Economics' Role in the Race Toward Digital TV

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ABSTRACT *Market economics sets are a useful, indeed inescapable, hurdle that new technologies must overcome—technological innovation by itself can't assure commercial success. HDTV's future has yet to identify or create a level of consumer demand that justifies the level of investment program producers and delivery systems will have to undertake. Investments currently are defensively driven, to prevent market-position losses should consumer demand appear. Globally, arguments for HDTV seem even less developed than in advanced economies. In the interim, government regulation and arm-twisting worldwide is acting as a powerful driver, though whether historically HDTV will benefit from such efforts (as computers once did) or lose (as nuclear power has) remains uncertain. The government's role won't disappear, despite talk of 'deregulation'; academics should spend more time examining producer and delivery-system alliances, their effects on competition, and their ultimate provision of HDTV as an economical surrogate to analog for global consumers.*

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> It is easy to get caught up in technomania. Those who are most deeply involved with technology want to know more, those who fear it want reassurance, and those who see an opportunity—financial or other—don't want to miss out. It's gonnna change everything. It's gonna be here next Thursday. Watch out or you'll be left behind!
>
> Nathan Myrvold, Microsoft[1]

> Everything will be different. The change is so extreme that many people have not grasped it.
>
> Reed Hundt, announcing the FCC's new HDTV standards[2]

> Digital TV picture remains a muddle.
>
> Headline in *Multichannel News*, 18 August 1997

As an economist, I'm fascinated by the debate over HDTV, digital TV, and their interrelated futures, not least because—as in so many other areas of the Information Age—economics seems to have consistently played (to borrow from an earlier revolutionizing technology) 'caboose' to the 'locomotive' of engineering. Or if the metaphor was perhaps more honest, it has played caboose to a freight train of technology, pulled too often by a locomotive of *hoopla* and *hype*.

Pardon the skeptical note, but because we know so much already about the dawn and dispersal of quite extraordinary earlier technologies (dating back at least to Mr Watt), I would hope that academics and industry figures closest to the modern electronic frontier might not judge me an Isaiah or Jeremiah for what here follows on the business economics of the looming digital TV era.

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From a simplified textbook economics' point of view, of course, HDTV and digital both represent a peculiar world. It's one in which consumer demand is weak at best, and the supply side is built on a 'technological imperative' that, more importantly, is nested in a combination of defensive producer/supplier moves, dramatically influenced by government imperatives. New products, by definition in part, always face similar peculiarities—Henry Ford, the Wrights, and Philo Farnsworth all could hardly have asked market researchers to accurately assess 'consumer demand' for their innovations prior to their actual introduction (or in the early years thereafter).

But as anyone who read *Popular Mechanics* or *Popular Science* 40 years ago knows, technological invention is the precondition, but by no means the guarantee, of the markets' embrace. As a boy in the 1950s, I was enthralled by the idea that someday I'd commute to work using my jetpack, or travel long distances piloting the plane that became a car upon landing, and even perhaps at night after dinner descend to my basement to admire (and tinker with) the family-sized nuclear reactor that would light, heat, and power my home.

Invisible Demand, in a World of Supply and Demand

HDTV—or, more broadly conceived, digital television—is in many ways (for economists), a technology in search of what by any definition is a compelling *demand*. To the public, which is only dimly aware of the whole subject, HDTV is being sold as the SuperBowl game so visually and audibly 'real', you can count the sweat drops on the quarterback's face. Projected through 40-, 50-, or 60-inch sets, come January a few years hence, we'll supposedly all huddle around America's collective electronic hearth and almost *live*—courtesy of HDTV—the clash of titanic athletes as they battle for touchdowns, six-figure bonuses, and half-pound commemorative rings. (And who knows, in this age of electronic redemption: maybe we'll even simultaneously get to count the hairs in a resurrected Marv Albert's toupee, as he provides commentary).

If this sounds belittling, it's meant to—though of course in a way it's unfair. Digital TV especially is about more than clearer pictures and better sound; it's about (we're ever reminded) the eventual convergence of television, telephony, the Internet, and the PC into a single box, with a promise of extraordinary access to all kinds of information and interactive communication unimaginable to anyone who, like me, entered the Television Age in front of a 12-inch Motorola that easily weighed 75 pounds, and brought in just three black-and-white channels as it hulked on our living room floor. (When in the late 1950s, there were suddenly *seven*, *full-color* channels available, I'm sure no one in my family could imagine what more that old set, or its successor, could bring us by way of miracles.)

But let me sketch out for you some of what I see as some of the important economic—as distinct from technological—constraints acting upon digital TV that I think sometimes, in the rush of hype and hoopla, we tend to overlook at our own peril. While I want to expand my comments to include international dimensions quite quickly, let me start here with the US, because I think it points to paradigmatic constraints that apply globally.

Supply Searching for Demand

First is the already remarked issue of indeterminacy around US consumer demand for HDTV and DTV generally—and the rate at which the new technology will be embraced.

The pollster Dan Yankelovich once told me that when he started out doing new product demand research for corporations a half-century ago, he discovered fairly quickly that consumers will tell marketers they'd like a lot of things, then when the products are launched, never buy them. Market research has lived with this dilemma ever since, and the fact that between 10,000 and 12,000 new products come on the market every year, only to quickly disappear, testifies that the dilemma hasn't been solved.[3]

What American consumers are vaguely aware of at this point is that HDTV *sets* will cost a lot more than current ones, at least initially ($2–4,000 seems the range at the moment). Most researchers agree that these set prices need to come down to around $500 before there's likely to be anything like mass-market penetration.[4]

What consumers don't seem to be aware of, however, is that a lot of their family's *associated electronic gear* is also going to have to be replaced—at separate and significant cost—when they leave the analog world. Most current VCRs, home video cameras, the collected library of home videos (including all those summer vacations and shots of the kids growing up), even the set-top cable box that sits in 60% of America's homes are going to have to be replaced (or expensively adapted) along with the multiple TV sets most families own. In dollar terms, beyond the initial cost of a first new HDTV set, all this adds up to something approaching a modestly decent used car or a year's tuition at a good private school—and will, I suspect, act to slow the whole conversion process compared to its more optimistic projections.[5]

Who Pays to Capitalize Producer Costs?

Second, note the problems of producer costs, on the supply side of the equation. (I use 'producer' here broadly to include everyone in the programming assembly and delivery line, from independent studios and production houses that create both programming and advertising to networks, cable companies, and satellite distributors.) The equipment cost for all these elements in the producer chain is immense, in the billions of dollars, because the new technology is not essentially backward compatible with the expensive existing stock of recording, editing, and transmission equipment in a number of ways.[6]

Some local affiliate stations—for example, in North Carolina and Washington—have already reported successfully testing the new digital studio equipment, albeit broadcasting for the time being into a world of home TV sets utterly incapable of receiving their signal.[7] But these early test market successes by no means guarantee wider producer adoption, although markets as distant as China likewise are set to begin their own experimental HDTV broadcasts.[8] (One needs to remember that when the FCC originally promulgated standards for color TV in the 1950s, those standards weren't backward compatible, and color TV languished in the US, until the FCC shifted to the NTSC standards in use today, which *were* backward compatible.)

What these costs—because of their scale—will engender is consolidation, mergers, and market exits, if previous technological leaps in other fields are any example. (Leaps, incidentally we must remember, that were often as deeply influenced by government policy—not just 'market forces'—as this technology is and will be.)[9] That's why those producer costs—and producer fears of them—of course are what's driving the willingness of ABC, NBC, and others to go slow on 'full' HDTV conversion, and for the time being, and instead explore using the FCC's bandwidth gift to carry four new channels of less-than-HDTV quality.

Enter Economics

The opportunity for the networks to actually do so raises a host of interesting questions, all of which (I'd suggest) highlight the central subtext of comprehensible business *economics* running through what, to an outsider, can often otherwise seem a maze of *technological* issues.

Any good textbook on video economics—as well as recent experience—testifies to the willingness of market members to hedge bets on new technologies that incorporate comprehensive new technical standards, especially those that are non incremental and capital-intensive, as HDTV and digital are.[10]

The 1980s row over HDTV standards between America, Europe, and Japan is a reminder that early market leaders tend often to end up looking more like the hare than the tortoise, with the hare's associated finish-line risks. Early standards-favorite Japan, for example, now broadcasts its own version of HDTV that is seen nowhere but Japan, and there, in only 400,000 households.[11]

Economists have long known, given these risks, that producers will often in these cases enter a market *defensively*. The goal is to maintain market share and position, without making a thorough going (and costly) commitment to the new technology, waiting to see what other market actors do, and what new technological developments appear. In these situations, at the theoretic level, game theory—rather than standard linear (or even non linear) 'rational maximizing' models—will provide the most robust frames for economists. The not-so-incidental misfortune for market actors—as distinct from economists—is that the very same game theory will offer frustratingly few stable predictive answers useful to the real-world decisions *they* must make.

In such models, built on risk minimization and path-option diversification rather than a simple aggressive individual profit maximizing, defensive alliances *within* an industry will emerge to spread around capital investment, and promote development sharing.

But such industry alliances may in turn engender more classic competitive behavior when interests and norms diverge *between* alliance groups from distinctively different industries.[12] In the latest HDTV debate—over whether to move quickly to meet the FCC's December 1996 guidelines—those alliances, while making their expected appearance within some industries, thus have been slow to form *across* some competing industry lines.

The broadcasters, for example, in trying to sort through among themselves what options exist below the 'full HDTV' work-out model, have noticed that choosing to carry a quartet of sub optimal alternatives quadruples their old carrying capacity—and suddenly opens up the possibility of challenging, on the basis of programming variety, their cable-industry competitors. Sinclair Broadcasting, for example, announced in mid-1997 that it plans to begin broadcasting a multichannel digital feed in 1998 just to demonstrate to other broadcasters how easy it would be, using off-the-shelf technology, to create a 50- to 70-channel, terrestrial over-the-air, subscription service that could go head-to-head with cable systems.[13]

Meanwhile, the PC industry has been watching the unfolding race with mixed emotions, fueled by its initial desire to retain progressive scanning as it steps into the PC/TV era. During the summer of 1997, there seemed to be a major breakthrough in the long-running battle between the TV and PC camps, when Intel officials signaled they might be willing to live with the broadcasters' demands that all parties work within the 1080-line interlaced (or '1080i') HDTV-video transmission standard. With the use of an add-on card, the Intel officials indicated, the compatibility problem with '1080i' might be resolved.[14]

But what alarms the cable industry, in turn, over such new cooperativeness of the PC industry is that the latter's potential alliance with broadcasters could have powerfully corrosive effects on cable's audience share. Their alarm is magnified by the fact that the cooperation seems to have active governmental support—far from the idealized model of a competitive market's playing field, but characteristic of this technology generally throughout its history.

Former FCC Chairman Reed Hundt, while still in office, for example, actively promoted the idea of PC-broadcaster cooperation as a way to spread the cost of new HDTV, as well as advance his larger vision of the single-box PC/TV.[15] In exchange for funding equipment and related transition costs, he suggested that the PC industry might get from broadcasters (particularly the 1400 or so non-network stations) guaranteed spectrum access for data services or even some version of the MSNBC concept. 'I think if the PC hardware/software industry were willing to finance the DTV buildout,' Hundt observed, 'they would be offering an irresistible enticement to accept the computer-friendly (transmission) standard.'[16]

Meanwhile Globally

If all that merely underscores the competitive economic complexity of the American HDTV and digital TV market battles at the moment (as distinct from its technological complexities), consider the even more complicated international market, and in particular the projected role of satellite-based DTV delivery.

Professor Michael Noll—a highly regarded figure in the field—has described the potential *consumer* appeal of DTV globally in one word: *variety*. Satellite DTV, he believes, promises to be capable of delivering 1000 channels instantaneously to literally billions of viewers around the globe. In Noll's words:

> ... the question then becomes what programming to offer. One answer is all the world's TV programming, thereby creating a form of '*world TV*'. A system capable of carrying 1000 TV programs would deliver all the world's unique TV programming each day. Each of us would be able to choose and watch any TV program from anywhere on this planet.
>
> Navigating and choosing from 1000 channels would be a challenge, but the ability to watch the local news of any city in the country, cultural shows from England, and game shows from Italy could be exciting—and a solution to today's boring programs.[17]

I've great respect for Noll's work generally, but on this I think he's absolutely wrong, if he imagines that there is some market-significant unexpressed consumer demand for Italian game shows outside Italy—or Tulsa's latest auto accident or high school sports score outside Tulsa—that DTV will satisfy.[18]

First, we have quite a lot of TV viewing data already indicating just how 'local' most demand is for news and information, apart from entertainment programming. In my *Mixed Signals: The Future of Global Television News*,[19] I found for example that although CNN International's satellite footprint covers more than 200 countries worldwide, its average viewership is on the order of 200,000 or so outside the US, and heavily concentrated among US tourists, expatriates, and a tiny swath of local government and broadcast elites.

Similarly, Rupert Murdoch's SkyNews, although its satellite footprint covers virtually all of Europe, barely draws measurable ratings compared to the various national news broadcasters in the region, limited in its appeal by its English-language format and its

British-oriented coverage. Given a choice, my research found, viewers seem universally to prefer watching news about their own country first, their region second, and then the larger world third (if at all). Moreover, they prefer to watch it delivered in their own language, by news anchors and reporters from their own country, whose reporting reflects their own national values and outlook.

This preference for 'local voice' isn't limited to multilingual, multinational Europe. Even in Canada, which shares a common border and (mostly) common language with the US, and where 90% of its population can easily watch US television broadcast from neighboring American cities such as Buffalo, Detroit, and Seattle, the great majority of Canadians watch 'The National', the CBC's evening news in preference to CBS, NBC, or ABC.[20]

In entertainment TV—which, unlike news TV has proved its transnational appeal since the late 1950s—the information we have again cuts directly against Noll's observation that satellite DTV will feed global consumer demand for 'foreign' programming such as Italian game shows.

In the frequently cited example offered as proof of a universal 'youth culture', MTV—the very successful lodestar of music TV for the young—has adapted its earlier thrust toward an 'international' satellite-based programming model into a series of much more customized 'regional' European, Latin American, and Asian focused services, tailored linguistically and in terms of the music broadcast, to serve market tastes that are far from globally uniform.

Second, a significant amount of 'global' TV programming—the heart of Noll's vision of immense variety—has always been nothing more than American reruns, not local fare. Thus, one discovery for anyone tuning in to Noll's 1000-channel DTV world would be that much of what he or she found would be old Hollywood fare dubbed into local languages.

I once spent several disconcerting minutes a decade ago in a Kuala Lumpur hotel, trying to make sense of a show I had clicked onto, aware that it seemed familiar, but not grasping why—only to realize I was watching a *Mr Ed* rerun, and the horse was talking in Malay (while the pitch of the unmistakably canned laughter was redubbed to a higher Asian register).

While some comparative cultural anthropologist or semiologist might find a life's work in 'deconstructing' the meaning of such programming, I'd submit that *Mr Ed* dubbed into Malay, *I Love Lucy* into Tagalog, or *Baywatch* into Mandarin won't be the basis for building a huge *international* audience of non-Malay, non-Tagalog, or non-Mandarin speakers—at least one of practical interest to the TV industry, digital or analog.[21]

Now of course, American reruns aren't the only fare on TV internationally; there is plenty of locally produced fare on stations around the world nowadays, and the amount is rapidly rising. But as we also know, from watching a highly developed trade in international TV programming that has existed for decades—and that is serviced by the annual Cannes MIPCOM meetings, where producers and programmers from around the world meet to buy and sell such programming—very little of that non-Hollywood programming enjoys a transnational market.

True, Mexican soap operas get sold to Russia and Spain, and Brazilian soap operas make it to Italy, but to an overwhelming degree, the 'international' market in programming exports is one that is thoroughly American, and to a much lesser extent, West European. The commercial export of programming from Asia, Africa, Latin America, and the Middle East in dollar terms—and to only a slightly greater degree, in broadcast hours—is trivial within the global TV market. Even within the European Community,

with all its emphasis on regional cross-border integration, 90% of domestic TV programming never leaves its country of origin.[22]

The Hard Borders of Global Program Demand

Why should so much programming produced around the globe be unexportable? The answer seems to be three-fold: *production values*, *cultural values*, and *language*. By production values, I mean the technical 'qualities' of program production—whether it's on tape or 35 mm, whether sets seem 'too in-studio' (in Hollywood's parlance), the degree of camera 'fluency' and style (stationary single camera *vs*, say, MTV-style 'cut-and-jerk'). While more and more, the influence of Hollywood shows up in foreign programming, somehow—to judge by the ongoing international market demand for its fare—Hollywood still represents the gold standard in these matters.

The same seems to apply to 'cultural values' (as expressed through TV programming), however loose that term is. While the US, and to a lesser extent Europe, can export its drama, music, action, and even some of its sitcoms worldwide, the same is not true of most other countries. For whatever complex reasons, those same types of programs do not draw audiences outside the original country of production, or do so only within common linguistic/cultural borders (within Latin America, for example).

Language is the third definitive roadblock to transnational demand for most entertainment programming. Within the world's largest language blocs (e.g., English, French, Spanish, Mandarin, Russian, Hindi) there is always of course some trade potential among nations which share one of those languages in common. But even here demand for imports (excluding the case of US exports) is limited—the US itself imports barely 2% of its programming hours, most of it confined to the PBS/BBC trade. Russian, Hindi, and Mandarin aren't really spoken extensively outside one country (or some immediately adjoining nations, in the Russian case), so when a program travels it is mostly to relatively tiny expatriate communities.

The War for Eyeballs

This raises a perplexing problem—again at least in classical economic terms—for proponents of HDTV and DTV generally, when it comes to the potential of the international market to sustain DTV development by satisfying what Noll suggests is a latent demand for global variety. If Peruvian news won't play in Peoria, and Tagalog pop music or variety shows won't garner much market in Tokyo or Trieste, what is the international *consumer* demand that underlies conversion from analog to digital in something like 180 national broadcast markets around the world?

Here, I think an economic—rather than a technological—view suggests we need to return to the issue of the producer/suppliers, rather than the consumer demand side, of this supply/demand equation. Intel CEO Andy Grove underscored the issue at COMDEX in 1996 when he told fellow computer-industry members that computer companies 'must look outside our own backyard for new users', and would have to jump into the TV business as part of what he called 'the war for eyeballs'.[23]

The phrase may be inelegant, but it is precise. In a number of ways, the traditional television industry in America had already 'matured' as a market as an over-the-air medium 25 years ago. Then in the 1970s and 1980s first new UHF stations, and ultimately cable, remade the industry landscape in distinctive ways, significantly eroding the market oligopoly of the networks in ways that are still having their effects.

Over roughly the same time, deregulation and privatization similarly have remade

the old-fashioned terrestrial national television markets throughout much of the industrial world, and most of the newly industrializing countries (NICs) as well.

The two driving parallel industry developments in the same period, of course, have been the emergence of the personal computer market and the privatization of telephony. As these two latter industries have grasped the potential new markets for themselves that reside in Groves' 'war for eyeballs', their role as new entrants has been as influential as any intra-industry factor in the broadcast and cable TV markets that have fueled the present digital TV situation.

By redefining both the 'scale' and 'scope' (in Alfred Chandler's sense) of 'the market' once conceived simply as discreet national over-the-air terrestrial television markets, the competitors for delivery and content to living-room TV sets globally have remade the economic equation underlying the instrument itself.

At this stage, though, such an observation adds little to what we already know (and have known for some time) about the promise that has been there, and yet still remains undelivered. Although I've located myself in this article as a skeptic, let me qualify that by stressing that over the longer run of, say, the next 25 to 50 years, it is obvious—for competitive supplier reasons, rather than overwhelming consumer demand—that the global TV market will go digital and not remain predominantly analog; that 'convergence' between TV and PC will occur; and that many of the technological battles, and underlying economic battles, will be settled—in the sense that market forms will stabilize, that the ranking of market actors will also, and that ranking will be dominated by a few global (though likely US-based) multinationals that will take on quite recognizable oligopolistic characteristics (with or without government regulatory help) while competing in specific regions with large and quite powerful, and probably regionally oligopolistic, challengers.

What We Might Learn from Betty Furness

Noll's emphasis on TV program variety is not, of course, the only use to which the 'converged' digital TV/PC box will be put by the middle of the next century. The merger of TV programming with the PC's potential to deliver the Web, e-mail, video games, etc. simultaneously *with* TV programming has been much touted. Thus, as one proponent celebrates it, in such a world 'football fans, for example, can click on an icon during the game and get scores, stats about players, and instant replays as desired'.[24]

One has been hearing about such capabilities for the Barcalounging American male now for years, and presumably there is a market for such capabilities, but I've yet to hear much that's persuasive about expansion of such *simultaneous* usage scenarios beyond this or the equally touted trading-room-floor model where Alan Greenspan talks as some hotshot 26-year-old watches him while simultaneously arbitraging currency futures.

I think there's a reason why there aren't more such scenarios covering a wider span of examples—which is that there frankly *isn't* much conceivable demand for them. Consider, during the same football game, how willing you'd imagine the viewer to be to learn—in the midst of a crucial touchdown pass—that new e-mail 'spam' (or memo from the boss) has arrived. Or consider whether he'd be willing to play 'split-the-screen' while his wife browses the Web equivalent of the Home Shopping Channel—or to have his 14-year-old play 'Myst' while he's waiting for a tie-breaking point kick?

Some of you may remember that 'convergence' of this sort—of multiple functions into one appliance—was a fetish in the 1950s, but applied to what Betty Furness and Westinghouse used to prattle endlessly about as the 'kitchen of the future'. In such a kitchen, the raw ingredients of a meal would be placed or poured into a single appliance

that would measure, mix, and bake (or roast or boil) said ingredients into a family meal, ready to serve the assembled Jetsons (I mix TV eras here) or whomever minutes latter.

Now note that while, 40 years later, we've added the microwave and (in fewer homes) the Cuisinart to our standard list of kitchen appliances, nothing like the one-in-all handy kitchen instrument that I once, as a boy, saw on display in Monsanto's 'House of the Future' at Disneyland has emerged, and that the fashion of hand-made meals (with the addition of raddichio, basil, and free-range chicken among the upper-middle-classes) is as much the practice as aluminum-wrapped Swanson TV dinners once were (and remain for many, suitably updated for calories and salt content).

I'd submit that something like this is going to happen to the dream of TV/PC 'convergence' in the digital era. Sets will be multiple, and largely ascribed with designated uses, much as the refrigerator, stove, and microwave remain today. One set (or more likely two or more sets) will serve household 'entertainment' needs, and will focus on delivery of updated TV programming demand, and whatever passes currently for the VCR's role (whether movie-on-demand from Blockbuster's DVD—or whatever—files, over the phone, satellite or cable).

Another set or two will essentially be a 'work' station just as it is today, with the PC function of helping us do homework, chat on the Internet, search the Web, etc. The fact that the various sets will be cross-substitutable technologically won't mean they'll be *used* that way, because the family's usage demand structure—and those of its individual members—at times of high multiple usage (i.e., evenings and weekends) will be multiple and competitive as well.

If I'm right about this, there are several implications for the various industries that will be competing for the consumer's dollar (or internationally, her Euro, yen, peso, or baht) over the coming years. For groups like CEMA, of course, this should sound like great news—multiple household use divided by sets implies multiple set purchases. But to the extent that consumers continue to purchase their 'work' sets from the PC industry, the end-market for sets—whether TV, PC, or TV/PC—will remain functionally as divided between the PC and consumer electronics industries as it has been to date.

But for the competing 'delivery' system industries—cable, satellite, telephony, and even the broadcasters (in their capacity as a over-the-air deliverer, vs content provider)—this obviously tells us little at all of real significance, because it doesn't specify what delivery medium households will use to fuel either their 'entertainment' or 'work' stations specifically. There, an economist suspects that the basic driving rationale will slowly focus on the consumer price-point. That is, given a *choice* among the various delivery mediums, the consumer will select the mix that optimizes some subjective combination of price and value.

But I say 'slowly focus' for a purpose, since in existing worlds that offer such choices, there seems to be enormous entropy at play as well: witness, for example, the American long-distance phone market, where ATT still enjoys 60% market dominance despite generally higher costs to consumers, and with Sprint and MCI, virtually defines the total market, even though many smaller vendors seem to offer superior price–service combinations.

Likewise the American cable TV market: in its infancy, there were real questions whether cable or satellite would emerge victorious in the home-delivery race. Even today, two decades later, when DirectTV and its competitors are in a second-generation race to challenge cable's overwhelming 10- or 12-to-1 US viewer lead, and seem clearly to offer more options for a similar price (suggesting, to an economist, an inexorable migration to DTH), if there's been a cable-destroying stampede to DTH since the new generation of satellite systems came on stream, it's escaped most reputable analysts.[25]

What one suspects economically more generally about this competition to deliver is that, far from being resolved technologically in favor of one form or another, the 'delivery' industries may in fact settle into relatively stable multiple delivery channels, all with parallel access to most households, and among which households will select alternatives depending on proposed usage and competing costs.

That is, barring an alternative scenario in which public regulators (and their political overseers) opt for allowing eventual monopoly to a single delivery form, the competitive alternatives we see today will likely remain competitors for market share well into the foreseeable future. The libertarian alternative—of completely unregulated competition, untouched by politics—otherwise, I would guess, likely favors the telephone companies, with their immense cash flow and enormous borrowing capacities, over cable or satellite to such a degree that one can hardly imagine victory for either of the smaller combatants in the end. In a world where the largest US cable company has *annual* revenue equal to *6 weeks*' income for the largest phone company, one can root for David, but is well advised to place at least a healthy side-bet on Goliath.

Of course, faced with such an outcome, the well-established history—here and abroad—of competitive industries as large as these, and their willingness to use government regulation as a prophylactic against ultimate destruction through competition, seems hardly worth observing.

Why Public Regulation Won't Go Away

In the current era's celebration of entrepreneurship and competition, however, bearing that realization in mind seems worthwhile. Governments, as much as the key competing DTV industries, have enormous stakes in the unfolding competition. They care about the new technologies as engines of aggregate national economic growth, and voters will make sure they care about imbalances that all new technologies create (whether it's consumer cable rates, fears about industrial monopoly, or simply the bureaucratic instinct to preserve oversight power, a la Mancur Olsen).

In some ways, the current love for telecom/broadcast deregulation globally is based on a belief that the 19th century model of the railroads' growth offers more economic potential than the much more structured and supervised 20th century model of telephony, broadcast, and electricity. But the railroads, it must be remembered, offer a very specific industrial life cycle (with quite distinctive lessons).

In the 1840s and 1850s, the railroad industry was one of unalloyed expansion, with multiple firms laying down sometimes incompatible trackage and often overlapping lines, yet fueling tremendous growth not only in rail itself, but in supplier industries, in capital markets, and the economy generally. After the Civil War, trackage and tonnage volume continued growing, but a new era of consolidation appeared as individual lines found capital and interline linkage harder to negotiate. Even the largest lines themselves often found life hard going, and in the West at least, branched into what today we call 'synergies'—real estate development, agriculture, and tourism.

None of this stopped the continuing growth of the great Class A lines—the New York Centrals, Santa Fes, and Union Pacifics—and their takeover or elimination of the weak. Nor did it stop their fratricidal competition over price—until the government stepped in to stabilize markets, using as its stated mission protection of the 'public' interest of farmers, passengers, and the like, even as it acted to save the industry from itself.

Asked where the current world market for digital TV is headed—and with it, all the subordinate questions of which industries and companies will emerge as winners or losers—one imagines that the academic economist's responsibility (as distinct from the

market analyst's) is to point to that longer earlier history, and ask whether or not it isn't full of equally interesting questions about what lies ahead, once the initial conversion is made—and whether or not what we're likely to see will be so new after all.

Notes and References

1. Nathan Myrvold, 'The Dawn of Technomania', *The New Yorker*, 20–27 October 1997, pp. 236–237.
2. Hundt, quoted in Joel Brinkley, 'Living with HDTV: "Everything will be different" ', *International Herald Tribune*, 3 December 1996, p. 1.
3. TCI's Leo Hindery, though for his industry's own reasons, hasn't been reluctant to focus on the missing consumer element in the supply/demand equation. 'If we cram HDTV down customers' throats, we'll lose', Hindery at the CTAM convention this summer, 'The push for HDTV should come from the consumer, not from technology'. Cf. Donna Petrozzello, 'Hindery takes aim at HDTV', *Broadcasting & Cable*, 28 July 1997, p. 67. (For a slightly more conciliatory tone from the cable industry, cf. NCTA President Decker Anstrom's remarks in *Multichannel News*, 4 August 1997, p. 57.)
4. One recent study of 1000 consumers by Price Waterhouse concluded starkly that Americans 'neither understand nor significantly value HDTV'. Cf. Mary Frost, 'It will take more than a PC to unlock the door to digital TV', *Electronic Engineering Times*, 14 July 1997. (Frost is managing director of the Entertainment, Media and Communications group at Price Waterhouse LLC Management Consulting.) On the need generally to bring set costs down to stimulate a mass market, cf. John Carey, 'Looking back to the future: how communication technologies enter American households', in John Pavlik & Everette Dennis, *Demystifying Media Technology*, Mountain View, CA, Mayfield Publishing, 1993.
5. California-based Multimedia Research Group—representative of the roll-out 'optimists'—claims there could be 38 million TVs nationwide receiving digital programming by 2000, if US broadcasters would just speed up their switch from analog. (Cf. 'Report reveals 22 million STB units for digital TV in US', COMLINE News Service, 25 September 1997.)

   But 'web TV'—which allows access to the web through existing TV sets using an add-on box—is at least one early measure of such a demand for part of the digital revolution. WebTV, the company which pioneered the technology, has so far however been able to sell barely 150,000 units (at $350 each), despite a $25 million marketing effort and extensive free press coverage. (Cf. Jeanne C. Lee, 'Web-ready television starts making Sense,' *Fortune*, (13 October 1997, p. 158.)

   WebTV's lackluster consumer experience moreover needs to be set against the larger engineering complexities associated with analog-to-digital conversion, according at least to one recent survey which concludes that 'the United States seems lost on the past to the digital millennium', and will need at least *15 years* to shift to digital. (Cf. Dr Joseph Schatz, 'DTV's rocky road', *Broadcast Engineering*, September 1997.)
6. Most current estimates just for in-studio new equipment costs run $2–$4 million for each of the existing 1600 or so US TV stations, and don't include tower-conversion costs. (Cf. Glen Dickson, 'The DTV push is on for 1998', *Broadcasting & Cable*, 21 July 1997, p. 92.)

   Complicating matters, the new FCC-approved digital standards may not even be compatible across the four new formats adopted, because of different bitstream characteristics, according to a recent study by Bhavesh Bhatt of the Sarnoff Corporation and David Mermreck of the National Institute of Standards and Technology. (Cf. Gerald Walker, 'DTV warning signs', *World Broadcast News*, October 1997.)
7. Cf. Gerald Walker, 'DTV warning signs', *World Broadcast News*, October 1997.
8. Cf. 'China digital TV may prove profitable and popular', *FT Asia Intelligence Wire*, 29 August 1997, p. 5.
9. Consider the history of railroads, municipal trolley lines, aircraft and auto manufacturers—all of which consolidated as capital requirements escalated as part of adaptive competition after initial technology development. Government's hand is seldom absent from such moments, though working in different directions at different times: consider the government's stated goal in 1970s airline deregulation, which included increasing the number of competitors. More than 100 new

entrants appeared, and more than 100 quickly disappeared—with air traffic today more concentrated among fewer carriers than under regulation. The 1996 Telecom Act clearly *advances* consolidation amidst competition, by lifting previous limits on the number of stations jointly owned, among other features.

10. Cf., for example, Bruce Owen & Steven Wildman, *Video Economics*, (Cambridge, MA, Harvard University Press, 1992), Ch. 7, 'Advanced television', for the basic issues.
11. One should also note cautionarily that the standards conflict persists among Europe, the US, and Japan over digital transmission, if not compression, criteria. Cf. Andrew Pollack, 'Tokyo speeds debut of digital broadcasts', *International Herald Tribune*, 11 March 1997, p. 11.
12. Banking deregulation is another contemporaneous example of this phenomenon, with extensive interbank alliancing squaring off against similar insurance industry and mutual-fund industry behavior, to determine dominance of the emerging integrated financial services business.
13. Cf. Fred Dawson, 'Digital TV picture remains a muddle' *Multichannel News*, 18 August 1997, p. 1.
14. Cf. George Leopold & Junk Yoshida, 'PC camp blinks in standoff over HDTV formats', *Electronic Engineering Times*, 21 July 1997.
15. For an informed behind-the-scenes look at how Hundt and Bill Gates maneuvered the PC industry into the Grand Alliance discussions, and its ramifications, cf. George Leopold & Junko Yoshida, 'When the chairmen of the FCC and Microsoft met, they altered the course of advanced television and opened the door to a new force in government', *Electronic Engineering Times*, 14 July 1997.
16. Hundt, quoted in Ref. 2.
17. Michael Noll, 'Digital television, analog consumers', *Telecommunications*, September 1997, p. 18.
18. My own intuition is that a good deal of any 1000-channel satellite-based delivery capacity—if and when it comes—will be used on a national or linguistically common regional basis to deliver feature movies on at least several hundred of those channels. The routine delivery of a dozen or so movies per 24-hour period, any one of which a home viewer can watch or download to the home VCR (or its coming replacement) is a more economically plausible use of those channels than global rebroadcasting of local-market-specific programming, as Noll suggests. The market future here is a threat to Blockbuster and its global equivalents, not the promise of being able to tune into what's on in Nairobi, Nogales, Nome, or Nagoya at that same moment.
19. Richard Parker, *Mixed Signals: The Future of Global Television News*, New York, Twentieth Century Fund, 1996.
20. Cf. William J. Fox, 'Junk News: Can Public Broadcasters Buck the Tabloid Tendencies of Market-drive Journalism? A Canadian Experience', Joan Shorenstein Center, JFK School of Government, Harvard University, Discussion Paper D-26, August 1997.
21. One should note that *Mr Ed* and the like will continue to be exported by Hollywood, and dubbed into scores of local languages for local markets. In that sense, Hollywood (and the US) can count on a continuing and rising balance of payments surplus, just as it has in the analog era. But like US trade in the larger global market, it can also expect to see its *share* of total global programming *decline* as privatization encourages local and cost-sharing regional program production efforts in a competitive multichannel environment.
22. Cf. Parker, *op. cit.*, Ref. 18.
23. Grove, quoted in Joel Brinkley, 'Living with HDTV: everything will be different', *International Herald Tribune*, 3 December 1996, p. 1. For TCI's Leo Hindery's reaction to Grove, and to the larger threat of cable-market 'invasion' by the PC industry, cf. Donna Petrozella, 'Hindery takes aim at HDTV,' *Broadcasting & Cable*, 28 July 1997, p. 67.
24. Jeanne C. Lee, 'Web-ready television starts making sense', *Fortune*, 13 October 1997, p. 158.
25. Cf. Geraldine Fabrikant, 'Satellite TV provider waits for world to catch up', *New York Times*, 3 November 1997, p. D1.