Appendix)

June 1986 and June 1989 were used as the times for the start of service, for Phase I and Phase II respectively.

1-2 Income Extimation

1-2-1 Telegraph Revenues

(1) Telegraph Revenues

Telegram rate/per message x forecast number of telegrams.

We assumed 3.20 pesos as the rate per message by multiplying the actual value in 1979 (2.13 pesos*) by the increase rate under the rate revision of October 1980 (1.31∿1.52 ≒ 1.5)

* $\frac{\text{Total revenues}}{\text{Total number of telegrams}}$ (Annual report, 1979)

(2) Telex service Revenues

Annual revenues per subscriber x number of telex service subscribers as of the end of fiscal year

We assumed 15,780 pesos as the annual revenues per subscriber by multiplying the unit amount of revenue under the Northern Luzon Project (10,520 pesos) by the increase rate under the telegram rate revision of October 1980 (1.31∿1.52≒1.5).

1-2-2 Telephone Revenues

(1) Telephone subscription fee

Subscription fee per subscriber x number of newly installed telephones.

We assumed 20 pesos (current installation charge) as the subscription fee per subscription.

(2) Rentals

Subscriber monthly rental rate x 12 months x number of subscribers as of the end of fiscal year.

We assumed 41 pesos for residential telephones and 54 pesos for business telephones (current rates) as persubscriber monthly rental rates and decided 7:3 as the ratio between residental telephones and business telephones by referring to examples in developing nations. Thus, the per-subscriber average monthly rental is 44.9 pesos.

(3) Local call rate

Local call rate per-call x per-subscriber annual originating telephone traffic ÷ per-call average call time x number of subscriptions as of the end of fiscal year

We assumed 0.40 peso as the per-call local call rate in accordance with the fee system proposed for this project. Regarding the per-subscriber annual originating telephone traffic, we assumed 67% of all originating traffic as paid local calls in accordance with the foregoing "V. Traffic Forecasting". We assumed 3 minutes as the per-call average call time by referring to Japanese examples.

(4) Toll call rate

1) Per-minute average toll call rate x per-subscriber annual originating telephone traffic x number of subscribers as of the end of fiscal year

We assumed 0.4 pesos for acall within the same

province for every 30 seconds, for a call within the same region for every 12 seconds on the assumption that the distance is 80 - 150 km and for a call among regions for every 8 seconds on the assumption that the distance is 150 - 250 km in accordance with the fee system proposed for this project. As a result, the message rate for a call becomes 0.8, 2.0 and 3.0 pesos each perminutes. Regarding the per-subscriber annual originating telephone traffic, we assumed 30% of all originating traffic as toll calls in accordance with the foregoing "V. Traffic Forecasting".

2) As for the toll call rates for originating/terminating calls between BUTEL and private-operating companies subscribers, due to limited available data we assumed that the rates for BUTEL-originating calls are entirely BUTEL's revenues and the rates for BUTEL-terminating calls are entirely private sector revenues.

3) It has been proven that generally when service improves from a delayed basis to manual non-delayed or automatic non-delayed, traffic increases both among old and new subscribers.

The toll call rate calculated by 1) above includes the traffic increase brought about by the improvement of service. However, due to the shortage of data for calculating only the general toll call rate, we cannot separately

calculate the toll call rate accompanying traffic increase or show its effects.

1-2-3 Leased Circuit Revenues

We anticipated 10% of the telegraph and telephone revenues as leased circuit revenues in view of the present conditions (PLDT. etc.) in the Philippines.

1-3 Estimation of Costs

1-3-1 Capital Investment

We used the amount of capital investment in the foregoing "VIII. Construction Cost" by revising the cost to present prices. The annual expenditures during the period of construction was over five years, 1982-1986, for Phase I and four years of 1986-1989 for Phase II in accordance with the terms of payment and the implementation plan.

1-3-2 Working Capital

Working capital is the operating funds necessary to continue operation by such acts as paying for outstanding telegraph and telephone rates and procuring equipment. We estimated 30% of the project's annual revenue in accordance with the results of analysis by the World Bank.

1-3-3 Maintenance Costs

Facility by-item maintenance cost = amount of investment by facility item x maintenance cost ratio by facility item x $(0.8 \times \frac{5}{10} \div 0.2)$

We assumed a certain ratio to the amount of capital investment (maintenance cost rate in Japan) as the maintenance cost. After Japanese examples, 8:2 was used as the personnel cost/property cost ratio in the maintenance cost. The personnel cost was corrected to $\frac{5}{10}$ after the examples of other projects because of wage gaps.

1-3-4 Administrative Costs

$$\text{Annual revenue} \times 0.3 \times \left(0.7 \times \frac{5}{10} + 0.3\right)$$

In the Japanese examples, administrative costs are about 30% of annual revenues and divided into 7/10 for personnel cost and 3/10 for property costs. Because of wage gaps, we corrected the personnel cost to $\frac{5}{10}$ after the examples of other projects.

1-3-5 Rentals of Leased Circuit

We provided for leased circuit rentals because privately managed circuits will be rented for part of BUTEL's toll circuits, and the rent was calculated at the rate of 14.62 pesos (present PLDT rate) monthly per km of circuit.

1-4 Results of Analysis

Annual revenues from this project are as shown in Table XIII-1-1 (Phase I) and Table XIII-1-3 (entire project). Costs per year and the results of the financial analysis are as shown in Tables XIII-1-2 (Phase I) and XIII-1-4 (entire project). The discount rates are 7.26% for Phase I and 6.89% for the entire project.

Therefore, this project has been proved by financial

analysis to be economically feasible and can be expected to be profitable.

1-5 Loan Repayment Plan

We assumed that foreign funds included in the amount of capital investment will be loaned and prepared a loan repayment plan under the loan conditions of a 30 years period at 3% per annum (simple interest) and repaying by the same amount every year after deferment for 10 years. The results are shown in Table XIII-1-5 (Phase I) and Table XIII-1-6 (entire project).

Table III-1-1 Project Income (Phase I)

(Unit:1000 pesos)

Fisical Year	Telephone revenues					Telegraph revenues			Leased circuit revenues	Total	Remarks
	Sub-scription fee	Rental	Local call rate	Toll call rate	Total	Telegram rate	Telex service	Total	Leased circuit rental		
1982											(*) Service for Phase I is to be started on June 1980.
83											
84											
85											
86	37	(*)578	803	8,829	10,247	5,898	(*) 74	5,972	1,622	17,841	
87	37	1,983	2,754	30,276	35,050	5,987	252	6,239	4,129	45,418	
88	37	2,974	4,132	45,414	52,557	6,077	379	6,456	5,901	64,914	
89	18	3,454	4,766	53,058	61,296	6,166	505	6,671	6,797	74,764	
90	18	3,933	5,400	60,705	70,056	6,257	631	6,890	7,695	84,641	
91	18	4,424	6,112	67,881	78,435	6,352	757	7,109	8,554	94,098	
92		"	"	"	78,417	6,448	"	7,205	8,562	94,184	
93		"	"	"	"	6,544	"	7,301	8,572	94,290	
94		"	"	"	"	6,643	"	7,400	8,582	94,399	
95		"	"	"	"	6,742	"	7,499	8,592	94,508	
96		"	"	"	"	6,845	"	7,602	8,602	94,621	
97		"	"	"	"	6,947	"	7,704	8,612	94,733	
98		"	"	"	"	7,052	"	7,809	8,623	94,849	
99		"	"	"	"	7,158	"	7,916	8,633	94,965	
2000		"	"	"	"	7,267	"	8,024	8,644	95,085	
1		"	"	"	"	7,376	"	8,133	8,655	95,205	
2		"	"	"	"	"	"	"	"	"	
3		"	"	"	"	"	"	"	"	"	
4		"	"	"	"	"	"	"	"	"	
5		"	"	"	"	"	"	"	"	"	
6		"	"	"	"	"	"	"	"	"	
Total	165	83,706	115,647	1,284,378	1,483;896	142,641	13,953	156,595	164,050	1,804,542	

Table XIII-1-2 Financial Analysis (Phase I)

(Unit: 1000 pesos)

Fisical Year	Expenditures						Revenues ②	Revenue/ expenditure balance ②- ①	Present value		Discount rate	Remarks
	Capital investment	Working capital	Maintenance cost	Administrative cost	Leased circuit rental fee	Total ①			11%	12%		
1982	19,943					19,943		Δ19,943	Δ17,967	Δ17,806	11% + 2160 / 2,160+17,746 = 11.1085%	(*1) Service for Phase I is to be started on June 1986
83	81,834					81,834		Δ81,834	Δ66,418	Δ65,238		(*2) Facility capacity is in keeping with demand 15 years after start of service.
84	107,579					107,579		Δ107,579	Δ78,661	Δ76,573		
85	57,850					57,850		Δ57,850	Δ38,108	Δ36,765		
86	43,497	5,352	(*1) 6,973	3,479	(*1) 1,685	60,986	17,841	Δ43,145	Δ25,604	Δ24,482		
87		8,273	11,954	8,857	2,889	31,973	45,418	13,445	7,188	6,812		
88		5,879	"	12,658	3,120	33,581	64,914	31,333	15,092	14,173		
89		2,955	"	14,579	3,370	32,858	74,764	41,906	18,184	16,925		
0		2,963	"	16,505	3,640	35,062	84,641	49,579	17,382	17,879		
91		2,837	"	18,349	3,931	37,071	94,098	57,027	20,084	18,361		
92		26	"	18,366	4,245	34,591	94,184	59,593	18,908	17,132		
93		32	"	18,387	4,585	34,958	94,290	59,332	16,960	15,229		
94		33	"	18,408	4,952	35,347	94,399	59,052	15,207	13,533		
95		33	"	18,429	5,348	35,764	94,508	58,744	13,628	12,020		
96		34	"	18,451	5,776	36,215	94,621	58,406	12,207	10,671		
97		34	"	18,473	6,238	36,699	94,733	58,034	10,924	9,467		
98		35	"	18,476	6,737	37,222	94,849	57,627	9,775	8,393		
99		35	"	18,518	7,276	37,783	94,965	57,182	8,739	7,436		
2000		36	"	18,542	7,858	38,390	95,085	56,675	7,806	6,583		
1		36	"	18,565	(*2) 8,487	39,042	95,205	56,163	6,966	5,824		
2		0	"	"	"	39,006	"	56,199	6,280	5,202		
3		0	"	"	"	"	"	"	5,657	4,644		
4		0	"	"	"	"	"	"	5,097	4,147		
5		0	"	"	"	"	"	"	4,592	3,703		
6		Δ28,563	"	"	"	10,443	"	84,762	6,239	4,980		
Total	310,703	0	246,053	351,887	122,572	1,031,215	1,804,540	773,325	2,160	Δ17,746		

TATable XIII-1-3 Project Income (Entire Project)

(Unit: 1000 pesos)

Fiscal Year		Telephone revenues				Telegraph revenues			Leased circuit	Grand total	Remarks
	Subscription fee	Rental	Local call rate	Toll call rate	Total	Telegram fee	Telex service fee	Total	Rental for leased circuit		
1982											(*) Service is started,
83											Phase I: June 1986
84											Phase II:June 1989
85											
86	37	(*)578	803	8,829	10,247	5,898	(*)74	5,972	1,622	17,841	
87	37	1,983	2,755	30,276	35,051	5,987	252	6,239	4,129	45,419	
88	37	2,974	4,132	45,414	52,557	6,077	379	6,456	5,901	64,714	
89	38	(*)3,778	4,885	61,338	70,039	6,166	(*)1,057	7,223	7,726	84,988	
90	38	5,043	5,807	89,091	99,979	6,259	2,525	8,784	10,876	119,639	
91	38	6,078	6,714	110,217	123,047	6,352	3,598	9,950	13,300	146,297	
92	17	6,541	6,879	122,124	135,561	6,448	4,545	10,993	14,655	161,209	
93	16	6,967	7,037	133,083	147,093	6,544	5,491	12,035	15,913	175,041	
94	16	7,392	7,300	143,805	158,413	6,643	6,659	13,302	17,172	188,887	
95		"	"	"	158,397	6,742	"	13,401	17,180	188,978	
96		"	"	"	"	6,875	"	13,504	17,190	189,091	
97		"	"	"	"	6,947	"	13,606	17,200	189,203	
98		"	"	"	"	7,053	"	13,712	17,211	189,320	
99		"	"	"	"	7,158	"	13,817	17,221	189,435	
2000		"	"	"	"	7,267	"	13,926	17,232	189,555	
1		"	"	"	"	7,376	"	14,035	17,243	189,675	
2		"	"	"	"	7,488	"	14,147	17,254	189,798	
3		"	"	"	"	7,600	"	14,259	17,266	189,922	
4		"	"	"	"	7,715	"	14,374	17,277	170,048	
5		"	"	"	"	"	"	"	"	"	
6		"	"	"	"	"	"	"	"	"	
Total	274	130,038	132,602	2,469,837	2,732,751	143,995	104,488	248,483	278,122	3,279,356	

Table XIII-1-4 Financial Analysis (Entire Project)

(Unit: 1000 pesos)

Fisical year	Capital investment	Working capital	Maintenance cost	Administrative cost	Leased circuit rental fee	Total	Revenues	Revenue/expenditure balance 2 - 1	Present value 10%	Present value 11%	Discount rate	Remarks
1982	19,943					19,943		Δ19,943	Δ18,130	Δ17,967	10% + 27,871 / 27,871+11,349 = 10.7106%	(*1) Service is started, Phase I: June 1986 Phase II:June 1989
83	81,834					81,834		Δ81,834	Δ67,631	Δ66,418		(*2) Facility capacity is in keeping with demand 15 years after start of service.
84	107,579					107,579		Δ107,579	Δ88,826	Δ78,661		
85	57,850					57,850		Δ57,850	Δ37,512	Δ38,108		
86	151,170	5,352	(*1) 6,973	3,479	(*1) 1,685	168,659	17,841	Δ150,818	Δ93,646	Δ89,503		
87	110,327	8,273	11,954	8,857	2,888	142,300	45,419	Δ96,881	Δ54,687	Δ51,797		
88	58,755	5,849	11,954	12,658	3,120	92,336	64,914	Δ27,422	Δ14,072	Δ13,208		
89	46,074	6,022	(*1) 19,537	16,573	3,370	91,576	84,988	Δ6,588	Δ3,073	Δ2,859		
90		10,395	24,954	23,330	3,640	62,319	119,639	57,320	24,309	22,408		
91		7,997	"	28,528	3,931	65,410	146,297	80,887	31,185	28,487		
92		4,474	"	31,436	4,245	65,109	161,209	96,100	33,682	30,491		
93		4,150	"	34,133	4,585	67,822	175,041	107,219	34,163	30,648		
94		4,154	"	36,833	4,952	70,893	188,887	117,994	34,179	30,385		
95		27	"	36,851	5,348	67,180	188,978	121,798	32,073	28,257		
96		34	"	36,873	5,776	67,637	189,091	121,484	29,075	25,384		
97		34	"	36,895	6,238	68,121	189,203	121,083	26,351	22,799		
98		35	"	36,917	6,737	68,643	189,320	120,677	23,875	20,471		
99		35	"	36,940	7,276	69,205	189,435	120,230	21,624	18,374		
2000		36	"	36,963	7,858	69,811	189,555	119,744	19,579	16,986		
1		36	"	36,987	8,487	70,464	189,675	119,211	17,720	14,786		
2		37	"	37,011	9,166	71,168	189,778	118,630	16,031	13,256		
3		37	"	37,035	9,899	71,925	189,922	117,977	14,495	11,877		
4		38	"	37,059	(*2) 10,691	72,742	190,048	117,306	13,101	10,639		
5		0	"	"	"	72,704	"	117,344	11,913	9,588		
6		Δ57,015	"	"	"	15,689	"	174,357	16,093	12,834		
Total	633,532	0	474,636	639,476	131,275	1,878,919	3,279,356	1,400,437	27,871	Δ11,349		

Table XIII-1-6 Loan Repayment Plan (Entire Project)

(Unit: 1000 pesos)

Fiscal Year	Amount loaned	Amount repaid	Balance	Interest rate	Interest paid	Amount of principal and interest repaid
1982	16,243		16,243		487	487
83	64,578		80,821		2,425	2,425
84	87,011		167,832		5,035	5,035
85	29,590		197,422		5,923	5,923
86	34,081		231,503		6,945	6,945
87			"		"	"
88			"		"	"
89			"		"	"
90			"		"	"
91			"		"	"
92		11,575	219,928		6,598	18,173
93		"	208,353		6,251	17,826
94		"	196,778		5,903	17,478
95		"	185,203	3%	5,556	17,131
96		"	173,628		5,209	16,784
97		"	162,053		4,862	16,437
98		"	150,478		4,514	16,089
99		"	138,903		4,167	15,742
2000		"	127,328		3,820	15,395
1		"	115,753		3,473	15,048
2		"	104,178		3,125	14,700
3		"	92,603		2,778	14,353
4		"	81,028		2,431	14,006
5		"	69,453		2,084	13,659
6		"	57,878		1,736	13,311
7		"	46,303		1,389	12,964
8		"	34,728		1,042	12,617
9		"	23,153		695	12,270
10		"	11,578		347	11,922
11		11,578	0		0	11,578
Total	231,503	231,503	4,050,643		121,520	353,023

Table XIII-1-6 Loan Repayment Plan (Entire Project)

(Unit: 1000 pesos)

Fiscal Year	Amount loaned	Amount repaid	Balance	Interest rate	Interest paid	Amount of principal and interest repaid
1982	16,243		16,243		487	487
83	64,578		80,821		2,425	2,425
84	87,011		167,832		5,035	5,035
85	29,590		197,422		5,923	5,923
86	119,800		317,222		9,517	9,517
87	93,347		410,569		12,317	12,317
88	33,087		443,656		13,310	13,310
89	37,076		480,732		14,422	14,422
90			"		"	14,422
91			"		"	14,422
92		11,575	469,157		14,075	25,650
93		11,575	457,582		13,727	25,302
94		11,575	446,007		13,380	24,955
95		24,036	421,971		12,659	36,695
96		"	397,935		11,938	35,974
97		"	373,899		11,217	35,253
98		"	349,863	3%	10,496	34,532
99		"	325,827		9,775	33,811
2000		"	301,791		9,054	33,090
1		"	277,755		8,333	32,369
2		"	253,719		7,612	31,648
3		"	229,683		6,890	30,926
4		"	205,647		6,169	30,205
5		"	181,611		5,448	29,484
6		"	157,575		4,727	28,763
7		"	133,539		4,006	28,042
8		"	109,503		3,285	27,321
9		"	85,467		2,564	26,600
10		"	61,431		1,843	25,879
11		24,039	37,392		1,122	25,161
12		12,461	24,931		748	13,209
13		12,461	12,470		374	12,835
14		12,470	0		0	12,470
Total	480,732	480,732	8,390,716		251,722	732,454

2. Economic Analysis

Financial analysis is the analysis of profitability from the standpoint of the business undertaking. Next comes the analysis of effects of the project from the stand-point of the national economy.

2-1 Premises

The effects of the project are measured by the IRR (internal rate of return) method, based on the social benefits and social costs of this project.

The social benefits are supposed to be expressed as the willingness of service users to pay their fees. This social benefit is estimated on the basis of the revenue from charges used in the financial analysis and using also the following factors.

(1) The fact that telephone fees include those that are institutionally cheap and that they also include shifts from elsewhere.

(2) Regarding telephones, there is the network effect by this project.

Indirect effects later described in 2-4 Section can be expected from the execution of this project but these are difficult to measure. So under this analysis they are not included in the social benefit that was calculated.

The social cost is conveniently based on the cost used in the financial analysis for reasons described later.

2-2 Estimation of Benefits and Costs

(1) Benefit of Telegrams

[Increase]

BUTEL's telegrams include those that are free of charge or those with only small fees but these tle telegrams are considered to be as effective as other telegrams. So, we added what corresponded to the difference from the fees of telegrams in general to the benefit from the viewpoint of the nation as a whole.

Forecast number of telegrams x {1977 ordinary telegram rate per message(4.68 pesos) x rate revision magnifying power (1.5 times) - telegram average rate per message (3.20 pesos)}

[Decrease]

Meanwhile, the number of telegrams is considered to include shifts from other undertakings. We estimated this at 1/3 of the total number and subtracted it from the benefit.

Forecast number of telegrams x telegram average rate per message (3.20 pesos) x 1/3.

(2) Network Effect

It is believed that if the number of subscribers increases as the result of the new project, the volume of originating calls from offices outside the area of the project (traffic of terminating calls from the point of view of offices in the target area of the project) increases accordingly. This is the network effect and can be added to the benefit from the standpoint of the nation as a whole.

We decided to express the benefit from the network effect as increased toll call fees at other offices

and calculated this benefit as follows:

Toll call fee by year x 0.68 x 1/2

*1. 0.68 is the ratio of the volume of terminating calls to the volume of originating calls.

According to "V. Traffic Forecasting".

	Ratio of originating calls	Ratio of terminating calls to originating calls
Manila, etc.	60%	80%
In Regions III.IV	20%	100%
In Regions III.IV -PC	20%	100%
	100%	

Therefore, the volume of terminating calls from outside the target area of the project:

(0.6 x 0.8)+(0.2 x 1.0)+(0.2 x 1.0) x 0.0=0.68

*2. 1/2 means that half of the benefit is used as the effect of this project because some burden is caused to other offices in such respects as the use of facilities.

*3. Strictly, BUTEL-originating telegrams for other offices should be counted in the financial analysis. Since, however, most of telephones at other offices are under private meanagement, we included them all here in the benefit of the nation as a whole.

(3) Other Benefits

We used income used in the financial analysis as benefits.

(4) Social Cost

Properly speaking, social cost is expressed by the

calculated price (shadow price), which is the revised market price. Because calculated price is considered to indicate the true cost from the viewpoint of national economy.

Revision from amrket price to calculated price is made using conversion factors, e.g., standard conversion factor for non-trade property and CCF (consumer conversion factor) for the wages of skilled workers.

But when we studied recent data, we found that they were inadequate for use in calculating these conversion factors. So, we conveniently regarded the market price used in the financial analysis directly as social cost.

2-3 Results of Analysis

As indicated in Table XIII-2-1 and Table XIII-2-2, the internal rates of return determined for Phase I of this project and the entire project from the viewpoint of the nation as a whole are, respectively, 12.53 and 11.75. Thus, it can be said that, from the viewpoint of the nation as a whole, this project is highly profitable and has great socioeconomic effects.

2-4 Indirect Effects of the Project

As indirect effects of this project, the following may be pointed out.

(1) Contribution to Administration

Administrators at both the central government and the local autonomous entities require detailed

knowledge of the circumstances in different areas and changes in these circumstances. They must be reflected in the planning and execution of administrative policies.

A complete telecommunications network provides a means of collecting information and communicating rapidly and accurately, which is necessary for administration and contributes toward the increase of administrative efficiency and the timely conduct of administration.

It is especially effective in coping with disasters. There are many typhoons in the Philippines. During the past several years, for example, more than 20 typhoons hit the islands every year. Also, the great flood on Luzon Island is 1972 nearly paralyzed the Philippine economy, though only temporarily.

A complete telecommunications network helps to strengthen a nation's disaster control system by making it possible to quickly gain information concerning damage, begin so proper rehabilitation and prevent the spread of damage.

(2) Acceleration of Regional Industries and Regional Development

According to the Philippine long-term development plan, in 2000 Region III will have 10.0% of the nation's population and will represent 11.4% of the Philippine GDP (gross domestic products). Region IV (Southern Tagalog) is expected to account for 12.4% of the national population and 13.0% of the GDP.

Regions III and IV are more important than any other region in population and GDP and adjoin Metropolitan Manila, which is the center of the nation's economic and social activities. Such being the case, the success or failure of the development of both regions is likely to affect the development of the nation as a whole.

In the vicinity of Metropolitan Manila, urbanization will progress and the production of consumer goods and intermediate products will be accelerated. While in other areas the production of products suitable for the respective areas will be expedited. As is clear from examples in other countries, the smooth circulation of information is important for urbanization, industrialization and the formation of a distribution structure. Lack of a telecommunications service would be a major bottleneck to the progress of this urbanization and industrialization.

In this sense, a telecommunications project forms the foundation of the development of Regions III and IV and will accelerate the development of these regions.

(3) Contribution to Tourism

The Philippines attaches great importance to tourism. In 1977, for example, it the annual total of tourist revenues was 300 million dollars, which constituted a factor responsible for the favorable balance of invisible trade.

The Philippine long-term development plan proposes to expand hotels, resort facilities and other tourist

facilities.

Improved telecommunications will further facilitate travel reservations, hotel reservations and the provision of various information airout tourist sites as well as contibute to the development of the tourist industry and the convenience of tourists.

(4) Improvement of Residential Environments in Rural Areas

Telecommunications facilities - like educational facilities, medical facilities such as hospitals and health centers, transport facilities and lifeline facilities including electricity and waterworks - are indispensable to the health and the civilized living of people. For example, the availability of telegrams and telephones as means of contact in case of emergency will give people convenience and psychological reasurance.

The spread of telecommunications services in rural areas will help to improve residential environments for people living there, narrow gaps with cities in these environments and enhance solidarity among the local inhabitants.

(5) Increase of Reliance on Telecommunications and Inducement of Communication Demand

Equipment now in the possession of BUTEL seems to often break down and cannot provide stabilized service at all times. This makes people hesitate to use telecommunications.

The installation of new telecommunications equipment will establish the confidence of people in

telecommunications, induce their use and make their socioeconomic activities more intense than over.

Table XIII-2-1 Economic Analysis (Phase I)

(Unit: 1000 pesos)

Fiscal Year	Benefit				Cost ②	①-②	Present value		Internal rate of return	Remarks
	Revenue	Portion of increase in telegrams	Network effect	Total ①			12%	13%		
1982					19,943	Δ19,943	Δ17,806	Δ17,649	$12\% + \frac{14,406}{14,406 + 5,461}$	
83					81,834	Δ81,834	Δ65,238	Δ64,088		
84					107,579	Δ107,579	Δ76,573	Δ74,558	$\fallingdotseq 12.7251$	
85					57,850	Δ57,850	Δ36,765	Δ35,480		
86	15,958	5,068	2,362	23,388	59,878	Δ36,490	Δ20,705	Δ19,805		
87	38,960	5,145	8,098	52,203	31,525	20,678	10,476	9,932		
88	55,225	5,222	12,147	72,594	35,170	37,424	16,928	15,907		
89	63,446	5,299	14,192	82,937	35,557	47,380	19,136	17,822		
90	71,691	5,379	16,237	93,307	38,373	54,934	19,810	18,287		
91	79,618	5,459	18,156	103,233	41,011	62,222	20,034	18,330		
92	79,704	5,541	"	103,401	38,675	64,726	18,607	16,874		
93	79,810	5,624	"	103,590	38,702	64,888	16,655	14,970		
94	79,919	5,709	"	103,784	38,724	65,060	14,910	13,283		
95	80,028	5,794	"	103,978	38,745	65,233	13,348	11,786		
96	80,141	5,882	"	104,179	38,768	65,411	11,950	10,459		
97	80,253	5,970	"	104,379	38,790	65,589	10,699	9,281		
98	80,369	6,061	"	104,586	38,814	65,772	9,579	8,236		
99	80,485	6,152	"	104,793	38,837	65,956	8,577	7,309		
2000	80,605	6,245	"	105,006	38,861	66,145	7,680	6,486		
1	80,725	6,339	"	105,220	38,884	66,336	6,877	5,757		
2	"	"	"	"	38,848	66,372	6,143	5,097		
3	"	"	"	"	"	"	5,485	4,511		
4	"	"	"	"	"	"	4,897	3,992		
5	"	"	"	"	"	"	4,373	3,533		
6	"	"	"	"	14,628	90,592	5,329	4,267		
Total	1,530,562	122,584	343,532	1,996,678	1,066,540	930,138	14,406	Δ5,461		

Table XIII-2-2 Economic Analysis (Entire Project)

(Unit: 1000 pesos)

Fiscal Year	Revenue	Benefit			Cost	1 - 2	Present value		Internal rate of return	Remarks
		Portion of increase in telegrams	Networ effect	Total			1 %	12%		
1982					19,943	Δ19,943	Δ17,967	Δ17,806	$11\% + \frac{35,241}{35,241 + 1,939}$	
83					81,834	Δ81,834	Δ66,418	Δ65,238		
84					107,579	Δ107,579	Δ78,661	Δ76,573		
85					57,850	Δ57,850	Δ38,108	Δ36,765	≒ 11.9478	
86	15,958	5,068	2,362	23,388	167,551	Δ144,163	Δ85,554	Δ81,802		
87	38,961	5,145	8,098	52,204	141,852	Δ89,648	Δ47,929	Δ45,418		
88	55,225	5,222	12,147	72,594	93,924	Δ21,330	Δ10,274	Δ9,649		
89	71,903	5,299	16,406	93,608	94,268	Δ660	Δ286	Δ267		
90	100,634	5,379	23,829	129,842	64,771	65,071	25,438	23,465		
91	122,783	5,459	29,479	157,721	69,061	88,660	31,225	28,546		
92	135,155	5,541	32,664	173,360	69,141	104,219	33,067	29,960		
93	146,651	5,624	35,596	187,871	71,705	116,166	33,205	29,817		
94	158,209	5,709	38,463	202,381	74,522	127,859	32,926	29,302		
95	158,300	5,794	"	202,557	71,100	131,457	30,497	26,899		
96	158,413	5,882	"	202,758	71,129	131,629	27,511	24,048		
97	158,525	5,970	"	202,958	71,150	131,808	24,818	21,501		
98	158,642	6,061	"	203,166	71,174	131,992	22,390	19,224		
99	158,757	6,152	"	203,372	71,197	132,175	20,199	17,188		
2000	158,877	6,245	"	203,585	71,221	132,364	18,224	15,368		
1	158,997	6,339	"	203,799	71,244	132,555	16,441	13,742		
2	159,120	6,435	"	204,018	71,269	132,749	14,834	12,287		
3	159,244	6,531	"	204,238	71,294	132,944	13,383	10,987		
4	159,370	6,630	"	204,463	71,319	133,144	12,075	9,824		
5	"	"	"	"	71,281	133,182	10,882	8,774		
6	"	"	"	"	23,470	180,993	13,323	10,647		
Total	2,752,464	123,745	660,600	3,536,809	1,920,849	1,615,960	35,241	Δ1,939		

XIV. CONCLUSION AND RECOMMENDATIONS

XIV. CONCLUSION AND RECOMMENDATIONS

1. Conclusion

Through careful study of the Rural Telecommunications Project in Regions III and IV from both technical and economic standpoints, the study team has concluded that this project is feasible on condition that the following recommendations will be followed.

2. Recommendations

2-1 Roles of Private Operating Companies for This Project

In this project, DDD service is to be provided between BUTEL's telephone offices but consideration should be given to communication between BUTEL's and private operating companies' telephone offices. The TSs and SHF radio routes to be constructed by this project are to provide sufficient capacities for switching by DDD connection and transmitting incoming/outgoing calls from/to BUTEL's and private operating companies' telephone offices, so that connection with private operating companies's facilities will readily be achieved if so requested by private operating companies.

However, connection between BUTEL's telephone offices and private operating companies' TS and transmission lines is very important.

In Talac, San Fernando (S.F.P.) and Lucena, BUTEL's telephone offices are to be connected to the national

telephone network through private operating companies' TSs or transmission lines, so that it is necessary for the related private operating companies to provide necessary facilities for allowing DDD connection with BUTEL's offices by the time of the commencement of service by this project.

For Manila where 60% of all toll calls originating from local offices are to be directed to, it is important sufficient Manila TC capabilities for coping with more than 500 originating/terminating lines in Phase I alone and more lines expected to reach thereafter. Accordingly, it is necessary to initiate deliberation with related private operating companies on private operating companies' facilities, connection with private operating companies' offices and transmission lines, charging, etc., at an early stage in designing the project.

2-2 Provision of Necessary Radio Frequency Bands

In this project, 6GHz frequency bands are to be employed for the SHF radio routes and 2GHz, 800MHz, 400MHz, and 250MHz bands for the UHF and VHF bands. The Government of the Philippines is requested to approve the use of these frequency bands.

2-3 Implementation of Construction Work to Be Covered by Local Currency

The provision of sites for telephone offices,

radio repeater stations, and access roads for radio repeater stations is the necessary condition for the implementation of the project and should be accomplished before beginning the construction of buildings and access roads and other works to be executed by the local currency component. The works to be executed by the local currency component make the prior condition for the implementation of the telecommunication construction work. The Government of the Philippines is requested to raise necessary budgets in necessary time for allowing the completion of the works by the local currency component as scheduled.

2-4 Provision of Personnel

In this project such up-to-date facilities as digital electronic switching equipment and digital transmission equipment that have not ever been employed by BUTEL and such equipments that are to be used in large quantities, e.g., IPTS and Gentex station equipment, are to be introduced and thus trained personnel are to be required for the construction, operation, and maintenance of these equipments. For Phase I 565 personnel are to be required in the field of telephone and 160 personnel in the field of telegraph as mentioned in SECTION X "MAINTENANCE AND OPERATION." These personnel to be engaged in equipment installation, operation and maintenance are to be trained

in the Philippines and Japan by contract and by training programs to be provided by TTI. BUTEL should provide the required number of qualified personnel by assignment from among existing personnel or recruitment.

2-5 Provision of Coordinators

As stated in SECTION IX "IMPLEMENTATION PLAN," the Central Luzon Project is to be controlled together with the Northern Luzon Project under a headquarters to be set up by the expansion of the Northern Project Headquarters. This project will geographically range to wide areas, cover many technical fields, relate to non-BUTEL telecommunication companies and overseas enterprises. In order to assure smooth operations of the headquarters for enhancing the project as scheduled, the existing coordinator group system should remain to work continuously.

The Government of Japan will be willing to make cooperation if requested regarding this matter.

Appendix

I . TELEPHONE DEMAND FORECASTING

Summary

i. Purpose

The main purpose of telephone demand forecasting in this project is to examine the growth in telephone subscription demand in Regions III and IV and to provide the basis for the economic and technical study of telecommunications network development.

The forecasting was conducted for all cities/minicipalities in Regions III and IV, using each city/municipalities as a unit and in term of five year intervals for twenty years from the year of start of the service under this project (1986).

Though not directly necessary for this tudy, the national macroscopic demand is estimated in order to check to see if microscopic forecast demand obtained for each city/municipality is resonable or not, to be more precise, to examine the difference between the national macroscopic forecast demand and the total of microscopic forecast demands for cities and municipalities.

However, microscopic forecast demand for cities/municipalities in other than Region III and IV is not calculated in this paper.

The demand for each rigion, therefore, is roughly estimated to be almost the same value as the total of microcropic forecast demands for cities and municipalities involved. But only NCR demand is separately studies since NCR is different from the other regions on the social and economic structure and the telephone development stage.

ii. Assumptions in Forecasting

(i) Economic Growth Rate

Economic growth rates shown in the MOTC Guideline are used for 1981 to 1987. For the years from 1988 on, 7% per year is used.

(ii) Population

The national population increment ratio has slowed down since 1970. The future population is estimated on the assumption that this tendency will continue in the future.

Population distribution by region is based on the statistics of the period ending in 2000 shown in the NEDA long-term plan.

(iii) Local Service Area

In calculating basic demand (demand in base year) by city/municipality, we assumed the local service area as the present jurisdiction of the existing telephone office or its slight expansion. The local service area is still extremely limited, particularly in rural area compared with city/municipality area. This situation cannot readily be improved. The local service area will have to be gradually expanded over a long period of time.

(iv) Rate Hikes and Inflation

By using values at a constant price, rather than values at current prices, for economic growth, etc., we can avoid problems due to in flation and, at the same time, ignore the impact of the rate revision that is made inevitable by inflation.

Past trends in telephone rates and inflation were affected by the "oil crisis", etc. and the past changes

of price indices and of telephone rates showed somewhat difference tendencies. In the future, too, this slight difference may occur.

(v) Service Conditions

The shortage of telephone supply suppresses the increases in telephone demand. Particularly at small exchanges in rural areas, poor services in long distance telephone calls also greatly diminishes the usefulness of the telephone and sometimes profoundly affects demand.
The present telephone service in rural areas in the Philippines is rather poor and strongly suppresses demand. So, the revelation of latent demand due to improvement of service is expected to be considerably large.
Demand to be forecast in this paper is the potential demand on the assumption of following service improvement.

(a) Toll connection is improved to be able to provide direct distance dialling service and delayed service requiring only relatively brief waiting time.

(b) The telephone demand-supply situation is improved fairy remarkably and waiting period from application to installation is expected to be a two or three years and to be shorter waiting period in the future.

At the early stage of telephone diffusion, installing telephones is very effective in inducing new telephone demand. If the supply of telephones is sufficient, the demand rapidly increases but if the supply of telephones is insufficient, it oppresses the generation of demand. In our demand forecasting, we assume that reasources necessary to maintain or improve the above-mentioned level of service can be procured.

If the procurement of resources smoothly progresses and the resources are sufficiently supplied, more demand will be generated. It must be remembered that if resources are not sufficiently procured, the appearance of demand will be considerably delayed.

iii. National Macroscopic Demand and NCR Macroscopic Demand

The national macroscopic demand forecasting and the NCR macroscopic demand forecasting shown here are used for the verification of microscopic demand forecasting method by city /municipality.

Note, however, that the demand estimated here corresponds to expressed demand rather than potential demand.

iii-i. National Macroscopic Demand Forecasting

The present Philippines include many areas still lacking telephone service and there are gaps between the service levels of areas already provided with telephone service. The country is now about to implement a rapid expansion plan, so forecasting the future by extrapolation or a regression model using past data cannot be expected to produce reasonable forecast values.

Therefore the national macroscopic demand forecasting is studied by refering to the data from other countries.

(i) The national macroscopic demand forecasting is conducted by two methods of estimation using the income elasticity model at CCITT GAS-5 and the same income elasticity value as Japan.

Comparing and analyzing the values estimated by both the methods shows that the latter is considered to be more

reasonable.

(ii) The following is the method that includes the same income elasticity valve as Japan.

The elasticity value of the main-line telephone demand to national income in Japan during the period of a main-line telephone penetration ration of 1.5∿7% (1951-1965) was about 1.45.

Therefore,

$$\frac{Y_t}{Y_o} = \left(\frac{V_t}{V_o}\right)^{1.45}$$

Y: Telephone demand (main line)
V: National income or GNP

o: Basic year
t: Year

However, since this method of estimation is an analogy to past demand trends in Japan, Great attention must be paid to the difference between the Japanese conditions of the time and present conditions in the Philippines as well as those in the near future.

iii-ii. NCR Demand Forecasting

(i) The estimation is conducted by three methods using economic growth rate, time series with the existing data and comparison with the Japanese growth rate.
Comparing and analyzing the valve estimated by these methods shows that the method by the comparison with the Japanese growth rate is considerated to be more reasonable than others.

(ii) The method of estimating by the comparison with the Japanese growth rate is as follows.

$$\frac{Y_t}{N_t} = \frac{0.5}{1 + e^{-0.0841t + 0.850}}$$

Y_t : Demand for main-line telephones

N: Population

t: Year (=AD - 1900)

The constant of 0.0841 to determine growth rate is decided by analogy from the Japanese growth rate, because the growth rate obtained from time series data is too slow and is deemed unreasonable from the future position to expand telephone service.

iv. Demand Forecasting for Cities/Municipalities/Regions

For forecasting by city/municipality, potential demand is used as the demand to be forecast. Basic demand is first estimated, using 1981 as the base year and future demand is forecast by multiplying the basic demand by the magnifying power.

(i) Basic Demand

Considered from the present situation of telephones in the Philippines, it is certain that most existing telephones are used for business purposes. Though shop telephones are often counted as residential telephones in the telephones as far as their purpose is concerned.
From this point of view, it is certain that basic demand in the base year (1981) is in general proportion to the social unit of business telephones (workers of secondary and tertiary industries). It has been also rpoven through principal component analysis and multi-regression analysis for the data on the telephone situation in Philippines.
The estimating equation for basic demand was determined by analyzing data of the existing telephone offices in Regions I∿V. The next equations are used to estimate basic demand in areas that are;

(a) Cities/Municipalities already provided with telephone service

Basic demand concerning existing telephone offices is estimated by doubling the number of existing telephones in 1981, as a principle. But depending on office conditions, different estimated values are used for a considerable number of offices. The reason why this foure was used as the basic is that we took into consideration the revelation of latent demand due to improvement of service situations. Double is the value adopted in view of the present situation of service and by referring to the Japanese experience.

(b) Cities/Municipalities without telephone service

The estimating equation for basic demand is shown as follows;

$$y = 0.27x - 0.156$$

y: Population demand ration (%)

x: $\frac{\text{Number of establishment workers on working Population (1981)}}{\text{Place basis (1975)}}$ (%)

The estimated value by the above equation is about double the number of telephones presently used by existing offices.

(c) Regions (except NCR)

Demand by region shown here is used for the verification of microscopic forecast value by city/municipality.

As mentioned before, as microcopic demand by city/municipality in other than Region III,IV is not calculated in this paper, basic demand by region is roughly calculated to be almost the same value as the total of basic demands of cities and municipalities involved.

Basic demand is first calculated by the following approximate:

$$Y_o = 0.24\ X$$

X: average number of workers in business establishments in 1975

except for some large cities. And it is figured out by adding what was separately estimated for large cities ($Y_o = 1.5\ S_o$, where, S_o: number as of 1981).

(ii) Future Demand

The magnifying power from basic demand is calculated as the product of the common magnifying power obtained as the 1.4 power of the Philippine per-capita GNP magnifying power and the population magnifying power by area.

$$Y_{it} = Y_{io} \cdot V_t^{1.4} \cdot \frac{N_{it}}{N_{io}}$$

Y_{io}: Basic demand in i area

V_t : Per-capita GNP magnifying power

N_i : Population in i area

(a) We did not consider regional differences in the per-capita income magnifying power due to the empirical law that the increase rate of income level is fairly equalized by the social flow of population which will effectively work at least in Regions I∿V.

(b) The magnifying power of population by area is

estimated not by simply extending past trends but by gradually revising the power projected in the NEDA long-term plan (1975-2000) of population in the order of nation - region - province - city/municipality by the difference between the population already known in 1980 and the value shown in the NEDA plan. This is based on the understanding that while national population is mainly affected by only its natural increase and maintains a generally constant trend, population by area is under the stron influence of its social flow and is therefore greatly affected by regional development plans.

v. Results of Forecasting

v-i. Demand for Cities/Municipalities

The results of forecasting by city/municipality in Regions III and IV are shown in the text.

v-ii. National Macroscopic Demand and NCR/each Region Demand

The results of the national macroscopic forecasting (expressed demand) and the forecast values (Potential demand) in all regions including NCR are shown in the following table.

The following study leads to conclusion that the microscopic forecasting method applied for demand by city/municipality is proven to be enough for practical use.

(a) The total of forecast values by region is 14% larger than the national macroscopic forecast value (main-line telephones) because it includes latent demand. This means that 1.53, the ratio between 876,000, the total of

potential demand by region in the base year, and 571,000, the expressed demand, falls to 1.14 by 2,000, which is generally satisfactory as a trend of development of telephone service.

(b) The magnifying power for potential demand is larger in the NCR and Mindanao Area than in other regions. This is due largely to the effect of population increase. If the magnifying power of demand per 100 people (demand ratio) is used to eliminate the effect of population increase, the magnifying power for NCR is 2.90, which is smaller than 3.16 for other regions. This result is considered to be generally reasonable because the penetration ratio in NCR is considerably higher than for any other region.

(c) 421,000, the basic demand in the regions other than NCR, is more than three times the present number of subscribers in these regions. This reflects the present low level of service including the size of areas still without service and the lack of telephone supply. In the regions other than NCR, therefore, the magnifying power of expressed demand is indeed large because of the revelation of latent demand.

Summary of Forecast Results (National and by Region)

Region	Basic demand, 1981		Projected demand, 2000		Growth power 1)		Remarks
	All kinds of telephones (10^3)	Main-line telephones (10^3)	All kinds of telephones (10^3)	Main-line telephones (10^3)	Total	Annual average	
Region I	50	39	212	164	4.22	1,079	
" II	20	16	96	76	4.69	1.085	
" III	68	53	350	272	5.12	1.090	Potential
" IV	76	60	336	268	4.40	1.081	Demand
" V	30	24	129	103	4.31	1.080	
VISAYA	159	115	635	459	3.99	1.076	
MINDANAO	152	113	897	671	5.91	1.098	
SUB TOTAL	555	421	2,655	2,013	4.78	1.086	
NCR	778 2)	455 2)	4,089 2)	2,514 2)	5.53	1.094	
GRAND TOTAL	1,333	876	6,744	4,527	5.17	1.090	
NATIONAL MACRO ESTIMATION	938 3)	571 3)	6,147	3,966	6.95	1.102	Expressed Demand

1) Growth power for main-line telephones

2) As the latent demand in NCR is almost negligible, this value means the potential demand.

3) The expressed demand in 1980.

1. Introduction

1.1 Demand to be Forecast

(1) Demand forecasting is the estimation of future demand under certain presuppositions (forecasting contitions). The forecast values vary by forecasting conditions. The forecasting conditions are set according to the purposes for which forecasting is used.
For example, if there is an uncertain regional development plan, forecast values presupposing the realization of that development plan are often used for planning conduits, which involves uneconomical additional work. Meanwhile, forecast values presupposing that the development plan will not be realized are sometimes used for designing subscriber cables.

(2) There are various kinds of demand to be forecast and it is essential to select the kind of demand in conformity with the purpose of using it.
For example, forecasting the demand of subscribers is required for designing local exchange switching equipment. On the other hand, forecasting the demand of lines, i.e. the demand including not only telephone subscriber but telex subscribers, etc., is required for planning local outside plants.

(3) Essentially, the demand forecast is selected depending on the purpose of the forecast values but, to provide forecasting best suited for different plans, there must be a great variety of forecasts -- a situation which is impossible to carry out. So, a single demand forecast is used as the common basis of a number of plans by

allowing the forecast demand to be somewhat different from the optimum demand to be used for the plan if it does not hinder practical use. Thus, forecasting work is reduced. To plan properly in this case, it is necessary to thoroughly understand what is meant by the forecast values that are shown.

1.2 Potential Demand

(1) Demand Structure

If customers financially can and will buy a certain commodity, generally there is demand for the commodity and it is sold. The domain of "A" in Fig. 1.1 shows this demand.

(a) If the purchasing power of customers increases with the growth of the economy, the domain of "A" in Fig. 1.1 expands downward and demand increases.

(b) The will of customers to buy depends on how individual customers evaluate the cost/benefit of the commodity in question. The evaluation of the benefit received from purchasing the commodity not only depends on the environment in which the commodity is used but it is also affected by the extent of customers' cognizance of the benefit of the commodity.

In the case of telephones, the evaluation is affected by the telephone penetration ratio but, at the same time, it is affected by the social customs concerning the use of telephones and experiences in using telephones. Therefore, the will of customers to buy, while being strongly affected by the state of diffusion of telephones, gradually increases with

time. Namely, the demand domain "A" in Fig. 1.1 expands to the right as time passes.

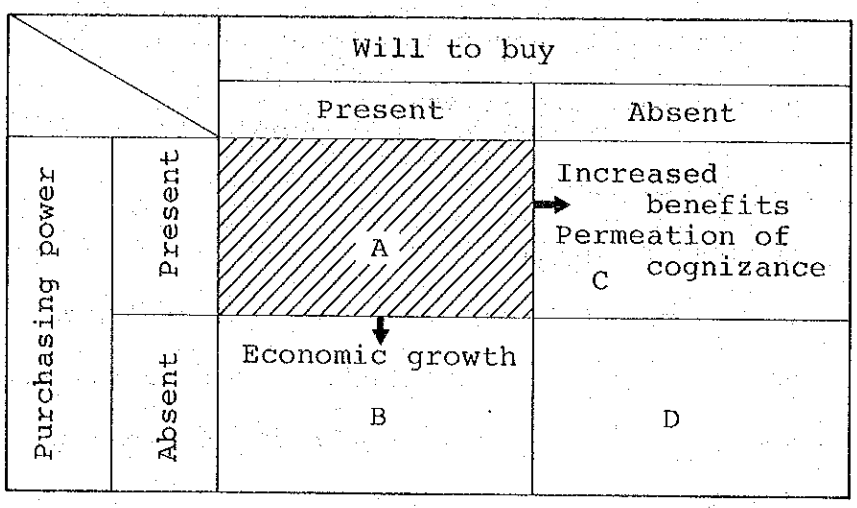


Fig. 1.1 Demand Structure

(2) Expressed Demand

If there is no time lag between demand and supply and if no particular conditions harming the usefulness of the commodity exists, the above-mentioned trend of will smoothly progress. Domain "A" directly corresponds to the expressed demand, namely, the demand that is actually known.

(3) Oppressed Demand

(a) If supply is less than the demand, there will be customers who do not actually buy in spite of their will to buy. There will be customers who have given up expressing their will to buy, being aware that they cannot easily acquire the commodity even if they have this will. In this case, domain "A" in Fig. 1.1

includes both expressed demand and oppressed demand which is given up to apply for subscription due to the poor supply situation.

(b) If specific restirictions are imposed on the usefulness that a commodity properly should have, the cost/benefit of that commodity deteriorates. And so the demand that should appear as a matter of course if it were not for these restrictions on the usefulness of the commodity is oppressed. Since the evaluation of the restriction of usefulness appears as the decrease of customers' will to buy, this effect takes the form of limiting the domain "A" in Fig. 1.1 to the left. Limiting the sphere of travel of automobiles or very poor connection services for long distance telephone calls brings about demand oppression in this sense.

(4) Potential Demand, Latent Demand and Basic Demand

If, in planning the service supply, the present situation of service is worse than the situation proposed by the plan, it is expected that there will be more demand, where is freed from oppression by the execution of the plan. This demand should be included in the demand forecast. In this sense, both demand abandoned due to short supply and demand diminished for such reasons as poor service are called latent demand and expressed demand plus this latent demand is called potential demand.

The relations between expressed demand, latent demand and potential demand are shown in Fig. 1.2.

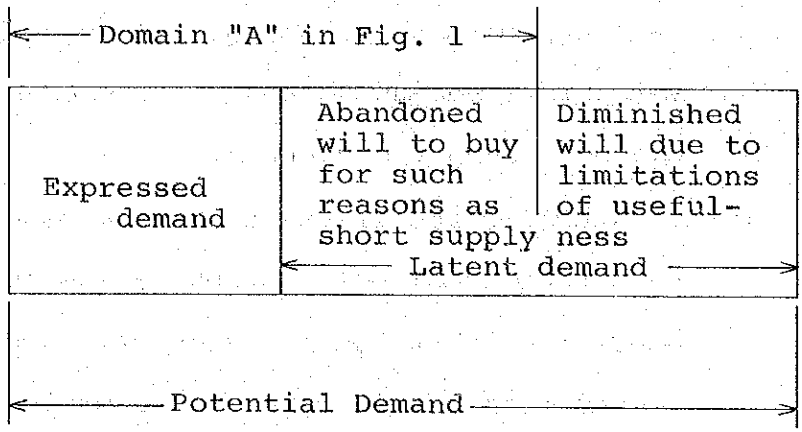


Fig. 1-2 Potential Demand

Potential demand at the time used as the base of demand forecasting (usually the time when the most recent actual data are available) is especially called basic demand.

N.B. The classification and nomenclature of demand are fairly important ideas in forecasting demand and using forecast results but there is no certain universal definition. In this study, we use the above definition out of consideration for convenience in planning expansions by region and to arrive at a demand relatively close to the demand that is expected to appear when equipment investment is made. The definitions of terms used here includes concepts based on unique views in this study and they do not necessarily appear in other papers.

The concept of potential demand is one of the most basic in demand forecasting and this term is used in a variety of ways. When making a comparative

study with other papers, great care must be exercised because it is sometimes used as the following concepts besides the concept defined in this paper.

(Example 1) Latent demand.

(Example 2) Future demand or demand that may newly develop during the period from the present until a certain time in the future.

(Example 3) Demand including all domains that it is financially possible to buy regardless of whether there is the will to buy or not. Namely, demand corresponding to demain [A + C] in Fig. 1.1.

(Example 4) Maximum demand presumed to be realizable during the period extending to a very distant future. The upper limit of the growth curve or the asymptote if the demand is likely to increase in the manner of a growth curve.

1.3 Basic Conditions and Points of View

Special matters concerning an understanding of the present circumstances of socio economic conditions, which affect the forecasting of demand trends, the selection of forecasting methods and the assessment of results are as follows:

1.3.1 Framework of Economic and Social Development

(1) Economic Growth Rate

Annual growth rates shown in the MOTC Guideline are used as economic growth rates for 1980 to 1987. For the years from 1988 on, 7% per year, the central value of growth rate in the NEDA long-term plan, is used.

(2) Population

Regarding the tendency of population increase, reference is made to the NEDA and other long-term plans, but we use values obtained by correcting these values in consideration of the slowdown of population increase that is already clear from the statistics of 1975 to 1980

1.3.2 Rate Hikes and Inflation

By using values at a constant price, rather than values at current prices, for economic growth, etc., we avoid problems due to inflation and, at the same time, ignore the impact of the rate revision that is made inevitable by inflation.

Past trends in telephone rates and inflation were affected by the "oil crisis", etc. and the past changes of price indices and of telephone rates showed somewhat different tendencies. In the future, too, this slight difference may occur.

(a) But in the early stage of telephone diffusion, most demand arises essentially for business use and the price elasticity is not large.

(b) Also, when using time series data in estimating the structure of forecasting models, the impact from the difference of trends between price indices and tele-

phone rates is included more or less in the structure of the model.

It seems, therefore, that unless the rate system is drastically revised for some reason unrelated to inflation, the impact of inflation and rate increases can be safely ignored if values at a constant price are used for economic growth, etc.

1.3.3 Income Growth Rates by Region

The future values of per-capita growth rates of real income by region and by municipality are, for the time being, represented by the national per-capita growth rate of real income.

(1) In the past, growth rates of real income have not been equal in the regions. There were variations in the rate of increase of nominal income and price increase rate in the regions.

(a) However, the variation of income levels by region naturally does not endure and these levels must be balanced by a suitable policy.

(b) Further, there is a principle that in a free economic society gaps between income levels should be corrected by the social flow of population. This law works fairly effectively unless there is a strong factor restricting the flow of population.

1.3.4 Limitations of Service

(1) Shortage of supply

(a) The shortage of telephone supply suppresses the increases in demand. Poor connections in long

distance telephone calls also greatly diminish the usefulness of the telephone and sometimes profoundly effect demand, particularly at small exchanges in rural areas. The present telephone service is rather poor and strongly oppresses demand. So, the revelation of latent demand due to the improvement of the service is expected to be considerably large. However, no effective data for determining the latent demand is available at present. Necessary data will soon become available in the process of executing the telephone service developing plan but, in the meantime, there is no choice but to use somewhat rough estimated values in determining the latent demand.

(b) From impressions gained in our visit to some areas and from experience in Japan, etc., basic demand including latent demand as at present (1981) is generally believed to be as follows:

NCR: existing subscribers + applications on waiting list = existing subscribers x 1.45

Specific cities: existing subscribers x 1.5

General areas : existing subscribers x 2.0

Of course, areas are individually assessed, if necessary, when special conditions are involved.

(2) Expansion of local service area

The local service area of a telephone office is still extremely limited, particularly in rural areas, compared with urban areas etc. This situation cannot

readily be improved. Even in an area where construction work is proposed, it is financially almost impossible to incorporate the entire area of the municipality into the local service area all at once. The local service area will have to be gradually expanded over a long period of time. At least 30 years will be necessary before the entire area becomes a local service area.

1.3.5 Social Unit

Telephone demand is generally divided into business use and residential use.

Demand for business use develops mainly from offices while demand for residential use develops from pure residences or residential households. These sources of demand measured by a yardstick numerically corresponding to telephone demand is called the social unit.
The social unit most frequently used in forecasting telephone demand is the unit corresponding to K, the limit for the logistic curve.

(1) Social Unit for Residential Telephones

The number of pure residences or the number of pure residential households is often used as the social unit of residential telephones.

(a) The reason why the term of "pure" residences is used here, rather than simply referring to them as residences, is because categorizing residences with shops as a social unit of business telephones is often more convenient in forecasting in light of the purposes of use of telephones and the motives

behind the installation of telephones.

(b) Using the pure residence as the value corresponding to the limit, K, means that one telephone for one residence is assumed to be the upper limit of telephone diffusion. This is not strictly correct. The upper limit naturally varies by country and by area and also varies by the conditions of residences and by economic standards. But when applying a growth curve at a point with a low penetration ratio, this is sufficient because, in this case, the value of K need not be very strict.

(2) Social Unit for Business Telephones

As a social unit for business telephones, an index related to workers rather than the establishment is usually used. This is because experience has shown that, the proportional correspondence between the number of offices and the number of telephones is rather unsatisfactory as some establishments are small and some are very large. On the other hand the number of workers, offers a measure that includes the effects of the scale of the establishment and thus, using this figure greatly improves the proportional correspondence to the number of telephones.

(a) When comparing business telephones and workers, one telephone circuit per worker is not considered necessary. The number of workers that best corresponds to one telephone is affected by the scale of the establishments and the structure of industries and varies by countries or areas.

But in most cases, it is considered reasonable to use 3∿4 as the number of workers in secondary and tertiary industries that corresponds to one main line.

(b) The social unit is used not only as the limit of growth but also as a proportional factor of demand by areas. An area with many social units is likely to have a large telephone demand in proportion to the number of its social units. In this case, proportional correspondence suffices and strict 1:1 correspondence between social unit and telephone demand is not necessary.

1.4 Forecasting Model

Basic demand is first estimated for the case where service concerning telephone supplying situation and toll call connection service are assumed to be improved to the extent to reliese the oppression of demand. The forecast value of future demand is calculated by multiplying the basic demand (potential demand including latent demand) in 1981 by the demand magnification power determined for each municipality.

Though not directly necessary for this study, the total demand in the nation and the total demand in NCR are also estimated in order to check to see if the forecast value obtained for each municipality is reasonable or not. A somewhat different forecasting method is used for these macroscopic forecasts (See paragraph 3 and 4).

1.4.1 Basic Demand

(1) Comsidered from the present stituation of telephones in the Philippines, it is certain that most existing telephones are used for business purposes. Though shop telephones are often counted as residential telephones in the Philippines, they can generally be considered as business telephones as far as their purpose is concerned.

From this point of view, it is certain that basic demand in the base year (1981) is nearly proportional to the social unit of business telephones (workers of secondary and tertiary industries).

(2) Up to now, telephones have been in extremely short supply in the Philippines and the supply of telephones is greatly restricted by the shortage of equipment including the capacity of switching equipment. Further, the service is not standardized due to the diversity of telephone operating undertakings and the very statistics concerning the number of subscribers are somewhat unreliable.

In the analysis designed to estimate basic demand, as a rule, we used data concerning telephone offices located in the areas of Regions I∿V but did not include data for areas with obvious abnormality in the supply situation nor data for telephone offices that were not yet in operation for over a year.

Basic demand areas still without telephone service is estimated using the average number of workers of establishments in the municipality concerned as a

factor. (cf. Paragraph 5)

1.4.2 Demand Magnifying Power

(2) The demand magnifying power δ is calculated by following equation:

$$\delta = \psi x \lambda$$

ψ : Magnifying power of penetration ratio by increase of income level

Using ν as magnifying power of income level, $\psi = \nu^{1.4}$.

ν is always national mean value.

λ : Population magnifying power by municipality

The elasticity value 1.4 of demand rate for the increase of income level is a value set as somewhat smaller than the elasticity value of the national demand rate (this is an elasticity value for existing demand or the number of subscribers, not an elasticity value for potential demand). (cf. Paragraph 5)

1.5 Accuracy of the Forecast

Considerable error is inevitable in forecasting for each municipality. Even in municipalities already having telephone service, the level of service varies. Further, the size of the local service area presumably differs by individual municipalities. Estimated values of potential demand in municipalities still without telephone service may involve great error.

(1) Factor Affecting Estimation

(a) It is thought that the accuracy of estimates has been considerably affected by the fact that we are

unable to use the latest data as statistics on workers, which play the most important roll to the analysis of basic demand. For reasons of time and timing, we had no choice but to use 1975 statistics in determining the number of workers in each municipality.

Due to the old statistics for the number of workers on a work place basis and the great variance of the present telephone penetration ratio resulting from the variance, etc. of local service area, supply situation and toll call connection service, such factors affecting basic demand as

o Area rank including the impact of income level, and

o Population scale of cities and municipalities (other than NCR and six largest cities)

did not show meaningful effects in the simultaneous analysis with the number of workers.

(b) Errors caused by the estimation of magnifying power are believed to have considerably less impact than errors in basic demand (when considering individual municipalities).

(2) Considerations

(a) For the purpose of F/S surveys, the feasibility of a project, even with a low accuracy of forecasting for each municipality, can be well assessed if the bias as a whole is not great. So, there is no need to proceed further with the recent analysis. But at the stage of final design, the problem of forecasting accuracy assumes far greater importance.

(b) More accurate estimation of basic demand should be possible if new statistics become available or it supplementing the present data with data gained by a field surveys is possible. In that case, income factors that were not significant in our survey may prove to be useful. In any event, this indicates that when detailed design is done analysis concerning basic demand should be attempted again using the such latest data.

(c) However, it should be noted that no matter how much data is used, forecasting accuracy at a time of low telephone penetration ratio cannot be improved as generally expected.

It is, therefore, necessary to have a fully flexible facility design so that it can cope with demand variation. It may be advisable at the early stage of penetration to plan equipment with a capacity somewhat smaller than the forecast value of demand (insofar as the wastefulness due to divided investment is not excessive), in order to prevent the occurrence of a state of prolonged idling of equipment due to errors in demand forecasting. It must, of course, be expected that a considerable number of applications on the waiting list may temporarily result from this plan. Yet, generally this is financially safer than to have excessive equipment.

1.6 The Time Gap Between Forecasting Trends and Realizable Demand

In consideration of revelation of latent demand, it is necessary to note the following items.

(1) Demand that was oppressed in the past takes some time to be completely expressed even if the oppressing condition is eliminated. Further, the portion of demand that was oppressed begins to be expressed from the time the customer learns about the elimination even before it occurs. This situation is illustrated in Fig. 1.3.

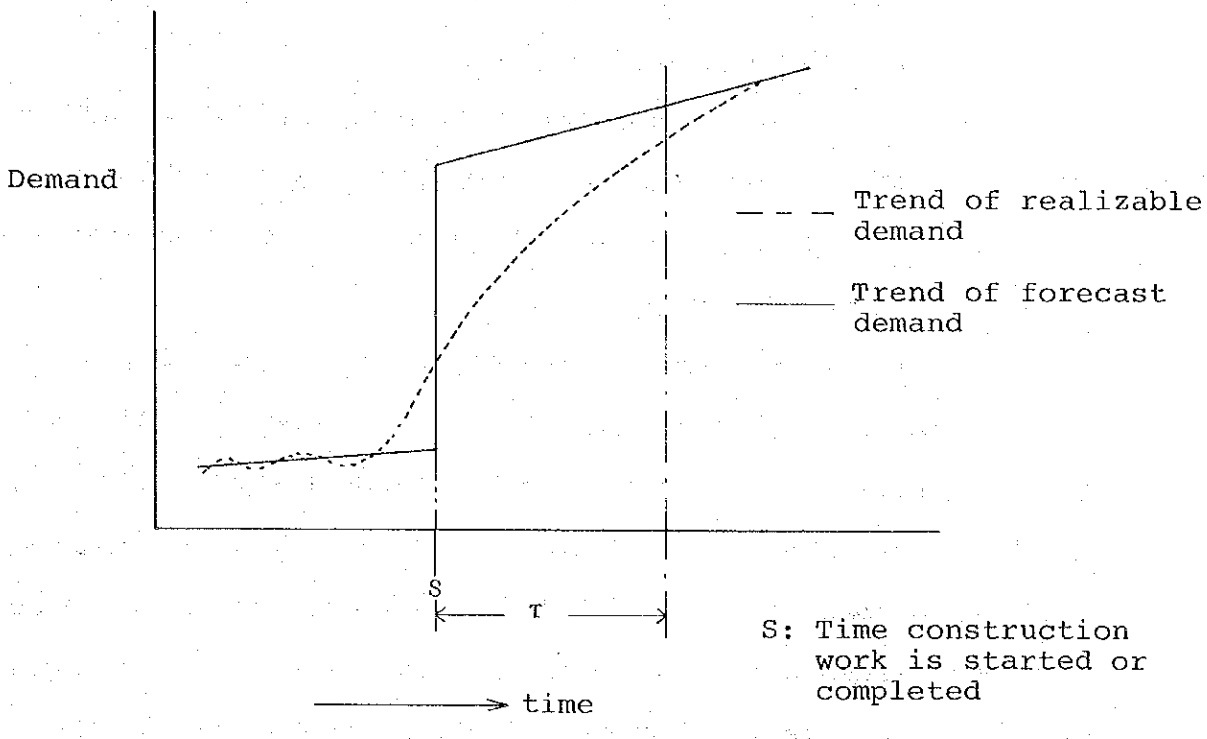


Fig. 1-3 Forecast Trend Line and Realizable Demand

(2)"τ", the time lag that it takes for latent demand to become expressed demand, seems to differ by country and by area in a country. It also depends on the characteristics of areas and is affected by the manner in which the telephone service is undertaken in the area. Since, therefore, it is practically impossible to accurately assess this transient state, it is usual to treat the forecast trend line as $\tau=0$.

Incidentally, the experience of NTT (Nippon Telegraph and Telephone Public Corporation), shows that the transient state including the time lag usually was approximately two to three years but this period may have, in a way, been special to Japan. It may be particularly attributed to the keenness of free competition and the high degree of equality of income levels.

2. Fundamental Figures

2.1 National Income (Gross National Product)

Values shown in the MOTC Guidelines (23 Nov. 1981) are used for the economic growth rate for 1981 to 1987. For 1988 and on, growth at an annual rate of 7% is anticipated as a growth rate in accordance with the central value in the NEDA long-term forecast. Past values are derived from the 1981 Philippine Statistical Yearbook. The results of summarization are shown in Table (2.1).

Table 2.1 Indices Concerning Incomes (National Values)

Year	Growth Rate of GNP (NI) at Constant Price ①	Cumulative Growth Rate of ① from 1980	Cumulative Growth Rate of GNP per Capita at Constant Price from 1980
1976	1.070	0.789	0.875
77	1.061	0.837	0.904
78	1.076	0.901	0.948
79	1.060	0.955	0.978
80	1.047	1.000	1.000
81	1.053	1.053	1.027
82	1.061	1.117	1.063
83	1.063	1.188	1.103
84	1.062	1.261	1.143
85	1.065	1.342	1.187
86	1.065	1.431	1.236
87	1.067	1.526	1.288
88	1.070	1.633	1.346
89	1.070	1.747	1.407
90	1.070	1.869	1.470
91	1.070	2.000	1.539
92	1.070	2.140	1.611
93	1.070	2.290	1.686
94	1.070	2.450	1.765
95	1.070	2.622	1.848
96	1.070	2.805	1.935
97	1.070	3.002	2.027
98	1.070	3.212	2.124
99	1.070	3.437	2.226
2000	1.070	3.677	2.333
01	1.070	3.935	2.446
02	1.070	4.210	2.565
03	1.070	4.505	2.690
04	1.070	4.820	2.822
05	1.070	5.158	2.961

2.2 Population

2.2.1 National Population

The population increase has slowed down since 1970. The future population is estimated on the assumption that this tendency will continue in the future.

The population increase rate is assumed to be in accord with a negative exponential curve.

$$y_t = e^{\alpha - \beta t} \quad \ldots\ldots\ldots \quad (2.1)$$

y_t : population increase rate in t year (%)

t : year expressed in [AD - 1900].

The annual average increase rate during 1970-1975 was 2.78% and the annual average increase rate during 1975-1980 was 2.64% (source: 1980 population census). If α and β in equation (2.1) are estimated by regarding these increase rates as the values of 1972 and 1977, intermediate years in the respective periods, the following can be obtained:

$\alpha = 1.7639$ $\beta = 0.0103$

The results of estimation of the national population based on the above are shown in Table 2.2.

Table 2.2 Estimation of National Population

Year	Growth Rate of Population (%)	Cumulative Growth Rate of Population from 1980	Population (10^3)
1976	2.67	0.901	43,192
77	2.64	0.926	44,346
78	2.61	0.950	45,516
79	2.59	0.975	46,705
80	2.56	1.000	47,914
81	2.53	1.025	49,126
82	2.51	1.051	50,359
83	2.48	1.077	51,608
84	2.46	1.104	52,878
85	2.43	1.130	54,163
86	2.41	1.158	55,468
87	2.38	1.185	56,788
88	2.36	1.213	58,128
89	2.33	1.241	59,483
90	2.31	1.270	60,857
91	2.29	1.299	62,250
92	2.26	1.329	63,657
93	2.24	1.358	65,083
94	2.22	1.388	66,528
95	2.19	1.419	67,985
96	2.17	1.450	69,460
97	2.15	1.481	70,954
98	2.13	1.512	72,465
99	2.10	1.544	73,987
2000	2.08	1.576	75,525
01	2.06	1.609	77,082
02	2.04	1.642	78,653
03	2.02	1.675	80,243
04	2.00	1.708	81,848
05	1.98	1.742	83,468

2.2.2 Population by Area

Population distribution by area is based on the statistics of the period ending in 2000 shown in the NEDA long-term plan. Since, however, the base year of the plan is 1975, this base year is changed according to the already known population in 1980.

As data corresponding to the NEDA long-term plan used for population distribution by area, there is "the population dimensions of planning, III population projections of cities & municipalities in the Philippine 1970-2000".

Population statistics in an area are strongly affected not only by the natural increase of population but also by its social flow (outflow and inflow). The social flow of population, in turn, is affected by income gaps and regional development plans. Therefore, long-term regional vital statistics cannot be estimated merely as an extension of past trends. That is why we used the NEDA plan for reference in population distribution by area.

(1) Population by Region

(a) In the NEDA plan, the annual average population increase rate for 1975-2000 is 2.8% but since a slowdown of the population increase is clear, the NEDA population increase rate by region has been revised to accord with the annual average increase rate of 2.3% for 1980-2000 in item (2.2.1) In other words, the annual average population magnifying power y_k for Rigion K is calculated as

$$Y_k = \frac{1.0230}{1.02777} \cdot y'_k \quad \text{.....(2.2)}$$

y'_k; annual average population magnifying power for Region K by NEDA long-term plan

Population in Region K in 2000, $N_R(2000)$, can be obtained as

$$N_R(2000) = Nk(1980) \cdot Y_k{}^{20} \quad \text{.....(2.3)}$$

The sum total of $N_k(2000)$ thus obtained does not necessarily coincide with the national population calculated by item (2.2.1). If the difference is great N_k is corrected so that the sum total of N_k may coincide with the national population. But if the difference is smaller than 1%, no revision is made.

(b) Population in the intermediate years, etc. by region is obtained by the following procedure: The population increase rate in each region is assumed to be in accordance with a negative exponential curve, equation (2.1). Here, the diminuation factor of the population increase rate, β , is assumed to be the same for all regions. Therefore, the model of the increase rate by region is

$$y_k(t) = e^{\alpha_k - \beta t} \quad \text{.....(2.4)}$$

α_k can be approximately estimated, using y_k obtained by equation (2.2). (For β, the national value of 0.0103 is used.)

(c) Population by region in 2000 calculated by the above and the values of α_k for calculating population in the intermediate years are shown in

Table (2.3).

Table 2.3 Population Estimates by Region

Region K	Population (10^3)			(Reference) Value set in NEDA plan			α_k in case of β=0.0103
	1980	2000	Annual average rate	1975	2000	Annual average rate	
Nation	47,914	75,525 [1]	1,0230	42,071	83,444	1.0278	1.7639
NCR	5,925	10,868	1.0307	4,971	11,905	1.0356	2.0526
Region I	3,544	4,815	1.0154	3,270	5,387	1.0202	1.3628
" II	2,220	3,370	1.0211	1,934	3,660	1.0258	1.6777
" III	4,794	7,979	1.0258	4,210	8,940	1.0306	1.8788
" IV	6,115	8,761	1.0181	5,214	9,180	1.0229	1.5243
" V	3,467	4,818	1.0166	3,194	5,413	1.0213	1.4378
Visaya	11,133	14,239	1.0124	10,132	15,479	1.0171	1.1461
Mindanao	10,719	20,766	1.0336	9,146	23,480	1.0384	2.1429

1) Macroscopic estimated value. Rate of difference from total of values by region: 75,616 is 0.12% - so small that no revision of calculated values by region was made.

2) Population calculated by year, using this α_k, somewhat differs in 2000 from population by region in this table but the difference is less than the equivalent of half a year and need not be revised.

(2) Population by Province and by City/Municipality

Population by city/municipality was estimated by the same method used in calculating population by region from the national population.

(a) Population by province is calculated using population by region.

(b) Then, population by city/municipality can be estimated using population by province.

3. National Macroscopic Demand Forecasting

The national macroscopic demand shown here is not arrived at by totaling the microscopic demands of individual municipalities, etc. Rathers, it is the demand directly forecast for the nation as a single unit to determine whether those microscopic forecasts are reasonable.

Also, care must be taken that the demand estimated here corresponds to expresed demand rather than potential demand.

3.1 General

The present Philippines include many areas still lacking telephone service and there are gaps between the service levels of areas already provided with telephone service. The national telephone demand is profoundly affected by the expansion of local service areas and the plan to improve the quality of service. The country is now about to implement a rapid expansion plan, so forecasting the future by extrapolation or a regression model using past data cannot be expected to produce reasonable forecast values. So, the national macroscopic demand is studied by referring to data from other countries.

3.2 Income Elasticity Model at CCITT, GAS-5

(1) The model equation is:

$$\frac{S}{N} = a\left(\frac{V}{N}\right)^b \quad \text{.....(3.1)}$$

N: Population

S: Number of main line telephones or number of all kinds of telephones

V: GNP or GDP, national income (NI)

a: Dimensioning constant

b: Elasticity value

GAS-5, taking the logarithm of the above equation, shows the international cross-section regression equations.

$$\log y = -3.6825 + 1.3720 \log v \quad \ldots \quad (3.2)$$

for the main line telephones from data of January 1975 and

$$\log y = -3.4612 + 1.3466 \log v \quad \ldots \quad (3.3)$$

for all kinds of telephones, from data of January 1977

y: S/N

v: V/N

(Figs. 3.1 and 3.2)

The number of subscribers in the Philippines at the end of 2000 estimated from this model is:

Main-line telephones: 2,134,000

All kinds of telephones: 3,235,000

The process of calculation using the Philippines Statistical Yearbook, etc. is shown in Table 3.1.

This model must be carefully used for short-term forecasting. Because contradictions develop unless the position of the present penetration ration coincides with the international regression line.

Also there are problems due to exchanging currency into the U.S. dollar.

(2) In short-term forecasting - and in long-term forecasting, too - if the difference between the present penetration ratio in any country concerned and the international regression line is taken for granted, the estimation equation.

$$\left(\frac{y_t}{y_o}\right) = \left(\frac{v_t}{v_o}\right)^b \quad \ldots \quad (3.4)$$

o: Basic year

t: Year

can be used by using the present value as the base and

using only the elasticity value b in the above regression equations (3.2 and 3.3).

If estimated from Table 3.2 using 1980 results, the number of main-line telephones is 2,200,000 and the number of all kinds of telephones is 3,541,000.

(3) The following special cautions must be exercised in these macroscopic estimations:

(a) This model corresponds to the expressed demand rather than the potential demand. Therefore, the number in demand should be considerably more than this estimated value.

(b) The elasticity value for the main line slightly exceeds the elasticity value for all kinds of telephones. The ratio of all kinds of telephones to main-line telephones - station/line ratio - tends to gradually decrease. (This would be reasonable until the medium stage of telephone penetration.)

(c) Estimates by this model would be underestimates in the case of the Philippines.

(i) An elasticity value should change according to stages of telephone development. At the Philippine stage of development, the value may well exceed the value in the regression equation (see Fig. 3.3).

(ii) The penetration ratio in the Philippines was once well above the international regression line and, though it later temporarily moved below the regression line, it has recently

returned to the regression line. In view of the willingness of the Government and other sectors to develop telephone service and the nation's social conditions including its educational level, the Philippine penetration ratio ought to move considerably above the regression line (to about double).

Table 3.1 Calculation result by GAS-5 Method

Year		1974	1976	1980	1981	2000
Population (10^3)		41,100[1]	43,192	47,914	49,126	75,525
GNP/Capita at Current Price (₱)		2,432	3,055			
GNP/Capita a 1972 Price (₱)		1,575	1,698	1,939		
Growth Rate of GNP/Capita at Constant Price[2]	1974	1.00		1.231	1.264	2.872
	1976		1.00	1.142	1.173	2.664
Exchange Rate for US Dollar[3]		6,781	7,432			
GNP/Capita at US Dollar at Constant Price	1974	358.6		441.5	453.3	1,030.0
	1976		411.1	469.4	482.2	1,095.1
Telephone (%) Penetration Ratio	Main line	0.6644		0.8838	0.9160	2.8256
	All kind		1.1448	1.3687	1.4192	4.2828
No. of Telephone (10^3)	Main line	273		423	450	2,134
	All Kind		495	656	697	3,235

1) Estimation

2) Forecast values by [2. Fundamental Figures] are used for growth rates in 1981 and on.

3) Weighted average of exports and imports.

Table 3.2 Estimation by Formula 3.4

Year		1980	2000
Population (10^3)		47,914	75,525
Growth Rate of GNP/Capita at Const. Price		1.00	2,389[2)]
Penetration Ratio	Mainline	0.882	2.913
	All Kind of Telephone	1.451	4.688
No. of Telephone (10^3)	Mainline	422.8[1)]	2.200
	All Kind of Telephone	695.2[1)]	3.541

1) Actual "Figure as of May 1980"

2) Includes revised growth rate for half a year (1.024).

3.3 Case Where the Philippines are Regarded as Haveing the Same Income Elasticity Value as Japan

(1) The elasticity value of the main-line telephone demand to national income in Japan during the period of a main-line telephone penetration ratio of 1.5∿7% (1951-1965) was about 1.45.

$$\left(\frac{Yt}{Yo}\right) = \left(\frac{V_t}{V_o}\right)^{1.45} \quad \cdots\cdots\cdots (3.5)$$

Y: Telephone demand (main-line) o: Basic year

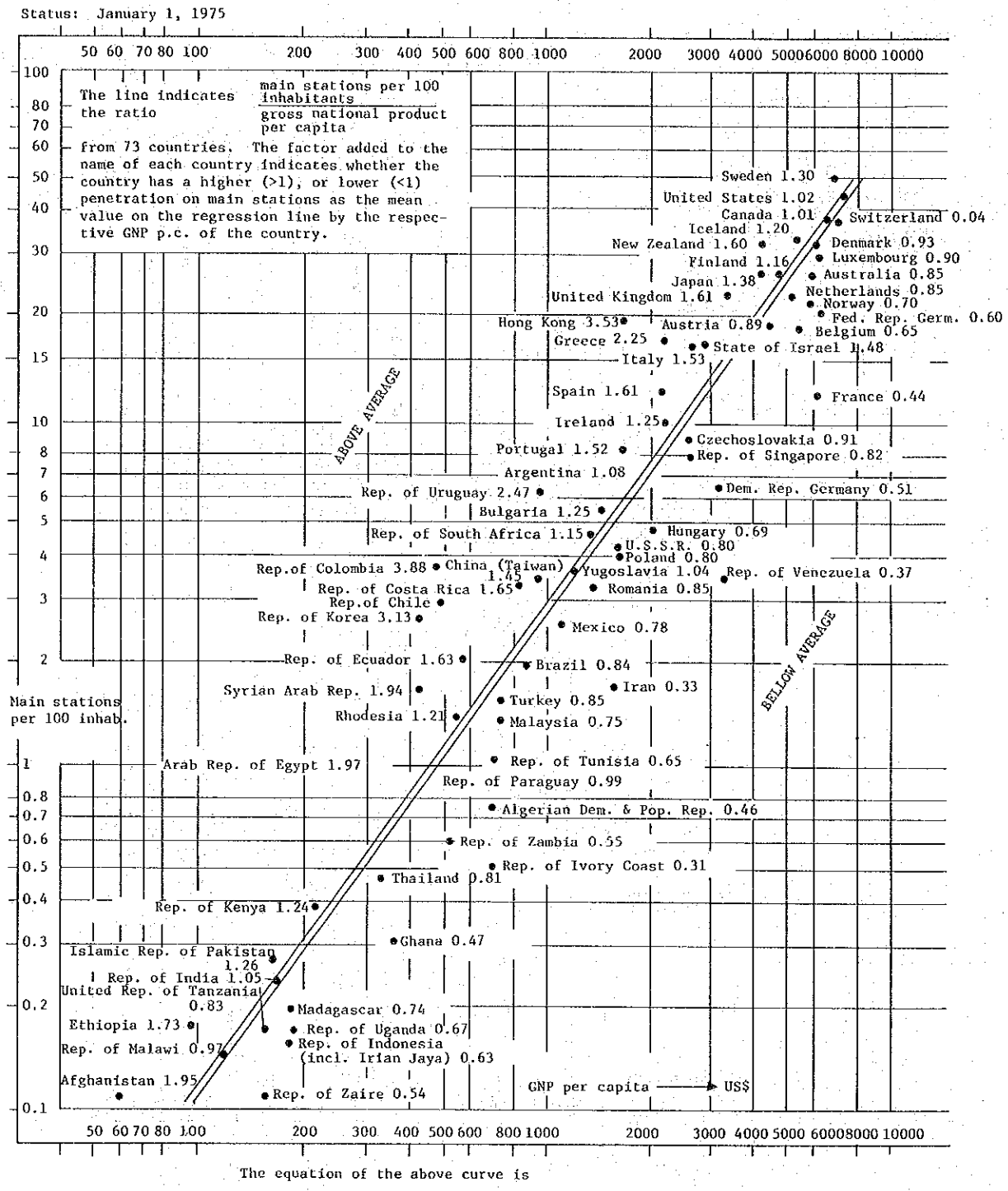
V: National income or GNP t: Year

The percentage of pending applications in the Philippines in 1981 is believed to have been about 45% in NCR and about 15% in other areas (PLDT data). Assuming that this was about the same in 1980, the main-line telephone demand including applications on the waiting list in May 1980 was:

NCR : $282,141 \times 1.45 = 409 \times 10^3$

Others: $140,637 \times 1.15 = 162 \times 10^3$

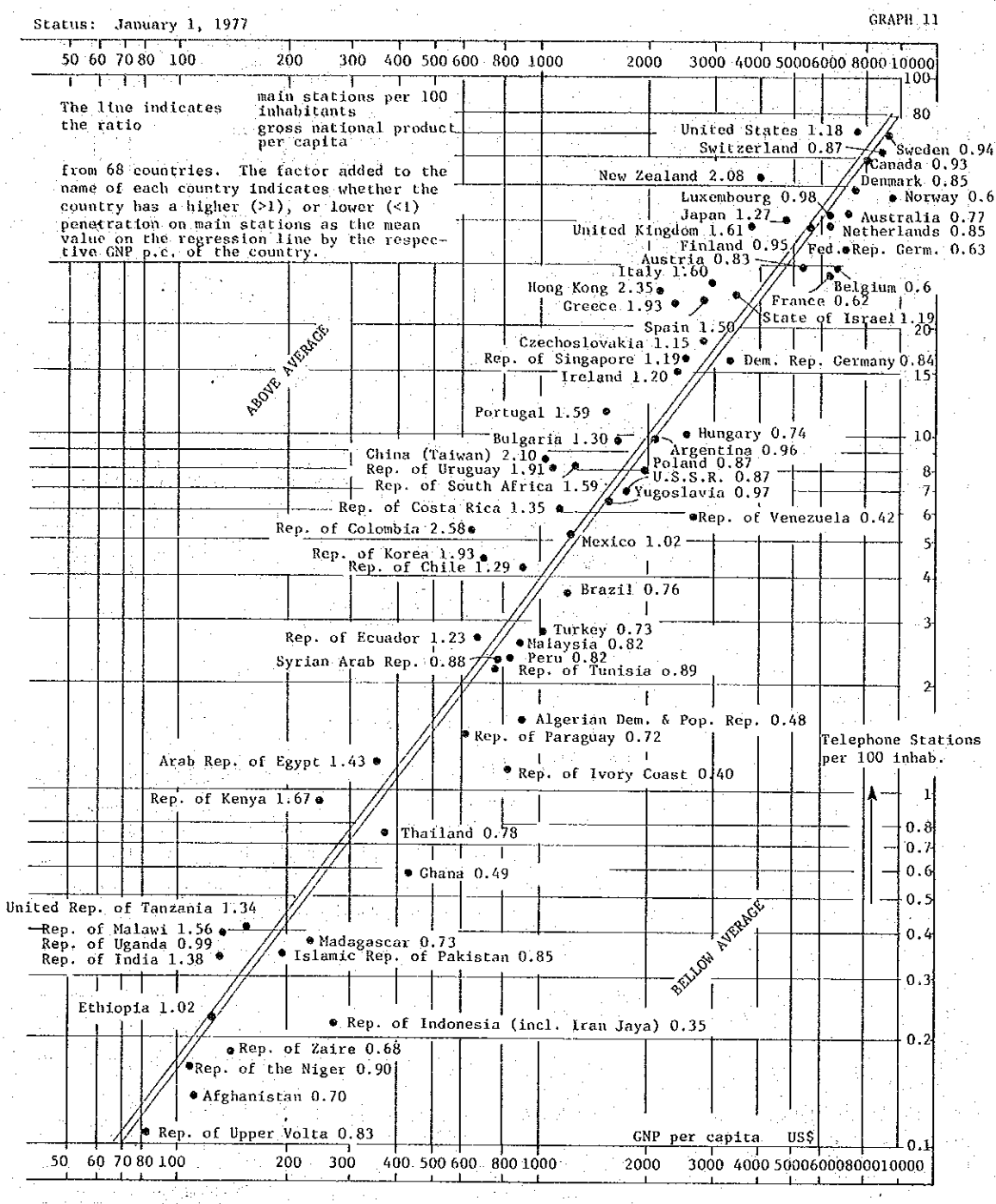
Total : $422,778 \times (1.35) = 571 \times 10^3$



The equation of the above curve is

$$\log \frac{\text{main station}}{\text{100 inhabitants}} = -3{,}6825 + 1{,}3720 \log \frac{\text{GNP}}{\text{per capita}}$$

Fig. 3.1 Telephone density (main stations) and gross national product



The equation of the above curve is

$$\log \frac{\text{telephone stations}}{100 \text{ inhabitants}} = -3{,}4612 + 1{,}3466 \times \log (\text{G.N.P. per capita})$$

Fig. 3.2 Telephone Density and Gross National Product

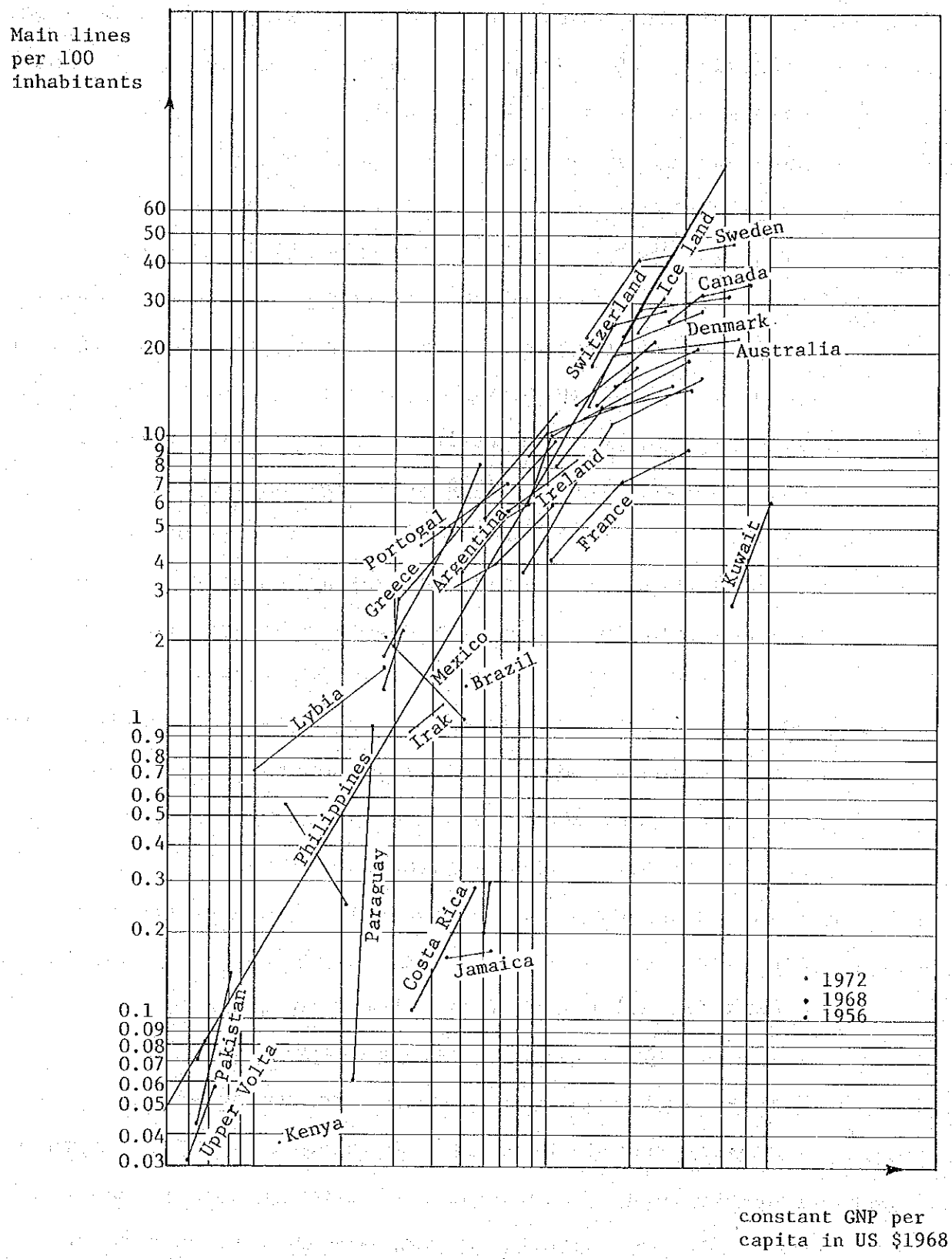


Fig. 3.3 Telephone density (main stations) and gross national product - by country over a period of time

V_t/V_o = 3.806 in equation (3.5) is obtained by multiplying the economic growth power 3.677 for the period from 1980 to 2000 by 1.035, revised figure for the period of about half a year from May to the end of the year. So, from equation (3.5) the demand for main line as of the end of 2000 is:

$$Y = Yo \times 3.806^{1.45} = 571 \times 6.945 = 3,966,000$$

(2) As to all kinds of telephones, change of the station/line ratio must be considered. The station/line ratio in 1980 was 1.644 (MOTC Guideline data) but this ratio is likely to considerably decrease in the future. The estimated station/line ratio in 2000 in Paragraph 3.2 above is 1.51 if the international regression equation is directly applied and 1.61 if only the elasticity value is used. The station/line ratio must considerably decrease if faster growth than by the international regression equation is desired and if an effort at penetration into rural areas is made. In Japan, the station/line ratio during the time when the per-capita main line penetration ratio was 3∿5% (1958-1962) was 1.50∿1.54.
If it is assumed from the above results that the station/line ratio in the Philippines in 2000 will be 1.55, the demand for all kinds of telephones will be:

$$Y = 3,966 \times 1.55 = 6,147 \text{ thousands}$$

(3) This estimated value corresponds to expressed demand and is nearly double the estimated value by the GAS-5 method (corresponding to the number of subscriptions). Because the estimated value by the GAS-5 method is considerably low, the estimated value by the subject method is deemed to be more resonable as a forecast value of future

demand.

However, since this method of estimating is an analogy to past demand trends in Japan, great attention must be paid to the difference between the Japanese conditions of the time and present conditions in the Philippines as well as those in the near future. Regarding the reasonableness of the elasticity value of 1.45, the following matters must be noted:

(a) The model's elasticity value of 1.45 includes the effects of the expansion of local service areas and the improvement of demand/supply relations and toll call connection service carried out in Japan. However, the extent of the effects of these service improvements are believed to be greater in the Philippines. In this sense, this estimate may be somewhat small.

(b) Generally, the trend of demand increase includes the effects of non-economic factors as well as economic factors. So, if the speed of economic growth is high, the apparent elasticity value may be somewhat small. The annual average growth rate of the Japanese real GNP in 1953-1965 was 8.9%. From this point of view, this estimate may be a slight underestimate.

(c) There is a difference between gross economic growth and per-capita economic growth corresponding to the increase of population. During the early stage of telephone penetration, per-capita economic growth affects demand increase somewhat more strongly than gross economic growth. So, if gross economic growth is the same, demand increase should be smaller where

the rate of population increase is the higher. The annual average rate of population increase at the time in Japan was 1%. From this point of view, this estimate may be excessive.

(d) Trends in telephone demand are affected by the industrial structure and various social structures. These structures in Japan seem to have been fairly favorable for the development of telephones. From this point of view, the elesticity value of 1.45 may be considerably high.

4. NCR Demand Forecasting

Though not directly necessary for this study, the NCR demand here is studied to use it with the national macroscopic demand mentioned in paragraph 3 for verifying the microscopic forecasting by city/municipality.

Also, care must be taken that the demand estimated here corresponds to expressed demand rather than potential demand.

4.1 General

At the early stage of telephone penetration, the trend of demand increase is exponential. But when the demand ratio increases to a certain extent, the demand ceases to show the exponential trend. It is theoretically impossible to point out a specific range of percentage for the per capita demand ratio to which the exponential equation can be applied. From experience, applying an exponential equation of more than 10% is quite dangerous.

The telephone penetration ratio in NCR is already fairly high and the exponential equation cannot be used for its

future forecasting.

The following logistic growth curve is used to forecast telephone demand in NCR:

$$y = \frac{K}{1 + e^{-\alpha x+b}} \quad \cdots\cdots\cdots \quad (4.1)$$

This equation can be transformed as follows:

$$\log \frac{y}{K - y} = \alpha x - b \quad \cdots\cdots \quad (4.2)$$

x is a factor concerning growth and is usually used for time or economy.

K is a constant showing the limit to growth. It is called the limit or asymptote. α and b are constants.

(1) Asymptote K

In applying the logistic curve, it is desirable to give K in advance. Even if the value of K is erroneous, in the demand domain of less than K/2 the estimating error of demand is rather small. But if the demand exceeds K/2, the estimated value is greatly affected by K. So, K must be carefully set.

In forecasting demand in NCR, 50% of population is assumed for the present as the value of K for the main line telephones in consideration of penetration ratios in advanced nations and data in Tokyo, Japan and its suburbs. Further, 75% is adopted for all kinds of telephones. This value is for NCR. Somewhat smaller values should be used for other areas or for the whole of the Philippines.

The value of K properly is not a pure constant. It is presumed to gradually increase with economic growth, etc. But until the demand approaches the value of K, the

handling of K as a constant does not cause any serious error and is very convenient as an estimating technique. That is why, we set K as a constant for the present.

(2) Constant α

The greatest problem in applying the logistic curve to the forecasting of demand in NCR is the decision of constant α to determine the speed of growth. Because of inadequate past data, it is difficult to calculate a reliable growth speed from actual data.

Shown below are three kinds of estimates: cases where α for economic factor or time is estimated from past results and case where α is analogized from Japanese examples. It is considered that, at the present stage, results from the use of analogized α should be adopted.

4.2 Funcamental Figures

(1) Social and Economic Fundamental Figures

Social and economic fundamental figures used as the base of forecasting are shown in Table 4.1.

Table 4.1 Fundamental Figures[2)]

Year	1975	1976	1977	1978	1979	1980	1986	1990	2000	'81
Population[1)] ($x10^3$)	4,970		5,332	5,523	5,720	5,925	7,205	8,147	10,868	6,128
Comulative Increase Ratio	0.839		0.900	0.932	0.965	1.00	1.216	1.375	1.834	
Family Income[2)] ($x10^3$₱)	8,057			15,732	19,725					
Income per Cepita (₱)	1,621			2,848	3,448					
Price Index ('72)	1.646			2.029	2.411	2.841				
Income Level C.P. ('72)(₱)	985			1,404	1,430	1,464				
Growth Rate	1.1254[1)]	1.1254[1)]	1.1254[1)]	1.019	1.024	1.047				
Comulative Index ('80)	0.673	0.756	0.852	0.959	0.977	1.00	1.236	1.472	2.333	1.027

1) Estimated from the data of 1978 and 1975

2) Mainly by the Philippines Statistical Yearbook "1981"

(2) Actual Data of the Number of Telephones

Actual data concerning the number of all kinds of telephones and the number of main-line telephones are shown in Table 4.2.

Table 4.2 Number of Telephones (in 1000)

	1976	1977	1978	1979	1979	1980	1980	1981
Month	DEC	JUN		JUN	DEC	MAR	MAY	JUN
All kinds of Telephones[1)]	316	406		439	461	506		537
Main-Line Telephones[2)]							282	

1) NTC data 2) MOTC Guide line

The actual time series of population and the number of telephones is illustrated in Fig. 4.1. As is clear from this chart, the trend in the number of telephones is

abnormal. At least, values for 1976 and 1979 are unconvincing. There may have been a mistake in adding or some reported values may have been left out. But anyway, the data should not be used as is. Thus, as results concerning the number of all kinds of telephones, only data for 1977, 1980 and 1981 are used.

The per-capita penetration ratios in 1977, 1980 and 1981 were:

All kinds of telephones: 7.61%, 8.61% and 8.76%, respectively

Main-line telephones : 4.76% (1980)

(3) Pending Applications and Number of Demand

The rate of pending applications in NCR in 1981 was about 45% (PLDT data). No data are available on the rate of pending applications in 1977. It is naturally presumed that the rate of pending applications for all kinds of telephones is smaller than the rate of pending applications for main-line telephones but there is no data to substantiate this in terms of quantity at present. With the knowledge that some problems are involved, for the present we uniformly use 45% as the rate of pending applications for the 3 years: 1977, 1980 and 1981 by ignoring idfferences between all kinds of telephones and main-line telephones.

Based on the above assumption, demand ratios, etc. are as indicated in Table 4.3.