

Tracking the Flow of Information Into the Home:
An Empirical Assessment of the Digital Revolution in the U.S. from 1960 - 2005

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Abstract

An analysis of the increasing dominance of electronic media in the American media diet and a growing discrepancy between supply and demand in the digital cornucopia. Drawing on the communication flow methodology pioneered by Ithiel Pool in the 1980s, the study tracks U.S. industry data on technology penetration and household behavior from 1960 to 2005 to reveal a transition from 'push' to 'pull' media dynamics and a reassessment of relative constancy theory.

At the dawn of the digital age in the early 1980s, the pioneering student of media technology Ithiel de Sola Pool published a series of studies on the growing flow of information in the American and Japanese mass media (Pool 1983; Pool et al 1984; Neuman and Pool, 1986). Pool had been working with Japanese and American colleagues over the previous decade in an effort to quantify the increasingly electronic media supply in meaningful terms and subject the analysis to further theoretical study of how these trends might affect levels of information, diversity of information and possible polarization within the mass population consuming these media.

The key variables of analysis were the number of words supplied and consumed yearly at a national level and the average price per word in various common media. His findings were dramatic and led to an obvious conundrum. First, the flow was increasingly electronic. Second, the price per word was falling radically. Third, the supply was growing at an impressive compounded rate of 8.8 percent per annum. Fourth, the consumption was also growing at impressive rate, in this case 3.3 percent per annum, compounded and thus generating a growing disparity between information supplied and information consumed. (See Figures 1 and 2)

The conundrum? Well, there might not be a technical limit on supply, but there are only 24 hours in the day -- a clear-cut limit on individual consumption of mass media. Pool and colleagues speculated about information overload, information diversity, and the economics necessary to sustain vibrant creative industries in journalism and popular and high culture. So the basic theoretical proposition of this research tradition was to challenge the generally

unquestioned tenet in the historical analysis of media trends that more is necessarily better by suggesting that some levels of media quantity might make informed choice impractical and perhaps even frustrating (Miller 1960; Bell 1979; Blumler 1980; Eppler and Mengis 2004). Further this research challenged the notion that new media replace or partially replace older media, a notion generally referred to as relative constancy theory (McCombs 1972; Dupagne & Green 1996). Relative constancy theory relies primarily on expenditure data rather than words or minutes of usage, but the underlying argument is the same – time budgets and financial budgets constrain growth of media supply and media use. Much of this work took place a decade before the introduction of the Internet-linked PC that would of course dramatically reinforce these trends and raise new questions about supply, demand, overload, attentional dynamics and economic viability (Gitlin 2002; Hindman 2009).

Curiously, there have been only a few limited attempts to expand and carry on this line of inquiry (Huang 1990; Lyman and Varian 2003). We felt the methodological promise and theoretical provocation of this work merited further attention so we picked up where Pool left off in 1980 and with a few adjustments and minor corrections and focusing on the U.S. case, we carried the data collection forward to 2005. So in this paper we will present and take a first cut at analyzing the supply and consumption vectors for twelve traditional mass and interpersonal media and the evolving Internet for the period 1960 through 2005.

In the years following 2005 we have been witnessing a dramatic digital convergence as traditional media flows from recordings, newspapers, books, television and movies are increasingly being delivered by the web itself making the distinction between, say, watching broadcast TV and a digitally delivered video program an increasingly subtle one. These trends have important ramifications for economic viability, audience choice, and content diversity and

represent the subject of our ongoing research. Because by 2005 digital video was still at an early stage (iTunes, for example, was not introduced until mid-2003) we have set aside the convergence/transition issue aside for a later analysis and will treat the Internet which occupied the users' active attention in the average American household for about an hour and a half per day by 2005 (US Census) as 'competing' in time budget terms with traditional media for users' attention with a mix of independent and overlapping content.

Methods

Pool's original Japanese and American work focused on the assessment of media volume measured in quadrillions of words per medium at national level per annum. It is a useful metric for international comparison of trends and infrastructure, but our focus in this paper is a more human level metric addressing the dynamics of choice and attention. Quadrillions of anything are hard to conceptualize. So we present all annual data divided by 365 days and the total number of households in the nation for an assessment of flow of information into the typical home on a 24-hour day measured for the most part in the thousands, in our view, a more interpretable and accessible metric. We also switched from words to minutes as the principal measure. Because we are analyzing print media that are measured in spatial terms – column inches, thousands of words – and broadcast media that are measured in temporal metrics of minutes and hours, the type of analysis requires a common metric. We follow Pool and take the average adult American reading speed of 240 words a minute to equate space and time. The original analyses of Pool and associates made a practical strategic choice and focused just on the flow of words ignoring proverbial "elephant in the room" represented by still and motion imagery and graphic representations. We live in a world of increasingly high-resolution graphics and expanded video displays. They warrant close attention and analysis. As a starting

point, however, we pick up where Pool left off and ignore the graphic component for the present analysis. In addition to the ongoing work on the years since 2005, we are expanding our analysis of trends in the consumer price associated with each medium per minute and we are developing an assessment tool for measuring diversity of content sources. In this paper, however, we will concentrate just on minutes supplied and minutes consumed.

We took Pool's original data and measurement definitions as our starting point turning to new data sources as necessary and dropping a few media such as telex and telegrams to focus on the historical continuity of the primary mass and interpersonal media. The key to the measurement of supply pivots on what is available at a particular historical interval to a typical household. So we picked a pooled average of the median sized cities for the US (Charlotte NC, Indianapolis IN, San Diego CA, Raleigh-Durham NC) for estimates of the typical number of available over-the-air broadcast television stations that calculate out to 4 stations in 1960 growing to 9 stations by 2005. We did similar calculations for radio, newspapers and the like. This averaging obscures the fact that the number of channels available to the typical urban household is often much higher than the typical rural one. Such differences, however, become less distinct with the increasing reliance on cable, satellite and the Internet rather than traditional over-the-air transmission and local printing as the primary medium of content transmission.

This is a period of significant growth for the US. The United States population grew from 181 million to 296 million individuals, from 52 million to 113 million households and fell from an average of 3.29 to 2.63 persons per household during these 46 years. So if the number of movie screens in existence stayed constant, the number of screens available per capita (or in our case per household) would have declined reflecting a relative decline in supply. That did not happen, however. The growth in the number movie screens outpaced population growth

significantly growing from 12,291 to 38,852 screens (more theaters and more screens per theater) typifying a growth of supply characteristic of almost all media for this period. Other patterns of increasing supply included an increased availability in the household (average number of working TVs from 1 to 2.7, radios -including portable and automotive- from 5 to 8.) Also people (perhaps a function of affluence, or at least the perception thereof) were buying more magazines and books, although, importantly, fewer newspapers. Our primary sources of data include industrial trade associations, audience measurement firms, academic studies and government analyses. A full list of the sources and the formulae for calculating supply and consumption for each medium is detailed in an appendix.

Because there is some significant money involved, the assessment of media supply is pretty carefully monitored and vetted as various commercial media outlets keep an eye on the competition. The matter of consumption is somewhat more difficult as individuals rely on their memory to fill out viewer diaries or recall how many minutes they spent reading a newspaper yesterday. Our strategy was to record all available measures, assess measurement biases associated with each and compute a weighted average. Take, for example the difficult assessment of number of minutes per day of radio listening. John Robinson's well-known 24-hour recall time budget survey reveals an average total of four minutes a day per individual (Robinson and Godbey 1997). The official Arbitron commercial radio ratings estimate an hour and 20 minutes per day per individual. The difference is significant but easily understood. Robinson asks people to recall what they were doing as they walk through the day hour by hour. Most radio listening from a bedside, bathroom, kitchen and car radios is, in fact, a secondary or tertiary activity and unlikely to be mentioned as the primary recalled activity of the moment in Robinson's methodology. Arbitron uses mechanical devices to assess radio listening and diaries

listing favorite radio stations that establish very different grounds for recall. Ball State's recent extensive field/ethnographic study following typical media users from morning to night reveals the Arbitron measures are more accurate (Papper et al., 2005). But since we are focusing on trends rather than static metrics, the parameter calculation is less important. Notably, both Arbitron and Robinson report equivalent and steep declines in radio listening over this period.

Findings

The patterns Pool uncovered continue today and in many cases accelerate. The broadcast media of radio and television continue to be the primary sources of information and entertainment for the American public. (See Figure 3) Although radio listening has decreased somewhat as the result of competition from other audio media such as the Walkman and iPod, the supply has increased as a result of more radio stations, more hours broadcast per day, and more radios in the home and car. The growth of television supply is accounted for in a small degree by a larger number of broadcast stations but primarily by the growth of cable and satellite TV. In 2005, 84% of American television viewers used cable or satellite delivery as their primary source for television. In 1960 the figure was only 1% cable subscribers. Commercial satellite TV was not yet available. In 1960 the typical number of cable channels available on most systems was 8. By 2005 it had grown to 110 channels. Figure 4 reports the growth of radio and television with separate and more fine-grained metrics with radio in blue with the minutes per day axis on the right of the figure and television in red with the left hand axis. This reveals a pattern hidden in the combined graphic of Figure 3. The growth of radio supply is steep and relatively constant. The growth of television supply takes off in the late 1970s just as Pool's data collection was concluding and it was fueled, as we have observed, primarily by the growth of multichannel cable and later satellite television.

Figure 5 tracks the recently exacerbated pattern and the matter of some concern in journalism -- the steady decline of the daily newspaper (Meyer 2004). In this case we report on the parallel slopes declining demand and declining supply. Fewer households subscribe or buy newspapers from newsstands. In 1960 there were on average 1.1 newspapers per household. In 2005 the number is .5 per household. And the number of minutes of newspaper reading per day declines from 18 minutes to 7. The newspaper reading habit is largely restricted to older Americans. Relatively few younger citizens read newspapers at all, so this decline is primarily cohort demographics and is fueling an exodus of youth-seeking advertisers that may intensify the economic decline of the industry.

Figure 6 illustrates the dramatic and relatively recent growth of the Internet as a home-information and entertainment medium. The left vertical axis in red records the percent penetration of Internet access (narrowband & broadband combined in this case) and the right vertical axis in blue and the corresponding blue curve depicts the levels of actual usage. Note that the usage curves in minutes per day reflect the usage for all households including those without Internet access and according zero minutes per day of use. As noted above the daily use of the web in Internet households is closer to 1 hour 30 minutes a day. So we find that in just a decade, the Internet has already begun to compete with radio and television in its usage levels. We note, however, that this notion of 'competition' will recede, as it will become less clear to the user whether the video they are watching or the music to which they are listening is being piped over traditional media or over the net.

Figure 7 provides an overview of the growth of supply of the remaining traditional media and the Internet from 1960 until 2005. The traditional mass media of books, magazines and movies hold their own against the growing competition in media supply. Recordings hold

strong, but dip in the last few years, apparently losing out to Internet-based competition (legal and otherwise.) The interpersonal media of first class postal communication and telephonic communication maintain a constant supply. In the case of telecommunication there is a dramatic shift from wireline to mobile communication and an actual decline in wireline household beginning in 2003 and accelerating after 2005. The evolving media of home video, portable audio, video games and Internet each grow to significant sources of supply beginning in the late 1980s and 1990s. We find that Pool had only begun to scratch the surface of an explosive pattern of growth of supply.

Figures 8, 9 and 10 summarize the preceding figures and allow us to begin to address our fundamental conclusion about the digital revolution. Here we review the growth of supply to the average American household of all media as measured in available minutes of supply per day. In Figure 9 we review the measured growth in actual consumption – listening to the radio, watching a movie, reading a book. In both cases there is growth. In the case of supply it approaches exponential growth. In the case of consumption it is a linear growth. People are spending more time with media and perhaps less time with each other or sitting on the front stoop. This is not surprising. It is a central element of Robert Putnam's widely celebrated case about declining social capital as he focused primarily on television viewing. There is also an increase in multitasking – reading a book while the TV is on, driving while talking on the cell and listening to the radio. It is widely observed to be a fashionable youthful practice and merits serious further attention, but our focus will be on a related issue – the question of the ultimate limits to attention and the dynamics of media choice.

Discussion

Our key conclusion is drawn from Figure 10. Indeed, it represents another growth curve, in this case the simple ratio of media supply to media demand. Such a curve follows, naturally enough, from the disjuncture of a nearly exponential growth in supply paired with a linear growth in consumption. But it is worthwhile to pause briefly to consider the actual metrics we have been at some pains to calculate. Take the ratio of supply to demand in 1960. It is 98. That represents the number of media minutes available in the typical American household in 1960 divided by number of minutes of actual consumption. It represents the fundamental a metric of choice. And it is a human scale choice. In 1960 there are typically 3.4 television stations available, 8.2 radio stations, 1.1 newspapers, 1.5 recently purchased books, 3.6 magazines and so on. It is relatively easy for one to know where the country music station, the public broadcasting station and the rock station are on the radio dial. It is a choice situation that with appropriate chunking, labeling, habitual behavior and radio-button-setting (Miller 1956) that can be intuitively managed by the human cognitive system. But if we take the ratio of supply to demand in 2005, we find a very different metric. The ratio is 20,943 – over 20,000 minutes of mediated content available for every minute to be consumed. In our view that is *not* a human-scale cognitive challenge; it is one in which humans will inevitably turn to the increasingly intelligent digital technologies that created the abundance in the first place for help in sorting it out – search engines, TiVo’s recommendation systems, collaborative filters. We see this as a historical variant of Beniger’s widely cited “crisis of control” in the 19th century (1986a, 1986b). Briefly, Beniger argued that the growth of automated intelligent control systems in transportation and manufacturing were not just a technical artifact but a necessary development as mechanized process speeds and complexity challenged the capacity of individual humans to control them. He cites frequent train crashes in the late 19th century resulting from human error as a

particularly dramatic exemplar. We may not be confronting equivalent dramaturgy in the realm of media flows, but it represents nonetheless a critical shift in how individuals will negotiate the mediated world.

Because it is a gradual process and lacks the obvious urgency of rail accidents, we may underestimate its structural significance. We have not adopted the linguistic usage of the term crisis. Instead, we conclude that the media abundance has led from a dynamic of *push* to one we characterize as *pull*. In the traditional one-way broadcast and publishing media, the audience accepts that the newspaper editors determine the headlines that audiences will read and the network executives pick which program is on at 8:00 pm. Push media. In a world of over 20,000 choices, audience members are less likely to passively wait to see what's on at 8:00. They use the evolving technologies to pull what they want to watch and read.

This logic leads us to an ongoing study of the search engine as the primary media interface of the future. Google is widely acknowledged to be an increasingly important factor in connecting potential online customers with online vendors. To date, that has been the prime factor behind the companies celebrated \$100 billion market value. What is just coming under appropriate scrutiny now is how Google and similar search and social networking based online resources such as YouTube will exercise their powers in setting norms, cueing fashions in popular culture and influencing public opinion and commonly held information in the future.

As noted above, for practical purposes in this analysis we have treated the Internet as if it were a single medium 'competing' with traditional media rather than serving as a digital gateway to all media sources. Currently Google monitors approximately 8.5 billion web pages. Such a number dwarfs our calculations of words and minutes. As analysis of the 'pull media' interface proceeds, we will need new metrics and need to rethink some of our most cherished theoretical

tools in the study of media effects. Agenda-setting, for example, is typically derived from comparing public opinion with media headlines and broadcast lead stories. Two-step flow analysis draws on opinion leadership from personal conversation rather than online mediated recommendation systems. Much of media effects theory, upon examination, turns out to be premised on a notion of push media (Katz 2001).

Our analysis leads us to conclude emphatically that the web and the digitization of traditional media is not just another step of growth. The digital revolution is not just another technical refinement. Relative constancy theory needs to be reexamined from its first principles. We confront not just a few more media channels, but an entirely new media environment.

Appendix

Volume of Demand Measurement Definitions

Each medium has a words-per-minute factor for converting words to minute metrics from Pool
Reading speed average for US adults is set at a constant of 240

Minutes = minutes per day

Pen= penetration as % of US households in which medium is available

1. Television (153 wpm avg)
 - 1.1. Broadcast
 - 1.1.1. no.bcast stations per avg market * avg % bcast hours day * TVs per household * pen
 - 1.2. Cable(153 wpm avg)
 - 1.2.1. avg channels per cable household(assume24hr)* cable TVs per household * pen
 - 1.3. Satellite(153 wpm avg)
 - 1.3.1. avg channels per sat household (assume24hr) * sat TVs per household * pen
2. Radio
 - 2.1. Broadcast (48 wpm avg)
 - 2.1.1. avg stations per market * avg bcast hours day * radios per household * pen
 - 2.2. Satellite
 - 2.2.1. no. channels * pen
3. Newspaper
 - 3.1. circulation per household * avg number pages [daily and weekly]
4. Books
 - 4.1. books purchased per household * avg book size
5. Magazines
 - 5.1. magazines per household * avg magazine size [subscript and newsstand]
6. Theatrical Motion Picture (110 wpm avg)
 - 6.1. number screens avg market
7. Recordings (41 wpm avg)
 - 7.1. Records
 - 7.1.1. recordings sold per household
 - 7.2. Cassettes
 - 7.2.1. recordings sold per household
 - 7.3. CD
 - 7.3.1. recordings sold per household
8. Video (153 wpm avg)
 - 8.1. VCR
 - 8.1.1. pen
 - 8.2. DVD
 - 8.2.1. pen
 - 8.3. DVR
 - 8.3.1. pen
9. Portable Audio (41 wpm avg)

- 9.1. pen
- 10. Video Game
 - 10.1. pen
- 11. Postal
 - 11.1. First Class Mail
 - 11.1.1. avg number letters/ household * avg letter length
 - 11.2. Direct Mail
 - 11.2.1. avg number letters/catalogs/ household * avg letter length
- 12. Telephone
 - 12.1. Wireline
 - 12.1.1. pen
 - 12.2. Cellular
 - 12.2.1. pen
 - 12.3. IM
 - 12.3.1. pen
- 13. Internet
 - 13.1. Dial-up
 - 13.1.1. pen
 - 13.2. Broadband
 - 13.2.1. pen
 - 13.3. Wifi
 - 13.3.1. pen

Volume of Demand Measurement Definitions

These vectors are averages for all households, so penetration is built into measures
 At later time measures of use for only HH with medium may be calculated

1. Television - mins viewing per person and per HH
2. Radio - mins viewing per person and per HH
3. Newspaper - mins reading per person and per HH
4. Books - mins reading per person and per HH
5. Magazines - mins reading per person and per HH
6. Theatrical Motion Picture - mins at movie theater per person and per HH
7. Recordings - mins listening per person and per HH
8. Video - mins viewing per person and per HH
9. Portable Audio - mins listening per person and per HH
10. Video Game - mins playing per person and per HH
11. Postal -mins all First Class Mail, fixed percent of Direct Mail and Catalog
12. Telephone - mins usage
13. Internet - mins usage

Primary Data Sources

Arbitron
Ball State Media Studies
Consumer Electronics Association
CTIA The Wireless Association
Federal Communications Commission
Magazine Publishers of America
Motion Picture Association of America
National Cable and Telecommunications Association
Newspaper Association of America
Nielsen
Pew Internet Project
Pool, Inose, Takasaki & Hurwitz 1984 Data Appendix
R. R. Bowker
Recording Industry Association of America
Robinson Time Budget Studies
SNL Kagan
University of Southern California
US Census Bureau
US Postal Service
Veronis, Suhler & Stevenson

Figure 1

Declining Costs and Increasing Volumes of Communication in US 1960-1977
 Source: Pool 1983

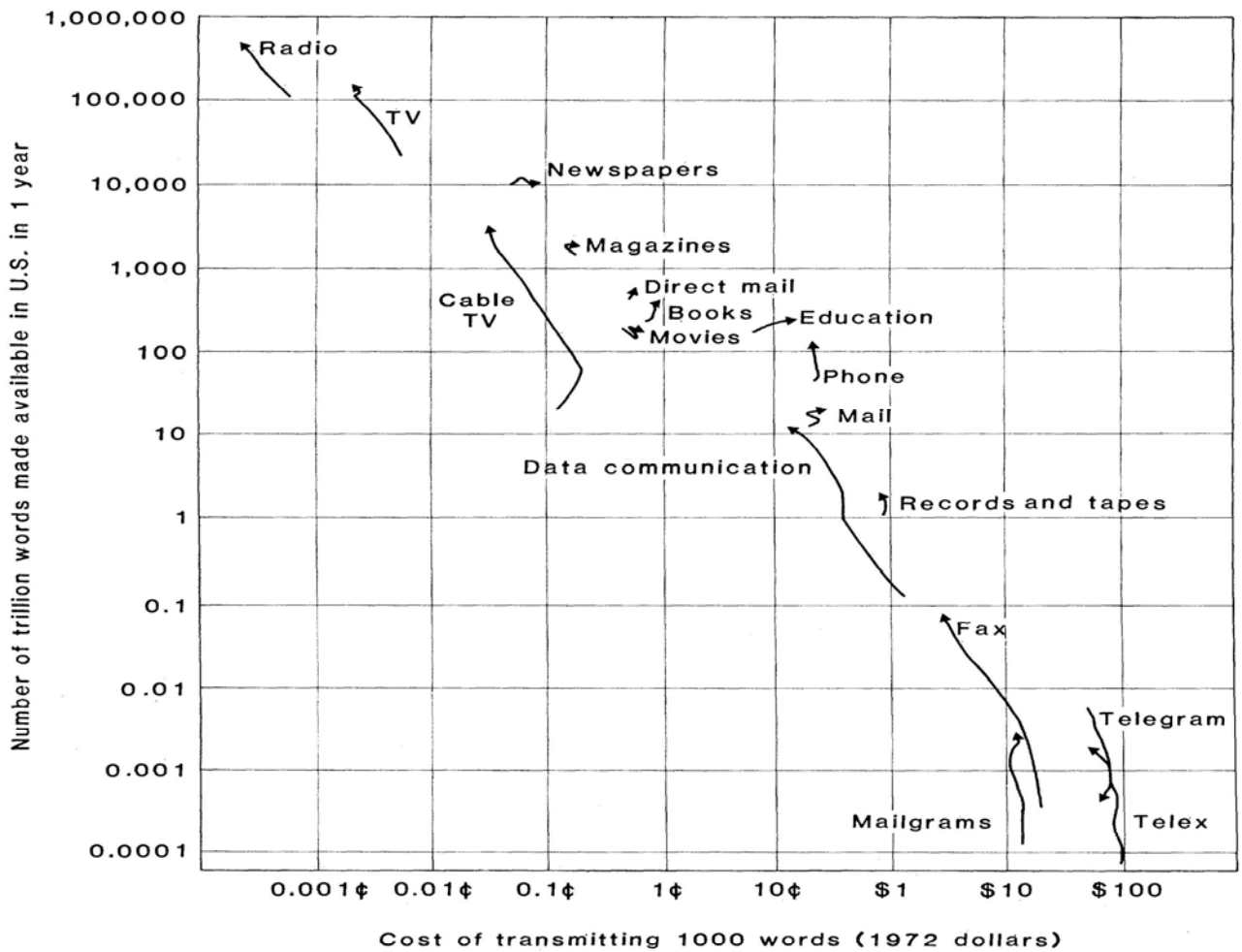


Figure 2
Increasing Supply Outpaces Consumption of Communication in US 1960-1980
Source: Neuman Pool 1986

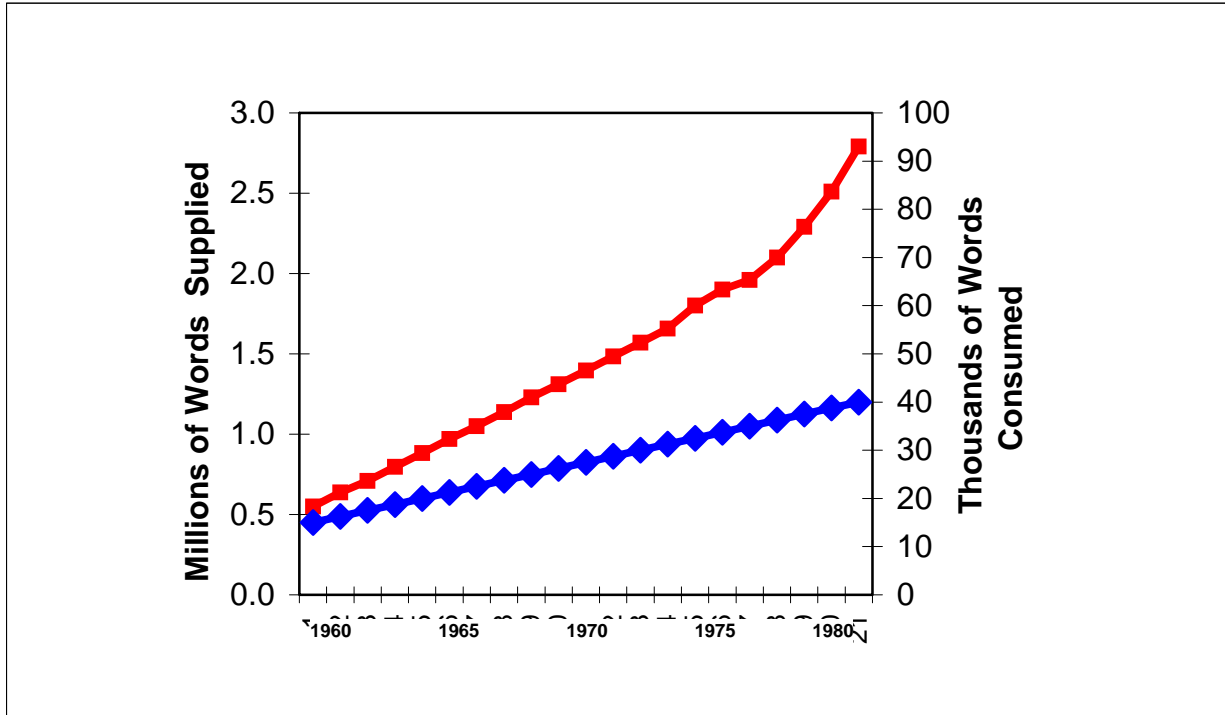


Figure 3
Media Supply to Home in Minutes Per Day: Radio and TV 1960-2005

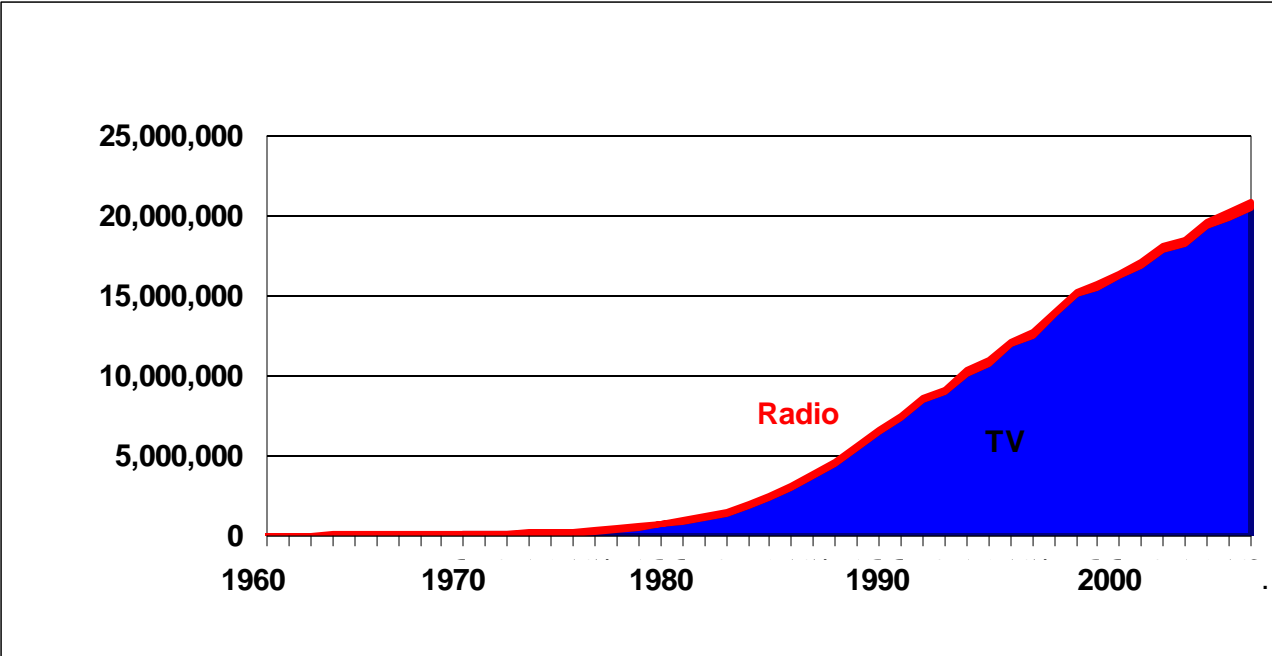


Figure 4
Media Supply to Home in Minutes Per Day: Radio and TV 1960-2005
Separate Axes of Measurement

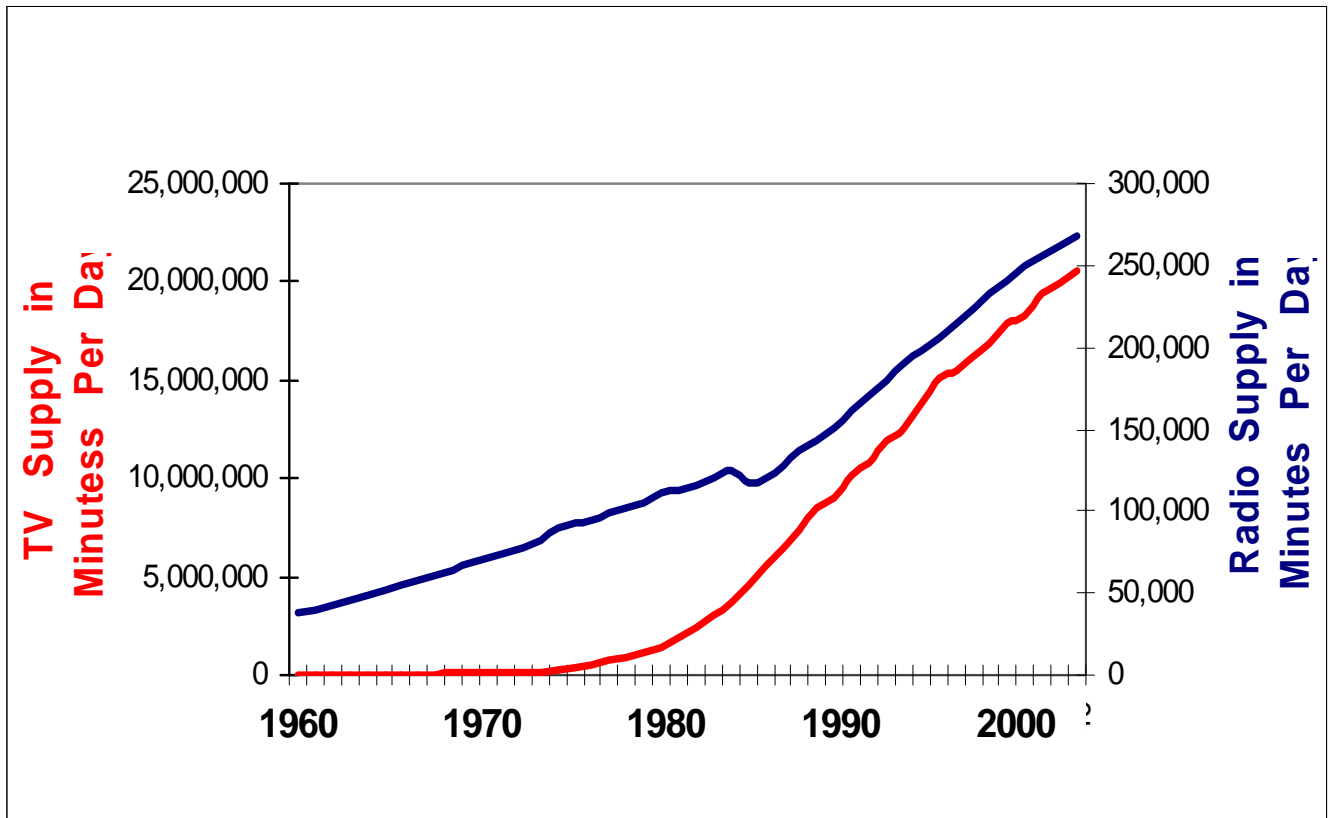


Figure 5
Newspaper Supply and Demand 1960-2005
Minutes Per Day

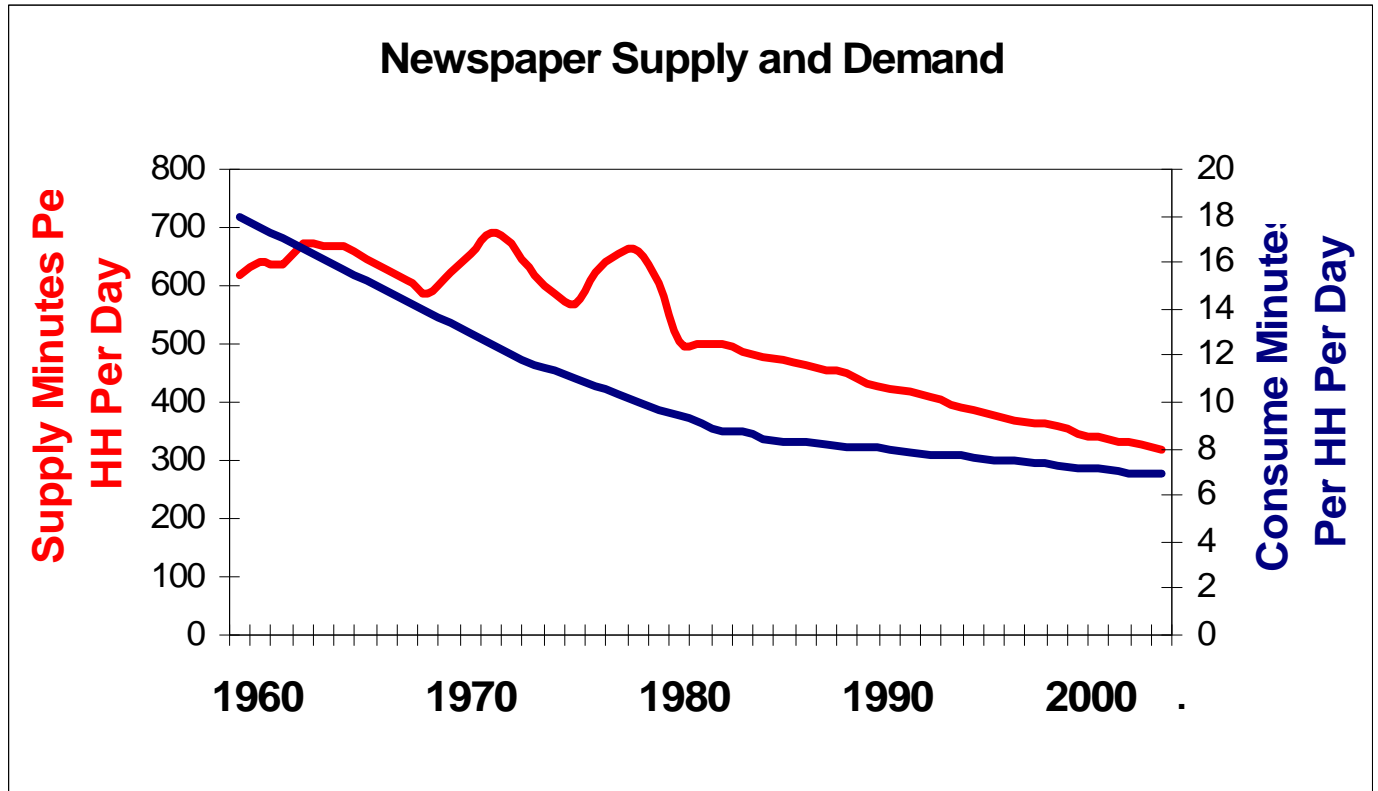


Figure 6
Growth of Internet Household Penetration and Minutes of Use 1960-2005

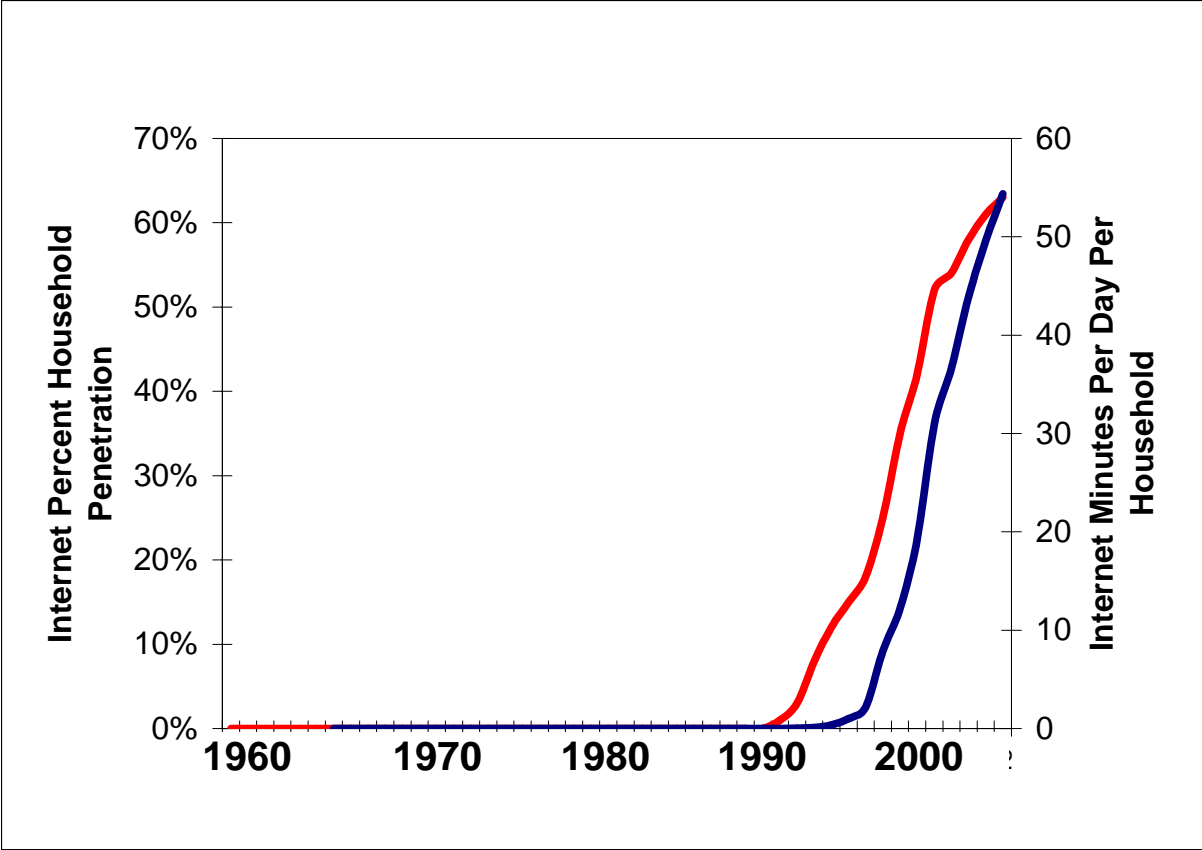


Figure 7
 Media Supply to Home in Minutes Per Day 1960-2005
 (Excluding Radio and TV)

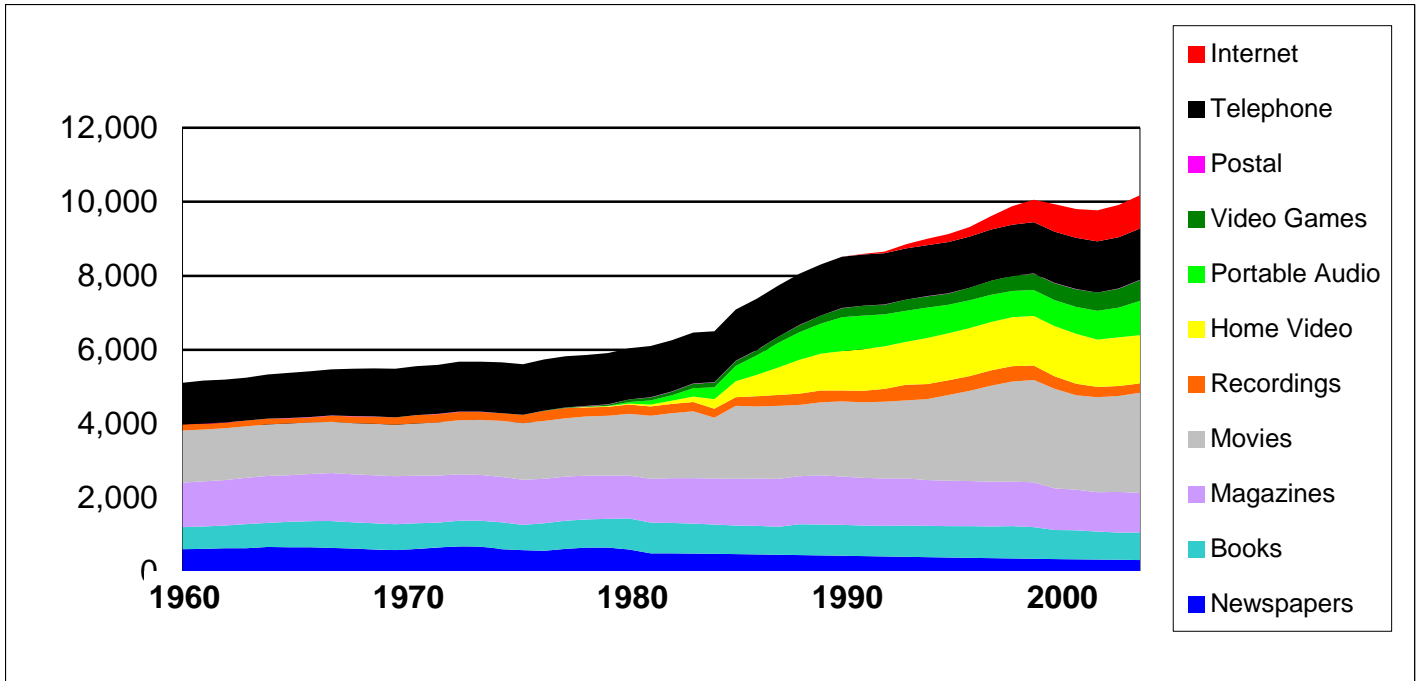


Figure 8
Total Media Supply to Home in Minutes Per Day: 1960-2005

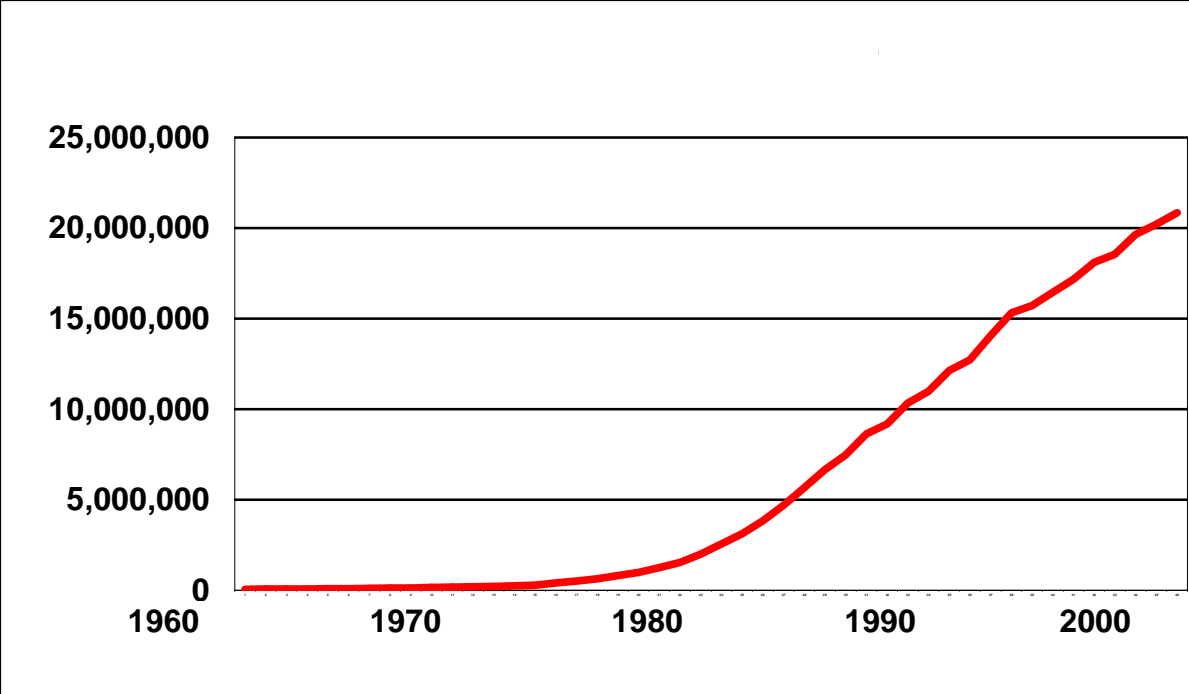


Figure 9
Total Media Consumption in Minutes Per Day 1960-2005

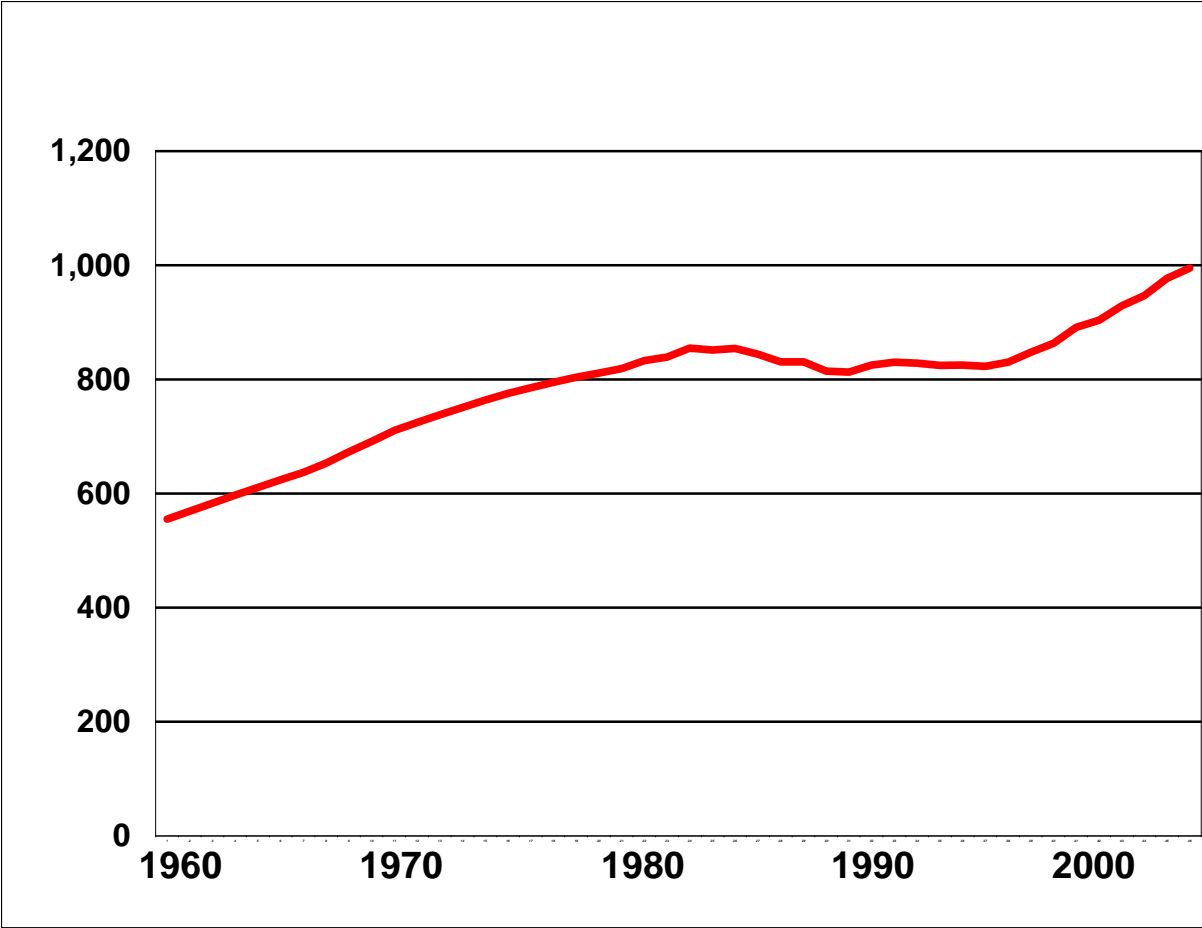
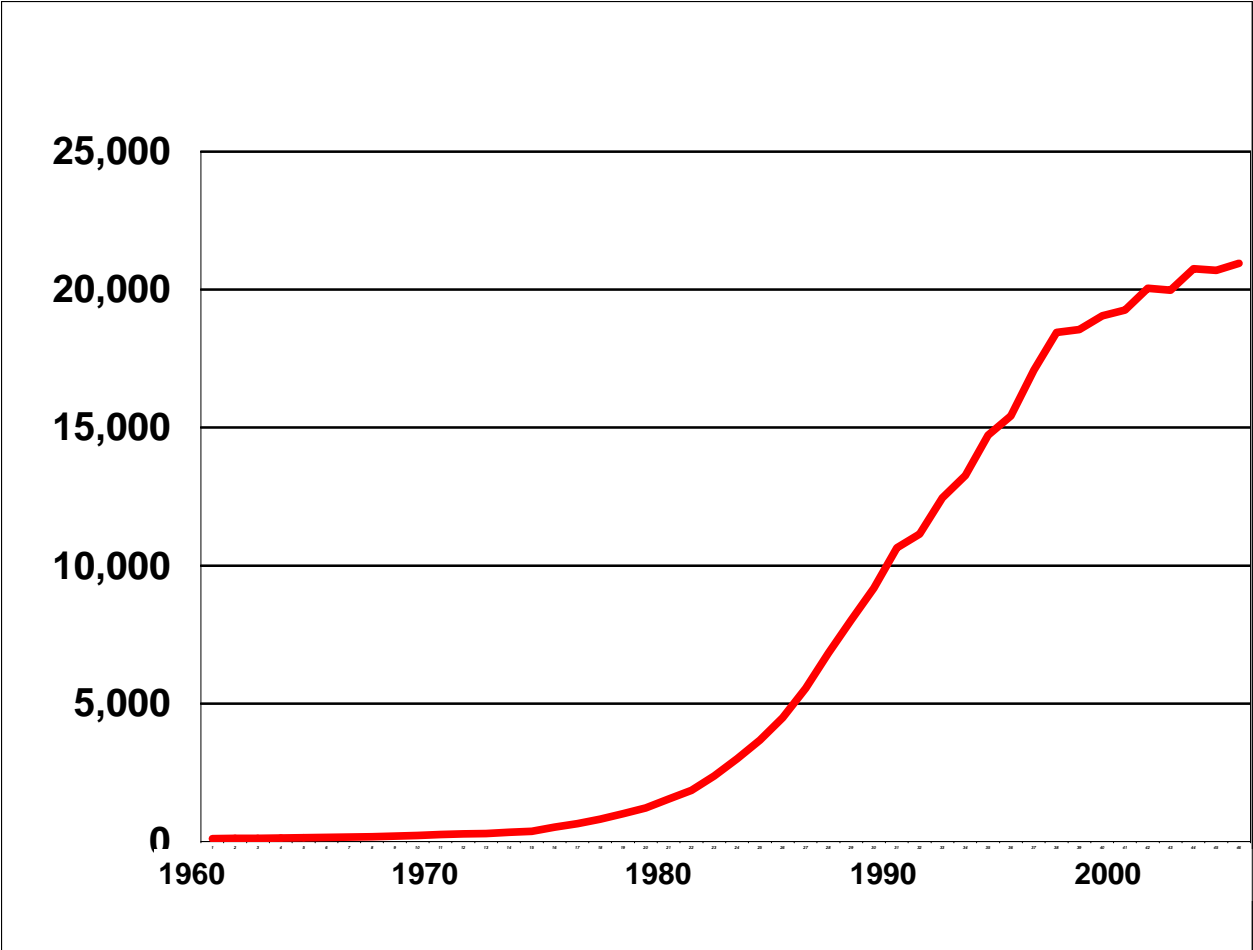


Figure 10
Ratio of Media Supply to Media Consumed in Minutes Per Day Per Household 1960-1980



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