

Adjusting VCR prices for quality change: a study using hedonic methods

Rapidly changing consumer electronic goods present particular difficulties when compiling a constant quality CPI; hedonic methods are used to quality-adjust price change for video cassette recorders

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Are there any “low hanging fruit” (or benefits) to be harvested from the use of hedonic methods to quality-adjust video cassette recorder (VCR) prices?¹ According to the December 1996 Final Report of the Advisory Commission to Study the Consumer Price Index (CPI), an upward bias of 0.6 percent per year in the CPI is attributable to unmeasured quality change and new goods.² To estimate the biases attributed to quality change and new products, the advisory commission divided the CPI’s market basket (the set of all consumer goods and services) into 27 major categories. The category that contributed the most to the quality change bias estimate was the *Appliances Including Consumer Electronics* component. The Bureau of Labor Statistics responded to the advisory commission’s bias estimate acknowledging “. . . that [high-tech consumer goods] present particularly difficult measurement problems, but the quantitative evidence is very fragmentary and the BLS is reluctant to speculate as to what the magnitude of any bias component might be.”³

In this study, the hedonic technique is used to estimate (implicit price) values for video cassette recorder (VCR) characteristics, and these estimates are used to quality-adjust VCR price changes when a new VCR model replaces an older model in the CPI sample. These adjusted VCR price changes are used to calculate a quality-adjusted price index. The resulting quality-adjusted index is, ideally, free of quality change bias. We compared it with the published CPI index to obtain an estimate of the quality change bias for VCRs.

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Market basket includes VCRs

The inclusion of VCRs in the CPI came almost a decade after their introduction to the marketplace. As part of the major CPI revision that went into effect in January 1987, BLS included VCRs in the CPI market basket and they became part of the *Video Products Other Than Televisions* item stratum (the lowest level of item aggregation for which the CPI calculates indexes).⁴

Many critics of the CPI contend that BLS introduces new products too late and tracks outdated products too long.⁵ The advisory commission describes the “new product” bias as follows:

A pervasive phenomenon called the “product cycle” is critical in assessing the issue of new product bias in the CPI and applies as well to new models of existing products. A typical new product is introduced at a relatively high price with sales at a low volume. Soon improvements in manufacturing techniques and increasing sales allow prices to be reduced and quality to be improved. For instance, the VCR was introduced in the late 1970s at a price of \$1,000 with clumsy electromechanical controls; by the mid 1980s the price had fallen to \$200 and controls were electronic, with extensive preprogramming capabilities. Later on in the product cycle, the product will mature and eventually will increase in price more rapidly than the average product of its class. The sequence is easily visualized as a “U”-shaped curve — the price of any given product relative to the consumer market basket starts high, then goes down, is flat for a while, and then goes back up. To the extent that the CPI overweights mature products and underweights new products, it will tend to have an upward bias.⁶

In response, BLS proposed to implement a more aggressive product initiation program, which would identify and include in the CPI new goods promptly after they enter the marketplace.⁷ Estimating the magnitude of the new product bias on the CPI due to the late inclusion of VCRs exceeds the scope of this article.⁸ However, acknowledging this “new product” bias, especially in the context of the “product cycle” helps to distinguish this type of bias from the “quality change” bias that is the subject of this article. Quality change bias occurs when new models of an old product appear in the marketplace and have valuable improvements. The challenge for the CPI is to factor out the value of the improvements while still capturing any price changes. BLS experience with measuring price change indicates that the time when new models appear in the marketplace is likely to be the time when price change occurs.

Mathew Shapiro and David Wilcox called the job of estimating the price change associated with a corresponding quality change for a new or evolving good or service as the “house-to-house combat of price measurement” because each situation requires special and continuing attention.⁹ A critical element in distinguishing new products from enhanced products is to evaluate how unique their characteristics (or service or both characteristics and service to the consumer) are from previous products.

History of the VCR

The idea of a videocassette was first proposed by Koichi Tsunoda, a Sony engineer, in 1964.¹⁰ With the development of this new consumer product came both marketing and legal issues. The first question was whether consumers were interested in being able to tape television programs. There were also judicial issues about whether it was legal to record copyrighted programs off the air. In spite of these issues, several companies raced to bring some sort of home recording system to market.

Tale of two formats. In February 1975, Sony introduced the first Betamax in the United States, telling consumers, “Now you don’t have to miss Kojak because you’re watching Columbo (or vice versa).”¹¹ And two movie studios, Disney and Universal, sued, claiming that home recording constituted copyright infringement. The Home Recording Rights Coalition, under Gary Shapiro, fought for consumers’ rights to copy copyrighted materials for their own use. It was a battle that would rage in the courts and the Congress for years. As the VCR became prevalent, however, both the legislative and judiciary branches bowed to its benefits. Ironically, home video has become a major profit center for the studios that once considered the VCR a threat.

It was clear by the mid-1970s that videocassettes were go-

ing to bring video recording to the home. Two companies were competing to develop a working videocassette recorder—Sony, with its Beta system, and JVC with its Video Home System, better known as VHS, developed by chief engineers Yuma Shiraishi and Shizuo Takano under the tutelage of cathode ray tube pioneer Dr. Kenjiro Takayanagi. Konosuke Matsushita, founder of Matsushita, JVCs parent company, tried to mediate and get the two companies to agree on a single format, but failed.

Two years after the Betamax was introduced, in October 1977, RCA unveiled its Matsushita-made VHS SelectaVision VCR. RCA marketing executive Jack Sauter made sure that each machine was packed with prerecorded tapes, including one of Muhammad Ali’s greatest fights, and backed the introduction with a \$4 million advertising campaign. In 6 months, the VCR format war was practically over. The VHS machines, which could record for 4 hours—enough for an entire football game—caught and passed Beta as the video-recording format of choice. By the summer of 1979, VHS was outselling Beta by a margin of 2 to 1.

Over the next 5 years, as advancements such as front-loading, remote controls, and hi-fi stereo were added, the VCR became the most important consumer electronics invention since the television itself. By the early 1990s, the combination of hi-fi stereo, videocassettes, large-screen TVs, and Dolby surround sound technology came to be known as home theater and allowed consumers to enjoy a movie theater experience in their own living rooms.

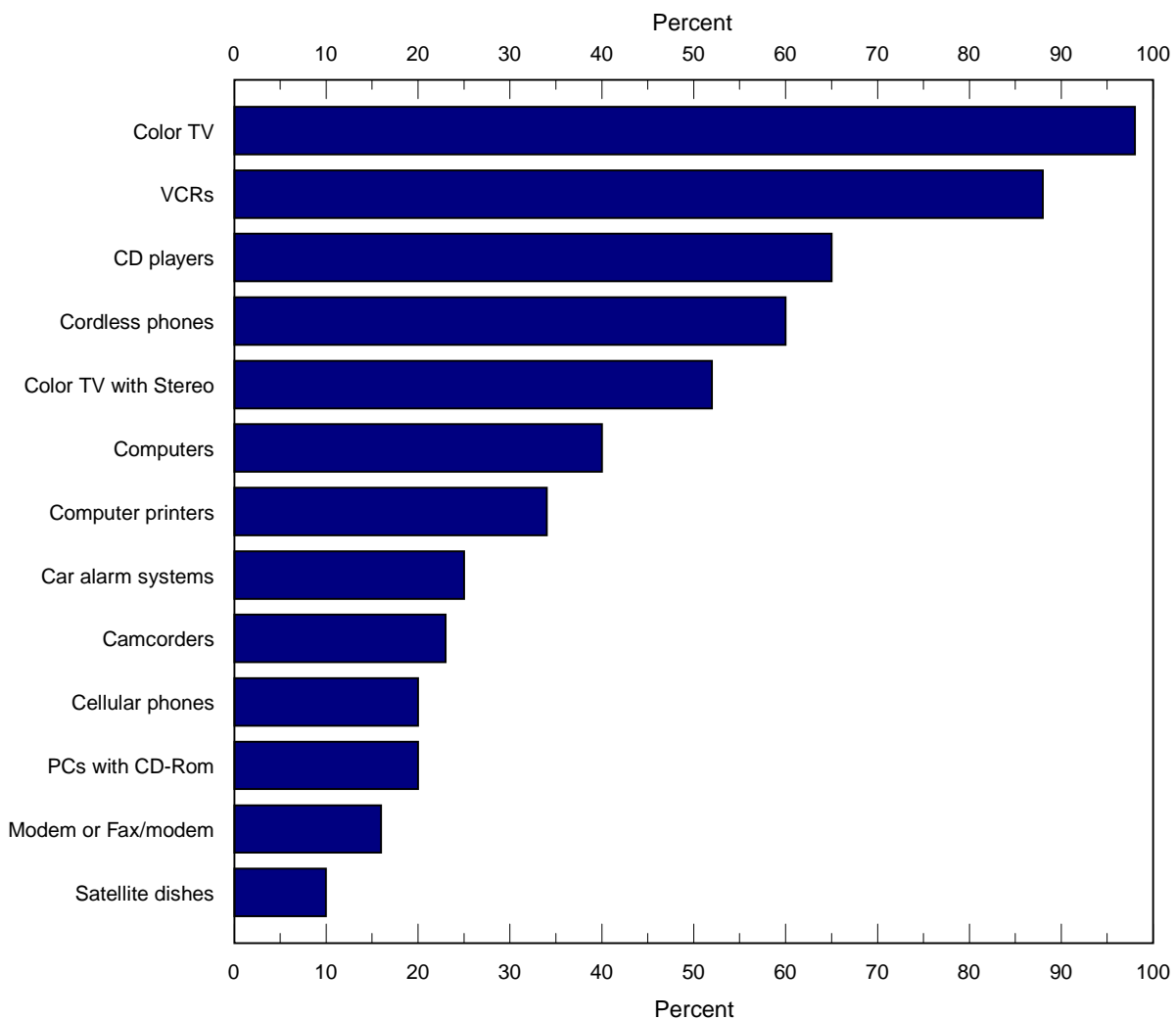
Old item with new features. There is little doubt that the price index literature refers to the VCR as an example of a new product for which the CPI missed price change during its introduction to the marketplace.¹² However, VCRs are no longer “new” goods. The Consumer Electronics Manufacturers Association estimates that as of January 1997, 89 percent of U.S. households own (at least) one VCR.¹³ (See chart 1.) Also, the 1998 *Consumers Digest* notes that:

it’s not uncommon to find a VCR almost everywhere in a home where there’s a television...manufacturers have learned to make a leaner, meaner machine that costs less but delivers more features. Today’s VCRs usually cost no more than \$300; most are in the under-\$200 price range, which has helped fuel multiple-VCR ownership.¹⁴

Consequently, with respect to today’s VCRs, the CPI faces the ‘quality change’ problem rather than the “new product” problem.

As indicated previously, the hedonic technique is used to quality-adjust VCR (substitution) price changes to determine what difference, if any, exists between a quality-adjusted CPI for *Video Products Other Than Televisions* and the official published CPI (without quality adjustments). In addition to

Chart 1. Percent of all U.S. households with selected consumer electronics products, January 1997



SOURCE: Consumer Electronics & the U.S. Economy: Consumer Electronics Manufacturers Association, Arlington, VA.

quality adjustment, there are other ways in which the results from hedonic regression analysis are used to improve the CPI. These uses include enhanced judgment by BLS economists when deciding how to use (substitution) price change in the index and better design for data collection documents that seek to capture price-determining characteristics.¹⁵

In 1998, Alan Greenspan, chairman of the Federal Reserve, noted that:

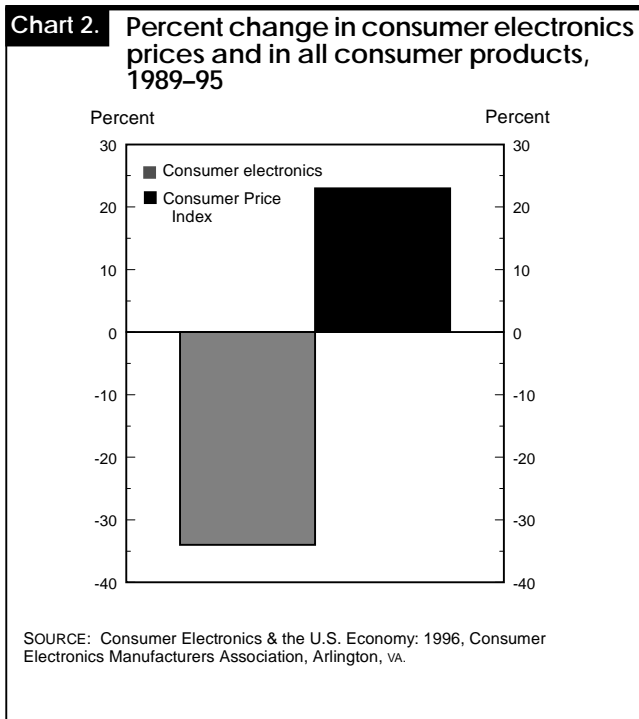
in recent years, we have developed an improved ability to capture quality differences by pricing the underlying characteristics of complex products. With an increasingly wide range of product variants available to the public, product characteristics are now bundled together in an enormous vari-

ety of combinations...In such an environment, when product characteristics are bundled together in so many different combinations, defining the unit of output means unbundling these characteristics, and pricing each of them separately. The so-called hedonic technique is designed to do precisely that. This technique associates changes in a product's price with changes in product characteristics. It therefore allows a quality comparison when new products with improved (different) characteristics are introduced...But hedonics are by no means a panacea. First of all, this technique obviously will be of no use in valuing the quality of an entirely new product that has fundamentally different characteristics from its predecessors...In addition, the measured characteristics may only be proxies for the overall performance that consumers ultimately value.¹⁶

VCR prices in the CPI

Since January 1989, the Consumer Price Index for *Video Products Other Than Televisions* has reflected price change for VCRs. Other products included in this index component are video disc players, video cameras/camcorders, video accessories (such as head cleaning cassettes, and camcorder carrying cases), blank videocassettes and discs, prerecorded video cassettes and discs, video game hardware, video game software, and video game accessories.¹⁷ Both VCRs and video cassette players are included in our study. For the 9-year period from December 1988 through December 1997, the Consumer Price Index for *Video Products Other Than Televisions* declined 38.7 percent, averaging about a 4.3-percent decline per year. The Consumer Electronics Manufacturers Association estimates that during the 1989–95 period, consumer electronic prices declined 34 percent, compared with a 23-percent increase for all consumer products. (See chart 2.) While that price change estimate for consumer electronics encompasses more goods than the CPI's *Video Products Other Than Televisions* index, it is interesting to note the similarity in price measures, especially because the CPI component index declined 32.9 percent for the same period.

This article focuses on the 1997 differences between quality-adjusted indexes that we constructed and the published official CPI indexes for *Video Products Other Than Televisions*.



Over the 12-month period in 1997, 683 prices were collected to compute monthly price indexes for the *Video Products Other Than Televisions* item stratum. Many of the prices were for the same cross section of items. CPI data collectors are instructed to try and collect prices for the exact item they were pricing in the previous collection period. If the data collectors are unable to find the same item, they are instructed to substitute to a new item. On average, about 57 price observations were used each month to calculate the CPI for *Video Products Other Than Televisions*.¹⁸ Of the 683 prices collected, 204, or approximately 29.9 percent of the total, were for VCRs. The remaining 70.1 percent of the total were other goods, such as camcorders, and video game hardware. Substitution price quotes accounted for 15.8 percent of the total price changes used to compute the *Video Products Other Than Televisions* indexes. About 41.7 percent, or 45 substitutions, reflected price change for VCRs. The remaining 58.3 percent, or 63 substitutions included the “other consumer electronic goods” that also are represented in the *Video Products Other Than Televisions* item stratum. Various methods that BLS employs for handling item substitution price change are described in appendix 1.¹⁹

All VCR substitution price changes used either the “comparable items” or “class-mean imputation” methods to compute the official published indexes for *Video Products Other Than Televisions* because the “direct-quality adjustment method” was not available for VCR substitution price changes in 1997 (a hedonic model was not employed then and there was no other way to estimate the value of improvements). In particular, of the 45 substitution price changes collected for VCRs in 1997, approximately 67 percent (30 substitution price changes), were reflected in the index using the “comparable items” method. The remaining 33 percent (or 15 substitution price changes) were included for index calculation via the “class-mean imputation” method. The average, or mean, price change for the “comparable items” was -1.4 percent and -0.5 percent for “class-mean imputation” groups of VCR substitutions.

The number of VCR substitutions and the method of item-replacement treatment they received in the (published) *Video Products Other Than Televisions* indexes during 1997 is important in this study because *only these price changes* will be eligible for hedonic adjustment in the quality adjusted indexes. Of the 683 price quotes collected to compute monthly price indexes for the *Video Products Other Than Televisions* stratum in 1997, only 45 VCR substitution price changes are eligible for hedonic quality adjustments. Given the heterogeneity of this item stratum and the fact that only 6.6 percent of the quotes will be eligible for hedonic quality adjustments, expectations of substantial index impact after quality adjustment should be low.

VCR regression data and model results

The data for the VCR regression model were obtained from the

Consumers Digest 1998 Annual Buying Guide published in December 1997. CPI data for VCRs could not be used in this study; the 1997 CPI sample was insufficient for model estimation because it contained only 35 to 40 VCR observations. The Consumers Digest data provided list prices and specifications for 25 different VCR brands and 213 unique brand/model combinations.²⁰ There were approximately 30 specifications used to describe the various VCRs. The initial sample comprised 213 total observations. Digital versatile disk (DVD) players, power cinema VCRs, superbeta VCRs, 8mm VCRs, and digital VCRs were all deleted from the CD data due to small sample sizes and lack of characteristic data. Observations that did not have a reported list price were deleted from the CD data except in instances in which list prices were obtained from the manufacturer.

The final data set contained 176 observations. The majority of the data, approximately 85 percent, consisted of video home systems (VHS) VCRs. The remaining formats were distributed between VHS players, dualdeck VCRs, quasi-super-VHS (S-VHS) VCRs, S-VHS VCRs and multiformat converter system VCRs. VHS players were included in the data set because they are grouped with VHS VCRs by the electronic industry and share several characteristics. An important price factor for VCRs is the number of video heads they contain. The majority of the data set included VCRs with four video heads and a small number had two or six video heads. VHS VCRs with four video heads were designated as base variables because they represented the majority. The remainder of the characteristics ranged from automatic head cleaners to special effect features. (For a complete list of the characteristics, see the box.)

The final model was specified in the semilog form, which uses the logarithm of list price as the dependent variable. Table 1 shows the results of the model.

The magnitude and direction of parameter estimates for the types of VCRs were consistent with *a priori* expectations. With VHS VCRs as the base variable, the parameter estimate for VHS players was negative indicating negative influence on price. Quasi-S-VHS VCRs, which attempt to simulate S-VHS VCR, rank above VHS VCRs and below S-VHS VCRs. However, the significance was marginal. The types of VCRs with the largest influence on price were S-VHS VCRs, which produce superior resolution than normal VHS; dual deck VCRs, which contain two tape drives; and multiformat converter system VCRs, which play both Phase Alternate Line (PAL) and National Television Systems Committee (NTSC) tape formats.

In the electronics' market, brand plays an important role as a price factor. Higher end brands typically contain more cutting edge technology. Also, greater marketing costs to achieve positive brand recognition among consumers could lead these brands to be more expensive. Several brands were found to be price factors for VCRs. Marantz, an upscale brand, which positions itself as a technologic leader, registered the largest brand parameter estimate. We collapsed Sony, Mitsubishi,

VCR characteristics, 1997	
Ac/dc	Index plus
Audio receiver (built-in)	Index search
Automatic head cleaner	Model number
Automatic rewind	Number of heads
Brand	Number of programmable events
Cable channel changer	On-screen programming
Child channel lock	Parental control feature
Commercial advance	Remote
Commercial skip	Skip search
Dolby digital	Special effect feature
DSS receiver	StarSight [®] on screen programming guide
Edit feature	VCR plus
Flying head feature	
Hi-fi	

SOURCE: *Consumers Digest*, "1998 Annual Buying Guide," Consumers Digest Incorporated, December 1997, pp. 81-83.

and Toshiba into a single variable after testing the restriction that the individual parameter estimates for each of these brands were equivalent via an *F*-test.²¹ Likewise, Funai, Phillips, and Symphonic were combined into a single variable after using an *F*-test to determine whether the parameter estimate for each brand was equivalent.

Among the other price determining characteristics, the latest cutting edge features were the largest price determinants. For instance, StarSight[®], exhibited one of the largest parameter estimates. According to a StarSight Telecast Inc., StarSight[®] is a new VCR feature which provides an "on-screen TV program guide with one-button VCR programming." Another recent advancement in the VCR market, the six-video-head VHS VCR, was also one of the larger price determinants according to the regression results. Features that have been on the market for a while were less price-determining than the newer features. For instance, hi-fi stereo is a highly recommended feature by various VCR consumer guides. However, because this feature was found on virtually every VCR in the mid-price range and above, it was not one of the strongest price determinants. Likewise, VCR plus is a desirable feature because it eases the programming function for timer recordings, but its parameter estimate was only moderate due to the amount of time it has been on the market.

Table 1. Regression results of VCR specifications and list prices, 1997

Variable name	Parameter estimate	Standard error	t-statistic
Intercept	5.12849	0.02864	179.013
Type:			
VHS player	-.13886	.04549	-3.053
VHS	Base		
Quasi s-VHS .....	.09705	.05171	1.877
s-VHS .....	.71605	.04288	16.697
Dual deck VCR .....	.89027	.05173	17.211
Multi format converter	1.38890	.10721	12.955
Brand:			
Marantz .....	.59280	.07768	7.445
Sony/Toshiba/Mitsubishi ....	.22754	.30102	7.559
Proscan .....	.15815	.06767	2.337
Other brands not listed	Base		
Funai/Phillips/Symphonic ..	-.17155	.02938	-5.839
Samsung	-.23819	.04137	-5.757
Number of video heads:			
Two heads	-.10864	.03149	-3.449
Four heads	Base		
Six heads .....	.48777	.07768	6.279
Features:			
Auto rewind .....	.12569	.02132	5.895
Cable channel changer .....	.12856	.02320	5.540
Child lock .....	.03977	.01987	2.002
Commercial advance .....	.17805	.03023	5.889
Commercial skip .....	.11848	.02495	4.748
Flying head edit feature .....	.27088	.03593	7.539
Automatic head cleaner .....	.03369	.02242	1.503
Hi-fi stereo .....	.19133	.02050	9.333
Index plus .....	.25869	.10981	2.356
Skip search .....	.17100	.02449	6.988
Starsightâ .....	.56336	.05974	9.431
VCR plus .....	.12219	.02207	5.537

NOTE: $N = 176$; $R^2 = 0.9581$; Adjusted $R^2 = 0.9514$; F -statistic = 143.746.

The automatic head cleaner is an example of a desirable VCR feature that was not significant according to the t -statistic. This is not a standard feature for VCRs although it appeared in 45 percent of the data set used in the model. *Consumers Digest* reported that this feature is “simple to implement” by manufacturers. Among other desired characteristics which were not found to be price determinants were remote controls and on-screen programming. Both these features were in 98 percent of the data set. Although these features are valued by the consumer, they were not price determinants because virtually all VCRs in this data set had remote controls and on-screen programming.

An experimental model was specified using the number of features as a single explanatory variable and logarithm of list price as the dependent variable. The number of features variable was created by adding together the characteristic specifications provided by the data in *Consumers Digest* (excluding type and number of video-head variables). The results of this regression model are illustrated in the following tabulation. According to the model, each additional feature adds

\$0.175 for each \$1.00 of the VCR price (note, $e^{(0.16117)} - 1 = 0.175$):

Variable name	Parameter estimate	T-statistic
Intercept	4.61823	61.145
Number of features .....	.16117	14.664

$N = 176$; $R^2 = 0.5527$; Adjusted $R^2 = 0.5502$; F -statistic = 215.021

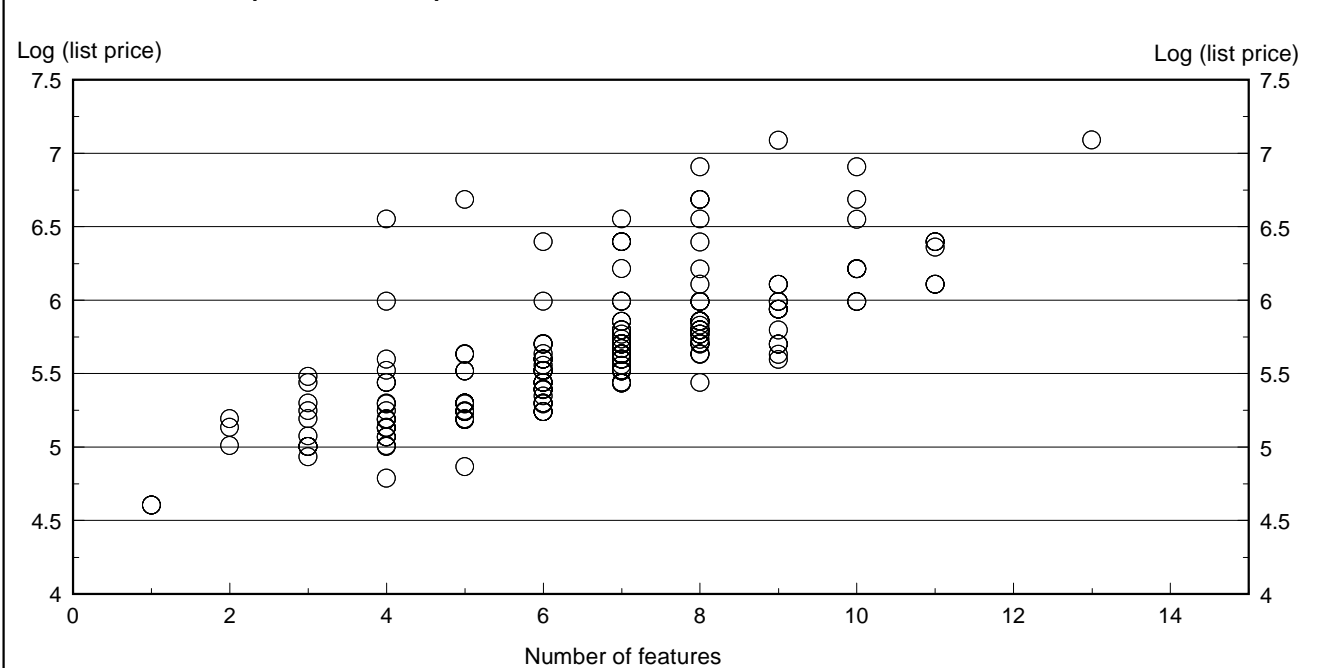
Chart 3 shows the relation between the log of price and the number of features. Also, it exemplifies that those VCRs which are fully loaded are generally more expensive, despite the type of VCR.

However, the number of features variable could not be included in the final model as it was highly correlated with other variables. Also, using dummy variables for the actual features provided a model with more explanatory strength according to the R -squared value.

The final model was examined for multicollinearity via the tolerance statistic. Although this is a common problem with hedonic regressions, no evidence of multicollinearity was found.

The specification for the final VCR regression model was deemed satisfactory, primarily because the magnitude and direction of the parameter estimates matched *a priori* expectations. The high R -squared value further validates model specification. However, additional data could be utilized to improve the model for future use. For example, data could be obtained from manufacturers, which were not included in *Consumers Digest*. Future hedonic models should include CPI data, but the difficulties with this data (for example, “several variables on the checklist appeared to be recorded incompletely or, in some cases, inaccurately”) would have to be addressed.²² There are also other price factors, which were not captured by *Consumers Digest* or the CPI; for instance, country of origin, quality of remote controls, and warranty information could all improve model specification. Also, obtaining more data for DVD players would allow these items to be included in the model and allow for quality adjustments between DVD players and VCRs.

Further research could help determine the stability of the regression model throughout time. Manufacturers typically introduce new products twice a year according to *Consumers Digest*. Because new products enter the retail market frequently, newer features also will be added frequently. The results of the model using the 1997 data indicate that the newest features have the greatest contribution on price, and, as features become more common they, in turn, become less price determining (for example, hi-fi and VCR plus). This leads to doubts that this model would be stable over time. New technologic advances in the home video market would further

Chart 3. Relationship between list price and number of features for video cassette recorders

SOURCE: "1998 Annual Buying Guide," *Consumers Digest*, Consumers Digest Incorporated, December 1997, pp. 81-83.

exacerbate the instability of the VCR model and, of course, would not provide estimates of the value of the latest features. Consequently, to make quality-adjusting VCRs a permanent part of the CPI, we would have to recalculate the hedonic models fairly frequently.

Quality adjusted versus official indexes

To determine the impact of quality-adjusted VCR substitution price changes on the official CPI for *Video Products Other Than Televisions*, we simulated monthly price indexes for calendar year 1997. First, we recreated the published indexes, that is, without quality-adjustment indexes, using Statistical Analysis System (SAS) computer programs with historical CPI data. The duplication of the published indexes provides a "control" environment from which the quality-adjusted *Video Products Other Than Televisions* indexes can be compared. Index price changes for the U.S. city level, such as those examined in this study, were obtained by summing price changes over all (elementary) index areas using aggregation weights derived from the Consumer Expenditure Survey. The results of the index simulation, with and without hedonic quality adjustments, are presented in table 2. In addition, graphical representations of the simulated price indexes for *Video Products Other*

Than Televisions are presented in charts 4 and 5.

Review of the empirical results referenced earlier reveals that there are only small differences between the annual and 1-month measures of price change for the published and quality-adjusted *Video Products Other Than Televisions* indexes. In particular, during the 12-month period from December 1996 to December 1997, price change for the published, or without quality adjustments, index series was down 8.1 percent, while the with-quality adjustments indexes fell 8.0 percent for the same time period. These annual inflation results for the *Video Products Other Than Televisions* component indicate that the published index is essentially the same as our quality adjusted index; if anything, the published CPI index (slightly) *understated*, rather than overstated, average price change for VCRs when quality differences due to item substitutions are taken into account. This is a surprising result given that the Boskin Commission and other critics of the CPI have targeted the area of "high-tech consumer goods" as an area in which BLS overestimates price change due to quality change. However, if one views the VCR market as having moved from the area of high-tech innovation to the area of standard home appliance, this result may not be so surprising. Indeed, the market may have moved to somewhere in the middle of the trough of the "U" curve referenced earlier, making *a priori*

Chart 4. Consumer Price Index levels for video products other than televisions, with and without hedonic quality adjustments, December 1996–97

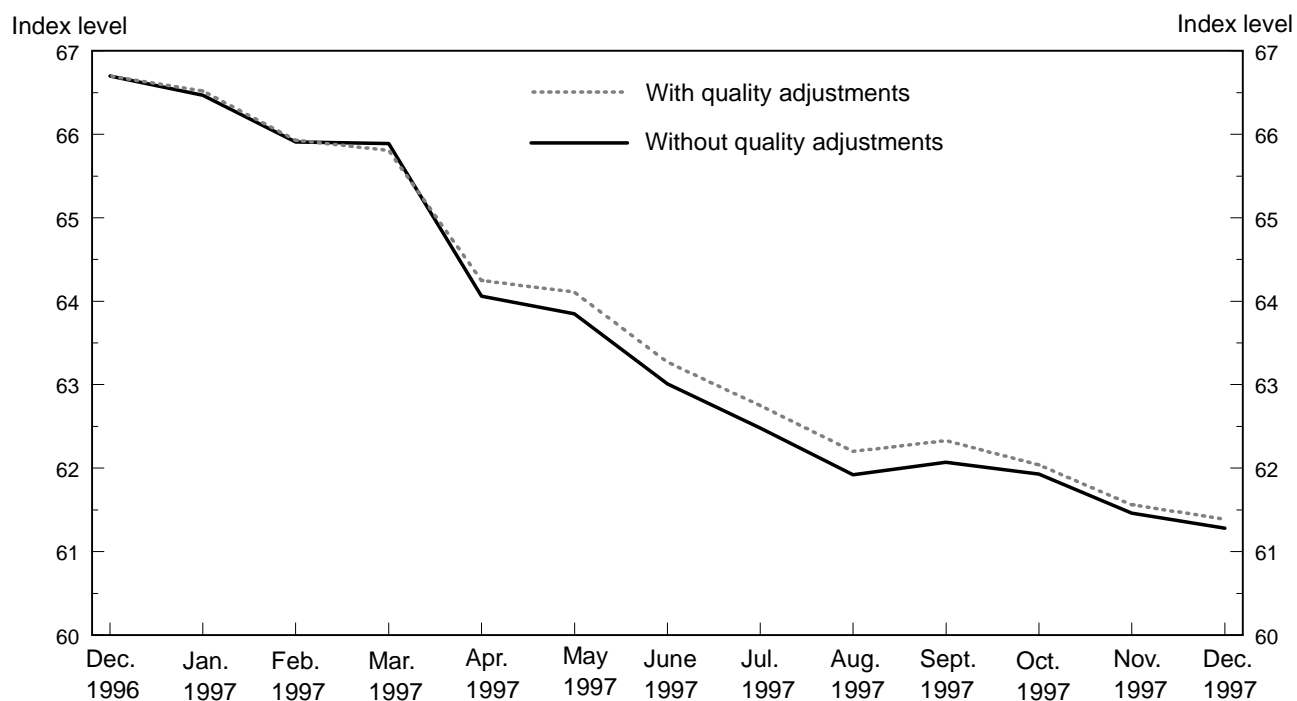
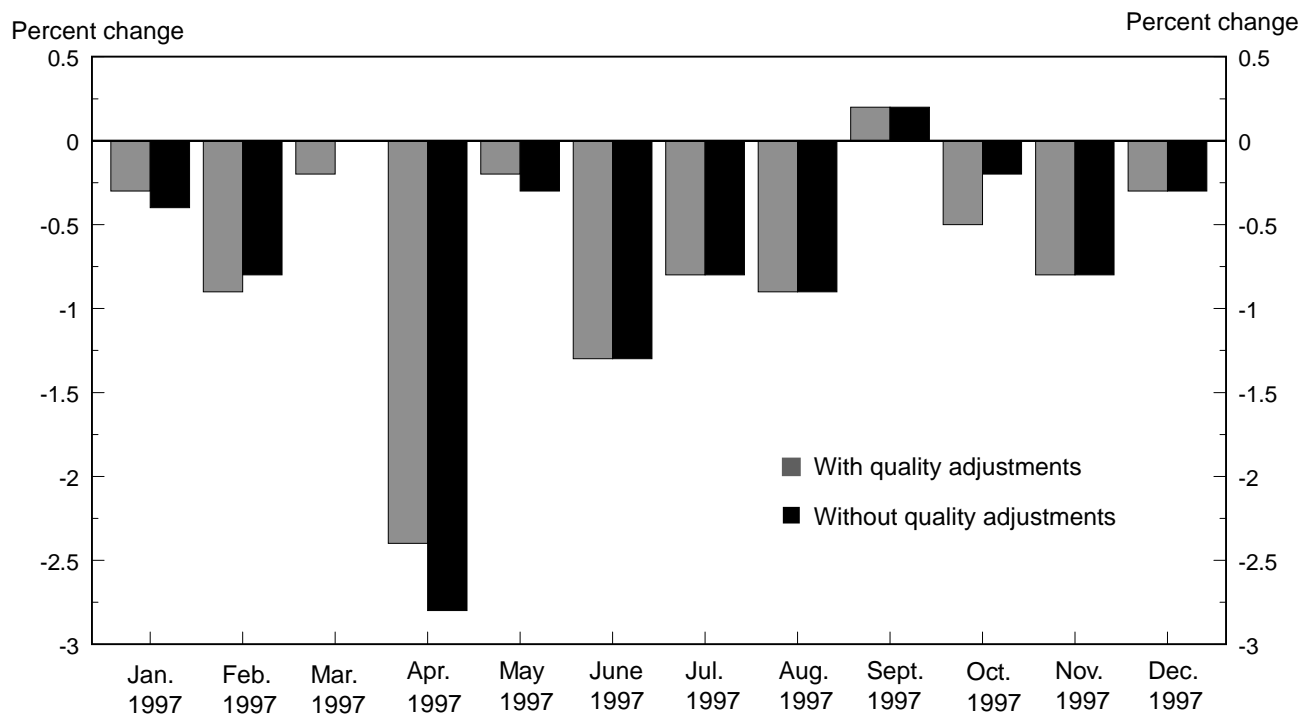


Chart 5. Consumer Price Index levels for video products other than televisions, with and without hedonic quality adjustments, December 1996–97



judgment more difficult.

Chart 5 illustrates the differences between the official published and quality adjusted indexes on a monthly basis. For 6 of the 12 months in the study (June, July, August, September, November, and December), there were no differences between the 1-month percent index changes for the published and quality-adjusted indexes. In the months of January, April, and May, the published measure of price change for *Video Products Other Than Televisions* fell more rapidly than the indexes incorporating hedonic quality adjustments. In the remaining months of the study (February, March, and October), the 1-month measures of price change for the published indexes did not fall as rapidly as the quality-adjusted *Video Products Other Than Televisions* indexes.

As noted earlier, the number of VCR substitutions and the method of item-replacement treatment they received in the (published) *Video Products Other Than Televisions* indexes during 1997 is important in this study because *only these price changes* will be eligible for hedonic adjustment in the quality-adjusted indexes. In particular, the composition of VCR substitution quotes in the hedonic adjusted indexes show that 93 percent of the price changes are using either the “comparable items” or “direct quality-adjustment” methods for including price change in the index. This 93-percent comparability ratio (the ratio of VCR substitute quotes reflecting (nonimputed) pure price change to the total number of VCR substitute quotes) in the quality-adjusted indexes is up from a 67-percent comparability ratio in the published indexes. While the “class-mean imputation” method represents an improved way

to capture pure price change for noncomparable substitutions in the CPI, direct comparison of quality-adjusted substitution prices is a preferred measure of pure price change.

Also noted earlier, the average (or mean) price change for the groups of VCR substitutions in the published indexes was -1.4 percent for the “comparable items” and -0.5 for the “class-mean imputation.” In contrast, the mean price changes for VCR substitute quotes in the quality adjusted indexes were -0.2 percent for “comparable items,” -4.5 for “direct quality adjustment,” and 1.9 percent for “class-mean imputation” groups. The mean price change of the VCR substitutions that employed the “direct quality adjustment” method was -5.6 percent prior to hedonic adjustment. These results indicate that substitutions that were adjusted for quality changes using the hedonic technique, reflected on average, smaller price declines than they did in the published indexes. The mean price changes for the “comparable items” and “class-mean imputation” groups of VCR substitute quotes also fell less rapidly after hedonic adjustment than in the published indexes. Given that many of the critics of the CPI claim that BLS is overstating price change for “high-tech consumer goods,” what do the empirical results of this study imply?

CPI data collection procedures instruct BLS field economists to choose (when the item they had been pricing is no longer available in a retail outlet assigned for it) the most similar substitution available in that outlet. Of all the VCR substitution price quotes in the 1997 CPI sample that were identified (in this study) for possible hedonic adjustment, more than 60 percent of these price quotes reflected changes only in model number, with no other observable difference in characteristics from the discontinued to the replacement item. Since model number is a specification on the CPI data collection document for VCRs, BLS field economists were required to substitute to the most similar item available in the outlet when the particular VCR (defined by model number) they were pricing became unavailable.²³ The mean price change for VCR substitution price quotes that reflect only a change in model number is 0.2 percent.

Thirty-eight percent of the VCR substitution price quotes in this study reflect changes in *bona fide* characteristics from the discontinued item to the replacement item. Most of these VCR substitute price changes were included in the published index using the “class-mean imputation” method. The mean price changes for this group of VCR substitutions were -4.9 percent for before hedonic quality adjustment and -4.4 percent for after hedonic quality adjustment. Given that the BLS criteria for substitution pricing is to choose the most similar item available in the observation’s retail outlet, as opposed to the most technologically advanced or newest model, in many cases, the 1997 VCR substitutes that reflected *bona fide* changes in characteristics did not experience an increase in quality.

Table 2. U.S. level price relatives, indexes, and index percent changes for *Video Products Other Than Televisions*, 1997

Month	Without quality adjustments			With quality adjustments		
	Price relatives	Indexes	One-month percent change	Price relatives	Indexes	One-month percent change
1996						
December .....	...	66.70	...	...	66.70	...
1997						
January	0.996495	66.47	-0.4	0.997230	66.52	-0.3
February .....	.991641	65.91	-.8	.991187	65.93	-.9
March .....	.999727	65.89	.0	.998188	65.81	-.2
April .....	.972219	64.06	-2.8	.976297	64.25	-2.4
May .....	.996699	63.85	-.3	.997867	64.11	-.2
June .....	.986898	63.01	-1.3	.986898	63.27	-1.3
July .....	.991537	62.48	-.8	.991751	62.75	-.8
August .....	.991089	61.92	-.9	.991224	62.20	-.9
September ...	1.002420	62.07	.2	1.002150	62.33	.2
October .....	.997660	61.93	-.2	.995240	62.04	-.5
November .....	.992362	61.46	-.8	.992362	61.56	-.8
December .....	.997143	61.28	-.3	.997143	61.39	-.3

NOTE: The *Video Products Other Than Televisions* is classified as CPI item RA03.

The 12-month percent change for December 1997 is -8.1 and -8.0 for without and with quality-adjusted indexes, respectively.

Conclusions

This article suggests that there may be no “fruits” to be harvested from the use of hedonic quality adjustment techniques to combat the problem of quality change when (high-tech) consumer goods, included in the CPI sample, are replaced in the marketplace. The use of the hedonic technique in this study to quality adjust VCR substitution price changes has reflected a minimal index impact when these quality-adjusted price changes were included for index estimation. Other BLS researchers have obtained similar results using the hedonic technique for high-tech electronic goods. In particular, Brent R. Moulton, Timothy LaFleur, and Karin E. Moses quality-adjusted more than 400 television substitution price changes using the hedonic technique and found that their indexes *fell* 0.4 percent more than the published CPI for televisions over the 4-year period (from August 1993 through August 1997). Thus, the television and VCR studies are similar in that both are reflecting about a 0.1-percent difference between (annual) index changes for the quality-adjusted and published series. These two studies differ in that the quality-adjusted indexes *fell more rapidly* than the published indexes in the case of televisions, while the quality-adjusted indexes *fell less rapidly* than the published indexes in the case of VCRs.

The empirical results for VCRs in this study are somewhat surprising because many critics of the CPI believe that BLS is not adequately reflecting price declines in the consumer price indexes for high-tech consumer goods. Two factors may account for the empirical results reported on in this study of VCR price change.

First, the small number of VCR substitution price quotes that were adjusted for quality differences in this study may have been too few to make a (significant) impact on the *Video Products Other Than Televisions* indexes in 1997. VCR substitution price quotes accounted for 6.6 percent of the 1997 CPI sample for *Video Products Other Than Televisions* and about 25 percent of these VCR substitutions had their price changes adjusted using the hedonic technique. Because other products, such as camcorders, are priced in this CPI stratum, a (potentially) bigger quality adjustment effect may have been realized but, unfortunately, there were insufficient resources available for this study to develop additional he-

donic regression models for these other products.

And second, because BLS procedures encourage BLS field economists to select replacement items that are similar in quality, fewer *bona fide* characteristic changes between VCR substitutes occurred than might have occurred if the procedures had instructed field economists to collect (substitute item) data for the most technologically advanced VCRs. This is an important factor in developing expectations as to the direction and magnitude of quality adjusted indexes for (high-tech) consumer goods when comparing these indexes with the published indexes. Certainly, if the BLS field economists were consistently substituting to more technologically advanced (VCR) products, the indexes for which these items are priced would be expected to reflect greater (quality adjusted) price changes.

BLS plans to expand the use of hedonic quality-adjustment methods and to reduce its reliance on linking methods for categories in which new models are likely to show important quality change.²⁴ (See appendix 2.) Pricing and characteristic data for samples of about 2,500 items will be collected. BLS also will collect more targeted item samples in dynamic market segments to identify new goods “as they appear in the marketplace” and to obtain the price of these goods.²⁵

The empirical results from this study reflect minimal index impact on the 1997 quality adjusted indexes for Video Products Other Than Televisions, though two mitigating factors may be responsible for these results. The BLS expansion of hedonic techniques and collection of augmented item samples in dynamic market segments might help alleviate problems associated with the “new product” and “quality change” biases.

Focusing on the *Appliances, Including Consumer Electronics* component of the CPI would require applying the hedonic modeling and quality adjusting techniques to many different products that are priced in the CPI.²⁶ (See appendix 3, which lists many of these products that are priced in the *Appliances, Including Consumer Electronics* component of the CPI along with their calendar year 1998 sample and substitution counts.) These sample counts reflect price quote allocation based on the 1998 revision using expenditure patterns for calendar years 1993–95.) Many of these products currently have insufficient sample sizes to develop reliable hedonic regression models. □

Notes

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¹ The phrase, “low hanging fruit,” was first used in connection with the CPI by Matthew D. Shapiro and David W. Wilcox (1997), and

conveys the notion of using superlative price indexes to calculate aggregate consumer price indexes that are (virtually) free of across strata “substitution” bias. See Mathew D. Shapiro and David W. Wilcox, “Alternative Strategies for Aggregating Prices in the CPI,” *Federal Reserve Bank of St. Louis Review*, May/June 1997, pp. 113–25. Substitution bias is the failure to adjust for changes in consumer behavior in response to relative price changes. Brent R. Moulton and

Karin E. Moses (1997) used the phrase "low hanging fruit" to suggest how the application of hedonic quality adjustment methods for the appliances including consumer electronics component of the CPI may yield significant reductions in the 'quality change' bias. Quality change bias occurs when new models of an old product appear in the marketplace and have valuable improvements. See Brent R. Moulton and Karin E. Moses, "Addressing the Quality Change Issue in the Consumer Price Index," forthcoming in *Brookings Papers on Economic Activity 1997*, vol. 1.

² U.S. Senate, Committee on Finance, "Final Report of the Advisory Commission to Study the Consumer Price Index," S. Prt. 104-72 (Washington, U.S. Government Printing Office, December 1996).

³ "Measurement Issues In The Consumer Price Index," Prepared Response for Jim Saxton, Chairman of the Joint Economic Committee (Bureau of Labor Statistics, June 1997).

⁴ Though VCRs were included in the CPI effective with the January 1987 revision, BLS did not begin calculating a separate index for the *Video Products Other Than Televisions* component of the CPI until January 1989.

⁵ See Robert J. Gordon, "Measurement Errors in the CPI: Causes and Consequences" Testimony before Senate Finance Committee (U.S. Congress, March 1995), pp. 1-7; and Jerry Hausman, "Cellular Telephone: New Products and the CPI" NBER Working Paper No. 5982 (Cambridge, MA, National Bureau of Economic Research, 1997).

⁶ U.S. Senate, Committee on Finance, December 1996.

⁷ *Ibid.*

⁸ For a recent study on VCR quality-adjusted price indexes in the United States, see Hiroshi Ohashi, "Quality-Adjusted Price Indexes for Home Video Cassette Recorders in the U.S. 1978-1987," presented at the National Bureau of Economic Research, Inc., Summer Institute 1999.

A recent study by Ohashi (1999) examines quality adjusted price indexes for in the U.S. from 1978 to 1987. VCRs were introduced into the U.S. economy in the late 1970's.

⁹ Mathew Shapiro and David Wilcox, Shapiro, "Mismeasurement in the Consumer Price Index: An Evaluation," in Ben Bernanke and Julio Rotemberg, eds., *NBER Macroeconomics Annual 1996* (Cambridge, MA, MIT Press, 1996), pp. 93-142.

¹⁰ The Consumer Electronics Manufacturers Association provides a history of VCR development since its inception. See *The History and Technology of the VCR* (Arlington, VA, Consumer Electronics Manufacturers Association, January 1997).

¹¹ *Ibid.*

¹² In particular, see page 9 of Robert J. Gordon's (1995) "Measurement Errors in the CPI: Causes and Consequences" (U.S. Congress, testimony presented before the Senate Finance Committee, March 1995).

¹³ Consumer Electronics Manufacturers Association, "Industry Origins and History" (Arlington, VA, 1997).

¹⁴ *Consumers Digest*, "1998 Annual Buying Guide," Consumers Digest Incorporated, December 1997, pp. 81-83.

¹⁵ For information on these other uses of hedonic results, see Paul A. Armknecht and Donald Weyback, "Adjustments for Quality Change in the U.S. Consumer Price Index," *Journal of Official Statistics* 5, 1989, No. 2, pp. 107-23; also see Paul R. Liegey "Apparel Price Indexes: Effects of Hedonic Adjustment," *Monthly Labor Review*, May 1994, pp. 38-45.

¹⁶ Alan Greenspan, "Problems of Price Measurement," Remarks at the Annual Meeting of the AEA and the AFA (Chicago, IL, January 1998).

¹⁷ Effective with the January 1998 revision, the CPI for *Video Products Other Than Televisions* also includes satellite video products. In addition, the data collection documents used to collect specification

data for each of the consumer electronic products in this item stratum have been revised and used in the CPI since April 1999.

¹⁸ Since the January 1998 revision, the CPI sample for *Video Products Other Than Televisions* has increased to more than 250 price quotes used each month for index calculation at the U.S. level.

¹⁹ See Armknecht and Weyback, "Adjustments for Quality Change;" Marshall B. Reinsdorf, Paul Liegey, and Kenneth Stewart, "New Ways of Handling Quality Change in the U.S. Consumer Price Index," BLS working paper no. 276 (Bureau of Labor Statistics, 1996); Moulton and Moses, "Addressing the Quality Change Issue," 1997; and Brent R. Moulton, Timothy J. La Fleur, and Karin E. Moses, "Research On Improved Quality Adjustment in the CPI: The Case of Televisions," Proceedings of the Fourth Meeting of the International Working Group on Price Indices, U.S. Department of Labor, sponsored by the Bureau of Labor Statistics, January 1999, pp. 77-99.

²⁰ The authors acknowledge that the use of "list" versus "transaction" prices to develop the hedonic model for this article might be affecting our index simulation results. As noted in an earlier section of this article, the data for the VCR regression model were obtained from the *Consumers Digest 1998 Annual Buying Guide* published in December 1997. CPI data for VCRs could not be used in this study because a 1997 cross sectional sample was insufficient for model estimation (for example, approximately 35 to 40 VCR observations).

The theoretical implications of hedonic prices developed in market equilibrium are discussed in Sherwin Rosen, "Hedonic Prices and Implicit Markets," *Journal of Political Economy*, January-February 1974, pp. 34-55. Mary Kokoski commented to us that "since no one really pays list prices, do they (the results) really reflect the equilibrium assumptions that underlie the hedonic method?" The authors feel that the "list" prices reported in the *Consumer's Digest 1998 Annual Buying Guide* represent some set of transaction prices at some point in time. To the extent that these prices did not represent "true" transaction prices, we feel that the prices were "uniformly divergent" from their market values. In addition, we believe that if the "list" prices used in this article to develop the hedonic model, were "uniformly divergent" from their market or transaction values that the relative magnitudes and directions of the parameter estimates calculated above approximate some market equilibrium. Market equilibrium is empirically difficult to determine for those goods and services that experience rapid (price and quality) change.

We would like to emphasize that there is no consideration by BLS to use the model developed in this article to adjust the official index for this category of items. As noted in appendix 2, BLS will collect, in addition to what is used for index calculations, "transaction" price and specification data in fiscal year 1999 to develop hedonic models for a number of consumer electronic goods including VCRs.

²¹ Moulton and others, "Research On Improved Quality Adjustment in the CPI," 1999.

²² The difficulties with including CPI data are exposed in Moulton, and others, "Research On Improved Quality Adjustment in the CPI," 1999.

²³ A copy of this document is available upon request from the authors: Paul R. Liegey and Nicole Shepler, Bureau of Labor Statistics, 2 Massachusetts Ave., NE., Rm. 3260, Washington, DC 20212 or by e-mail: liegey_p@bls.gov or Shepler_N@bls.gov.

²⁴ Katharine G. Abraham, John S. Greenlees, and Brent R. Moulton, "Working to Improve the Consumer Price Index," *Journal of Economic Perspectives*, Winter 1998, pp. 27-36.

²⁵ *Ibid.*

²⁶ Upon request, researchers may obtain a list of many of these products that are priced in the *Appliances, Including Consumer Electronics* component of the CPI along with their calendar year 1998 sample and substitution counts. These sample counts reflect price quote allocation based on the 1998 CPI revision, using expenditure patterns for calendar years 1993-95. By e-mail contact liegey_p@bls.gov or send request to Paul R. Liegey, Bureau of Labor Statistics, Rm. 3260, 2 Massachusetts Ave., NE, Washington, DC 20212.

Appendix 1: Methods used by BLS for quality adjustment of item replacements

The following is a "heuristic description" of the methods BLS uses when handling item substitution.¹

1. Comparable items. In some cases, the commodity analyst examines the differences in between the two specifications and determines that the change did not result in a significant change in the quality of the item, so that the prices of the old version and the new version can be directly compared. Let $P_{t-1,i}^1$ denote the price in the previous period ($t - 1$) of the old version (denoted by superscript 1) of quote i and P_{ti}^2 denote the price in the current period (t) of its new version (2). This method counts the entire price difference, $P_{ti}^2 / P_{t-1,i}^1$, as part of inflation, i.e., no quality difference is attributed to the new version of the item. These comparable replacements would typically consist of pairs of versions that differ by minor changes in styling or other minor differences in characteristics that do not reflect quality differences.²

2. Overlap method. The second method is used when prices of the old version and the new version are both available during an overlap period so that the difference in price level between versions can be used as an estimate of the quality difference. The pure price change (or "price effect") prior to period t is measured by the price change of the old version, and the price change after period t is measured by the price change of the new version. The availability of an overlap-period price is relatively uncommon for item replacements, but an aggregate version of the overlap method is used when an entire CPI component sample is replaced during sample rotation. Both the old and new samples are collected during an overlap period t , and the old sample is used to measure the price change from $t - 1$ to t while the new sample is used to measure the price change from t to $t + 1$.

3. Link method. When items disappear, it is typically not detected until the item is no longer available at the sample outlet, so prices of the old and new versions are not available concurrently.

Consequently another method must be used to estimate the portion of the price difference that is attributable to inflation and the portion that is attributable to quality change. The link method first calculates the rate of inflation for the stratum during that month by omitting the item from the calculation of price change. For example, say that the inflation rate based on the other goods was 2 percent, but that the replacement version, when it appeared, cost 5 percent more than the earlier version. The link method effectively assumes that of the 5 percent, 2/5 was due to the overall rise in the price of goods, and the other 3/5 was due to a quality improvement. Notice that the estimated quality change is essentially a residual in this calculation.

4. Class-mean imputation method. A related method is *class-mean imputation*, which was introduced to the CPI new cars index in 1989, and to other items in 1992.³ Like the link method, this method also imputes a price change and treats the quality change as a residual. In this method, however, the price change is imputed from a set of similar items that are classified as comparable replacements or that are directly quality adjusted. This method is based on the assumption that the inflation occurring when a new model of an item replaces an earlier model is different from the inflation occurring when the model doesn't change.

5. Direct quality adjustment. These methods are applied when information is available for directly estimating the dollar value of the change in quality. Sometimes (especially in the cases of new and used cars and motor fuel) these come from information provided by manufacturers of the product on the cost of the quality improvement. In other cases the hedonic method is used to estimate the price-quality relationship from regressions of price on characteristics of the goods. The coefficients of these regressions are then used to infer the value of changes in characteristics of the goods in the sample. The CPI has used hedonic methods since 1988 for calculating the effects of depreciation and other housing characteristics on rent, and since 1991 for quality changes in apparel. For a direct quality adjustment, an adjustment is made to the period $t - 1$ price of the old item for the estimated value of the quality improvement embedded in the new item.

Notes to the Appendix

¹ Brent R. Moulton, Timothy J. LaFleur, and Karin E. Moses, "Research On Improved Quality Adjustment In the CPI: The Case of Televisions," Proceedings of the fourth meeting of the International Working Group on Price Indices (U.S. Department of Labor, sponsored by the Bureau of Labor Statistics, January 1999), pp. 77–99.

² The terminology used to describe the various methods of handling item substitutions is not standardized. We follow the terminology used by Paul A. Armknecht and Donald Weyback, see "Adjustments for Quality Change in the U.S. Consumer Price Index," *Journal of Official Statistics* 5 no. 2, pp. 107–23. The advisory commission and Jack E. Triplett use different terminology: "direct comparison" instead of "comparable," "linking" instead of "overlap method," and "deletion" instead of "link method;" the Advisory Commission report omits the relatively new "class-mean imputation" method. See

U.S. Senate, Committee on Finance, "Final Report of the Advisory Commission to Study the Consumer Price Index," S. Prt. 104–72 (Washington, Government Printing Office, 1996); and Jack E. Triplett, "Quality Bias in Price Indexes and New Methods of Quality Measurement, in Zvi Griliches, ed., *Price Indexes and Quality Change: Studies in New Methods of Measurement* (Cambridge, MA, Harvard University, 1971).

³ See Paul A. Armknecht, Walter F. Lane, and Kenneth J. Stewart, "New Products and the U.S. CPI, in Timothy F. Bresnahan and Robert J. Gordon, eds., *The Economics of New Goods* (Chicago, IL, University of Chicago Press, 1997) and Marshall B. Reinsdorf, Paul Liegey, and Kenneth Stewart, "New Ways of Handling Quality Change in the U.S. Consumer Price Index," BLS working paper no. 276 (Bureau of Labor Statistics, 1996).

Appendix 2: The 1999 hedonics project

Since the time that this study was conducted in early 1998, BLS has commenced a hedonics project as part of the fiscal year 1999 CPI Improvement Initiative. The CPI Improvement Initiative is an effort by the CPI program to use specially designated funds to expand the size of the Consumer Expenditure Survey, to quicken the updating of the CPI market basket, to collect additional information for hedonic modeling (to improve quality change measurements), to hasten the introduction of new products into the CPI, and to develop new superlative price measures that more closely approximate cost-of-living indexes.

Items selected

The particular commodity items selected for the fiscal year 1999 hedonics project were chosen with a few simple criteria in mind:

- A perception that there may be some quality bias in the items
- A belief that useful hedonic models can be developed for at least some subset of the items in the stratum
- A workable ratio of substitutions to price quotes

The CPI improvement initiative provides (hedonic) resources to collect two pricings of approximately 2,500 observations in current CPI outlets. These additional data are being used with current CPI production data to study the effects of different quality characteristics on prices. Eight item groups have been selected for collection and analysis in fiscal year 1999:

1. Telephones, including telephone/answering machine combinations;
2. Videocassette recorders (VCRs)
3. Digital versatile disk (DVD) players
4. Camcorders
5. Microwave ovens
6. Refrigerators
7. Washers
8. Dryers

The choice of products for the study was limited to a certain number of item strata. The strata available include a few products, which are currently marked by very rapid technological improvements, while some are undergoing slower development cycles. Much of this differential relates to where these products are in their development stream, some being fairly new and innovative (DVD players) and others having been on the market for some time (refrigerators and microwave ovens). Telephones are somewhere in between, having been around for a long time, but currently marked by important changes (the digital revolution in home-station portable phones). We hope to learn a great deal, not only about these particular products, but also about how much success we might expect in the future with other similar studies.

How the data will be collected

The 5,000 price quotes (2,500 x 2) collected in 1999 are being distributed among the eight item groups in order to have at least 500 quotes for each group after adding in the observations in the current CPI sample. Past experience and guidance from other senior researchers suggest that this is a workable set of data to use.

We have identified outlets around the country where we currently price these item strata. BLS economic assistants in the field have chosen the individual items according to a set of instructions for each item group in order to optimize the variety of items selected for pricing. The timing and procedures for collection of the data have been coordinated from the BLS Washington office.

Research using the data

The specification and price data that are being sent to the Washington office are being reviewed by the BLS economists with expertise in the particular commodity groups. The BLS economists are adding further detail to the specifications submitted by the field. This entails the use of secondary source information that may be difficult to collect in the outlet, but might be available through industry sources. The hedonic modeling itself is being undertaken by economists in the apparel section; these economists have a number of years of experience in these techniques. The results will be reviewed by researchers in the Division of Price Index Number Research for further enhancement. The modeling effort is designed to provide estimates of the values of the individual characteristics that are bundled together in a particular product. The modeling consists of many iterations of combining variables in different ways to yield results that satisfy both the commodity experts and the modeling experts. The goal is to provide Washington office economists with estimates of the value of quality changes in order to make price comparisons even when a substitute item is technically improved. This will permit constant-quality price comparisons that are very difficult to do, using our current methods.

Future work

After completing work on the items chosen for the first year's study we will do a comprehensive review of all CPI item strata to choose those items most likely to yield improvements. We then expect to schedule additional items for collection of special samples as has been done for the eight items in 1999. How many items can be selected in future years will, of course, be influenced by our experiences with the 1999 sample, including how much attention will have to be given to remodeling items on a regular basis. Our knowledge of apparel commodities suggests that stability of the characteristic values is relatively short, so we would expect items marked by rapid technological change to have even shorter time frames for stable estimates. In any case, we will need to reevaluate our strategy as we learn more about the results from the products selected for the initial year's work.

Note to the Appendix

¹The information in this appendix is from Charles Fortuna, "Hedonics Project on Quality Change," *Quality Quarterly; Internal BLS Newsletter*, Winter 1998–99, pp. 1–3.

Appendix 3: CPI sample composition for *Appliances, Including Electronic Equipment, 1998*

CPI expenditure classes, item strata, and, entry level item descriptions		Item codes	Products priced	Calendar year, 1998	
				Number of sample prices collected	Substitutions/ as a percent of prices collected
Information and information processing other than telephone services		EE		4,443	714 / 16.1
New	Personal computers and peripheral equipment	EE01		1,222	449 / 36.7
	Personal computers and peripheral equipment (69011)	EE011	Computer systems Computer components Peripheral equipment		
New	Computer software and accessories	EE02		1,285	141 / 11.0
	Computer software and accessories (69012)	EE021	Computer software Computer accessories		
New	Computer information processing services	EE03		823	7 / 0.9
	New entry level item Other information services (includes Internet, for example)	EE031	Online service company Internet service provider Local cable company Telephone company Bulletin board system		
New	Other information processing equipment	EE04		1,113	117 / 10.5
	Telephone, peripheral equipment and accessories (69013)	EE041	Telephones Answering machines Auto-dialers Cords, jacks, adapters	815	97 / 11.9
	Calculators, typewriters, and information processing equipment (69014)	EE042	Calculators Adding machines Typewriters	298	20 / 6.7
New	Unsampled information and information processing	EE09			
	New entry level item Unsampled retinal/repair of computer/telephone equipment	EE090			
Appliances					
New	Major appliances	HK		5,452	636 / 11.7
	Refrigerators and home freezers (30011)	HK011	Refrigerators Refrigerator-freezers	3,018 945	394 / 13.1 130 / 13.8
	New entry level item Washers and dryers (30021 + 30022)	HK012	Washers/Dryers	989	94 / 9.5
	Stoves and ovens, excluding microwave ovens (30031)	HK013	Stoves and ovens less microwave ovens	514	56 / 10.9
	Microwave ovens (30032)	HK014	Microwave ovens	570	114 / 20.0
New	Other appliances	HK02		2,434	242 / 9.9
	New entry level item Floor cleaning equipment (32051-sewing machines)	HK021	Vacuums Electric brooms Shop vacuums	636	56 / 8.8

CPI expenditure classes, item strata and, entry level item descriptions	Item codes	Products priced	Calendar year, 1998	
			Number of CPI sample prices collected	Substitutions/ as a percent of prices collected
New entry level item Small electric kitchen appliances (part of 32052)	HK022	Blenders Mixers Knives Can openers Broiler/roisseries Toaster ovens Toasters Coffee makers Irons Electric pots Waffle Irons Griddles Food warmers Bun warmers Hot trays Hot plates Corn poppers Ice cream freezers	772	59 / 7.6
New entry level item Other electric appliances (30034 + 69015 + part of 32052)	HK023	Fans Humidifiers Dehumidifiers Heaters Window air conditioners Alarms and detectors Intercoms Timers Remote control devices	1,026	127 / 12.4
New Unsamped appliances	HK09			
New entry level item Portable dishwashers (30033 + part of 34090 + possible future items)	HK090			
Video and audio	RA		15,359	1,488 / 9.7
Televisions (3101)	RA01		2,326	364 / 15.7
Televisions (31011)	RA011	Televisions		
Cable television (2703)	RA02		5,567	107 / 1.9
Community antenna or cable TV (27031)	RA021	Cable TV providers Satellite TV providers Community TV providers		
New Other video equipment	RA03		2,834	498 / 17.6
Other video equipment (31021)	RA031	VCRS Video disk players Camcorders Video accessories		
New Video cassettes, discs, and other media including rental	RA04		1,121	67 / 6.0
Videocassettes and discs, blank and prerecorded (31022)	RA041	Prerecorded video	441	44 / 10.0
New entry level item Rental of video tapes and discs (62055c2)	RA042	Video tape rental Video disc rental	680	23 / 3.4

CPI expenditure classes, item strata and, entry level item descriptions	Item codes	Products priced	Calendar year, 1998	
			Number of CPI sample prices collected	Substitutions/ as a percent of prices collected
Audio equipment (3103) New entry level item Audio components, radios, tape recorders/players, and other audio equipment (31031 + 31032 + 48021c6)	RA05 RA051	 Radio Phonographs Tape recorders Audio systems Audio components Audio accessories Automobile audio equipment	2,119	345 / 16.3
New Audio discs, tapes and other media Audio discs and tapes, prerecorded and blank (31033)	RA06 RA061	 Prerecorded cds Prerecorded records Prerecorded tapes Blank audio tapes	1,392	107 / 7.7
New Unsampler video and audio (3109 + 34061) New entry level item Unsampler items 31090 + 34061 + 34090 rent audio/video equipment)	RA09 RA090			