DEMAND FOR ELECTRONIC COMPUTERS IN JAPAN

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§1. INTRODUCTION

The advent of electronic computers had a great impact not only on such activities as business, industry, research and education, and government, but also on our way of thinking. We are now in an age of computer revolution such as that Dr. Edmund C. Berkeley has already talked about. In 1957 when I was studying high speed computation at the University of Michigan, only 1,474 sets of electoronic computers with comparatively low speed and small memory were running, most of which, that is, 1,350 sets were in U.S.A.. Since then, such environments have greatly changed.

According to the Survey Report of JECC (Japan Electronic Computer Company—doing a rental business for Japanese six leading manufacturers of EDP—), June 1965, more than 25,300 sets of EDP including from small to large scale computers are said to be operating in the world at the end of March 1965, about 74 per cent of which, that is, 18,600 sets, being in U.S.A., 19 per cent in Europe and 7 per cent, that is, 1,840 sets in Japan, excluding unknown sets in U.S.S.R.. Comparing the 3 sets of computer installation which existed in 1958 in Japan with those in 1965, we have to say that computer manufacturers and users in Japan after eight years of experience in marketing and in the use of electronic computers have made considerable progress in their recognition and use of electronic computers. The impact of electronic computers has been so great that industries in Japan, modernizing machines, equipments and plants of production, and marketing new products in the country and overseas, now regard EDPS as decisive tools for rationalization of management or as a necessary investment good in free competitive

Table I Number and Average Paid-in Capital of Firms

Paid-in Capital / Industries	~ and over less than 1 ~ 50		50 ~ 100		100~1,000		1,000~5,000	
	No. of firms	Paid-in capital per firm	No. of firms	Paid-in capital per firm	No. of firms	Paid-in capital per firm	No. of firms	Paid-in capital per firm
Agriculture	—	—	—	—	1	108	—	—
Forestry	—	—	—	—	1	100	—	—
Fishery	—	—	2	60	3	306	1	3,000
Primary Industries	—	—	2	60	5	225	1	3,000
Construction	—	—	4	56	31	280	5	2,075
Mining	—	—	2	62	4	305	4	1,700
Foods	—	—	8	64	12	223	8	2,881
Textiles	1	2	10	65	17	191	9	2,720
Pulp & Paper	—	—	4	67	8	341	8	3,098
Chemicals & Petroleum	1	27	13	71	55	278	26	2,898
Iron & Steel	2	20	9	61	10	387	8	2,566
Base Metal	—	—	4	73	6	283	3	2,183
Machinery	1	6	13	87	41	298	14	2,329
Electrical Machinery	—	—	6	67	23	338	12	1,985
Transportation Equipment	—	—	6	63	20	288	14	2,282
Other Manufacturers	3	22	7	67	37	246	13	1,937
Glass & Cement	—	—	1	80	25	298	7	3,056
Secondary Industries	8	17	87	69	289	283	131	2,495
Wholesale & Retail Trade	4	22	39	90	63	218	15	2,287
Banking	5	27	2	68	38	418	10	2,072
Insurance	—	—	1	50	4	362	9	1,843
Secrities	—	—	4	50	10	326	0	1,905
Real Estate	—	—	—	—	2	480	1	1,200
Transportation & Communications	1	24	16	66	43	285	14	2,764
Public Utilities	—	—	2	72	3	496	2	1,100
Other Services	8	10	1	96	18	426	6	2,837
Testiary Industries	18	18	65	80	181	313	66	2,259
TOTAL	26	18	154	74	475	294	198	2,420

from which answers to questionaires were received. Unit: 1 million yen

5,000~10,000		10,000~50,000		more than 50,000		TOTAL		Unknown
No. of firms	Paid-in capital per firm	No. of firms	Paid-in capital per firm	No. of firms	Paid-in capital per firm	No. of firms	Paid-in capital per firm	
—	—	—	—	—	—	1	108	—
—	—	—	—	—	—	1	100	—
—	—	2	11,250	—	—	8	3,317	—
—	—	2	11,250	—	—	10	2,674	—
3	6,333	—	—	—	—	43	890	—
2	6,930	—	—	—	—	12	1,833	—
3	5,628	2	12,671	—	—	33	2,074	—
4	6,947	5	17,742	—	—	46	3,150	—
2	6,650	—	—	—	—	22	1,867	—
14	6,837	6	18,419	—	—	115	2,589	—
4	6,267	4	22,350	5	75,909	42	12,357	—
4	6,602	4	11,183	—	—	21	3,794	—
3	5,433	1	27,900	—	—	73	1,235	—
8	5,865	3	29,816	2	74,042	54	5,860	—
7	7,539	7	23,717	1	79,118	55	6,109	—
3	6,128	—	—	—	—	63	845	—
1	5,000	3	14,966	—	—	37	2,130	—
58	6,507	35	19,627	8	75,843	616	3,386	—
10	6,572	3	16,972	—	—	134	1,256	—
12	7,266	11	17,409	—	—	78	4,045	20
3	7,800	—	—	—	—	17	2,440	20
1	8,000	2	12,000	—	—	26	2,023	—
—	—	—	—	—	—	3	720	—
6	7,506	5	12,647	—	—	85	1,886	—
1	6,875	7	25,922	3	89,204	18	25,544	—
—	—	—	—	—	—	33	754	1
33	7,158	28	18,254	3	89,204	394	3,110	21
91	6,743	65	18,778	11	79,487	1,020	3,273	21

Table I Continued

	No.	Average	No.	Average	No.	Average	No.	Average
Hospitals	2	more than 1,000 beds 1,327	—	—	27	more than 700 beds 341	14	more than 300 beds 403
Universities	35	less than 50 Teachers & staff 27	22	less than 100 T & S 70	32	less than 200 T & S 143	20	less than 400 T & S 264
Other Institutes	3	23	1	53	1	100	—	—
Government	—	—	—	—	—	—	—	—
Local Government	—	—	—	—	—	—	—	—
Defense & others	—	less than 1 —	—	1~50 —	—	50~100 —	1	100~1,000 100
Corporations	1	1	8	16	6	69	6	369
Religious	—	—	—	—	—	—	1	384
Research Institutes	2	1	2	18	—	—	1	376
Libraries	—	—	—	—	—	—	—	—

The "Average" for Defense, Corporations, Religious, and Research Institutes

business environments. Glancing sideways at EDP manufacturers, they devote great effort to technological development of hardware, software and applicationware of computers and for systems engineering problems for the optimum use of computers.

Considering these facts, it seems there is or will be so large a demand for computers which no one could estimate before, and the environments of EDPS are so dynamically changing with changes of economic situation in Japan that the Machinery Development Association and JECC supported by MITI (the Ministry of International Trade and Industry of Japan) requested the Comittee of Research and Forecasting of Demand for Computers to study the market for electronic computers in Japan with myself acting as chief of this research and survey.

We took one year and half to study this problem, and compiled a detailed report in August 1965. It is entitled "A Study on Economic Forecasting Method for Electronic Computers". In our study, aiming at a synthetical grasp of the nature of EDPS in Japan, we questionaired

No.	Average	No.	Average	No.	Average	No.	Average	No.	Average of all	
	more than 400 beds		more than 500 beds		more than 600 beds					
16	531	1	600	5	730	—	—	65	467	
	less than 800 T & S		less than 1,600 T & S		more than 1,600 T & S					
16	533	5	1,325	2	1,897	—	—	133	236	3
—	—	—	—	—	—	—	—	4	56	3
—	—	—	—	—	—	—	—	—	—	19
—	—	—	—	—	—	—	—	—	—	19
	1,000～5,000		5,000～10,000		10,000～50,000		more than 50,000			
2	3,500	—	—	8	22,015	3	100,637	14	34,653	3
4	1,477	—	—	—	—	—	—	25	347	47
1	1,058	—	—	—	—	—	—	2	721	4
1	1,000	1	5,548	—	—	—	—	7	994	3
—	—	—	—	—	—	—	—	—	—	1

gives annual budget figures in millions yen.

all users of EDP and some potential users chosen by sampling, that is, 2,637 firms, organizations, schools and governments selected from a population of 7,801 as well as all manufacturers (Hitachi, Fujitsu, Mitsubishi, Oki, Toshiba, Nippon, and Matsushita, domestic electronic manufacturing companies, and Burroughs, IBM, NCR, and RR which are foreign companies in Japan.) We received answers to the questionaires from 1,393 firms, organizations, schools and governments and from all manufacturers, as shown in Table I. In this present paper, I wish to explain the past environments and development of electronic computers in Japan and to make some estimates for demand for computers in 1968 using simple economic models. This study covers the situation in Japan as of June 30, 1964.

§2. PCS

One clue on which we can estimate the future demand for electronic computers is found in the extensive information available on PCS, because

Table II Cumulative Trends of

Calender year / Machine	Up to 1953	1954	1955	1956	1957
Card Punch	403	720	813	867	977
Verifier	282	473	513	512	572
Sorter	114	186	226	251	316
Collator	53	86	107	128	158
Interpreter	51	91	103	115	131
Accounting Machine	83	145	173	216	250
Gang Punch	60	116	137	164	190
Calculating Punch	49	72	86	107	131
Paper Tape Punch	—	20	20	20	46
Tape to Card Converter	3	3	7	16	41
Card to Tape Converter	—	—	—	8	16
Others	2	12	17	20	26
Total	1,100	1,924	2,202	2,424	2,854
Total as per cent of previous year (%)	—	173	116	110	118

of our having much longer experiences on it than EDPS. Before 1953, we had only about 1,100 machines including card punch and accounting machine, but we had 12,823 machines at the end of June, 1964. If we summarize the characteristics of industries from the trend exhibited in their introduction of PCS, we can say that the primary industries were so late in introducing PCS that we are not in a position to talk about a trend of growth of PCS in this industry, but in the secondary industries, 434 machines of PCS (39.8 per cent of all industries using PCS) had been installed before 1953, and installation in industries such as electrical machinery, iron and steel, chemicals and petroleum, and transportation machinery has been proceeding rapidly up to 1964, and the tertiary industries having long experience since prewar days as seen in insurance industry, had 415 machines (37.8 per cent of all industries) in 1953, and have continued to show a steep growth in its installation until in 1964, especially in such industries as banking, securities, public utilities, and wholesale and retail trade, they had 4,707 machines (38.3 per cent).

Office management with machines in Japan began with PCS after

Numbers of Punched Card Machines.

1958	1959	1960	1961	1962	1963	1964	Sets per accounting machine
1,198	1,449	1,889	2,720	3,414	3,890	4,383	5.76
703	811	949	1,347	1,762	1,973	2,078	2.74
412	517	668	929	1,094	1,121	1,235	1.62
206	240	344	508	615	646	684	0.90
170	214	277	369	472	536	612	0.80
310	405	527	702	781	761	761	1.00
241	320	391	561	638	638	663	0.87
155	188	232	305	324	310	328	0.43
77	80	147	224	765	1,057	1,159	1.51
50	97	132	218	278	334	374	0.49
18	31	34	46	52	58	63	0.08
35	46	73	194	370	442	483	0.63
3,575	4,398	5,663	8,123	10,565	11,766	12,823	—
125	123	128	141	115	106	109	—

the war and even today many firms show a tendency to experiment first with PCS when they plan to introduce EDPS. A configuration of PCS, if permitted to be calculated on the basis of an accounting machine, is illustrated in Table II. One set of average configuration of PCS consists of 16.8 machines per accounting machine, which are 5.8 card punch machines, 2.7 verifiers, 1.6 sorters, 0.9 collators, 0.8 interpreters, 0.9 gang-punch machines, 0.4 calculating punching machines, 1.5 paper tape punching units, 0.5 card to tape converters, 0.1 card to tape converters, 0.6 of others. In Japan, paper tape reading and punching machines are often said to be quite popular as input-output devices of EDP, because manufactrers of EDP have a long history of electrical communication devices. But the fact is different. Because as Table III shows us, input-output devices of EDPS are lergely based on punched card systems at present, except for the smallest types of EDPS or electrical communication systems.

The total amount of annual investment made in PSC was over 7 billion yen in 1963, and the average rate of growth of the amount has

Table III Average of Monthly Rentals of

Industry \ Machine	Mean	Card Punch	Verifier	Sorter	Collator
Primary	58,178	12,246	18,000	70,120	36,000
Secondary	48,766	11,289	15,923	38,857	75,576
Tertiary	51,244	16,247	18,841	46,786	91,987
Other	47,930	18,561	27,643	69,498	86,753
Average of all	48,220	13,862	17,946	45,102	83,003
Standard Prices of IBM	—	14,400	18,000	50,040	149,400

Table IV Average Monthly Rentals Paid by a Firm for PCS

Industry	Cumlative sets, in 1964	Sets of direct purchase	Rented sets			Unknown
			Total rentals (yen)	No. of firms	Average monthly rental	
Primary	38	—	2,210,760	1	2,210,760	1
Secondary	6,743	162	276,111,836	179	1,542,524	29
Tertiary	5,020	210	189,090,723	112	1,688,310	23
Others	3,056	153	82,774,509	61	1,356,959	11
Total	14,857	525	550,187,828	353	1,558,606	64

been about 28 per cent annually. Average monthly rentals paid by all industries, classified by machines and by industries are shown in Table IX respectively. Average monthly rental per firm is 1,558,606 yen in all industries, 1,542,524 yen in the secondary industries, and 1,688,310 yen in the tertiary industries. The highest monthly rental is paid by

Table V Annual Amount of Investment

Industry \ Calendar year	Up to 1953	1954	1955	1956	1957
Primary	—	—	—	—	—
Secondary	253	446	486	550	644
Tertiary	255	532	621	661	762
Others	144	170	202	232	293
Total	652	1,148	1,316	1,443	1,699
Total as per cent of previous year (%)	—	176.0	114.6	109.7	117.7

Punched Card Machines Classified by Industries. Unit: 1 Yen

Inter-preter	Account-ing machine	Gang punch	Calculat-ing punch	Paper tape punch unit	Tape to card converter	Card to tape converter	Others
78,480	283,250	55,440	115,200	—	61,560	—	—
51,096	223,089	49,488	211,635	50,206	46,506	47,458	60,913
64,332	271,374	59,921	215,268	62,112	49,712	16,663	205,544
39,140	221,782	56,075	283,107	15,880	22,274	10,800	112,702
54,481	236,528	52,890	222,051	44,698	42,357	22,417	38,962
78,480	331,200	52,560	297,000	—	—	—	—

business firms in iron and steel industry, the average amount being 3,443,627 yen. Bussiness firms in industries such as base metal, transportation machinery, insurance, and corporation pay more than 2 million yen of monthly rental per firm. The other industries rank from 1 million yen to 1,800,000 yen of monthly rental for PCS. Judging from these figures, most firms may be said to possess a minimum configuration of PCS around one accounting machine. In addition to this fact, we have to recall the fact that a monthly rental of PCS of more than 3 million yen corresponds to that of a medium size computer. Why do not firms in industries like iron and steel and insurance thoroughly change over from PCS to EDPS? In the field of mechanized office management, we have to say that there still remain some difficulties in substituting PCS for EDPS. Generally speaking, arithmetic operations or computational business executed by PCS are thought to be

made in PCS Classified by Industries. Unit: 1 Million yen

1958	1959	1960	1961	1962	1963	1964	Total
—	—	—	17	17	22	26	82
821	983	1,258	2,028	2,548	2,789	3,246	16,052
978	1,231	1,619	2,108	2,633	2,800	2,888	17,088
334	412	505	691	1,091	1,389	1,451	6,921
2,133	2,626	3,382	4,844	6,289	7,000	7,611	40,143
125.5	123.1	128.8	143.2	129.8	111.3	—	—

easily replaced by EDP, but even in these cases the basic machines like card punch, verifier, line printer etc. in PCS, have supplementary relationships with EDPS, if these machines are not improved. Even leading firms using large scale computers today have experienced PCS operations in the earlier stage of mechanizing managements for about two or three years. Even though the past growth of PSC has been remarkable, we can not expect the future demand for PCS to be so, because most manufacturers of EDPS offer or will offer more efficient computers at lower prices than PCS, and many big firms and even minor firms change or have plans to change their office machine systems from PCS to EDPS. Whatever the basic environments around PCS may be, this does not mean that there is no future demand for PCS, for it will take a long time to thoroughly change over as long as the basic devices of EDPS remain the card punch system, as mentioned above.

§3. EDPS

1. Installations:

The past information on EDPS will give us some knowledge on the future demand for EDPS in Japan. Concerning the installation of EDPS in Japan, we have only two reliable sources of data, namely the Interim Report submitted by Research Committee of Industrial Structure (published by MITI) and the Quarterly Report of JECC. But it is quite difficult for us to get accurate basic data on the number and amount of sets of computers, produced, sold, or installed, classified by models or configurations and industries, as Japan has neither a registration system nor a designated statistic data system of EDP, and moreover each data is based on a different basis of definition, time period of research, or way of computation. For instance, the Interim Report of MITI give the largest figures because of its including the total amount of finished products produced in domestic Japan plus imported parts and products of computers, which means a duplication. The number of sets in the Quarterly Report of JECC is comparatively accurate at the fiscal year basis, but total amounts of EDP installations in it are calculated by simple multiplication of sets by estimated standard prices, that is, a standard

configuration being assumed for each set of installation, owing to the difficulties of collecting accurate data of each configuration.

In our survey, we requested all manufacturers directly to submit detailed information like configurations, total amounts, not at actually negotiated prices, but at the standard prices, etc. of EDPS. Thus, we were able to get reliable data on EDPS in Japan, thanks to all manufacturers who went to a great deal of trouble to help us in our survey.

The number of sets of EDP installed is seen in Table VI. The years 1958~59 saw the beginnings of EDP in Japan when electrical machinery industry was quite eager to experimentally develop some kind of computers and to find out whether electronic compters deserved great costs of reaeach, development and production in the future. A few sets of computers were introduced from U. S. A. to this industry, and some universities like Waseda University and the University of Tokyo took an academic interest in electronic computers, in these years. Some pioneering firms as users of EDP started to install electronic computers in 1960, but strictly speaking, we can not say that they could use EDP's satisfactorily. They were trying to become familiar with EDP's to rearrange their business and management to take better advantages of EDP's, and to train the staff for EDPS. In 1961, securities industry confronted with unexpected boom was obliged to introduce many sets of computers in order to dispose of voluminous transactions in the face of scarsity of manpower. Since 1962, big business firm such as in petroleum, iron and steel, banking and insurance industries have proceeded to mechanize office management with large scale EDP's. It was in 1963 when wholesale and retail trade industry showed great initiative in the installation of computers for processing voluminous sales vouchers. Electronic computation companies came into being and computation on contract became a business.

Looking back over the trend in the amount invested in EDP in the past six years 1958~1963, we can notice that there has been an explosive demand for computers, the amount of which was 48 million yen in 1958 and 27,143,550,000 yen in 1963. The largest amount of investment was

Table VI Annual Sets and Amount of Investment made in EDPS Classified by Industries. Unit 1 million yen

	Industries \ Calendar year	33		34		35		36		37		38	
		Sets	Amount	Sets	Amount	Sets	Amount	Sets	Amount	Sets	Amount	Sets	Amount
Secondary	Construction	—	—	—	—	—	—	—	—	—	—	1	29
		—	—	—	—	—	—	—	—	1	4	3	82
		—	—	—	—	—	—	—	—	1	4	4	111
	Mining	—	—	—	—	—	—	—	—	—	—	1	55
		—	—	—	—	—	—	—	—	—	—	3	109
		—	—	—	—	—	—	—	—	—	—	4	164
	Foods	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	1	15	2	8
		—	—	—	—	—	—	—	—	1	15	2	8
	Textiles	—	—	—	—	—	—	1	83	3	5	4	161
		—	—	—	—	—	—	2	96	9	475	32	237
		—	—	—	—	—	—	3	179	12	480	36	398
	Pulp & Paper	—	—	—	—	—	—	1	17	1	102	—	—
		—	—	—	—	—	—	—	—	—	—	1	6
		—	—	—	—	—	—	1	17	1	102	1	6
	Base Metal	—	—	—	—	—	—	3	245	—	—	1	201
		—	—	—	—	1	84	—	—	3	287	5	251
		—	—	—	—	1	84	3	245	3	287	6	452
	Machinery	—	—	—	—	—	—	1	44	2	247	—	—
		—	—	—	—	—	—	—	—	1	100	8	654
		—	—	—	—	—	—	1	44	3	347	8	654
	Other Manufacturers	—	—	—	—	—	—	—	—	1	5	4	96
		—	—	—	—	—	—	—	—	—	—	10	130
		—	—	—	—	—	—	—	—	1	5	14	226

	Glass & Cement	—	—	—	—	—	—	1	69	1	22	—	—
		—	—	—	—	—	—	1	216	2	34	1	728
		—	—	—	—	—	—	2	285	3	56	1	728
	Chemicals & Petroleum	—	—	—	—	—	—	1	175	4	2	2	8
		—	—	—	—	1	124	3	319	8	916	29	2,219
		—	—	1	21	1	124	4	494	12	918	31	2,227
	Iron & Steel	—	—	—	—	—	—	1	74	6	731	1	13
		—	—	—	—	1	26	4	1,532	5	418	8	948
		—	—	1	21	1	26	5	1,606	11	1,149	9	961
	Electrical Machinery	1	10	2	58	8	317	25	219	19	670	25	1,040
		—	—	1	26	1	13	4	246	6	562	17	746
		1	10	3	84	9	330	29	465	25	1,232	42	1,786
	Transportation Equipment	—	—	—	—	—	—	3	384	1	25	2	53
		—	—	—	—	—	—	1	53	8	673	16	1,546
		—	—	—	—	—	—	4	437	9	698	18	1,599
	Total in Secondary Industries	1	10	4	105	12	564	52	3,772	82	5,293	176	9,320
Tertiary	Wholesale & Retail Trade	—	—	1	36	—	—	1	150	1	24	14	28
		—	—	—	—	—	—	1	52	5	218	17	1,083
		—	—	1	36	—	—	2	202	6	242	31	1,111
	Banking	—	—	1	72	1	364	2	310	28	1,016	35	1,218
		—	—	—	—	1	302	4	672	8	1,088	14	2,738
		—	—	1	72	2	666	6	982	36	2,104	49	3,956
	Insurance	—	—	—	—	—	—	1	167	2	75	6	496
		—	—	—	—	—	—	4	424	13	2,030	4	452
		—	—	—	—	—	—	5	591	15	2,105	10	948

Industries \ Calendar year		33		34		35		36		37		38	
		Sets	Amount	Sets	Amount	Sets	Amount	Sets	Amount	Sets	Amount	Sets	Amount
Tertiary	Securities	—	—	1	385	8	476	11	476	8	962	4	912
		—	—	—	—	—	—	—	—	2	360	10	2,496
		—	—	1	385	8	476	11	476	10	1,322	14	3,408
	Public Utilities Transportation & Communications	—	—	1	60	—	—	6	430	3	145	4	341
		—	—	—	—	2	380	1	72	3	405	12	1,147
		—	—	1	60	2	380	7	502	6	550	16	1,488
	Other Services	—	—	1	116	1	31	7	958	1	74	9	320
		—	—	—	—	—	—	2	178	10	1,708	18	2,478
		—	—	1	116	1	31	9	1,136	11	1,782	27	2,798
	Total in Tertiary Industries	—	—	5	669	13	1,553	40	3,889	84	8,105	147	13,709
Others	Universities & Other Institutes	1	14	—	—	1	69	4	251	22	672	16	645
		—	—	—	—	—	—	—	—	—	—	—	—
		1	14	—	—	1	69	4	251	22	672	16	645
	Governments	—	—	1	45	2	205	4	175	7	266	10	583
		—	—	1	396	1	124	1	424	13	1,352	19	1,976
		—	—	2	441	3	329	5	599	20	1,618	29	2,559
	Corporations	—	—	1	64	2	93	2	60	2	251	—	—
		—	—	—	—	1	8	—	—	1	98	2	605
		—	—	1	64	3	101	2	60	3	349	2	605
	Total of above industries	1	14	3	505	7	499	11	910	45	2,639	47	3,809
All	Grand Total	2	24	12	1,279	32	2,616	103	8,571	211	16,037	370	26,838

Table VII Cumulative Number of Sets and Amount of EDP's Classified by Paid-in Capital in 1959~1964.

Industries & Computer \ Paid-in Capital			Less than 1	1~50	50~100	100~1,000	1,000~5,000	5,000~10,000	10,000~50,000	More than 50,000	Unknown	No paid-in capital	Total
Secondary	Domestic	Sets	—	5	4	15	61	103	17	13	2	—	220
		Amount	—	20	105	62	1,186	2,852	1,610	1,266	271	—	7,372
	Imported	Sets	—	—	6	12	34	38	34	7	—	—	131
		Amount	—	—	386	1,085	3,883	6,439	6,026	1,484	—	—	19,303
	Total	Sets	—	5	10	27	95	141	51	20	2	—	351
		Amount	—	20	491	1,147	5,069	9,291	7,636	2,750	271	—	26,675
Tertiary	Domestic	Sets	—	7	3	17	55	115	27	2	7	1	234
		Amount	—	1,550	5	663	594	667	632	59	593	5	4,768
	Imported	Sets	—	—	6	12	37	18	6	1	30	8	118
		Amount	—	—	1,682	1,315	6,312	3,086	780	139	4,922	1,703	19,939
	Total	Sets	—	7	9	29	92	133	33	3	37	9	352
		Amount	—	1,550	1,687	1,978	6,906	3,753	1,412	198	5,515	1,708	24,707
Total	Domestic	Sets	—	12	7	32	116	218	44	15	9	1	454
		Amount	—	1,570	110	725	1,780	3,519	2,242	1,325	864	5	12,140
	Imported	Sets	—	—	12	24	71	56	40	8	30	8	249
		Amount	—	—	2,068	2,400	10,195	9,525	6,806	1,623	4,922	1,703	39,242
	Total	Sets	—	12	19	56	187	274	84	23	39	9	703
		Amount	—	1,570	2,178	3,125	11,975	13,044	9,048	2,948	5,786	1,708	51,382

by banks investing 7,780 million yen (125,360,000 yen per set) and the second was 6,670 million yen (131,890,000 yen per set) by the securitities industry. Universities were the third, investing a total of 5,963,500,000 yen (141,980,000 yen per set) in 1957~1963. In 1964, there was a large amount of investment in EDPS in industries like textiles, chemicals and petroleum, iron and steel, electrical machinery, transportation machinery, banking, insurance and public utilities.

The installing of electronic computers has gone through many periods of vicissitudes. In 1958, a certain firm whose paid-in capital came in the group from 1 billion yen to 5 billion yen introduced one set of electronic computer. The next year, the scale of paid-in capital of firms installing EDPS became larger and larger. As time passed the average size became still larger reaching 50 billion yen in 1960. The wave of electronic computer installation reached the layer of minor firms whose paid-in capital was less than 1 billion and over 100 million yen in 1962, and even the 1 million yen class in 1964. This is a common phenomenon among Japanese industry and firms in their innovational behavior which reflects what might be called the diffusion-effect of new products and practices. This leads us to a conclusion that the biggest firms are not always the pioneering firms in Japan, and new products are experimentarily used by medium scale firms (1 billion to 5 billion yen in their paid-in capital). The large scale firms tend to watch the results of the use of new products by medium scale firms for two or three years and to start to use the new products after ascertaining the results.

2. Configurations:

It is quite difficult for us to find out the differences between configurations of domestic EDPS in 1958 and those in 1964. An average configuration of EDPS per main processor consists of 0.65 card reading and punching units, 0.14 card reading units, 0.07 card punching units, 1.19 paper tape reading units, 0.62 paper tape punching units, and 0.24 paper tape reading and punching units. The reasons why these figures have been almost stable till 1964 may be due to following facts; users of computers have been so deliberate to introduce, to install or to enlarge

their systems of digital computers that their configurations of EDPS had to be at a minimum level, that is, a main processor being connected with two units of paper tape reading or punching devices and one third units of card reading or punching devices, and domestic manufacturers of EDPS mainly have grown up from those of electric communication machineries so that they were good at producing paper tape devices but a little behind in card punching or reading devices. Even in 1964, 1.25 magnetic tape units were only used per main processor, core memory units being only 0.09.

The configurations of imported EDPS per main processor consist of

Table VIII Configuration of EDP's Classified by Year

Calendar year	33	34	35	36	37	38	39	Total
Main Processor				(20)	(28)	(44)	(149)	902 (241)[2]
Card Read & Punch Unit	—	4	15	49	93	85	55	301(0.33)[1]
Card Reader	—	4	10	23	33	97	94	261(0.29)
Card Punch	—	1	—	5	10	56	81	153(0.17)
Tape Reader	4	9	19	49	142	263	201	687(0.76)
Tape Punch	—	2	11	17	78	163 (3)	144 (3)	415(0.46) (6)
Tape Read & Punch	4	3	6	7	22	57 (12)	41 (216)	137(0.15) (228)
Magnetic Tape Unit	—	12	23	223	393	722	442	1815(2.01)
High Speed Printer	—	6	13	50	107	211	171	558(0.61)
Flexowriter	2	4	15	20	85 (22)	185 (33)	128 (220)	439(0.48) (275)
Billing Machine etc.	—	—	1	2	1	1	1	6(0.006)
Core Memory Unit	—	4	2	19	39	36	31	131(0.15)
Magnetic Drum Unit	—	8	11	14	7	16	8	64(0.07)
Disk MemoryUnit	—	—	—	—	3	17	19	39(0.04)
Others	—	5	14	49	129	259	270	726(0.80)
Off Line Unit	2	5	14	32	65	148	87	353(0.39)

1. Figures in parenthesis in the column 'Total' are the ratio of sets of machine per main processor.
2. Figures in parenthesis in each row are numbers of sets of "smallest computers".

0.57 reading and punching units, 0.83 reading card units, 0.30 punching card units on line. In contrast to domestic EDPS, an imported compter is connected with only 0.04 units of reading and punching paper tape devices, 0.12 punching paper tape and 0.20 reading paper tape units. Paper tape devices are almost not used in imported EDPS except for the use of data transmissions.

3. Motives & Operating Time:

Speaking of motives for introducing EDPS into business firm, organizations, schools, governments etc., EDPS is used for the following objects like processing office work like payroll, accounting, etc. (27.5 per cent), collecting or calculating fees of telephone, insurance etc. (17.9 per cent), management control over personnel, finacials, inventory etc. (14.6 per cent), scientific use (12.0 per cent), synthetic use for the whole organization (9.3 per cent), statistical work, say, forecasting demands for new products, (8.6 per cent), others (7.2 per cent) and process control (2.9 per cent). In industries using EDPS for scientific computation, we can point out the following industries like construction, iron and steel, electrical machinery, transportation machinery, wholesale and retail trade, banking, and government, for office work in textiles, banking, insurance, transportation and communications, for process control in iron and steel, machine manufacturer, public utilities, and for statistical work in chemicals and petroleum, electrical machinery, wholesale and retail trade, banking and insurance.

At the date of this research in 1964, EDPS were mainly used for office work to prevent increases in office workers with higher wage rate and because it was easy and necessary to mechanize the works with EDPS, like computation of architectural structure in construction, scientific computation in university, business computation in banking, insurance and public utilities, management control of bills or notes, inventory in textiles, chemicals and petroleum, electrical machinery, and wholesale and retail trade. Synthetic use in business firms can be seen in quite a few companies in chemicals and petroleum, iron and steel, transportation machinery, banking, local government and trans-

portation. True merit of EDPS may be expected at the third stage of its development where EDPS taking the place of human decision of routine work, is synthetically used for the whole business management in a firm as described by SRI in its "Report on Market for EDPS in U. S. A.". Synthetical use of computers in this meaning is now so few in Japan. However, some leading companies having much knowledge and experience about computers, in such industries as iron and steel, transportation machinery, banking, insurance, and chemicals and petroleum, have plans that they will bring the synthetical use of EDPS in operation in one or two years after 1965. This fact enables us to expect that some pioneering users of EDP's are coming across to the threshold of the third stage of EDP's development.

The average running time of EDP per firm in all industries is 7 hours in a day and 22 days in a month. The average maintenace time for EDP's is 42 minutes in a day. Local governments used computers for 28 days in a month, which were the highest running time as an average, and an industry using EDP at the lowest machine time, that is, for 17 days in a month, was securities industry which had been bitterly affected by the bad business situation. Average running times for other industries are illustrated in Table IX.

4. Expenditure:

An average amount of monthly expenditure including depreciation for EDPS is shown in Table XI. The average amount per firm was 11,845 thousands yen, 61 per cent of which, namely, 7,202 thousands yen, was paid for hardware—40.52 per cent for a monthly payment for rental plus 20.28 per cent for a machine depreciation. The expenditure for personnels working in EDPS was not negligeble, but quite significant, that is, more than 15 per cent of all monthly expenditure. According to the data on monthly expenditure for EDP's clasified by paid-in capital it is quite natural that a monthly expenditure for EDPS should increase with increase in paid-in capital of firms. Most business firm whose paid-in capital were less than 5 million yen installed EDP's by rental owing to their limits of financial ability. In those with paid-in

Table IX Objective of Use

Objective / Industries	Office work	Scientific computation	Business computation	Business control	Process control
Primary	1				
Secondary	208	69	43	112	18
Tertiary	104	14	162	52	12
Other	14	60	9	10	4
Total	327	143	214	174	34
%	27.5	12.0	17.9	14.6	2.9

Table X Future Plans for EDP Classified

Objectives / Scales of computors	Office work	Scientific computation	Business computation	Business control
Large	3	7	8	11
Medium	56	31	29	54
Small	50	15	24	35
Smallest	13	2	5	9
Others	23	13	10	20
Total	145	68	76	129
%	19.9	9.3	10.4	17.7

Table XI Monthly expenditures

Item / Industries	Personnel	Depreciation of machine	Rentals	Machine attachment	Card
Secondary	1,821	2,442	4,540	230	372
(%)	(15.88)	(21.29)	(39.58)	(2.01)	(3.24)
Tertiary	2,043	2,969	4,805	301	411
(%)	(15.36)	(22.32)	(36.13)	(2.26)	(3.09)
Other	1,031	1.056	5,920	124	468
(%)	(10.33)	(10.58)	(59.35)	(1.24)	(4.69)
Total	1,783	2,402	4,800	235	397
(%)	(15.05)	(20.28)	(40.52)	(1.98)	(3.35)

and Operating Time.

Research & survey	Symthetic nse	Others	Running time			
			Days/month		Hours/day	
			Total	Average	Total	Average
			25	25	4	4
37	44	19	8,967	22	2,969	7
61	49	44	7,590	22	2,315	6
4	18	22	2,916	23	1,041	8
102	111	85	19,498	22	6,329	7
8.6	9.3	7.2				

by Objectives of Use in 1964～1970.

Process control	Research & survey	Symthetic use	Others	Blank	Total
—	1	20	13	16	79
2	12	26	27	44	281
—	21	9	22	29	205
—	3	—	1	13	46
—	5	6	10	32	119
2	42	61	73	134	730
0.3	5.8	8.4	10.0	18.4	100.0

for EDP's classified by Industries. Unit: Thousand yen

Paper tape	Magnetic tape	Paper for print	Communi-cations	Miscella-neous	Insurance	Total
19	631	378	426	539	72	11,470
(0.17)	(5.50)	(3.30)	(3.71)	(4.70)	(0.63)	(100.0)
34	1,264	441	392	535	106	13,301
(0.26)	(9.50)	(3.31)	(2.94)	(4.02)	(0.80)	(100.0)
40	496	207	123	471	38	9,974
(0.40)	(4.97)	(2.07)	(1.23)	(4.72)	(0.38)	(100.0)
29	850	366	376	523	84	11,845
(0.24)	(7.18)	(3.09)	(3.17)	(4.42)	(0.71)	(100.0)

capital from 5 to 10 million yen, however, an amount of the monthly machine depreciation was as much as twice of monthly rental. This indicates that firms in this rank preferd directly purchasing machines to paying monthly rental for EDP's. As the paid-in capital became larger and larger, an amount of monthly rental approached to the amount of machine depreciation and exceled the latter in case that paid-in capital was 100 million yen and more. The comparison of the paid-in capital with the amount of monthly rental plus machine depreciation shows an interesting fact as follows: while paid-in capital increased 1,000 times from 25 million yen to 25 billion yen, an average monthly expenditure for hardware increased only about 10 times from 1,265 thousands yen to 12,065 thousands yen. The reasons why such a phenomenon occured seemed to be due to the small paid-in capital of lower firms compared with their business activities and comparatively small amount of investment made in EDP's in large scale firms. Even if we take an account of these facts, the amount of investment in EDP's was slower to increase than the amount of sale proceeds of firms increased. In a sense, EDPS requires some constant cost for its basic operation, maintenance and depreciation even in the case of processing a minimum volume of business operation requested in a firm, so that the amount of investment for machine has to be relatively higher in a small size business firm than a large scale firm. Whatever the fact might be, the ratio between the amount of investment and sale proceeds being 0.005 in large scale firms is extraordinarily small. This tells us that we shall have a huge volume of demand for EDP's in the near future when many leading business firms will have finished the first or second stage of EDPS, or they will come to use electronic computers as their information center directly to connect their main offices with branches, factories, dealers etc.

§4. AN ESTIMATION OF DEMAND FOR EDPS

As mentioned in the preceding sections, we are able to expect demand for EDP's in Japan to be prosperous in future.

In case of building economic forecasting models for demand for

EDPS classified by industries, it is important for us to find out strategic factors affecting EDP's as well as to trace their past trends. As the result of analyzing these factors, we were able to pick up important factors as follows:

1. Total sale proceeds in the ith industry A_{it}
2. Total business profit in the ith industry P_{it}
3. Rate of return in the ith industry R_{it}
4. Average wage rate in the ith industry W_{it}
5. Management cost in the ith industry B_{it}
6. Average cost of computer classified by jth scale (large, medium, small etc.) and installed in the ith industry C_{ijt}
7. Total fixed assets in the ith industry J_{it}
8. Demonstation effect on the jth scale computer in the ith industry D_{ijt}
9. etc.

If E_{ijt} is a demand for a specific type (j) of computer in a specific industry (i) in a certain period (t), we have a function of E_{ijt} like,

$$E_{ijt}=f\,(A_{it},\ P_{it},\ R_{it},\ W_{it},\ B_{it},\ C_{ijt},\ D_{ijt},\ \ldots)$$

Each variable appearing in the right hand of the function has its proper characteristics, for instance, sale proceed (A_{it}) being affected by national income (Y_t), average wage rate being affected by factor cost (F_{it}), number of employees (N_{it}) etc., and demonstration effect being affected by psychological attitude of people in a specific industry. Even though we knew much about the great importance of accepting qualitative factors like demonstration effect into economic forecasting models for demand for EDP's in Japan, it was so regrettable for us not to hand in and not to afford to take a time to analyze those qualitative data so that our models seemed to be so simple.

The economic variables used in our models were selected as follows:

At first we chose time series data of common items arranged in financial statement of each firm which sent back us answers to

Table XII Financial Variables

	Secondary industries, wholesale and retail trade, public utilities, etc.	Bank
X_2	Paid-in capital	Paid-in capital
X_3	Sale proceed	Loan
X_4	No. of employee	Discounted bill
X_5	Management cost	Short term loan
X_6	Business profit	Securities
X_7	Sale profit	Cash and deposit
X_8	Misc. income	Foreign account
X_9	Gross profit	Other assets
X_{10}	Tangible fixed asset	Mobile and real estate
X_{11}	Investment for eqip.	Deposit
X_{12}	Fixed debit	Borrowing
X_{13}	Short term debit	Short term borrowing
X_{14}	Gross debit	Misc. account
X_{15}	Depreciation	Net profit
X_{16}	Retained income	Total capital
X_{17}	Devidend	Income
X_{18}		Pay roll
X_{19}		Management cost
X_{20}		No. of employee

questionaire in a paticular industry and then aggregated them in one industry as seen in Table XII. The main reason why we chose endogenous variables in the model from financial statement, which were called financial variables, was that it was difficult for us to treat variables from other sources than financial statement, at a same level or criterion. Briefly speaking, we regard these financial variables in a specified industry as those in a firm, or a group of firms chosen in a particular industry as one making decisions in the particular industry. We made equations combining activity of the group with demand for EDP in a particular industry. The total number of sets (703 sets) and amount (54 billion yen) of computers of those firms chosen in this model covered 61.72 per cent and 81.61 per cent of all sets and amount of computers installed in Japan respectively.

Table XIII Total Demand for Computer in All Industries

Unit: Million yen
Term: Biannual

		Data from Questionaries Cal. yr.		JECC Data Fisc. yr.		MITI Data Cal. yr.	
		Observation	Estimate	Observation	Estimate	Observation	Estimate
33	I	—	—	73.89	−1,510.69	—	—
	II	22.06	1,561.25	841.61	292.60	—	—
34	I	357.64	252.76	1,408.97	467.86	539.23	−2,353.03
	II	921.36	439.28	1,848.79	2,682.32	1,389.20	−280.00
35	I	1,452.79	2,283.94	1,306.90	3,097.18	2,860.25	2,530.83
	II	1,163.21	1,834.90	4,739.82	5,378.88	2,290.13	4,554.79
36	I	5,329.51	5,304.36	4,666.71	6,230.95	7,837.16	7,261.10
	II	3,224.49	6,249,91	9,402.79	8,906.77	4,741.68	9,187.91
37	I	7,718.14	7,984.36	8,879.32	8,456.76	11,276.06	12,320.76
	II	7,746.86	6,573.17	11,176.62	11,121.32	11,318.01	14,165.18
38	I	12,429.66	12,053.34	11,918.38	11,790.93	17,786.51	17,041.11
	II	14,408.33	13,359.29	15,633.41	15,188.04	20,617.93	18,682.55
39	I	—	14,002.12	14,786.33	15,284.52	21,705.85	21,195.31
	II	—	12,373.96	19,880.70	19,176.78	26,158.94	23,441.87
40	I	—	17,926.72	—	17,028.46	—	25,724.21
	II	—	15,999.94	—	21,093.40	—	25,642.06
41	I	—	20,620.07	—	20,037.76	—	30,182.08
	II	—	18,200.54	—	24,487.96	—	29,747.85
42	I	—	22,995.37	—	23,295.53	—	34,456.70
	II	—	20,032.33	—	28,170.99	—	33,567,07
43	I	—	25,019.48	—	26,828.14	—	38,523.06
	II	—	21,457.68	—	32,171.92	—	37,115.81
44	I	—	26,657.16	—	30,662.99	—	42,352.70
	II	—	22.435.38	—	36,522.98	—	40,357.13
45	I	—	27,868.69	—	34,831.17	—	45,913.28
	II	—	22,920.04	—	41,259.68	—	43,241.02

At the next step we decided the strategic factors affecting EDPS' demand and causal relationship of them in a particular industry after calculating simple correlations between variables and variations of them with care of avoiding multicolinearity of variables. As to exogenous variables, national income, GNP, disposable income, time etc. were chosen avoiding from difficulty of collecting and adjusting data.

Demand functions, estimates of parameters and estimates of total demand for computers in all industries, secondery industry and representative industries such as chemicals and petroleum, electrical machinery,

banking and wholesale and retail trade, are illustrated in Table XIII, XIV, XV, and Fig. 1 to 9. We composed demand functions of each industry, the parameters of which then were computed. In iron and steel industry, the demand for computer fluctuated so violently, because this industry includes many big business firms and their behavior of installing computer was so cyclical. As to securities industry, we could get only annual financial statements as data.

Generally speaking we confronted with those difficulties, that is, lack of full data in some industries as seen in securities, and insurance, and short observations periods of demand for computers. We are not necessarily satisfied with the present results of our estimation of demand, but we hope that such an effort as we devoted will be a stepping stone for the study in this field.

§ 5. CONCLUSION

As the results of this survey as mentioned above, we are now in a position to summarize the future demand for EDP's in Japan, as follows. The demand for EDP's up to date has been mainly supported by an object of investment aiming at rationalization of office work or save of indirect cost, but not by utilization of EDP's directly connected with executives' making decision in management. Most users in Japan may be said to use computers at the first stage of EDP's development, and some leading users are working at the second stage of it. However, we may expect a voluminous demand in the following industries such as chemicals and petroleum, electrical machinery, construction, iron and steel, banking, insurance, transportation, public utilities and governments.

Chemicals and petroleum industry, quite a pioneer, has still wide regions which EDP's will have to solve, that is, not only in optimal management, for instance, composition and allocation of materials, design for plants and equipments, development of engineering techniques of production and new products, transportation problems, inventory problems and so on, but also automatic control of production. Moreover this industry are ready to accept these executions for its capital

Table XIV Demand Function of Computers

All Industreis		
Questionaire Data	$E_{66A}=-43,300.05+0.27040X_{26}-0.00299X_{91}$ (4,788.02) (34,337.84) (1,601,195.08)	$R^2=0.970$
JECC Data	$E_{66B}=-15,870.16+0.02639X_{26}+0.00234X_{91}$ (6,127.70) (45,499.00) (2,103,523.22)	$R^2=0.991$
MITI Data	$E_{66C}=-50,237,999.22+269.67X_{26}-0.98931X_{91}$ (8,540.21) (37,117.85) (1,807,202.42)	$R^2=0.974$
Secondary Industry		
Classified by Calendar year	$E_{50A}=-13,758.29+0.000006X_3-0.00577X_4-0.00398X_5-0.01666X_6+106,370X_{26}$ (1,691.80) (643,241.67) (111,161.52) (68,824.99) (57,815.09) (0.031647)	$R^2=0.9733$
Classified by Fiscal year	$E_{50B}=-7,647.97+0.00364X_3-0.01909X_4-0.01962X_5-0.02210X_6+123,276.88X_{26}$	$R^2=0.997$
Representative Industries		
Chemical and Petroleum	$E_{51}=-3,139.38-0.00457X_3-0.03667X_4+0.04206X_5+0.00499X_6-0.00443X_{26}$ (400.46) (89,301.89) (8,998.74) (14,548.71) (7,741.78) (40,854.73)	$R^2=0.996$
Electric Machinery	$E_{53}=-993.74-0.002995X_3+0.00584X_4+0\cdot02189X_5-0.00075X_6-0.00231X_{26}$ (301.85) (101,690.29) (38,171.18) (14,320.91) (9,806.04) (22,491.60)	$R^2=0.996$
Wholesale and Retail trade	$E_{58}=766.23-0.00086X_3-0.02418X_4+0.11914X_5-0.02409X_6-0.00883X_{26}$ (200.47) (304,933.36) (7,347.57) (8,798.16) (3,705.52) (43,725.48)	$R^2=0.922$
Banking	$E_{55B}=-1,910.54+0.000238X_{11}-0.00908X_{17}+0.12145X_{18}+0.00246X_{19}-0.01128X_{20}$ (693.77) (2,237,695.03) (120.463.99) (9,483.26) (95,049.17) (14,066.99)	$R^2=0.994$

Table XV Estimates of Parameters

Secondary Ind.

	α_0	α_3	α_4	α_{10}	α_{26}	α_{80}	α_{91}	R^2
X_3	−312,897.4	—	—	—	—	—	0.3933	0.998
X_4	482,818.7	0.1011	—	—	1,348,316.8	—	—	0.999
X_5	71,073.0	0.1282	−0.1423	—	—	—	—	0.997
X_6	−4,004.8	0.2411	—	−0.1771	—	—	—	0.998
X_{10}	131,490.3	0.8512	—	—	—	—	—	0.997
X_{26}	0.1249	—	—	—	—	0.0102	—	0.998

Chemical and Petroleum

	α_0	α_3	α_4	α_{10}	α_{26}	α_{80}	α_{91}	R^2
X_3	−14,024.5	—	—	—	—	—	—	0.999
X_4	75,013.9	0.0583	—	—	0.0864	—	0.0542	0.999
X_5	4,484.8	0.1707	−0.1836	—	—	—	—	0.996
X_6	2,319.6	0.1937	—	−0.0988	—	—	—	0.996
X_{10}	43,176.3	1.0450	—	—	—	—	—	0.995
X_{26}	135,258.6	—	—	—	—	12,641.2	—	0.999

Electric Machinery

	α_0	α_3	α_4	α_{10}	α_{26}	α_{80}	α_{91}	R^2
X_3	−86,997.6	—	—	—	—	—	0.0614	0.993
X_4	−40,707.9	0.1848	—	—	0.8578	—	—	0.999
X_5	−18,502.1	0.0594	0.2457	—	—	—	—	0.989

X_6	1,196.9	0.2372	—	−0.1887	—	—	—	0.998
X_{10}	−40,285.8	0.7491	—	—	—	—	—	0.996
X_{26}	97,533.5	—	—	—	—	6964.9	—	0.999

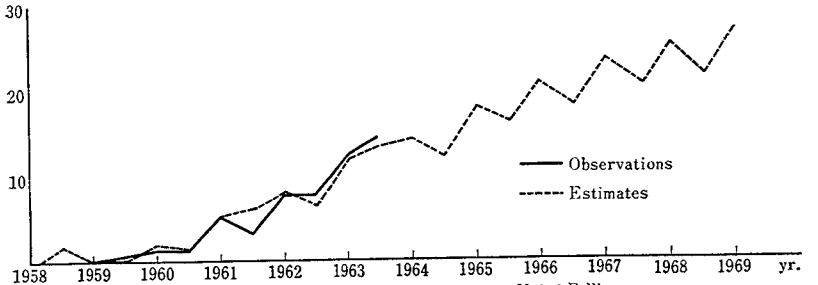
Wholesale and Retail trade

	α_0	α_3	α_{13}	α_{26}	α_{80}	$\alpha^6{}_1$	R^2
X_3	−236,322.2	—	—	—	—	0.1854	0.989
X_4	32,988.1	0.0323	—	−0.0699	—	—	0.997
X_5	6,862.7	0.0303	−0.0757	—	—	—	0.999
X_6	804.0	0.0129	−0.0449	—	—	—	0.998
X_{13}	4,132.9	0.0200	—	—	—	—	0.884
X_{26}	137.720	—	—	—	13,047.4	—	0.998

Banking

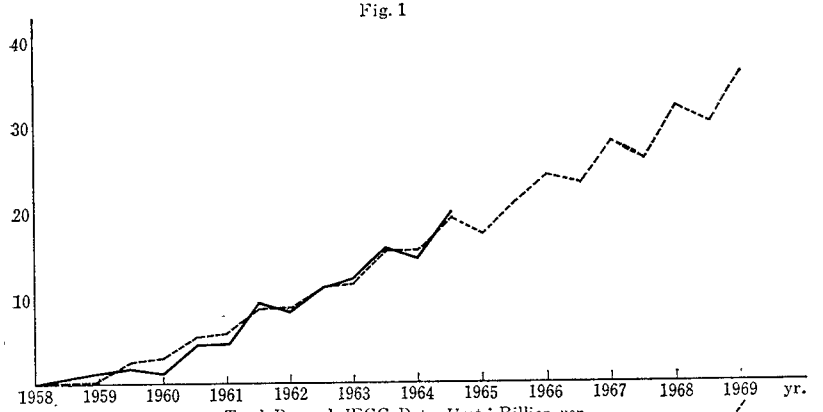
	α_0	α_3	α_4	α_{11}	α_{20}	α_{91}	α_{93}	R^2
X_3	−80,400.7	—	—	—	—	1.0202	—	0.992
X_4	−40,112.0	—	—	—	—	0.4328	—	0.991
X_{10}	15,806.7	—	—	0.0151	—	—	—	0.998
X_{11}	−516,914.6	—	—	—	57.9491	—	1,059.1	0.998
X_{17}	−50,779.7	0.0299	0.0082	0.0327	—	—	—	0.999
X_{18}	−48,417.2	—	—	—	0.6358	—	—	0.994
X_{19}	2,931.8	0.0049	0.1137	—	—	—	—	0.999
X_{20}	93,979.5	0.0076	—	—	—	—	—	0.999

α_i is a parameter of variable X_i and X_0 is 1.
R^2 is a multiple correlation coefficient adjusted by degree of freedom.



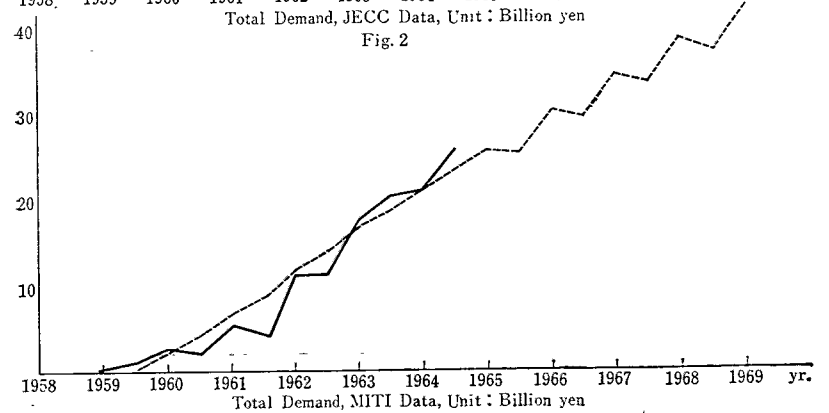
Total Demand, Data from Questionnaire, Unit : Billion yen

Fig. 1



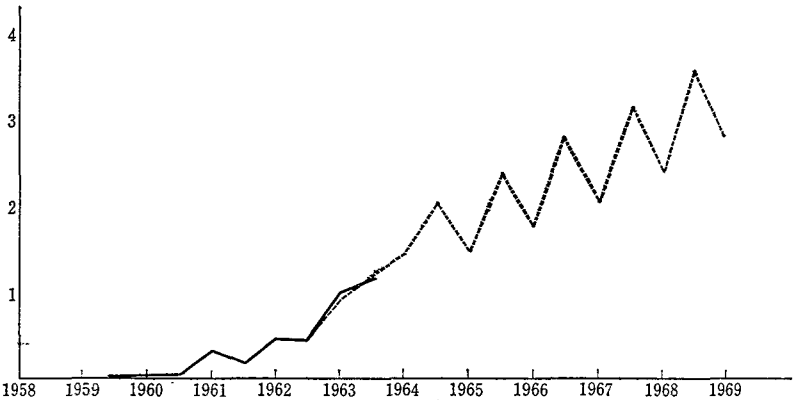
Total Demand, JECC Data, Unit : Billion yen

Fig. 2



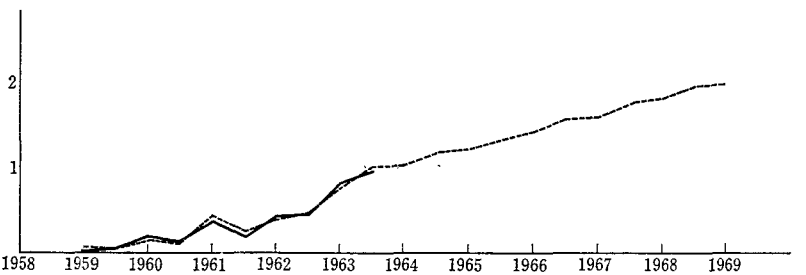
Total Demand, MITI Data, Unit : Billion yen

Fig. 3



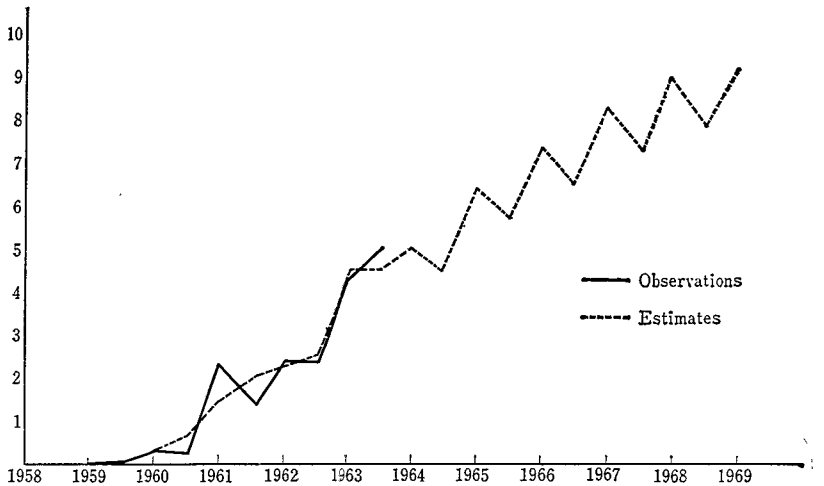
Demand in chemical and petroleum industry, Unit : Billion yen

Fig. 4



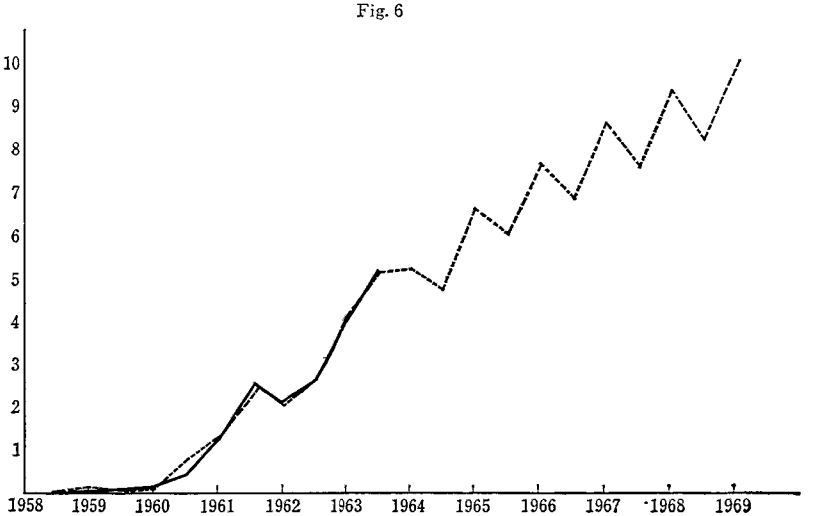
Demand in electrical machinery, Unit : Billion yen

Fig. 5



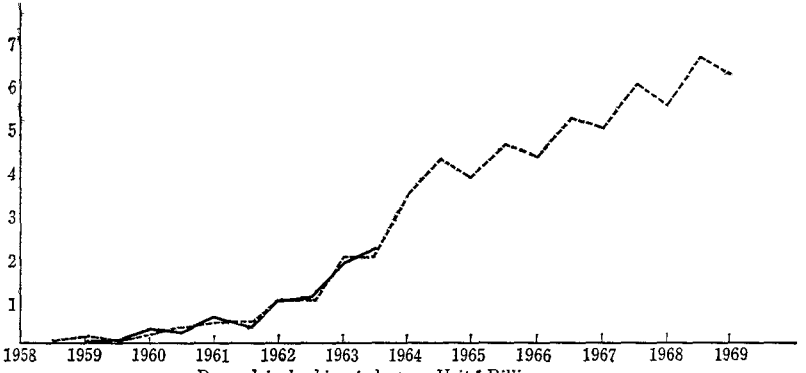
Demand in the Secondary Industry clasified by calendar yr.
Data from Questionnaire. Unit : Billion yen

Fig. 6



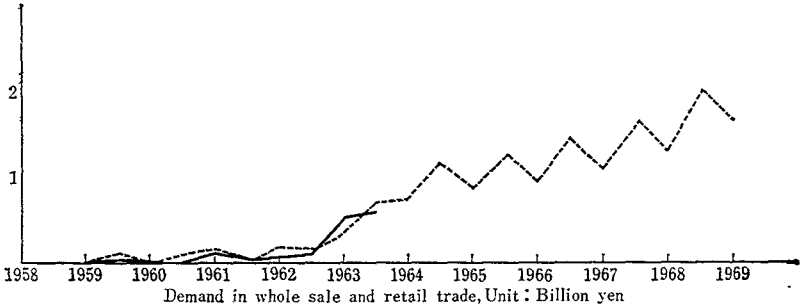
Demand in the Secondary Industry classified by fiscal yr.
Data from Questionnaire. Unit : Billion yen

Fig. 7



Demand in banking industry, Unit : Billion yen

Fig. 8



Demand in whole sale and retail trade, Unit : Billion yen

Fig. 9

intensive character or highly mechanized system and huge difficulty of manual computation and operation of complex analysis.

Electrical machinery industry will use EDP's in such fields as development of production techniques, process control, and inventory control. These tendencies seen in these two industries may be common in iron and steel, transportation machinery, cement, base metal, textiles and, pulp and paper industries.

These industries having five or six years' experience of using computers will make an effect to organize information systems based on EDP's and replenish their installed computers in accordance with progress in hardwaee, softwere and applicationware of computers.

In financial industries such as banking and insurance, other service industries such as transportation, gass, water, electric and hotels and government, EDP's will be used for communicating informations and daily business, for instance, accepting or paying cash, reservations and contracts between main office and branchs, in order to fill the service for their clients, to register and to store information correctly.

In some business firms in transportation machinery and automobil industries, symthetic use of computers in management are now schemed with nation wide network on sales, inventory production line, bills and accounting systems.

Farther more, we expect a large demand for specific types of computers in such fields as hospitals, libraries, police administration and racing worlds.