’s, about average of the three.

\(^{20}\) CTC, the largest company deemed by the competition authority to have market dominance in local telephone service through much of country, was not allowed to include common and joint costs in its calculation of access charges. This contributed to CTC’s exceptionally low urban access charges. Service provided by CTC under licenses awarded through the Fund are subject to the rules and access charges of rural service generally, but rural service provided by CTC under its main license is treated as urban service including regulated retail prices and low access charges.
Table 9. Access Charges for Different Companies, 2001

<table>
<thead>
<tr>
<th>Company</th>
<th>Localities</th>
<th>Charge (US cents/minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Peak</td>
</tr>
<tr>
<td>CTC – national</td>
<td>All</td>
<td>1.0</td>
</tr>
<tr>
<td>CNT - regional</td>
<td>Cities</td>
<td>1.5–2.4</td>
</tr>
<tr>
<td></td>
<td>Towns</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>Rural areas</td>
<td>7.2</td>
</tr>
<tr>
<td>Rural only</td>
<td>All</td>
<td>18.7</td>
</tr>
<tr>
<td>Mobile</td>
<td>All</td>
<td>21.1</td>
</tr>
</tbody>
</table>

Note: Pesos converted to U.S. dollars at the rate of US$1=Ch$600.

Rural access charges are passed on to the parties originating the calls. For example, an urban CTC customer calling a rural CTR customer in the same primary calling area pays one-half the regular local call charge of CTC (about US$0.015/min peak) plus the charge to access CTR (US$0.19/min). Customers calling to a different primary area would also pay the long-distance charges of a carrier between both primary areas (typically US$0.08/min).
Improving the Basic Design

The overall concept and design of the Fund has proven quite robust. Nonetheless, as experience was gained in implementing the Fund program, some problems were identified and to some extent resolved in the limited time left before the program was largely completed: imprecise definition of the target population, selection bias, limited local participation, and implementation delays. Also, once the main task of awarding licenses and subsidies was well under way, the Fund gave more attention to ensuring the quality of service, monitoring results, fine-tuning project administration, and adjusting the regulatory framework.

Target Population

A review of the Fund in 1998 found that a more precise definition of the target population was needed to focus the Fund’s support as well as to assess the extent to which its objective was being met. The Fund’s objective had been broadly defined in the telecommunications law and regulations as promoting increased public telephone coverage of rural and urban areas of low income and low telephone density. Before the Fund program got underway, surveys had identified about 600 rural localities countrywide that would qualify for Fund support thus defined. The actual number, however, proved to be much larger. In the first round in 1995, the Fund received requests for payphones in 2,429 localities. By the end of 2000 the Fund had awarded licenses for more than 6,000 localities and about 1,000 remained in the roster. More than a problem of counting, this was one of knowing what to count.

Specific eligibility criteria were tested on samples of localities, leading to the following definition of target population adopted by the Council in 1999:

*Rural communities with more than 60 inhabitants (12–15 families) in the three lowest quintiles of the income distribution and located at least three kilometers or 30 minutes away from the nearest public telephone.*

The reviewers had recommended also targeting smaller localities that are exceptionally hard to reach. Although distance and time (included in the definition above) provide a measure of access, extreme isolation carries with it a disproportionate economic
and social disadvantage as well as problems of political integration and security. Although the Council did not include these places in the definition of target population, to some extent they were added case-by-case by regional authorities during the selection process.

The new definition was used by SUBTEL to screen payphone requests in 1999 and 2000, but problems remained. First, income distribution data were available at the level of municipalities but not disaggregated further into individual localities, so pockets of poor people in better-off municipalities may have been excluded, and vice-versa. Second, because information on population, distance, and travel time was provided by whoever submitted a request for service, it was often unreliable and inconsistent with other sources. The Fund's history is sprinkled with anecdotes of double-counting or non-existing localities, scattered houses or single farms counted as localities, and places approved for Fund support that already had telephone service. Third, it was difficult, and often impossible, to match small localities proposed for Fund support to localities listed by the population census. On average there were 1.5 Fund localities for each census locality, and the census could not be used effectively to identify target localities still without service.

Thus a significant design weakness remained largely unresolved. A roster of all remaining eligible localities as well as of all localities already with service—including verified data on each locality, related topographical information, and up-to-date information on existing networks—was never fully in place. This would have reduced the time needed at the start of each round to collect and confirm demand data. Also, by making the roster available to prospective providers, bid preparation time and cost could have been reduced. Longer-term solutions, including using the next population census to identify eligible locations and subscribing to a geographical information system, were proposed but not implemented.

**Selection Bias**

The analytical method for selecting localities was somewhat biased against the localities in greatest need of help. Small or poor places make few calls and hence appear in the calculus of costs and benefits to generate little revenue as well as have little to gain from being connected. Important benefits are ignored, such as those resulting from improved security and political integration of remote or border localities. Places that are far from the main network are costly to reach. The cost-benefit analysis tends to over-state costs and under-state revenues (Annex 1).

On all these counts small, remote, or poor places tended to rank low in terms of social NPV per unit of subsidy and were therefore less likely to be selected for early funding. They remained, nonetheless, in the roster of eligible localities and stood growing chances of being supported in later rounds as the program extended into more marginal localities. Although this was roughly right from the viewpoint of economic efficiency, it was regarded as inequitable and politically undesirable.
The 1998 review identified this bias and recommended that the results from the cost-benefit analysis be tempered by other considerations in making the final selection of localities within and among regions, in particular:

- Among regions, allocate *a priori* part of the available funds to the lower-income regions, in line with broader government priorities for poverty alleviation. This would tilt the balance in their favor as they compete with other regions for total funds.

- Within regions, give municipal and regional authorities a larger role in the final selection of localities. This would reflect these authorities’ priorities among localities.

The existence of some bias also highlighted the importance of ensuring that the actual allocation of subsidies be determined by the market, not the calculus of costs and benefits. This was the case for the bulk of Fund allocations. In both early and late rounds, however, limited competition for some projects resulted in subsidies for these projects being awarded at or near the maximum available, which had been determined from the cost-benefit analysis, not the market.

**Local Participation**

The considerable potential for local authorities to contribute to the mission of the Fund was not fully realized. Municipal and regional governments could have helped identify needs, provide accurate information on proposed localities, and reflect regional priorities in the selection. In practice, however, their role was mainly limited to forwarding payphone applications to SUBTEL. Regional branches of the Ministry of Transport and Telecommunications were required to add, in each payphone request form, their own assessment of the location being proposed.

They were also, in recent rounds, asked to review the lists of localities selected by SUBTEL for each round of tenders before these were finalized. In practice, however, these agencies lacked a clear mandate, direct accountability to SUBTEL, and the necessary resources (including staff) to do the job properly. A survey of regional authorities in 1998 confirmed the inadequacy of the institutional and budgetary arrangements for them to play a more substantial role. Although SUBTEL has since placed greater emphasis on dissemination of the Fund and consultation with regional authorities, these structural flaws remain largely unresolved.

The 1998 survey identified the need for local authorities to keep the population informed of the status of applications—which places had been selected, when operators should tender bids, award results, deadlines for implementation, progress of works. Whereas dissemination of opportunity and process to request rural payphones was quite effective, little feedback was thereafter provided.

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21 The *servicios regionales ministeriales*, or regional ministerial services, mirror in each region the central government structure. Thus in each region there is a SEREMITT, or branch of the Ministry of Transport and Telecommunications.
Monitoring, especially handling of customer complaints, could be carried out most cost-effectively by local and regional government authorities. Guidelines and technical assistance for monitoring would be provided by SUBTEL, which would oversee and periodically report on aggregate results, identify problem areas, and promote corrective action. SUBTEL would remain the channel for enforcing regulations and license conditions.

**Implementation Delays and Penalties**

Implementation delays were common in the early rounds, mainly related to start-up difficulties of new entrants. As new companies became established, however, an increasing proportion of projects was completed on time (Table 10).

**Table 10. Committed and Installed Rural Payphones, 1997–2002**

<table>
<thead>
<tr>
<th>Total Rural Payphones in Service by Year End</th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Committed</td>
<td>265</td>
<td>1,816</td>
<td>4,390</td>
<td>5,403</td>
<td>5,916</td>
<td>6,093</td>
</tr>
<tr>
<td>Installed</td>
<td>149</td>
<td>1,159</td>
<td>4,423</td>
<td>a</td>
<td>5,436</td>
<td></td>
</tr>
</tbody>
</table>

\*Includes 241 payphones or 24 percent of the number committed for 2000 that were installed in 1999 ahead of time.

**Sources:** SUBTEL, Fondo de Desarrollo de las Telecomunicaciones: Memoria 1999, results from 2000 round, and online statistics as of January 2001.

The case of CTR illustrates some of the early problems. A consortium of Chilesat, a competitive long-distance carrier expanding into mobile and fixed local service, and SR Telecom, a Canadian manufacturer of rural telecommunications equipment was awarded about one-third of all Fund projects in 1995. The financial difficulties of Chilesat’s parent company, however, led SR Telecom to take over the rural licenses and set up a Chilean wholly-owned operating subsidiary, CTR. These ownership and organizational changes, compounded by initial management problems of CTR, led to major project implementation delays. By 1998, however, once an experienced local management team was in place, construction moved ahead fast. CTR eventually became the largest of the new entrants in rural telecommunications with about 32 percent of payphones and 73 percent of all rural lines licensed through the Fund.

SUBTEL chose to use penalties for implementation delays sparingly. Although penalties could have been as high as three times the maximum subsidy that had been available for the project, much smaller penalties were imposed in practice. Larger fines would have compounded the difficulties of start-up companies, coming on top of subsidy withholding (without adjustment for inflation) until full project completion. Although these small penalties had little financial impact on the operators, they did call public attention to companies that failed to deliver.
Quality of Service and Monitoring

As the task of rolling out rural payphones was largely completed, the Fund turned its attention in 2000 toward setting and enforcing quality standards and monitoring compliance with licenses and regulations.

Specific standards for quality of service were outlined for fault duration, cumulative outage, and aggregate outage per company. The licenses specify that payphones must provide service to the public 24 hours per day, every day, throughout 10 years. The objective of this requirement was to exclude services that are available only at certain times or days, such as when placed in the inside of homes or shops. A strict 24-hour standard, however, is technically not feasible, and outages inevitably occur. On the other hand, frequent and long outages had been fairly common, especially during adverse weather and in localities that are hard to reach. These outages reduced significantly the value of the payphones to users and at times caused considerable hardship.

A monitoring system was needed to ensure compliance with licenses issued through the Fund, the emerging standards for quality of service, and the Fund’s and other applicable regulations. SUBTEL outlined a system that would:

- Create and maintain a reliable database of all Fund-supported facilities
- Assess performance through field visits, user interviews, and telephone surveys
- Establish a process for filing and resolving customer complaints
- Educate customers on their rights and complaints procedure
- Decentralize monitoring to regional and local authorities.

The database was to include, at a minimum, the geographical coordinates of each payphone, the operating company in charge, the date when service began, and the technology used, as well as up-to-date information on population, maintenance, reported faults, and repairs. In order to contain costs, monitoring would be limited to samples of payphones and follow-up of identified problems. Sampling, however, would recognize that faults are more likely in some localities than in other, and that it is necessary to verify that all projects, although not necessarily each individual payphone, are working well.

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22 Fault duration is the number of days during which a payphone is continuously out of service or unusable for normal communication. Cumulative outage is the total number of days in one month during which the payphone is out of service or unusable. Aggregate outages per company are the number (or proportion) of payphones out of service at any time during a month for each rural operating company. One day of outage is counted when the payphone is continuously out of service at least six hours within a calendar day. Repeated outages of one payphone are counted as separate outages. Operators would be required to report to SUBTEL on fault duration and cumulative outage once a month, and on aggregate outages per company once a year.

23 For example, about 12 percent of CTR’s payphones failed and remained inoperable for several days during the month following heavy rains and floods in the winter of 2000. This compares with about 9 percent during normal months, about one-half of which are repaired in 24 hours or less.
28 Closing the Gap in Access to Rural Communication: Chile 1995–2002

Administration

In the beginning the projects were too large. On average, each project awarded has comprised about 30 localities, ranging from 90 in 1996 down to 6 in 2000. Some early projects, however, had more than 100 localities. This proved to be excessive. Smaller projects in later rounds gave bidders greater flexibility to configure aggregate technical solutions.

Payphone location was found to be a critical determinant of use, but operators were initially not allowed to change locations after bidding, and especially after licenses had been issued. Operators that bid on the basis of SUBTEL’s data and analysis without doing full due diligence investigations on their own, sometimes found themselves committed to providing service in wrong or inexistent places. Also, once payphones were installed, they could not be moved even if a better placement in or near the original locality was found, nor closed down before 10 years even if usage dwindled due to local demographic or economic changes. From 1999 the tender documents provided for changes in location subject to approval by the Council. The administrative process to follow was not prescribed, however, so considerable delays remained.24

Payments for substantially completed projects were initially held back due to delays in one or two payphones. In accordance with the tender documents, subsidies were paid in full only once all payphones in the project were certified to be in service. Subsequently, partial payments were allowed against certified progress, a substantial balance being paid on completion of the full project.

Regulatory Framework

Companies that provide service only in rural areas were allowed some cost-cutting exemptions from the national numbering and routing plans. This recognized that the design of low-traffic networks serving scattered customers, typical of rural areas, was unduly constrained by technical plans that had been intended to encourage long-distance competition in the main interurban networks. For example:

- Under the prevailing rules, GVT would have been required to build costly hubs and switches for its satellite network in each primary area, the areas being connected to one another through competing long-distance carriers. GVT was eventually authorized to have a single hub and switch for the whole country.
- CTR’s initial investment costs would have been about 5 percent lower, had it been allowed from the start to connect rural telephones in one primary area to a switch and multi-access radio base station located in the neighboring primary area. This was authorized only later for network expansion.
- The numbering system was changed so rural numbers could be readily identified by urban callers and their originating companies. Before this, callers could not

24 On a related problem, SUBTEL’s consultants eventually were allowed to modify or cancel applications on the basis of improved information gained from their own field visits.
know in advance that they would be billed additional rural access charges. Likewise the originating companies in some cases had no way of accounting and billing for these charges.\footnote{25}

In order to allow these sensible solutions for rural companies without revising the regulatory framework for competition generally, three successive ministerial decrees provided guidelines to determine rurality and established exemptions from the generally applicable regulations.\footnote{26} Although these contortions met the immediate need of preventing major diseconomies in the provision of rural service, they suggest that the regulatory framework was already due for an overhaul.\footnote{27}

\footnote{25} For example, all GVT rural customers had a number from Santiago, which is where the national VSAT hub was connected to the main network.

\footnote{26} Subsecretaría de Telecomunicaciones, Decree No 50 of April 16, 1987, as modified by Decree No. 45 of March 31, 1999, and by Decree No. 266 of May 26, 2000. An operating company is classified as rural by SUBTEL, at the company's request, when it provides service exclusively in localities or areas that meet at least three of the following eight criteria: (1) low demand for telephone lines, (2) geographical dispersion of this demand, (3) low traffic volume, (4) high proportion of long-distance traffic, compared with urban customers, (5) isolation of population relative to main centers, (6) topographical impediments to building conventional telephone networks, (7) exceptionally adverse topography or climate for operation and maintenance, and (8) lack of reliable electric power supply.

\footnote{27} The local and long-distance markets have become very competitive and may no longer need to be artificially segmented. The highly competitive mobile phone market, for example, never was segmented. Most long-distance carriers now charge a single rate countrywide, suggesting that distance is no longer a significant cost factor. Broader revisions are probably also needed in response to the rapid blurring among traditional lines of business and technologies in telecommunications, as well as between telecommunications, computers, and media.
Outstanding Questions

Some important questions remain unanswered. These refer to how to sustain rural service, especially beyond the 10-year obligatory period; how to take care of the small and scattered population still unserved; and what should be done, if anything, in low-income urban areas.

Sustainability of Rural Service

Some rural operations may lose money despite the subsidies and hence may be discontinued at the end of the 10 years of obligatory service. In cases where positive cash flows occurred only at the start of the project when subsidies were received, there may be no financial incentive for operators to stay put. SUBTEL has retained consultants to examine the question of long-term sustainability.

Financial performance of the operating companies so far has been mixed. CTR’s 1999 operating profits of US$1.2 million (after depreciation but before interest and tax) were forecast to increase to US$5.5m in 2000 as additional business and residential customers were connected in areas of lower investment cost and higher revenue potential, and as operating costs continued to decline following technological innovation and organizational improvements. Also, while in 1999 the subsidies received from the Fund accounted for all of the operating profits (and more), in 2000 the proportion would be less than one-half, which suggests CTR’s operations may remain viable after these subsidies end. The operating profits in 1999 did not quite cover interest and taxes, resulting in a small net loss, which was forecast to turn into a small net income in 2000. Shareholders, however, were worried. After adjustments for inflation and foreign exchange, they had lost six percent of their equity in 1999 and the outlook for 2000 was uncertain.

GVT, on the other hand, has been losing money and is unlikely to ever break even. Operating losses of US$2.1m in 1998 increased to US$3.2m in 1999. With limited prospects of generating additional business at marginal cost, GVT’s parent company has committed to cover GVT’s losses for the duration of the 10-year service obligation. These losses may be offset, however, because the parent company, a manufacturer, has used its Chilean experience to demonstrate competence as an operator of rural systems and has successfully developed a much larger presence in other Latin American countries. Also,
technicians and managers trained in the Chilean operation have been used to establish and initially run operations in other countries.

A related question arises as to the separation of responsibilities between public and private sectors. As designed, the Fund makes only a one-time financial contribution to each project and thereafter the responsibility for service continuity lies squarely with the private operating companies. In practice, however, the government is implicitly providing the operating companies some insurance against commercial risk. Should a private operator fail and cease to provide service, this would also be to some extent a failure of the Fund. Since the government's objective is to ensure service, it would probably step in to achieve continuity. This may result in additional public resources being needed to salvage an operation by, for example, compensating another operator to take it over.

This raises the question of whether SUBTEL should have worked more closely with prospective operators to ensure the emergence of viable and sustainable businesses. Although there is no reason to believe that government officials would have known better than entrepreneurs and investors, it can be argued that tougher review of proposals would have encouraged bidders to do a better job preparing their plans. This view is supported by the perception that, especially in the initial rounds, bidders did not perform full due-diligence investigations on their own but rather relied on the findings of SUBTEL and were anyhow more interested in market position than sustainability. In such situations it may also be appropriate to make the eligibility requirements for prospective operators more stringent, to ensure the operators have sufficient financial and management resources to successfully negotiate start-up and other difficult times.

A related question is whether more substantial and longer-term or rolling guarantees should have been required from the licensees or their parent companies. Also, financing by international development institutions might reduce moral hazard by committing the companies to abide by their licenses, including 10 years of service; although the financing institution would have little formal recourse, failure to honor this commitment would risk damaging the company's international banking reputation. The question also arises as to whether the subsidies should be paid over a number of years rather than up-front on project completion, although this would increase investor risk as availability of funds from year to year is contingent on budget allocations.

**Remaining Unserved Rural Population**

About one percent of Chile's population (about 150,000 countrywide) still will lack ready access to payphones even after completion in 2002 of projects awarded by the Fund in

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28 Under the current arrangements, performance bonds posted by the bidders are returned once the projects are completed and subsidies paid.

29 CTR investments were partly financed by a US$25 million loan from the Inter-American Development Bank's private sector funding arm.
This unserved population is likely to be widely scattered, mostly in clusters of less than 60 persons.

Responsibility for the residual unserved population is being transferred from the Fund to the regional governments and their development budgets, with technical assistance from SUBTEL. It is believed that very small and scattered population groups can best be identified by local and regional authorities, rather than by a central government agency. They probably also can be served most cost-effectively as part of regional development programs that also comprise other infrastructure (e.g., electricity, water) with which some installation, maintenance, and administrative functions can be shared. SUBTEL is also considering subsidizing the use of telephones by low-income customers, through issuing telephone vouchers that can be applied toward service provided by competing operators.

Low-Income Urban Areas

Although the Fund was intended to extend payphone service in low-income urban areas as well as in rural areas, in practice no urban payphones have been supported by the Fund. It remains unclear whether there was no need for Fund support or, rather, that the process for deciding on locations and estimating private net costs was flawed.

Most requests for urban payphones were found to have a positive expected private NPV, which rendered them ineligible for funding because they would be viable on their own, yet few were subsequently installed by the telephone companies. The 1998 review of the Fund suggested that the cost-benefit analysis of urban payphones underestimated costs, especially those arising from vandalism and provisions for added security. It also suggested that higher compensation for local telephone administrators would be needed to attract qualified personnel. Revised calculations yielded some urban payphone projects with negative private NPV and positive social NPV, but there were no takers.

The 1998 review also proposed that, even if potentially profitable, these urban payphones were not of strategic interest to established telephone companies. Rather, local micro-enterprises might be promoted by the Fund, but this was not attempted. In the meantime, telephone and fax shops and, more recently, Internet kiosks have flourished in poor urban areas entirely at the initiative of local small entrepreneurs.

There is some uncertainty about the number of people still without service because a list of unserved eligible locations cannot be derived from published data.

A related system is in place for water supply.
Beyond Voice

*De la prehistoria a la ciencia ficción – sin escala.* 32

While the Fund was extending basic access to voice communications throughout the rural areas, Chile also made significant progress adopting more advanced information and communication technologies. Although less than one-third of Chileans have access to computers at home or workplace (Table 11), the number of Internet users per computer is as high as in some developed countries. Many schoolteachers have been trained in the use of email and the Internet and are now leading the adoption of these technologies in rural areas. A large retail store successfully established a virtual branch in a city where a full retail outlet would not be viable. Specialized software for electronic stock trading and hospital management is developed locally and exported.

**Table 11. Access to Computers, 1998 (% of population)**

<table>
<thead>
<tr>
<th>Population Sector</th>
<th>At Work</th>
<th>At Home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>22.8</td>
<td>12.5</td>
</tr>
<tr>
<td>Rural</td>
<td>4.1</td>
<td>1.8</td>
</tr>
<tr>
<td>Income distribution quintile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (lowest)</td>
<td>3.6</td>
<td>1.5</td>
</tr>
<tr>
<td>2</td>
<td>4.1</td>
<td>2.1</td>
</tr>
<tr>
<td>3</td>
<td>12.7</td>
<td>6.8</td>
</tr>
<tr>
<td>4</td>
<td>22.7</td>
<td>12.1</td>
</tr>
<tr>
<td>5 (highest)</td>
<td>45.3</td>
<td>24.7</td>
</tr>
<tr>
<td>Total</td>
<td>20.0</td>
<td>10.9</td>
</tr>
</tbody>
</table>

*Source: Universidad de Chile, Departamento de Economía, 1998.*

In 1999 an inter-ministerial commission on new information and communication technologies recommended launching several programs aimed at accelerating universal

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32 “From pre-history to science fiction—non-stop.” Comment by a librarian in the town of Lautaro, when a telecenter was inaugurated.
access to knowledge.\textsuperscript{33} Government content is seen as a key driver of the demand for information services and is being developed concurrently with modernization of the public administration. The public sector information program aims at building up widespread online use of government services. The first major service placed on line was tax administration: in 2000 about two-thirds of all businesses, including many small and medium enterprises, filed their tax returns using the Internet. Online procurement of public sector goods and services is currently in the pilot stage. Birth certificates will be available on line to be printed and authenticated by agents countrywide. The Chilean Library of Congress’ collection of current laws, decrees, and regulations is expected to follow.

Kiosks and telecenters will make government and commercial services available to people lacking computers or Internet access. A pilot program is underway trying out telecenters in urban areas with large rural hinterlands throughout the country. The pilot is jointly financed by SUBTEL and Corporación de Fomento de la Producción (CORFO)\textsuperscript{34} at a cost of about US$100,000 in initial investment, start-up, and one year of operation.\textsuperscript{35} The pilot will help identify user needs and willingness to pay, define services, give shape to the role of facilitators, and outline training activities.\textsuperscript{36} A typical telecenter in this pilot program has two multimedia computers connected to the Internet; a printer, a scanner, and a facsimile machine; a portal containing regional and local information; and a person to help use the facilities and online services as well as train the community to develop local content.\textsuperscript{37}

The government is seeking to redefine the Fund so it can support telecenters in rural and low-income urban areas. To this end, it submitted to Congress an amendment to the telecommunications law that would broaden the scope of the Fund beyond payphones to include more advanced communication and information services, expand the Council to include the ministers of education and health, and give the Fund indefinite duration.\textsuperscript{38} The

\textsuperscript{33} Ministry of Economy, 
\textit{Chile: Hacia la Sociedad de la Información} (Santiago, Chile, 1999). The Presidential Commission was established in 1998, chaired by the minister of economy and including other ministers, deputy ministers, members of the civil society, academics, and experts. Four priority programs focus on access to government information and services, participation in political life, reaching the disabled, and monitoring the impact of information technologies on society.

\textsuperscript{34} CORFO is the state development corporation and the holding company of public enterprises.

\textsuperscript{35} The investment cost is small because all pilot telecenters have easy access to the main telecommunications network. That may not be the case of the full-fledged program later, as rural areas often lack high-speed data capabilities.

\textsuperscript{36} A facilitator helps customers with specific applications, such as filing a tax return on line or seeking government funding through a website. Facilitators also provide training in the use of computers and the Internet and help develop local content, such as artisans placing information on line about their products.

\textsuperscript{37} These are expanded versions of the simple kiosks already in place for public access to tax administration. Larger versions, with up to 20 computers and several facilitators, have also been tried.

\textsuperscript{38} The Fund had expired in 1998 but kept going through provisions in the budget laws of 1999 and 2000.
amendment was enacted in late 2000. Taking into account the results of the pilots, SUBTEL will prepare regulations for privately owned telecenters and competitive tenders for licenses and subsidies, much along the lines of the rural payphone projects. The Fund would launch a national telecenters program in 2001. An initial target is to install telecenters in each of about 90 municipal headquarters towns with over 8,000 rural inhabitants. By 2006 there would be telecenters in all 341 municipalities.

It is not self-evident, however, that the government should intervene at this time to accelerate access to advanced information and communication services. Public points of access to the Internet are springing up around the country at the initiative of small entrepreneurs and local community groups, even in low-income areas. Government intervention, at a time when technological and business choices are still fast unfolding, risks distorting the market, limiting effective competition, and prompting wrong investment decisions.

It is also unclear whether the Fund, so successful in extending access to basic voice communication, will be as valuable in accelerating access to more advanced services. The success of the telecenters program will depend in great measure on the availability of relevant content, which is largely beyond the control of the Fund and the telecenter operators. Key success factors, such as the quality of facilitation and the ability to develop local content, are not amenable to objective prequalification or competitive bidding. Recurrent subsidies would be subject to uncertainty in the Fund's annual budget and thus add to investor and sustainability risks. Many factors beyond access to financing, some probably still unknown, will affect results.

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39 The regulatory framework, however, needs to be adjusted to enable effective deployment of new technologies. Issues such as privacy, intellectual property rights, electronic signature, and encryption must be addressed.

40 In contrast, the Fund extended payphones to unattended rural areas only after barriers to effective commercial provision of telephone service had been dismantled and the value of voice communication had been demonstrated through the market - the service had already been taken up in commercial terms by a large part of the population.
Conclusion

This review confirms the continuing validity of the Chilean model for extending basic communication service throughout the population of a developing economy: remove impediments from effective working of the market, then mobilize additional investments through the market. Following successful sector reforms, the Fund reduced the remaining gap in rural access telephone service by an order of magnitude in five years, its efforts funded primarily by the private sector and catalyzed by minuscule amounts of public money. The Fund remains one of the most efficient and effective schemes worldwide for extending basic service beyond the market.

Questions remain, however, about long-term sustainability, what to do with the small residual rural population still excluded, and whether anything needs to be done beyond the market in low-income urban areas. These questions—in addition to design improvements suggested by the Fund’s experience, and work still in progress on quality standards and monitoring—are relevant to the Fund’s proposed extension into new fields as well as to other countries learning from the Chilean experience.

Moving Chile along from payphones to the Internet and other advanced information and communication services, while appealing and fashionable, means that the government is now getting into the business of leading new markets rather than supplementing a mature market. There are benefits to this, but surely the risks of getting it wrong are great, as are the costs. It is also not clear why the government needs to intervene at this time beyond revising the regulatory framework to accommodate new technologies and applications, nor whether the features that made the Fund a success in promoting payphones will make as much of a difference in accelerating take-up of more advanced services.

Time will tell. For now, about one-half of the world’s developing and transition economies still have not even started along the road of sector reform. Three billion people live in rural areas, most of them without access to basic communication services. The Chilean model remains a proven way to make progress toward universal access to voice communication.
Annex 1. Cost-Benefit Analysis of Projects

The amount of subsidy allocated to each project supported by the Chilean Telecommunications Development Fund is determined through competitive tenders. As is standard for public sector project analysis, however, the government uses cost-benefit analysis to decide which projects are eligible for Fund subsidy and the maximum subsidy that should be made available for each project. This annex outlines the analytic method, discusses some shortfalls, and comments on scope for improvement.

Private Cost-Benefit Analysis

To obtain the private net present value (NPV) of each project, costs and revenues attributable to the project and accruing to the operating company during the 10 years of required service are forecast and discounted at prevailing interest rates. Projects with a negative private NPV would result in a loss and presumably would not be undertaken unless the operator is compensated for the loss. Projects whose private NPV is zero would just recover all costs, including the cost of capital; those whose NPV is greater than zero would result in surplus profits. In the last two cases the project is likely to be undertaken.

Costs

At the start of each round of financing, SUBTEL collects requests for payphones from regional and local authorities, neighborhood associations, and the general public. A basic engineering model, updated annually to reflect changing technologies and costs, is applied to the ensemble of these locations. The model helps identify feasible network solutions and compare investment costs of various alternatives using cables, terrestrial radio links, and satellite links. As a result, the localities are grouped into a smaller number of projects (each typically comprising 20–50 localities) that are technically viable. This grouping roughly minimizes overall investment cost and gives investment cost estimates for each project.

The engineering model provides rough rules for initial project design and costing. In 2000, for example, cables were assumed for localities spaced up to two kilometers along a road; multi-access UHF and microwave radio systems for 12 or more localities within the reach of one system; repeaters or intermediate base stations to overcome path obstacles or distances beyond system range; single-channel VHF or UHF links to reach dispersed localities; and satellite links elsewhere. Cellular and PCS mobile systems were also considered in 1998 but excluded for the time being because stand-alone costs remained too high.

For consistency with competition rules and fundamental technical plans applicable to all telecommunications operators, all localities in one project are typically from a single primary area of the national network. Exceptions (in the cost-benefit analysis as well as later in practice) were made in the case of localities that could only be served cost-effectively using satellite solutions, to take into account the broader regional or national footprint of these systems.

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Recurrent costs for each project mainly include salaries, benefits, and transportation for maintenance and repair work.\(^4\) Other items are spare parts (estimated at 1.0 percent of investment cost), insurance (0.5 percent of investment), energy (average for all localities), commissions paid to local payphone administrators (20–30 percent of collected revenue),\(^4\)\(^4\) and general expenses (10 percent of total recurrent costs).

**Benefits**

Revenue generated by a project is the sum of the revenues generated by each locality in the project. It is estimated as (a) the average per capita income in the locality times (b) the proportion of income people are willing to spend in telephone calls times (c) the proportion of the locality's population effectively served by the payphone. Income information is available from national surveys disaggregated at the level of municipalities but not at the level of individual localities within each municipality. The following is assumed:

- The per capita income of a locality equals the upper limit of the second lowest quintile of the municipality's income distribution.
- People will spend 0.8 percent of their income making phone calls (0.6 percent in the more remote regions).
- The payphone effectively serves 100 percent of the population in places with less than 500 inhabitants, tapering off to 20 percent for those with over 5,000 inhabitants.

The expected number of outgoing regional calls is the revenue divided by the maximum price per minute specified in the license and by the expected average call duration (typically three minutes). In addition there will be incoming calls, estimated as 30 percent of outgoing calls.

**Social Cost-Benefit Analysis**

To calculate the social NPV of each project, the Fund forecasts and discounts the costs and benefits attributable to the project and accruing to the economy as a whole during the 10 years of required service. Projects whose social NPV is less than zero would result in a loss to the economy and should not be undertaken. Projects whose social NPV is equal to or greater than zero are desirable. Social costs and benefits are derived from the private costs and benefits.

\(^{43}\) In the 2000 round it was assumed that most localities would be visited four times per year, one technician would average two visits per day, and each visit would require traveling 60 kilometers round-trip. More frequent visits, fewer visits per technician-day, longer trips, and higher salaries were assumed for localities in the more distant and sparsely populated regions. A standard transportation cost per kilometer was assumed countrywide.

\(^{44}\) Some payphones are administered by local persons (e.g., those living in a house to whose exterior wall the payphone is attached) who look after the facility and collect payments from customers. Most payphones, however, are coin operated. Calling cards were only introduced in 2000.
Costs

Costs are adjusted to reflect real scarcities in the economy. This involves correcting for distortions in the price system. In the 2000 round, for example, foreign exchange was valued six percent above market rates and unskilled labor costs were discounted 15 percent. Also, costs that reflect transfers within the economy rather than claims on scarce resources are removed. Custom duties and other tax elements fall in this category.

Benefits

In addition to revenues, social benefits include an estimate of the increase in consumers’ surplus (the difference between what consumers actually pay and the higher amount they would have been prepared to pay) resulting from providing the payphone. This is obtained by estimating the demand curve for calls. Point A of the demand curve is defined by the price $p_1$ and number of calls $q_1$ with the project, which follows from the revenue calculation. Point B of the demand curve is calculated to reflect the (higher) cost $p_2$ of communicating without the project. This assumes that, because users travel to other payphones, they incur transportation and time costs in addition to paying the price of the call. Standard figures are used for the cost of transportation, the value of time, and the proportion of these costs that are attributable to making the telephone call. The price elasticity of the demand for calls is assumed to be constant and equal to -0.7. This, and point A, determine the number of calls $q_2$ that would be made at price $p_2$. The gain in consumer’s surplus attributable to the project is equal to the area under the demand curve between $p_1$ and $p_2$ (AB$p_2p_1$ in Figure 1).

Project Selection

Projects with positive social NPV and negative private NPV are added to the pool of projects eligible for financing. In the 2000 round, for example, all 95 rural projects considered had negative private NPV, of which 84 had positive social NPV and were added to the pool.45

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45 The 2000 round also considered 280 urban payphone projects, all of which had positive social NPV but only 13 of which had negative private NPV. As discussed in the main text, none of these urban projects was awarded.
The maximum subsidy to be made available for a project equals the absolute value of the (negative) private NPV. This is the amount of subsidy that would make the project just viable commercially.

The projects added to the pool are ranked by social NPV per unit of maximum subsidy, down to the last project for which financing would be available should all projects be bid at the maximum subsidy. This is the list of projects for which bids will be solicited. Projects in the pool for which bids are not solicited or awarded in the current round stay in the pool for possible inclusion in the next round.

Discussion

Although this method is quite conventional, the Fund ran into some difficulties applying it.\textsuperscript{46} Costs were initially understated and later overestimated, while revenues were underestimated, and consequently the maximum subsidies made available for some projects may have been too small and others too large. A bias of the analysis against small and poor places may have postponed support for projects serving some of the neediest people.

Private Costs and Revenues

In calculating project costs, the question arose as to whether existing networks in the project area should be considered. In the first round, SUBTEL’s cost estimates took into account ENTEL’s extensive transmission network. Access to this network was expected to reduce the cost of several new projects. In practice, however, ENTEL did not bid and, since terms to interconnect competitors were not sufficiently clear, the maximum subsidies offered were too low to attract other operators. Subsequently, the cost calculation was amended to ignore existing networks in all project areas. An effective interconnection regime had been put into place so that new entrants could choose whether to build their own facilities or interconnect with existing ones. It could be assumed, therefore, that incumbents and new entrants alike could use existing networks at roughly the same cost. This should reduce actual project costs below the calculated costs, in some cases quite considerably.

The advent of wireless technologies presented additional opportunities for reducing costs below the calculated figures. Although cellular technology had remained too expensive for use in supplying fixed service in rural areas on a stand-alone basis, it became cost-effective to install fixed phones using mobile technology near towns and roads where mobile service was available. CTC, one of the three main rural telephone operators, has reportedly used the mobile network to provide fixed rural service in some areas without Fund support. Also, various modalities of wireless local loop (WLL) provided cost-effective alternatives to cable connections in the later years of the Fund.

\textsuperscript{46} This section is partly based on an extensive review of the Fund in 1998 encapsulated in two reports: Conclusiones: evaluación de resultados del FDT y propuestas (mimeo, Departamento de Ingeniería Industrial, Universidad de Chile, July 1999) and Evaluación del Fondo de Desarrollo de las Telecomunicaciones: sobre la evaluación social y privada de proyectos (same source, November 1998).
For example, in 2000 CTR was using WLL to connect about 20 percent of its customers to its multi-access microwave terminals and expected the proportion to rise in new installations. WLL could have been included in the engineering model, but by that time the bulk of the Fund program had been completed.

On the other hand, because subsidies were paid on completion of the project (usually about two years after the license was awarded), the licensee incurred financing costs. However, because these were not included in the cost calculation, the latter was understated by about 15 percent.

Revenues were underestimated by including the price of only regional (i.e., intra-primary area) calls. Eventually, about one-half of all outgoing calls turned out to be long-distance calls for which customers incurred additional charges. Also, access charges paid to the rural operators by other companies to terminate calls originated in the main network accounted in some cases for as much as 40 percent of the rural companies' revenues, but also were not included in the analysis.

Revenue and traffic forecasts based on assumed willingness to pay, although representing the best that could be done initially, ultimately proved unreliable. After several years of Fund operation a considerable body of empirical evidence built up and was used to predict traffic (and thereby revenue) from new payphones more accurately on the basis of population numbers alone.

Impact on Subsidies

In the first round, costs were underestimated and therefore the maximum subsidies offered were too low. Several projects had no bidders; these were included again and awarded in the next round. In later rounds, however, overall high cost estimates and low revenue estimates probably exaggerated the negative private NPV of several projects and resulted in unduly large maximum subsidies being offered. In principle this was preferable to offering too little subsidy, which had resulted in some projects with no bidders. Also, the subsidy actually awarded was primarily determined through competitive bids, which could be expected to reflect the lower real costs.

In practice, however, limited competition for some projects—especially toward the end of the program, when operators had consolidated market positions on a regional basis—led to only one or two bids per project, and to bids at or near the maximum available subsidies. In those cases the actual subsidy awarded was determined more by the cost-benefit calculus than by the market, so the high cost estimates may have resulted in excessive subsidies.

Social Costs and Benefits

Social NPV calculations were subject to significant additional uncertainties. The determination of consumers' surplus was based on rather arbitrary assumptions about demand elasticity and the cost of alternative means of communication. The assumption of constant elasticity of demand (i.e., the demand curve is an equilateral hyperbola) was
unrealistic and may have understated the gain of consumer's surplus attributable to the project (compared, for example, with the more usual but also arbitrary assumption of linear demand curves). The value of price elasticity of demand used (-0.7) was based on a survey carried out before the advent of long-distance competition. Competition substantially increased use and changed calling patterns and may have resulted in more inelastic demand. The estimated cost of communication without the project was based on assumptions that were plausible (e.g., one-half the cost of traveling to the next payphone was added to the cost of making a call) but not supported by empirical evidence. Externalities were not taken into account, such as benefits to the locality as a whole from being connected (e.g., improved security).

Reviewers also argued that the method was inherently biased against smaller and poorer places. These places make fewer calls and hence appear in the calculus of social benefits to have less to gain from being connected. Also, to the extent that these places are farther from the main network, the cost of reaching them is higher. On both counts, then, these places rank low in terms of social NPV per unit of subsidy and are less likely to be selected for funding, even if the Fund's mandate is precisely to help the less-favored population groups.

**Scope for Improvement**

It is unclear whether these limitations of the cost-benefit analysis led in practice to significant errors in the selection or timing of projects for Fund support or to excessive public financing of some projects. It would appear, therefore, that improvements in the analytic method would have been worth undertaking only if they were fairly easy and reduced processing costs or delays. For example, little would have been gained by undertaking extensive econometric studies to determine more accurately the price elasticity of calls. But it made sense to use actual payphone traffic data instead of assumptions on willingness to pay to forecast revenues as soon as such data became available.

There are, however, two broader lessons to be drawn. First, the risk of errors in cost-benefit analysis should be limited by using the results of the analysis in conjunction with other decisionmaking tools. For example, the bias against small and poor localities can be offset by giving them additional weight when drawing up the final list of projects for which bids will be solicited, reflecting priorities in government programs for poverty alleviation. Also, regional authorities, which have a better understanding of the local places than central Fund analysts, should participate closely in the selection of localities.

The second lesson is that effective competition for all or most projects must be maintained throughout the program. Limited competition in the initial and late rounds resulted in subsidies awarded at or near the maximum available, with all its potential errors and uncertainties, rather than through the market. Comparison with the experience of other countries may shed some light on whether the Chilean design can be improved in this regard.
Annex 2. Setting Access Charges for Rural Telephone Companies

Access charges proved to be a major determinant of the commercial viability of rural telephone service in Chile. This annex outlines how access charges were determined in terms of the costs of a hypothetical efficient rural operating company. The approach was consistent with the method used in Chile for determining regulated telecommunications prices generally, and it illustrates how efficient, roughly correct prices can be set quickly—without resort to mature cost accounts that are rarely in place or sufficiently reliable in developing countries making the transition to competition.

Background

The telecommunications law establishes the principles for calculating any charges that are subject to regulation. For rural telephone companies, only access charges are regulated. Access charges are what the companies are paid to terminate calls addressed to their customers but originated in other parts of the network, mainly urban local telephone companies and long distance carriers. Charges for other services (such as transit traffic, use of infrastructure, and billing) rendered by the rural companies to other companies with which they are interconnected are subject to approval by the regulator but determined by the rural companies on the basis of actual costs. Maximum retail prices for calls made from subsidized rural payphones are set in the license tender documents, not through the regulatory process. The companies freely set all other prices, including retail prices of individual business and residential phone lines covered by the rural licenses in addition to the subsidized payphones.

The method prescribed by the law to determine regulated charges is based on creating a model of a hypothetical company capable of meeting the relevant demand efficiently, using the latest available technologies and business practices, for five years. This is the period during which access and other interconnection charges, once established by decree, remain in force. The hypothetical company does not necessarily resemble any of the real companies to which the regulated charges will apply. When rural access charges were first being determined, however, several new rural companies were being set up. In practice, the hypothetical company closely resembled one of them.

47 This annex is based on a paper prepared by Roberto Gurovich. For additional information contact rgurovich@gva.cl and www.gva.cl
Method and Application

A model of the hypothetical rural operating company was built by forecasting demand, investments costs, operating expenses, cost of capital, depreciation, and traffic. The model was then used to determine the annual revenue $y$ that would satisfy the following equation:

$$
- \sum_{i=1}^{5} \frac{I_i}{(1 + K_0)^i} + \sum_{i=1}^{5} \frac{(y - c_i) \times (1 - t) + d_i \times t}{(1 + K_0)^i} + \frac{V_r}{(1 + K_0)^5} = 0
$$

Where:

- $i$ year (0,1,..,5)
- $I_i$ investments in year $i$
- $c_i$ operating expenses in year $i$
- $d_i$ depreciation in year $i$
- $V_r$ residual value of investments
- $K_0$ cost of capital
- $t$ corporate tax rate
- $y$ annual revenue

Investments

When calculating investment costs, the model took into account that regulation required traffic between different primary numbering areas to be carried by competitive long-distance companies rather than the rural company itself, even if its networks spanned several primary areas. This implied the use of low-capacity switches, usually located in the main town within each zone where they would interconnect with the principal local and long distance companies.

The model also took into account that the rural communities to be connected were small and widely scattered. That meant that the network to reach them would be wireless. The quality of service, however, should be comparable to what could be obtained from conventional wireline telephone networks (for example, service is available more than 99 percent of the time and lines can carry facsimile data).

The network solution chosen for the hypothetical efficient company, therefore, comprised multi-access radio transmission systems (Time Division Multiple Access, or TDM-A).

48 These primary zones are equivalent to Local Access and Transport Areas (LATA) in the United States, within which calls are local and between which local companies cannot carry traffic.

49 Several local telephone operators can coexist and compete in a given zone, as well as several long-distance operators interconnected with these local companies.
TDMA) with terminals of 2, 10, 30, and 100 lines capacity (depending on the population of the localities being served) and copper cable distribution networks to reach the end users located up to 2,000 meters away from the radio terminals.

Investments needed for operation and administration were also included:

- Information systems for network management, billing, customer service, and technical support
- Vehicles, tools, and instruments
- Office equipment, spare parts, and other.

Total investment for the hypothetical company added up to US$5,064 per line, broken down as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching equipment</td>
<td>5.0 percent</td>
</tr>
<tr>
<td>Radio transmission systems</td>
<td>61.8 percent</td>
</tr>
<tr>
<td>Local cable networks</td>
<td>16.4 percent</td>
</tr>
<tr>
<td>Operation and administration</td>
<td>16.8 percent</td>
</tr>
</tbody>
</table>

**Operating Expenses**

The operating expenses of this type of rural network are strongly influenced by the costs of network maintenance, equipment and line repair, and billing and collection. These costs vary considerably with population distribution, topographical conditions, and ease of access. The average annual operating expenses for the hypothetical company were estimated at about US$700 per line, broken down as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel</td>
<td>75 percent</td>
</tr>
<tr>
<td>Other expenses</td>
<td>25 percent</td>
</tr>
</tbody>
</table>

**Cost of Capital**

The method for determining the cost of capital is prescribed in the applicable legislation. This method, however, is intended for use with large companies whose shares are traded in the stock market, or that at least have sufficiently long accounting records to be able to assess the business risk involved. That was not the case with the new rural companies. Where a sufficiently long accounting record does not exist, international experience should be used, according to the law. This, however, was also not possible because at the time there were no stand-alone rural telephone companies in emerging economies. Rural service was typically a marginal activity of companies that provided telephone services mostly in urban areas.

For these reasons, the cost of capital used for the hypothetical rural company was one previously approved by the regulator for another small company with a similar number of lines, operating in a zone well removed from the country’s main population centers. This rate, 13.41 percent, was likely to be at the low end of the range of the cost of capital.
Other Parameters

The tax rate used is the one applied to all businesses in Chile: 15 percent on profits, with the option of deducting accumulated losses from up to five previous years.

The residual value of investments was determined using a method whereby the gross margin (operating income minus operating expenses) of the fifth year was considered a perpetuity; in other words, the residual value is the gross margin divided by the cost of capital. It is assumed that the company continues its activities after the fifth year, investing annually an amount equal to the depreciation of the fifth year.

For depreciation purposes, assets are considered to have the following service lives:

- Switching equipment and computers: 5 years
- Radio transmission systems: 5 years
- Local cable networks: 30 years
- Buildings: 30 years
- Land: No depreciation

Cost Allocation

Once the annual revenue satisfying equation (1) had been determined, it was necessary to decide how much of this revenue was to be financed by access charges.

According to the telecommunications law, when as a result of the indivisibility of investments the same assets are used to provide both regulated and unregulated services, the assets should be allocated to each category in proportion to the actual utilization of the assets in providing these services. In the case of the hypothetical rural company, only access charges were deemed regulated and all other charges, including outgoing call charges, were considered unregulated.

This meant estimating the volume of telephone traffic (measured in seconds) corresponding to access (i.e., incoming calls from other companies directed to the rural company’s customers) as a fraction of the total traffic circulating in the rural company’s network. This fraction was then applied to the annual revenue, and the resulting amount is what should be financed by the access charges, according to equation (2) page 53.
Where:

\( T_i \)  access traffic in seconds in year \( i \)

\( p \)  access charge per second\(^{50}\)

\( \gamma_{access} \)  part of the annual revenue to be met from access charges

\( K_0 \)  cost of capital

**Results**

The result of the process was a decree establishing maximum prices for the company’s various services to other operators wishing to use its network. Table 12, page 54, provides a summary.

**Conclusion**

Because traffic from other companies typically amounts to a high percentage of total traffic circulating through rural networks (sometimes more than 50 percent), the revenue accruing from it can mean the difference between the commercial success and failure of a rural project. Determining access charges that reflect the costs of providing the rural telephone service is thus extremely important.

It should be emphasized that the Fund did not seek to establish some sort of cross-subsidy from the other companies to the rural operations. Rather, it was simply recognizing and applying (in the form of access charges) the production costs of the rural services, which differ significantly from similar services provided in urban areas.

\(^{50}\) Chilean regulations define the charging unit as one second of communication, with no charge for setting up the call.
Table 12. Rural Tariffs, Official Gazette, February 26 1999

<table>
<thead>
<tr>
<th>Services</th>
<th>Charges ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptation of civil works</td>
<td></td>
</tr>
<tr>
<td>Manholes per unit</td>
<td>185,309.6</td>
</tr>
<tr>
<td>Ducts per linear meter</td>
<td>26,388.6</td>
</tr>
<tr>
<td>Use of space</td>
<td></td>
</tr>
<tr>
<td>Monthly charge per square meter</td>
<td>11,841.4</td>
</tr>
<tr>
<td>Electricity</td>
<td></td>
</tr>
<tr>
<td>Monthly charge per kilowatt installed</td>
<td>43,200.0</td>
</tr>
<tr>
<td>Connection to a Network Termination Point (NTP)</td>
<td></td>
</tr>
<tr>
<td>NTP switch capacity: 0 to 3000 customers</td>
<td></td>
</tr>
<tr>
<td>Initial charge per 2 Mb/s trunk card</td>
<td>879,620.0</td>
</tr>
<tr>
<td>Monthly charge per 2 Mb/s trunk card</td>
<td>21,470.6</td>
</tr>
<tr>
<td>NTP switch capacity: 3001 to 6000 customers</td>
<td></td>
</tr>
<tr>
<td>Initial charge per 2 Mb/s trunk card</td>
<td>439,810.0</td>
</tr>
<tr>
<td>Monthly charge per 2 Mb/s trunk card</td>
<td>21,470.6</td>
</tr>
<tr>
<td>NTP switch capacity: more than 6001 customers</td>
<td></td>
</tr>
<tr>
<td>Initial charge per 2 Mb/s trunk card</td>
<td>0.0</td>
</tr>
<tr>
<td>Monthly charge per 2 Mb/s trunk card</td>
<td>21,470.6</td>
</tr>
<tr>
<td>Customer connection/disconnection (per event)</td>
<td>239.4</td>
</tr>
<tr>
<td>Access charges to terminate calls from other operating companies</td>
<td></td>
</tr>
<tr>
<td>Normal hours ($/sec)</td>
<td></td>
</tr>
<tr>
<td>Year 1</td>
<td>1.2693</td>
</tr>
<tr>
<td>Year 2</td>
<td>1.2629</td>
</tr>
<tr>
<td>Year 3</td>
<td>1.2503</td>
</tr>
<tr>
<td>Year 4</td>
<td>1.2315</td>
</tr>
<tr>
<td>Year 5</td>
<td>1.2069</td>
</tr>
<tr>
<td>Reduced rate hours ($/sec)</td>
<td></td>
</tr>
<tr>
<td>Year 1</td>
<td>0.6346</td>
</tr>
<tr>
<td>Year 2</td>
<td>0.6315</td>
</tr>
<tr>
<td>Year 3</td>
<td>0.6251</td>
</tr>
<tr>
<td>Year 4</td>
<td>0.6158</td>
</tr>
<tr>
<td>Year 5</td>
<td>0.6034</td>
</tr>
<tr>
<td>Transit traffic ($/sec)</td>
<td></td>
</tr>
<tr>
<td>Year 1</td>
<td>0.4933</td>
</tr>
<tr>
<td>Year 2</td>
<td>0.4909</td>
</tr>
<tr>
<td>Year 3</td>
<td>0.486</td>
</tr>
<tr>
<td>Year 4</td>
<td>0.4787</td>
</tr>
<tr>
<td>Year 5</td>
<td>0.4691</td>
</tr>
<tr>
<td>Traffic measurement</td>
<td></td>
</tr>
<tr>
<td>Monthly charge</td>
<td>27,555.1</td>
</tr>
<tr>
<td>Charge per completed and reported communication</td>
<td>0.352</td>
</tr>
<tr>
<td>Pricing</td>
<td></td>
</tr>
<tr>
<td>Monthly charge</td>
<td>4,511,017.6</td>
</tr>
<tr>
<td>Charge per completed call</td>
<td>1.410</td>
</tr>
<tr>
<td>Invoicing</td>
<td></td>
</tr>
<tr>
<td>Charge per invoice</td>
<td>46.142</td>
</tr>
<tr>
<td>Collection and Complaints</td>
<td></td>
</tr>
<tr>
<td>Charge per invoice</td>
<td>71.086</td>
</tr>
</tbody>
</table>

Source: Diario Oficial, 22 February 1999, Santiago, Chile
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