

recorders are required, and the cost of this equipment is again incorporated in the station's conversion costs. Apart from the depreciation charges for the new equipment, the operational cost of program production is no greater than that now incurred with NTSC. To defray the high cost of new production equipment, program producers may choose to rent all the equipment needed for a production, a procedure that has been followed in the film production industry for many years. Rental companies now exist for this purpose.

2.6 Availability of HD Consumer Equipment.

The availability of consumer equipment will impact the timing of the penetration of the market and the rate at which the penetration takes place. The most critical element, because it affects all the delivery media, is the display unit. Today, the most optimistic projection is that display units will be available 18 months after the FCC selects a standard for transmission and issues its Report and Order. In the projections which follow, Year 0 is the time when the Report and Order is issued. Some set manufacturers believe that display units will be available in one year, but that the incorporation of a broadcast receiver may be the pacing item.

Terrestrial transmission service is unlikely to be introduced to the first markets before Year 2, given the amount of preparatory work and investment that must be accomplished.

Cable appears well positioned to introduce HD service as soon as display units and decoders are available, and the same consideration applies to Home Video service and to DBS .

3. AVAILABILITY OF FUNDING FOR THE ACQUISITION OF CONSUMER EQUIPMENT.

It is assumed that the investment by the consumer in HD equipment will be constrained firstly by the total discretionary income now applied to the purchase of all video services and equipment, and including terrestrial broadcast, cable, Home Video, and DBS.

Table I lists the approximate funds now being applied to video equipment and services. Some part of this total annual expenditure will be applied to the purchase of HD equipment, and this portion will increase with time, as projected in Table I.

It may be argued that, if the perceived value of HDTV service is low, such discretionary funds may be spent on goods and services other than HDTV service. Equally, if the perceived value of HDTV service is sufficiently high, it is possible that a part of the historic expenditures on non-video consumer electronics may be directed to the acquisition of HDTV service. In this regard, it is noted that the total annual expenditure on all consumer electronics is over \$31 billion.

In this study, the upper bound of available funding is taken as the present level of expenditures on video services, and is referred to as "High Perceived Value". The lower bound, or "Low Perceived Value" is taken arbitrarily to be approximately one half of the funding now expended, and is presented in Table II.

In Table I, the sources of funding are taken from the several delivery media. As a base we consider the funds now expended annually on present video services, project the time at which they will be virtually all redirected to HD video services, and their subsequent growth through market expansion and the introduction of TV households with multiple HD services.

The rate at which this redirection of funds will occur will vary with the perceived value of the services. If the perceived value is low, the full redirection of funds may never take place. If the perceived value is high enough, it is possible that some discretionary income presently applied to non-video consumer electronics, may also be redirected to HD equipment and services. Such diversion of discretionary funds has been noted in the past when a major new product is introduced. However, this possibility is not considered in the present projections.

3.1 Available Funding from each Video Service

3.1.1 Terrestrial Broadcast

For terrestrial broadcast, the funds applied to HDTV service increase each year until the present full annual expenditure on TV sets of \$7 billion is applied in Year 9.

3.1.2 Cable

For funding now applied to cable service, it is noted that the consumer does not pay for any equipment directly but purchases basic and premium cable services which now total \$15.6 billion annually. Of this total, premium or pay services amount to \$4.1 billion. It is assumed that 25 percent of this sum, or \$1 billion will be used for the purchase of HD equipment and services in Year 4, the primary equipment purchases being for the wide screen display units. The balance of \$3.1 billion would be used in part for the purchase of premium services on the HD channels, and would be fully applied by Year 10.

3.1.3 Home Video

Home Video equipment is now installed in 86 percent of television households, and the annual investment in equipment is \$3 billion. It is projected that 85 percent of this sum will be applied to the purchase of HD equipment and services by Year 10.

3.1.4 DBS Service.

The annual expenditure on DBS receiving equipment is estimated on the basis of an annual growth rate of 10 percent in the number of DBS households, to be \$150 million. It is projected that this sum will be fully applied to the purchase of HD receiving and display equipment by Year 6, and will increase thereafter with an expanding market.

3.2 Reallocation of Existing Funds

It has been tacitly assumed herein that the discretionary funds historically applied to the purchase of TV sets, home video, premium cable services, and DBS equipment, will continue to be applied to the same categories during the growth of HD. However, it is possible and even likely, that funds historically used in one category, may be applied to another category of HD video equipment. For example, a consumer presently having only a terrestrial broadcast receiver, may opt to purchase a HD Home Video system or a HD cable service rather than a HD terrestrial transmission receiver. He will be the more inclined to do this if HD cable and Home Video is available and he must wait for a year or more for the local introduction of terrestrial transmission service.

Recognizing the likelihood that cable and Home Video service will be available in many areas before terrestrial transmission service is introduced, Table III presents a redistribution of the available funds for each of the ten years considered in this report, and is for the condition of "High Perceived Value". The total funds available in each year remain the same as in Table I.

4. EQUIPMENT PRICES

The price of equipment and services is now projected for each of the HD delivery services. No firm data on prices is available, and therefore both a high and a low range of prices is presented for each service. In each succeeding year, it is projected that the prices will fall with economies of scale in manufacture, and through refinements in equipment design.

It may be expected that equipment manufacturers may introduce some forward pricing policies to seed the market in the early years, but no specific attempt has been made to take account of this in the following price estimates.

4.1 HD Display Units.

Display unit prices are based on a nominal 50-inch projection system, and on a nominal 25-inch CRT.

The decline in prices through Year 10 is presented in Table IV. Both high and low price estimates are presented for each display unit. The introduction of the 25-inch display unit will occur in Year 4. While it is recognized that this size display is not optimal for viewing HDTV, it affords an entry point for the less affluent consumer, and helps ensure that TV service in the home will be maintained when NTSC service is discontinued in the local market.

4.2 Terrestrial Broadcast Receiver

For terrestrial broadcasting, the primary equipment to be purchased by the consumer is the receiving system consisting of a tuner, demodulator, decoder, and interface processor. The introductory price is expected to be between \$2,000 and \$1,000, falling as LSI circuitry is introduced, and as economies of scale are achieved. The projected prices are presented in Table V. To these costs must be added the cost of a display unit. While these costs are considered separately for convenience, in practice the consumer will purchase a HD "TV set", comprising the receiver and the display in a single unit.

4.3 Cable

The consumer equipment for HD cable service consists of a "converter" unit which comprises a tuner, demodulator, decoder, and interface processor, possibly similar to that required for the reception of terrestrial broadcast. While "converters" are normally provided "free" by the cable system, the cost is in fact borne by the consumer, and incorporated in the monthly rental charge. Therefore the actual projected cost is presented in Table VI with both a high and low estimate for each of the ten years under review.

In addition, and because HD cable service will likely be introduced as a premium service and possibly also as a pay-per-view service, an estimate of the annual cost of the HD service is included in Table VI.

Finally, the consumer will be required to purchase a display unit as described in 4.1, unless he already possesses one required for another HD delivery service.

4.4 Home Video Service

A high and low estimate of the price of Home Video players is presented in Table VII. The prices are projected to fall during the ten-year period with manufacturing economies of scale.

A HD display unit will also be required, if HD Home Video is the first HD service acquired by the consumer.

4.5 DBS

The new HD DBS consumer must purchase a downlink dish, a receiver system, and a display unit if it is his first HD service. High and low price estimates are presented for this equipment in Table VIII and Table IV. The cost of converting an existing DBS receiving system to HD DBS has not been considered, but presumably the same dish may be used for both services.

5. PROJECTED PURCHASES OF HIGH DEFINITION EQUIPMENT.

We now draw upon the assumptions and the projections of available discretionary income and the projected cost of each item of equipment, developed in the preceding sections, to estimate the number of units of HD equipment which may be purchased in each year.

The delivery systems which will contribute to the growth of the service are terrestrial broadcasting, home video, cable television, and direct broadcast by satellite (DBS).

Some account has been taken of the historic penetration of the consumer market by color TV, home video (VCR), and cable television, each being modified by eliminating the effects of certain market conditions that are inapplicable to the present situation, as previously discussed.

The discretionary income available for the acquisition of HD service is based on the conditions prevailing in 1990, and no account is taken of the current recession.

In terms of timing, the base line, or Year 0, is the time at which the FCC selects a standard, promulgates a Report and Order, and issues a table of spectrum allotments for which broadcasters may apply for specific assignments. This base line Year 0 is expected to be 1993.

Using the "high price" estimates for each unit of equipment presented in the previous section, and using the funds available where the consumer has a "high perceived value" of HDTV service, Table IX presents the number of units of each piece of equipment that may be acquired in each of the ten years under consideration. Each of the four HD delivery services listed requires the purchase of a display unit, and the total of display units acquired is listed in a separate column. A TV household (TVHH) with a HD Display unit is considered a High Definition TV household (HD TVHH).

For Years 1 through 5, the number of Display Units is the sum of the individual units of equipment acquired for each of the delivery services. In years 6 through 10, however, the sum of the Display Units is less than the sum of the other units of equipment. This is because it is projected that as HD penetration grows, consumers will acquire a second HD delivery service, but will continue to share the same Display Unit acquired with the first delivery service. It has been assumed in developing Table IX, that in each of the years 6 through 10, 10 percent of the consumers adding a cable service or a Home Video service, will already have a Display Unit acquired with the first service they installed. The growth of multi-service HD TVHH derived from this projection is presented in Figure 1.

Table X presents similar projections for the condition of "low equipment prices" and "high perceived value" of HDTV service by the consumer.

Similar projections have been developed for the conditions of "low perceived value" with "low equipment prices", and "low perceived value" with "high equipment prices".

6. MARKET PENETRATION OF HDTV SERVICE

The penetration of HD service into the TV household market is calculated from the data developed in the preceding Section 5.

Figure 2 presents the results for the four conditions considered, viz:

- (i) High perceived value with low cost,
- (ii) High perceived value with high cost,
- (iii) Low perceived value with high cost, and
- (iv) Low perceived value with low cost.

It is seen that the penetration curves for conditions (ii) and (iv) are similar, and represent a mean between the other two conditions.

If, as is likely, a forward pricing strategy is adopted by the manufacturers for the display units in Years 1 through 4, the median condition penetration could reach 5 percent by the Year 5.

The growth of the four HD delivery services considered separately, is presented in Figure 3, for the condition of "high price" with "high perceived value". With regard to the small growth shown for HD DBS service, the available funds from historic investment in DBS have been applied to new consumers. If the available funds were applied to the conversion of existing NTSC DBS systems instead, the growth would be three times greater.

In summary, it is believed reasonable to project a mean penetration between the high and low boundary curves, suggesting a 5 percent penetration in Year 5, and 37 percent in Year 10.

If, however, the present proposals of the FCC's NPRM become requirements for the timely introduction of HD terrestrial broadcast service, the upper bound penetration curve in Figure 2 for the condition of "High Perceived Value" with "Low Price" is more likely. This curve projects a penetration of 8 percent in Year 5, and 56 percent in Year 10.

**CONSUMER EXPENDITURES ON VIDEO SERVICES AND THEIR POSSIBLE
DIVERSION TO HDTV SERVICES**

For High Perceived Value of HDTV
\$ billion

Yr	TV	Cable	Home Video	DBS	TOTAL
CURRENT	7.0	4.1	3.0	.15	14.25
0	0	0	0	0	0
1	1.0	0.2	0.1	0	1.3
2	1.5	0.4	0.15	0.07	2.12
3	2.0	0.7	0.25	0.08	3.03
4	2.5	1.0	0.4	0.09	3.99
5	3.0	1.3	0.6	0.11	5.01
6	4.0	1.7	0.85	0.14	6.69
7	5.0	2.1	1.15	0.17	8.42
8	6.0	2.6	1.5	0.21	10.31
9	7.0	3.2	2.0	0.26	12.46
10	8.0	4.0	2.6	0.3	14.9

TABLE I.

DIVERSION OF CONSUMER EXPENDITURES TO HDTV SERVICES

For low perceived value of HDTV

Yr.	TV	Cable	Home Video	DBS	Total
0	0	0	0	0	0
1	0.2	0.1	0.1	0	0.4
2	0.4	0.15	0.15	0	0.7
3	0.7	0.2	0.2	0.07	1.17
4	1.1	0.35	0.3	0.08	1.78
5	1.6	0.45	0.45	0.09	2.59
6	2.2	0.6	0.65	0.11	3.56
7	2.9	0.8	0.9	0.13	4.73
8	3.7	1.1	1.25	0.16	6.21
9	4.6	1.5	1.6	0.19	7.89
10	5.6	2.0	2.0	0.23	9.83

TABLE II.

REDISTRIBUTION OF AVAILABLE FUNDING FOR HDTV SERVICES

For condition of high perceived value.
\$ billions

Yr	Terr. B'cast 50"	Terr B'cast 25"	Cable 50"	Cable 25"	Home Video 50"	DBS 50"	Total
0	0	0	0	0	0	0	0
1	0	0	0.7	0	0.6	0	1.3
2	0.4	0	0.9	0	0.75	0.07	2.12
3	1.1	0	1.0	0	0.85	0.08	3.03
4	1.5	0.2	1.1	0.2	0.9	0.09	3.99
5	1.85	0.4	1.4	0.3	0.95	0.11	5.01
6	3.0	0.55	1.6	0.4	1.0	0.14	6.69
7	4.1	0.65	1.85	0.45	1.2	0.17	8.42
8	5.25	0.75	2.1	0.5	1.5	0.21	10.31
9	6.1	0.9	2.6	0.6	2.0	0.26	12.46
10	6.95	1.05	3.25	0.75	2.6	0.3	14.9

TABLE III

PRICES OF HD DISPLAY UNITS

\$.

HIGH PRICE ESTIMATES			LOW PRICE ESTIMATES	
Yr	50"	25"	50'	25'
0	0	0	0	0
1	3000	0	1800	0
2	2700	0	1600	0
3	2500	0	1400	0
4	2300	1000	1300	500
5	2100	900	1200	450
6	1900	800	1100	400
7	1800	750	1000	350
8	1700	700	900	300
9	1600	650	800	250
10	1500	600	700	250

TABLE IV.

PRICES OF CONSUMER RECEIVER/INTERFACE PROCESSOR

\$

Yr.	HIGH PRICE	LOW PRICE
0	0	0
1	2000	1000
2	1900	1000
3	1800	900
4	1700	800
5	1500	700
6	1200	600
7	1000	500
8	800	400
9	600	300
10	500	200

TABLE V.

PRICES OF EQUIPMENT FOR HD CABLE SERVICE AND PAY-SERVICE

\$

"CONVERTER EQUIPMENT"			ANNUAL HD PAY-CABLE FEE
Yr.	HIGH PRICE	LOW PRICE	\$/YR
0	0	0	0
1	900	600	300
2	800	400	250
3	700	300	200
4	600	300	200
5	500	200	200
6	400	200	200
7	300	100	200
8	200	100	200
9	200	100	200
10	200	100	200

TABLE VI.

PRICES OF HD HOME VIDEO PLAYERS

\$

YR.	HIGH PRICE	LOW PRICE
0	0	0
1	1500	1000
2	1300	900
3	1200	800
4	1100	700
5	1000	600
6	900	500
7	800	400
8	700	350
9	600	300
10	500	300

TABLE VII.

PRICES FOR HD DBS RECEIVER SYSTEM AND DISH ANTENNA

\$

YR	HIGH PRICE		LOW PRICE	
	RECEIVER	DISH	RECEIVER	DISH
0	0	0	0	0
1	0	0	0	0
2	1800	500	900	300
3	1700	500	800	300
4	1500	500	700	300
5	1300	400	500	250
6	1100	400	400	250
7	900	300	300	200
8	800	300	250	200
9	700	250	200	200
10	500	250	200	200

TABLE VIII.

HD EQUIPMENT ACQUIRED

Condition of "High Price" and "High Perceived Value"

UNITS IN THOUSANDS

YR.	TERR. BROADCAST	CABLE	HOME VIDEO	DBS	DISPLAY UNITS
0	0	0	0	0	0
1	0	167	133	0	300
2	87	240	188	14	529
3	256	294	230	17	797
4	449	466	265	21	1201
5	681	688	306	29	1704
6	1273	951	370	41	2533
7	1936	1132	496	57	3428
8	2753	1543	673	75	4642
9	4240	1984	980	102	6238
10	4666	2607	1405	136	8112

TABLE IX.

HD EQUIPMENT ACQUIRED

Condition of "Low Price" and "High Perceived Value".

UNITS IN THOUSANDS

YR.	TERR. BROADCAST	CABLE	HOME VIDEO	DBS	DISPLAY UNITS
0	0	0	0	0	0
1	0	259	214	0	473
2	154	400	300	25	879
3	478	526	386	32	1422
4	867	811	450	39	2167
5	1322	1228	528	56	3134
6	2374	1607	647	80	4530
7	3694	2115	923	113	6318
8	5410	2725	1293	156	8832
9	7616	3640	1961	217	12385
10	10595	4859	2796	273	17056

TABLE X.

CUMULATIVE GROWTH OF MULTI-SERVICE HD TVHH

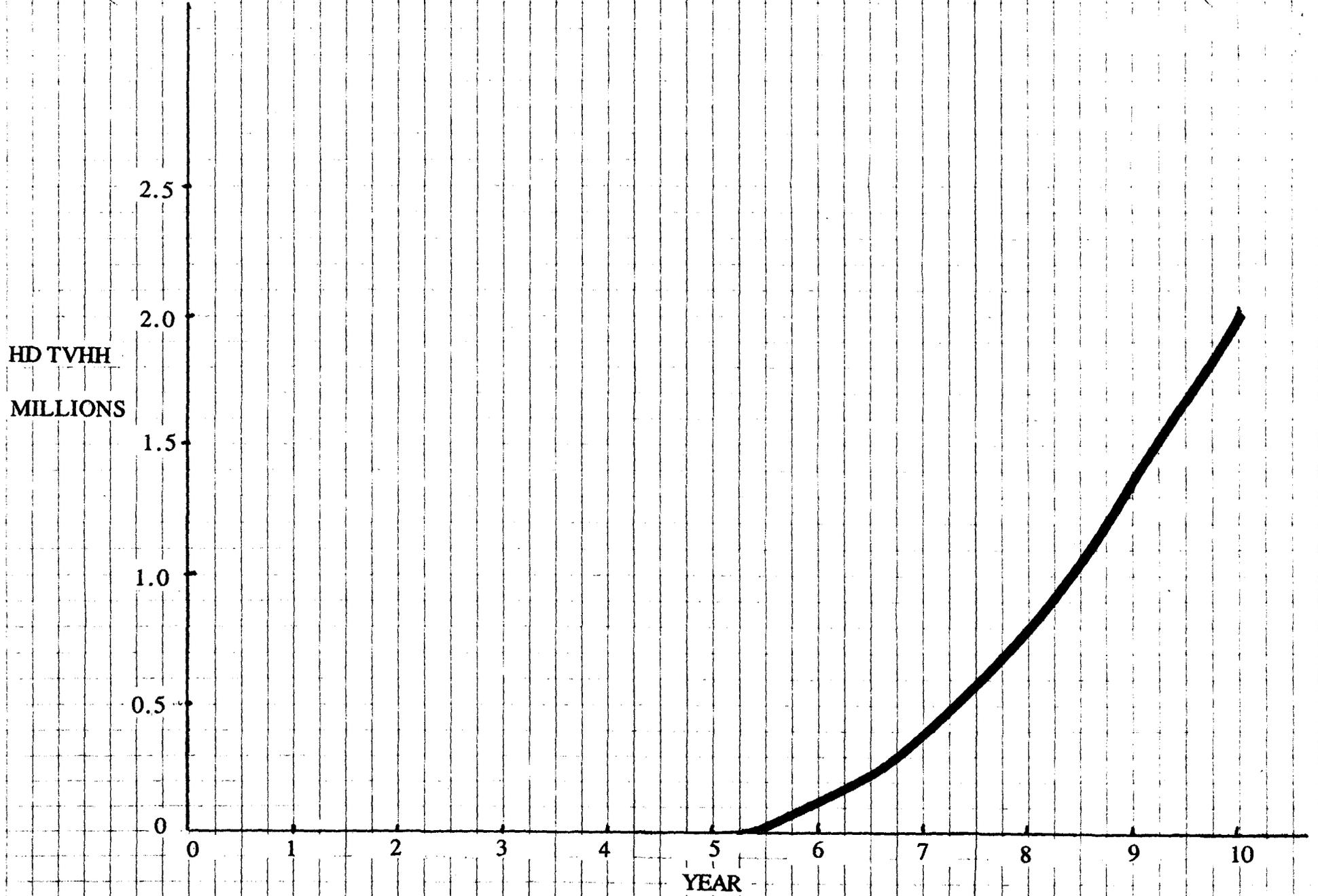


Figure 1

PENETRATION OF HDTV INTO TV HOUSEHOLDS (HD TVHH)

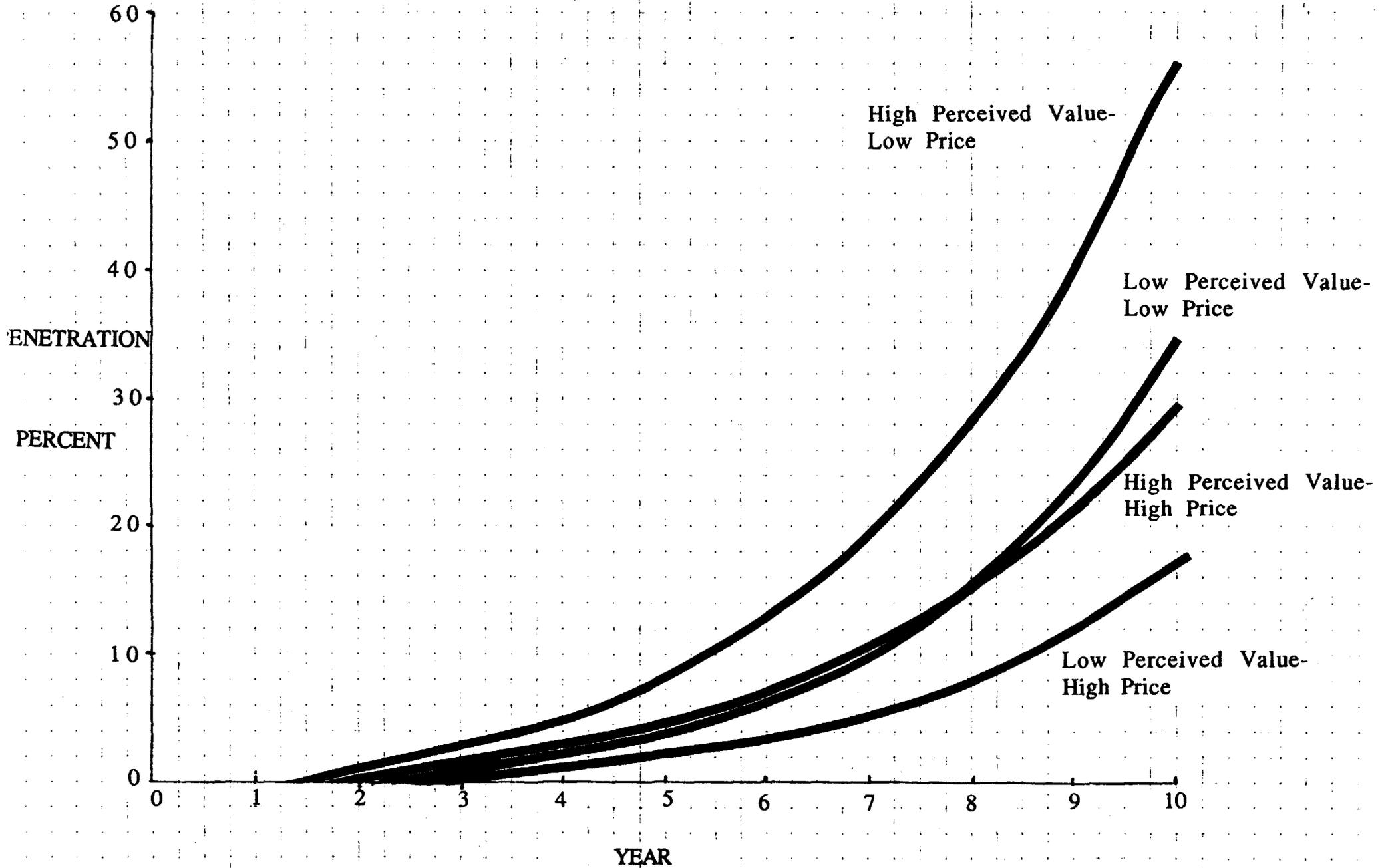


Figure 2