

# An hedonic analysis of American collectable comic-book prices

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**Abstract** A well-documented instance of the establishment and evolution of a modern market is that of the American collectable comic-book market. The development of this can be reliably traced from inception to the present day. A sample of 1,100 American collectable comic-books is subjected to an hedonic analysis to determine the relative contribution of pricing components (predictor variables) to the market price. Issues arising from the model's significance and predictive power are addressed in terms of provenance (path dependency of price). The history of the market is examined in terms of the dates by which predictive variables were introduced. The difficulty of obtaining a universal pricing rule is considered, and conclusions are drawn regarding the form and value of such a rule.

**Keywords** Hedonic analysis · Market model · Comic-books · Alternative investments · Long-term returns

**JEL Classification** G1 · Z11

## 1 Introduction

The establishment of specialist price guides in the 1970s enabled the development of the American comic-book as an investment. The study of such investments has received limited attention in the literature. The appreciation and inflation-hedging characteristics of comics were examined by Ang et al. (1982), since when the value of the market has considerably increased. GPA, the analysis and reporting service

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for online auction and dealer comic-book sales, reports on 894,371 sales, totalling \$190 Million (GPA 2009). High grade, rare and highly collected comics command prices normally reserved for the fine art market; Action Comics #1 was (July 2010) valued at \$750,000 in highest grade (Overstreet 2009), and a rare edition sold for \$1.5 million on 29 March 2010 (USA Today, 2010). Dewally and Ederington (2006) address the distribution of comic-book prices achieved in online auctions as a consequence of information asymmetry between buyer and seller. As such, they regress the prices of a small sample of comic-books against reputation, certification, warranty, information disclosure, grade, book (issue number) and reserve. The present study, by employing only industry standards [as quoted by Overstreet (2010)], assumes no asymmetry in information, addressing only the hedonic composition of a price.

Hedonic models have long been applied to the economics of new goods, having been established in Court's (1939) analysis of automobile prices as a means of deriving price as a function of the number and type of distinct utility-bearing characteristics possessed by the product. In addressing the same problem, Griliches (1961), while updating the data, follows Courts' procedures, indicating that Court effectively established the essential methodology. Rosen (1974) models product differentiation through their utility-bearing attributes, examining the mechanics of consumption and production decisions. Rosen's examination in terms of implicit markets has particular bearing on the present paper, in which a distinction is drawn between the market as experienced by collectors and that of speculators. An assumption of the present authors is that the same utility-bearing characteristics that attracted collectors are employed by speculators as measures of intrinsic worth, that is, of worth distinct from provenance. The market established for the convenience of collectors, therefore, is the same as that exploited by speculators; they are the same market implied by the recognition of these characteristics. Lazzaro (2006) addresses definitions of quality in the context of collectible goods; in the fine arts market, the concepts of collector and speculator have long been conflated. Quality in the comic-book market, as in that for fine art, accrues to particular names (artists) and genres, and the method used to quantify the utility accruing to these is original to this paper.

Roach and Wyburn (2009) model the development of the market through three stages, distinguished by pricing mechanism. For the purposes of the present paper, this may be summarised as:

- the new and second-hand market, in which a comic-book may be purchased for at most its cover price;
- the collectors' market, in which prices above the cover price are offered for personal reasons such as nostalgia and in which mechanisms for distribution and exchange become established and
- the speculators' market, in which a comic-book is purchased speculatively for its increasing value as an investment and in which the mechanisms originating in the collectors' market are formalised.

The "modern American comic-book", cheap (typically 10 cents) with relatively short page counts (typically 32–68 pages), low-quality printing in four colours and sold on newsstands, began only in late 1933 (Beerbohm and Olson 2009). The sale

of comics within a second-hand market is reported as beginning almost immediately, with a notable early dealer, Harvey T. “Pop” Hollinger, wholesaling second-hand comics at that time to other outlets such as cafes and food stores in parallel with the distribution of new comic-books (Hessee 1982). By the 1940s, early comic dealers began operating from book storefronts in many of the big cities in the US (Schelly 1999), selling comics alongside other paper goods, including paperbacks, magazines and pornographic material. Within this second-hand market, most comic-books were sold to children, but there are a small number of specific accounts of adult collectors, from across the US, visiting dealers’ stores in the 1940s and 1950s (Hessee 1982; Schelly 2003). Gradually, teenage and adult collectors began to offer to purchase comics, which met specific criteria, at greater than cover price [up to \$1 for a 10 cent comic (Forro 1996; Schelly 2003)]. The shift from isolated cases of paying high prices for old comics to more widespread acceptance of the practice seems to have happened in the late 1950s, marking the start of the collectors’ market. From that time, comic collecting became a more recognisable and widespread hobby. That period also marks a shift from sporadic sales of old comics in book stores to the beginnings of widespread and coordinated dealing in comics, and of dealers beginning to employ mail order lists of stock (Schelly 1999). The publication of an annual price guide, from November 1970 (Overstreet 1970), made the analysis of investment potential possible; early editions made specific reference to the term “speculation” in relation to comic-books, and an “Investor’s Data” section was added to the publication in 1976 (Overstreet 1976). However, for most comic-books, the emergence and significance of a speculators’ market has been more recent. The rapid appreciation in value of collectables in high grade in the 21st Century can be attributed in part to the establishment of third-party comic-book grading companies (Roach and Wyburn 2009). Recently, comic investment brokers have begun to emerge, and professional restoration services, once controversial, have become increasingly accepted.

In relation to the above general history of the emergence of the three markets, the specific dates at which each market comes into existence are different for each title. That is, there is some point in the history of each early comic-book in which speculative interest came to outweigh that of collectors’ as a determinant of price. This can be taken to be the origin of the speculative market and the conclusion of the collectors’ market (although the two may in fact have overlapped for some time).

The speculative market for comic-books is now well-established, to the extent that there is no longer a second-hand or collectors-only market for any comic-book after issue. Rather, the purchase price of the comic-book will be immediately subject to the market forces of the speculators’ market. In particular, it will appear against a speculative price in the next edition of the Overstreet Comic Book Price Guide. This publication is now considered to be the market standard.

While there are recognised factors contributing to the worth of a comic-book, these have not been universally or consistently applied throughout the three markets. Rather, factors that reflected collecting habits emerged throughout these markets. Consequently, *provenance*, interpreted as path dependency of the current price, will be addressed later (Sect. 5); a brief history of the introduction and importance of each factor (*italicised*) follows.

## 1.1 Scarcity and grade

Despite the popularity of comic-books in the US (with over 20 million copies of comics being published each month in the mid-1940s, rising to a peak of nearly 75 million by the early 1950s), few copies were retained (Gerber and Gerber 1989). A survey of availability conducted by Gerber and Gerber (1989) during the 1980s resulted in survival rate estimates of less than 0.2 % of 1930s comics and less than 1 % of 1940s comics. Along with other paper goods, comics were mostly regarded as disposable juvenile objects that were deemed to hold a low cultural value. Second World War paper drives, politically driven campaigns and mass comic burnings in the 1950s (Hajdu 2008), coupled with ageing and “normal wear” from reading, also account for the attrition rate (Gerber and Gerber 1989) and for the relative scarcity of higher condition copies. From the mid-1960s, as the number of copies of comics published each month fell to below 5 million, the survival rate estimates exceed 50 % and are estimated to be closer to 100 % for comics published in the last few decades (Gerber and Gerber 1989). Those older comics that survived did so through the concerted efforts of early dealers to amass stock, made up of unsold stock (either sold on to book stores or accumulated in distributors’ warehouses), and the infrequent discovery of single-owner collections and “file” copies set-aside by the publishers as records of publication (Roach and Wyburn 2009).

Throughout the second-hand market, knowledge of *scarcity* was limited to the direct experience of dealers and was considered largely unimportant in determining price. During the collectors’ market, scarcity became increasingly important, in that collectors were willing to outbid each other for the remaining supply. However, it was not until the establishment of the speculative market that the conservation of comic-books became the norm, and supplies of a particular issue reached a stable (often quite low) number.

The emergence in the 1960s of comic fandom, which can be thought of as a collection of activities surrounding a shared interest in the hobby of comic collecting, enabled a concerted “movement to transform comics into legitimate, insurable collectibles” (Schelly 1999). Continuation of the hobby required ensuring that comics would be valued, as other collectables and artistic objects are, and preserved for future generations. This in turn implied two requirements—an accepted, universal system of grading comics, and a recognised price guide (Schelly 1999). In the beginnings of the collectors’ market, the condition of comics was deemed unimportant, and amateur repairs (such as the sealing of tears by tape and the replacement of staples) did not affect value. *The Grading Guide* (Bails 1965) established *grade* as a factor determining value, offering the terms Mint, Near Mint, Very Good, Good, Fair and Poor, and explanations of them. The terms gradually came into common usage [being adopted by the first widely accepted price guide, published in 1970 (Overstreet 1970)], but were by no means universal until well into the 1970s. Overstreet began reporting known instances of particularly scarce issues by the mid-1970s, following information gathered within fandom and in accordance with dealers’ personal experience, but concerted efforts to associate scarcity with value began only in 1991, following Gerber and Gerber (1989). Collectors now have access to information on (relative) scarcity from the above sources, and dealers and

other sellers make explicit reference to reported scarcity, encouraging speculative demand. The knowledge that a particular issue is (relatively) rare increases the appeal of that issue and is therefore an hedonic factor in the price.

Stable supply numbers and consistent preservation measures are taken to indicate the beginning of the speculators' market. Twenty-five grades are now recognised by Overstreet (2010), with "very good" taken to be the median grade.

## 1.2 Title and associated factors

The predictor variable *title* was the principle consideration of those purchasing in the new and second-hand market. Comic-books were purchased principally to follow the adventures of a favourite character (often eponymous). Comic-books have moved from being drawn from existing media forms during the 1930s and 1940s (cinema, radio and pulp-fiction) to becoming an important source of global brands and franchises. Comic creations are now consumed through products beyond the comic-book form: cinema, television, computer games and toys. Hence, title has remained a key determinant of price throughout the speculators' market.

The variable *age* may be considered to be the prerequisite of nostalgia, which is taken to initiate the collectors' market. While title retained importance, purchases were made to fill gaps in collections. With the establishment of a speculators' market, the importance of complete collections has diminished, and the importance of individual issues has grown. The *issue number* itself provided one desirable factor; issues #1 and #2 of a title had appeal certainly by 1970 [with those issues being recorded, generally, as having greater value in Overstreet (1970)]. The rising value of notable issue numbers extended to the 100th issue from 1980 (initially only for comics of the 1930s to 1950s, but eventually including even very recent, but high-selling, titles). For the most collected of titles, and where a publisher had specifically constructed an "anniversary" issue, the 200th issue similarly accrued value during the 1980s.

## 1.3 Content and characters

The increasing importance of individual issues over complete collections had by 1980 lent importance to *first appearance of title character(s)* and *origin of title character(s)* (where the latter refers to an explanation of the history of a character, and specifically to the source of that character's powers in the case of the superhero genre). Fan publications in the 1960s contributed to the identification of these factors for many older comic-book titles, and these were largely completed in Overstreet listings by the mid-1970s.

The popularity of a title depends not only the on title character, but also on adversaries, "love interest" characters and other regular characters—and these other characters might also make appearances in other comic-book titles. Here, the notion of "character" extends to objects or locations also deemed significant as recognisable associations with a comic-book title (such as the Batplane, or the first mention of Batman being located in Gotham City). While notable appearances of a few such characters (including the Joker and Lex Luthor) were partly

established by 1970, the process of identifying such attributions for comic-books generally was slow. By 1990, the variables *first appearance(s) of non-title character(s)*, *origin(s) of non-title character(s)*, *encounter(s) between notable characters* (typically early occurrences of battles) and *title crossover* (a title character appearing in a different title) were frequently cited as contributing to value. For older titles, encounters between notable characters were reasonably well-documented even by 1980. Between the mid-1980s and mid-1990s, Overstreet recorded more precise information about characters, devices and locations, usually in response to detailed archival research conducted by collectors and reported in fan publications. From 1980, these details would be listed for newer collectable titles within a year or two of publication (compared to, typically, 5–8 years for comic-books published in the 1970s).

The variable *cover elements* had likewise become notable, in that a speculator might build on an interest in a particular genre (*e.g.*, the Second World War, appearances of the American flag, events contemporary to publication, horror, the risqué) and become familiar with the market attached to this. Overstreet listed such elements from 1977, and new categories of cover elements continued up to 1996. A particular attribution, ‘classic cover’, is granted to a significant selection of comic-books in the mid-1990s, due primarily to the increased availability and corresponding market awareness, of cover reproductions in Gerber and Gerber (1989).

It is worth noting here that the significance to collectors of a single issue is not independent of the title of the comic, but is relative to it. For example, while the first appearance or origin of a title character generally makes an issue more collectable within its run, such a factor relating to a globally recognised brand would make that issue one of the most desirable and valuable comics across all titles; the first appearance of Superman in Action Comics #1 is recorded as the most valuable comic-book (Overstreet 2010).

#### 1.4 Art

E.C. Comics were keenly sought by collectors during the early development of the collectors’ market (Forro 1996), and this may relate in part to the quality of artwork. One artist in particular, Frank Frazetta, has been credited for redefining the visual appearance of the modern fantasy genre (Weber and Itzkoff 2010); Frazetta’s original paintings have sold for up to \$1 million. Particular artists were associated with notable characters and periods in the history of the comic-book, and the attribution of artists’ work became a significant feature of early fan articles. The work of a few “fan favourite” artists began to be highlighted by Overstreet between 1972 and 1975, making *cover artist* and *interior artist* recognised contributors to comic-book value. Corrections and extensions to attributions continued up to the late 1990s, with increasing numbers of artists being listed. For many years, cover artwork attributions for an artist tended to be given a few years after interior artwork attributions, indicating the relative importance of these factors. More recently, the two have been listed simultaneously, perhaps indicating the growing importance of the cover in determining desirability.

## 1.5 Media presence

The above addresses all the variables cited in the pricing literature. However, throughout the speculators' market, as the importance of the comic-book market impinges on the economy in general and the newsworthiness of major sales garners non-specialist interest, the variable *non-specialist media presence* starts to impinge. This variable is not cited in the pricing literature and is here introduced as a partial compensation for provenance. This factor is not initially employed here in the modelling of comic-book value, but is revisited in Sect. 3 with reference to an augmented hedonic model and in Sect. 4 in connection to a pricing mechanism for the speculative market.

## 2 Methodology

### 2.1 Data

The source of the initial data set was Overstreet (2010), from which a representative set of 275 issues in each of four grades was randomly selected, giving 1,100 prices to test against. The grades (Good, Very Good, Fine, Mint/Near Mint) are all those that are both currently used and historically referred to by the market literature, ensuring availability of comparable data. Note that the category Mint/Near Mint refers to the highest published grade in Overstreet (with Mint being the term used to refer to that grade between 1970 and 1988, and Near Mint used from 1989).

The purpose of the model developed is to investigate the effect on price of predictive factors that are either common to all comic-books (such as age), or that are uncommon and content-related (such as significant appearances of characters). This latter category of factors, which represents a specific focus of interest of collectors and investors, constitutes an extremely small proportion (certainly less than 0.1 %) of the total number of comic-books extant. Hence, a random sample of all comic-books listed in Overstreet would have to be excessively large (more than 100,000) in order to capture a sufficient sample of comic-books possessing many of the predictive factors of interest. Instead, the sample was taken from a more restricted population than all comics in Overstreet. A population was constructed, by selecting the six most collected publishers (DC, Marvel, E.C., Dell, Fawcett and MLJ) and the genres that have most consistently been collected (super-hero, horror and funny animals, including Disney and Warner Brothers cartoon characters). It was further restricted to individual titles, instances of which evince all predictive factors, and of period no later than the 1980s. Comic-books issued after this date have typically been printed in sufficient numbers, and retained in sufficiently good condition, to fail the "scarcity" criterion required of collectables.

The predictive pricing factors are not strictly quantified by any pricing agency. Rather, where no current price is extant or where this is disputed, a dealer will rely on his or her own experience in estimating the contribution of each factor (i.e., will estimate or negotiate a price). However, the process is implicit in the prices given by Overstreet, in that a dealer can recognise a price as justified by the familiar factors.

The Guide's ubiquity in transactions results in a published price creating an expectation of value for buyer and seller. For example, sellers (particularly in online transactions) will make specific reference to the most recent Overstreet price, setting up the basis for negotiations. Negotiations may bid the price up or bargain it down; it is reasonable to assume that either change is equally likely. It should be noted, however, that the major factor in updating an edition of Overstreet is the price cited in the earlier edition. This is not an hedonic variable, that is, it is not an intrinsic factor contributing to the utility of the comic-book. This is discussed further in Sects. 4 and 5.

The majority of the factors are quantitative. *Scarcity* is represented using the Scarcity Index due to Gerber and Gerber (1989), which resulted from an extensive study of the numbers of surviving copies for each of approximately 21,000 individual known US comics published between 1933 and 1965. The index employs a scale of 1 (very common) to 10 (unique, or close to it). The distribution of the sample by Scarcity Index is shown in Table 1, where comics published after 1965 are assumed to have an index of 1, and comics having index 7 (scarce, between 21 and 50 copies thought to exist) to 9 (between 6 and 10 copies) are grouped together. (The sample includes no comics of index 10.) The apparent bias towards scarcer comic-books is due to the restricted population, favouring titles evincing the predictive pricing factors studied here, and the age range.

The sample was found to include 29 titles, including the globally recognised (e.g., *Superman*, *Batman*, *Amazing Spider-Man*, *X-Men* and *Mickey Mouse*) and the less recognisable (e.g., *Adventures of the Fly* and *Vault of Horror*). The distribution of the sample by *age*, where that factor is represented as a whole year, is indicated in Table 2 (grouped here by decade). The apparent bias towards older issues is a result of the restricted population and age range.

The factors *first appearance of title character*, *origin of title character*, *first appearance(s) of non-title character(s)*, *origin(s) of non-title character(s)*, *encounter(s) between notable characters*, *title crossover*, *notable cover elements* and *notable issue number* have been modelled as binary (dummy) variables; they all denote the presence of one or more relevant contributions, or the absence of all such. That is, while the number of recognised contributions to the factor (e.g., character, theme and contemporary reference in the case of *notable cover elements*) could be enumerated, one such typically makes the main contribution to a purchase and hence to a pricing decision. Table 3 provides a summary of the frequency with which each of these factors occurs in the sample. Again, the restricted population favours the occurrences of these factors, beyond that which would be expected across all published comic-books.

The quantification of the variable *grade*, typically given as a qualitative term, reflects the ratio of the mean prices within each grade. Mint/Near Mint (recalling

**Table 1** Distribution of Gerber scarcity index values within sample of 1,100 comic-books

1	2	3	4	5	6	≥7
164	60	156	248	264	136	72



**Table 2** Distribution of comic-book age by decade within sample of 1,100 comic-books

1930s	1940s	1950s	1960s	1970s	1980s
88	412	196	256	120	28

**Table 3** Frequency of the characteristics within sample of 1,100 comic-books

Title character 1st app.	Title character origin	Non-title character notable app.	Non-title character origin	Encounter(s) between notable characters	Title crossover	Notable cover elements	Notable issue number
96	96	348	132	48	148	220	200

that the category refers to the highest grade for which price data were available in a given year) was normalised to score 100, and the remaining grades were scored in proportion to this according to the ratios of their average prices to the average Mint/Near Mint price: 17 for Fine, 11 for Very Good and 6 for Good. (This decision was taken after attempts to employ an index of grades from 1 to 4 failed to achieve significance in the earlier part of the model-making process.)

The predictor variables *title*, *cover artist* and *interior artist* are likewise qualitative. Data on artists were taken from Overstreet and a variety of professional and fan publications; while the accuracy of some of the data cannot be guaranteed correct, all data used are subject to the same ambiguities suffered by the industry's current system of pricing. The fundamental nature of quality [as addressed for example by Lazzaro (2006)] requires the typical hedonic model to incorporate “dummy” variables, representing the presence or absence of a qualitative variable. In the present case, however, the large number of instances of a given variable (such as the individual titles among the sample taken, and most particularly the number of artists contributing to the comic-books) would severely complicate this approach, demanding a binary variable for each instance. Moreover, while variables such as title and artist are qualitative, the contribution made to the value of a comic-book is quantitative. Hence in this study, “artist” is taken to be shorthand for “artist's quantitative contribution to value” (and similarly for other predictor variables). The assumption is made that this contribution falls on a continuous scale (that is, between the contributions made by any two artists, some third artist may be found whose contribution occupies a place between them). As a means of evaluating this quantitative contribution, it was therefore decided to substitute for these qualitative elements their internet presence, taken to be proportional to the number of hits obtained by Google Web Search. This necessarily renders the quantification contemporary to the time of the search; application to earlier prices must be approached with caution (as noted below in Sect. 5). However, comic-book value, as that of all collectables, is “sticky”, and so prices will not fluctuate so quickly as to reflect current popularity of characters. (For example, within the sample *X-Men* accrues the most hits, but the historically higher values of *Amazing Spider-Man* and

*Batman* will not be quickly overturned.) Therefore, the span of contemporary validity may be surprisingly long.

Originally developed by L. Page and S. Brin in 1997, Google Web Search is a web search engine owned by Google Inc. The number and order of search results is based on a priority rank called a “PageRank” and provides many options for customised searches of topics “xyz”, such as exclusion (“-x”), inclusion (“+x”) and exact phrase (“xyz”). Search parameters may also be limited by “filtering” intended to exclude inappropriate “adult” material.

Under moderate filtering, the following set of results were obtained (as of 12/12/10) against the topics cited.

“Superman” about 28,600,000 results (0.31 s)

“Superman + comics” about 5,460,000 results (0.15 s)

“Superman + comics – film” about 3,130,000 results (0.16 s)

“Superman + comics – film – television” about 2,690,000 results (0.33 s)

“Superman + comics – film – television – toys” about 2,350,000 results (0.33 s)

“Superman + comics – film – television – toys – radio” about 2,150,000 results (0.39 s)

The term “about” indicates that the responses have been rounded up to three significant figures. For the purposes of this paper, the parameters “Superman + comics – film – television – toys – radio” (with the appropriate variable name substituted for “Superman”) were employed under moderate filtering. This addresses the possibility of the Google hit count including factors irrelevant to this study (such as appearances of a character in radio or television shows or, under moderate filtering, pornography). A difficulty arises in the frequent identification of a character with a group, where both character and group have their own titles, and with anthology titles that feature different characters in different issues. There will likely be many hits for, say “The Flash” that should rightly be attributed to “All-Star Comics” or “Showcase” and vice versa. This ambiguity, however, is likewise evident in the pricing mechanism employed by the market, which mechanism the present model investigates. A copy of “All-Star Comics” (or “Showcase”) might be bought for the presence of the “The Flash”, or a copy of “The Flash” for the guest appearance of one or more members of the “Justice Society of America” (the group featured in “All-Star Comics”). In that the population was restricted to the publishers cited, characters are well represented in both team and single appearances, and it is anticipated that the combination will make the proper contribution to the significance of the title variable.

The data sample includes several atypically expensive comic-books, notably Action Comics #1 (the first appearance of Superman), and it is anticipated that this will skew the mean price to the right. The range of ages (1930s–1980s) similarly complicates interpretation as follows. Older comic-books are possessed of a provenance (an exogenous variable) which tends to inflate their prices; although this is largely accounted for by the variable “age”, these older titles will have higher prices for given values of endogenous variables. Older comic-books are affected by previous reported prices to a greater extent than new. As new pricing factors

emerged in the course of market development, so the newer comic-books were immediately subject to these, whereas the older prices were justified in terms of, or adjusted according to the new prominence of, these factors. As such the effect of the newer factors on comic-books of disparate ages cannot be consistent.

## 2.2 The model

The contribution of a given variable to the price was found to be multiplicative. For instance, the utility afforded by a favourite character, and that afforded by a favourite artist, will not add but multiply when the two are evinced by a single issue. The incidence of a given variable, then, may be considered to add a dimension to the issue's utility. This was not an *a priori* assumption, but one found to be the case after first experimenting with linear, quadratic and higher-order polynomial models. When these failed to attain significance, the following exponential model (Eq. 1) was investigated.

$$P = e^{\beta_0} Y_1^{\beta_1} Y_2^{\beta_2} Y_3^{\beta_3} Y_4^{\beta_4} Y_5^{\beta_5} Y_6^{\beta_6} Y_7^{\beta_7} Y_8^{\beta_8} Y_9^{\beta_9} Y_{10}^{\beta_{10}} Y_{11}^{\beta_{11}} Y_{12}^{\beta_{12}} Y_{13}^{\beta_{13}} Y_{14}^{\beta_{14}} \quad (1)$$

$P$  refers to the prices as given in Overstreet (2010).  $Y_i$  represents the  $i$ th predictor variable as below, where  $Y_1, \dots, Y_6$  are continuous, and  $Y_7, \dots, Y_{14}$  are transformed binary variables that may take the values 1 or  $e$  (Studenmund 2006). The  $\beta_i$  are the corresponding regression exponents.

$e^{\beta_0}$  is constant

$Y_1$  is *title presence*

$Y_2$  is *cover artist presence*

$Y_3$  is *interior artist presence*

$Y_4$  is *grade*

$Y_5$  is *scarcity*

$Y_6$  is *age*

$Y_7$  is *first appearance of title character*

$Y_8$  is *origin of title character*

$Y_9$  is *first appearance(s) of non-title character(s)*

$Y_{10}$  is *origin(s) of non-title character(s)*

$Y_{11}$  is *encounter(s) between notable characters*

$Y_{12}$  is *title crossover*

$Y_{13}$  is *notable cover elements*

$Y_{14}$  is *notable issue number*.

Logarithms were taken of the qualitative variables, and of the re-evaluated *grade* variable (Sect. 2.1). In that the quantitative variables supply mostly low integers, these were taken to be logarithms, that is, it is supposed that the industry indices and binary values are logarithms taken of an implicit continuous variable. A continuous model is appropriate as most of the variables may themselves be taken to be continuous (discussed in part in Sect. 2 for *title*, *cover artist* and *interior artist*). Age is demonstrably near-continuous, and grade effectively also occupies a continuous scale; in both cases, a specified discrete value for the variable indicates a position on

a continuous scale. For grade, the condition of a comic-book can fall anywhere from shop-new (typically referred to as “newsstand”) to heavily damaged and soiled. Four exemplars are here employed, and these are not taken to be equally spaced along the continuum (see under Sect. 2.1)

Aside from the empirical success of the model, the authors cite the exponential growth in prices since industry standards attained their modern form in the 1970s. The form of the model as investigated is therefore as in Eq. 2,

$$\ln(P) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + \beta_{12}X_{12} + \beta_{13}X_{13} + \beta_{14}X_{14} \tag{2}$$

in which  $X_i$  represents the logarithmic transform of the  $i$ th predictor variable ( $X_7, \dots, X_{14}$  having the value 0 or 1), and  $\beta_i$  is now its regression coefficient. That is,  $X_i = \ln Y_i, i = 1, \dots, 14$ , with  $\beta_0$  the intercept.

### 3 Empirical results

The following values of the coefficients  $\beta_i, i = 1, \dots, 14$ , were found by means of least squares multivariate regression (Table 4). The coefficients were investigated for multicollinearity by means of the corresponding variance inflation factors and tested for against the hypothesis  $H_0: \beta_i = 0$  according to the  $t$ -distribution (2-tailed).

All coefficients achieved significance when subjected to a  $t$  test with 1,086 degrees of freedom, with the exception of  $X_{12}$ . All factors are used explicitly in pricing, although their application and quantification are inconsistent. While  $X_{12}$

**Table 4** Values of  $\beta_i$  coefficients determined by least squares multivariate regression

Coefficient	Coefficient value	Variance inflation factor	$t$ statistic $t_{13,1086}$	$p$ value	Standardised coefficient value (elasticity)
$\beta_0$	-9.105	N/A	-32.252	0.000	N/A
$\beta_1$ (title)	0.076	1.633	5.889	0.000	0.079
$\beta_2$ (cover artist)	0.268	2.062	13.690	0.000	0.207
$\beta_3$ (int. artist)	0.167	1.562	8.812	0.000	0.116
$\beta_4$ (grade)	0.026	1.000	41.649	0.000	0.437
$\beta_5$ (scarcity)	0.219	3.595	8.060	0.000	0.161
$\beta_6$ (age)	0.125	3.782	31.636	0.000	0.646
$\beta_7$ (1st app. title character)	1.191	1.256	11.315	0.000	0.133
$\beta_8$ (origin of title character)	0.294	1.413	2.743	0.006	0.034
$\beta_9$ (1st app. non-title character)	0.757	1.413	11.905	0.000	0.149
$\beta_{10}$ (origin of non-title character)	0.178	1.287	2.090	0.037	0.025
$\beta_{11}$ (encounter)	0.507	1.131	3.582	0.000	0.040
$\beta_{12}$ (title crossover)	0.107	1.152	1.395	0.163	0.016
$\beta_{13}$ (cover elements)	0.555	1.265	7.957	0.000	0.094
$\beta_{14}$ (issue)	0.712	1.242	9.866	0.000	0.116

makes a contribution to price, its contribution is less, and less consistent, than that of any other variable.

The variance inflation factor (VIF) is in every case less than 4, and mostly closer to 1; a VIF of 10 is typically taken to indicate collinearity (Kutner et al. 2004). It may be noticed however that the variables  $X_5$  (scarcity) and  $X_6$  (age) deliver rather higher VIF values (3.595 and 3.782, respectively), which is to be expected, given that scarcity will naturally increase with age. It should be noted, however, that the two are distinct, and the relationship perhaps not linear. As a comic-book becomes older, and more valuable, more measures will be taken to preserve it, mitigating the effects of ageing and attrition.

The model's  $F$  statistic (497.465, with significance  $p = 0.000$ ) indicates that there is less than one in 1,000 chance that the observed correlation between one or more of the independent variables and the dependent variable is due solely to random sampling error. More informative, however, is the adjusted  $R^2$  statistic, which indicates that 0.866 of the variability in price is accounted for by the model. The standardised coefficients have been presented as measures of elasticity. It is to be noted that all are positive and that  $\beta_4$  (grade, at 0.437) and  $\beta_6$  (age, at 0.646) indicate those factors of highest elasticity.

While the above figures indicate success in identifying the relative contributions of the independent variables, the failure of  $R^2$  to attain unity by some 13.4 % suggests that considerable caution should be exercised in using the model as a predictor of price. The authors attribute this failure to the high history dependence of the price; in terms of general collectables, the item's provenance is an exogenous rather than an intrinsic property. This is dependent on the purchase history, public prominence and pop-cultural importance of the comic-book in question and cannot be modelled by the endogenous (predictor) variables here employed. Roach and Wyburn (2009) address the path dependency of comic-book prices by means of a system dynamics model. An alternative strategy is examined further in this paper.

However, not all the discrepancy between  $R^2$  and unity can be attributed to provenance. A comic-book such as Action Comics #1 (to take the extreme case) has an element of high desirability, media presence and pop-cultural relevance outside the community of collectors and speculators.

The variable  $Y_{15}$ , *non-specialist media presence*, was introduced to the model as an attempt to introduce this extrinsic characteristic, with  $X_{15}$ , its logarithm, explicit in the model. In that the variable addresses awareness outside the specified market, an internet search by title and issue number was performed within Google "News Archive Search" (<http://news.google.com/archivesearch>), and the resulting number of hits within non-specialist publications taken to quantify this awareness. The results are shown in Table 5.

The changes to most of the previous coefficient values (Table 4) are small, but  $X_3$ ,  $X_7$ ,  $X_8$ ,  $X_{10}$  and  $X_{11}$  no longer attain significance. Again the model's  $F$  statistic (186.131, with significance  $p = 0.000$ ) strongly supports the validity of the model, while the adjusted  $R^2$  statistic has risen to 0.913. Table 5 also indicates that the coefficient of this new variable is significant. The lack of significance of these content-related factors is to be expected, as they represent the reasons for a comic-book to come to wider attention (in particular the first appearance and origin of a

**Table 5** Value of  $\beta_{15}$  coefficient determined by least squares multivariate regression

Coefficient	Coefficient value	Variance inflation factor	$t$ statistic $t_{5,1085}$	$p$ value	Standardised coefficient value (elasticity)
$\beta_{15}$ (media)	0.482	2.198	11.438	0.000	0.308

globally recognised character). The lack of collinearity, which is to be expected, will be of particular relevance in the predictive mechanism of Sect. 4.

#### 4 A predictive mechanism

The above model has limited value as a predictive mechanism in that the issue of path dependency is insufficiently addressed. The price in year  $x$  owes much to that quoted in year  $x - 1$ ; if this were not the case, stickiness would not be observed, and the conditions necessary for a bubble would not occur.

The most efficient means to compensate for path dependency is the incorporation of previous prices as a predictor variable. The inclusion of such prices takes the model outside the strictly hedonic. Issues of collinearity come to dominate the analysis, with only the variables cover artist, age, first appearance of a title character, origin of a non-title character, title crossover, cover elements and issue number retaining significance. Therefore, if the hedonic requirement is relaxed, and the 2009 price introduced as a new predictor variable  $Y_{16}$ , such that  $X_{16} = \ln Y_{16}$  with its associated  $\beta_{16}$ , then much of the history of pricing, which tends to drive price ever upward, is naturally incorporated (Table 6). The variables remaining are those which retain significance.

Both the  $F$  test (117,310.610) and adjusted  $R^2$  (0.999) statistics indicate that this model, though of limited value as an hedonic analysis, is the more useful predictive tool.

**Table 6** Values of  $\beta_i$  coefficients determined by least squares multivariate regression

Coefficient	Standardised coefficient value	Variance inflation factor	$t$ statistic $t_{13,1093}$	$p$ value	Standardised coefficient value (elasticity)
$\beta_0$	0.025	N/A	0.877	0.381	N/A
$\beta_2$ (cover artist)	0.009	1.632	5.137	0.000	0.007
$\beta_6$ (age)	-0.002	3.211	-6.738	0.000	-0.012
$\beta_7$ (1st app. title character)	0.058	1.157	5.893	0.000	0.007
$\beta_{10}$ (origin of non-title character)	-0.014	1.047	-1.856	0.064	-0.002
$\beta_{12}$ (title crossover)	-0.030	1.086	-4.030	0.000	-0.004
$\beta_{13}$ (cover elements)	0.022	1.211	3.247	0.001	0.004
$\beta_{14}$ (issue)	-0.034	1.117	-5.044	0.000	-0.006
$\beta_{16}$ (2009 price)	1.017	2.859	576.508	0.000	1.006

The success of the predictive model may be taken to suggest the dominance of the speculative market; it certainly confirms the “stickiness” of prices, the importance of a pricing history and the tendency of prices to rise.

## 5 Provenance and market development

As a history of former prices has been established (Sect. 4), the pricing mechanism has become somewhat divorced from its hedonic aspect. It is therefore anticipated that the model will be more accurate for earlier than for current prices. It should be noted, however, that the collinearity between former prices and several of the hedonic variables confirms that these factors remain the implicit bases of the price [as argued by Rosen (1974)]. Overstreet contains guide prices on many hundreds of thousands of comics, making it infeasible to modify each and every price by sets of sales. Instead, large numbers of sales reported by the major dealers are used to determine trends (proportionate increase linked to titles and publishers), which are applied to large sets of comics. Unusual, comic-book issue specific, trends are used to alter prices on an individual basis.

The introduction indicated that different predictor variables attained importance at different times (Sects. 1.1–1.4). It is possible to apply regression analysis to prices for earlier periods as a tool for investigating market development, with the caveat that variables quantified against present-day data may not be reliable in the conditions of earlier markets. The results of this, using price data from five editions of Overstreet (1970, 1980, 1990, 2000 and 2010), are shown in Table 7; \*number indicates that the factor does not achieve significance at a 5 % level. (Note that coefficient  $\beta_{15}$  has been omitted, as current non-specialist media presence is inappropriate for historical price data.)

The best coefficient of determination was found to be  $R^2 = 0.887$  (or 0.885 when corrected for the degrees of freedom), both corresponding to the year 2,000 data. The continuing climb of the  $R^2$  up to 2,000 can be viewed here as further justification of the model; as prices approach the present day, the model becomes more reliable. The  $R^2$  value is relatively steady for 2010; this drop is insufficient to warrant revision of the assumptions and choice of variables in the model. The earlier years would seem to be adversely affected by the use of predictor variables (*title*, *cover artist* and *interior artist*) represented by current Google Web Search data.

The regression for 1970 is the least reliable, with many predictive factors not in common usage. In particular, the comparative worth of “Title” has almost certainly changed considerably over the last 40 years, and notions of scarcity also likely to have been very different. The lower coefficient of determination is therefore unsurprising. At that time, the market would have been very different to the present one and might reasonably be viewed as typifying one which is collector, and not speculator, oriented. By 1980, all coefficients reach significance and the coefficient of determination climbs steeply. This market is considerably more comparable to that of the present day and may be viewed as effectively being the modern (speculator-orientated) market. All coefficients remain significant except  $X_{12}$ , but at a  $p$  value of no more than 16 %, this might suggest that the variable is becoming accepted, while not yet being universally recognised.

**Table 7** Values of  $\beta_i$  coefficients determined by least squares multivariate regression for different years

Coefficient	1970	1980	1990	2000	2010
$\beta_0$ (constant)	-30.245	-11.111	-11.600	-11.132	-9.105
$\beta_1$ (title)	-0.008*	-0.041	0.080	0.084	0.076
$\beta_2$ (cover artist)	N/A	0.222	0.236	0.251	0.268
$\beta_3$ (int. artist)	N/A	0.239	0.138	0.140	0.167
$\beta_4$ (grade)	0.135	0.371	0.636	0.765	0.026
$\beta_5$ (scarcity)	N/A	0.075	0.117	0.248	0.219
$\beta_6$ (age)	7.768	0.147	0.144	0.131	0.125
$\beta_7$ (1st app. title character)	N/A	1.103	1.024	0.982	1.191
$\beta_8$ (origin of title character)	N/A	0.325	0.192*	0.296	0.294
$\beta_9$ (1st app. non-title character)	N/A	N/A	0.609	0.668	0.757
$\beta_{10}$ (origin of title character)	N/A	N/A	0.185	0.254	0.178
$\beta_{11}$ (encounter)	N/A	0.394	0.185*	0.324	0.507
$\beta_{12}$ (title crossover)	N/A	N/A	0.133*	0.203	0.107*
$\beta_{13}$ (cover elements)	N/A	0.309	0.258	0.418	0.555
$\beta_{14}$ (issue)	(#1, 2) 0.878	(#1, 2) 0.918	(#1, 2, 100, 200) 0.834	(#1, 2, 100, 200) 0.800	(#1, 2, 100, 200) 0.712
$F$	1543.454	589.594	504.359	596.808	497.465
$R^2$	0.855	0.859	0.869	0.887	0.867
$R^2$ corrected	0.855	0.858	0.867	0.885	0.866

The revision of prices according to previously cited prices is of course true of all markets against which hedonic analysis may be applied and does not invalidate the findings; intrinsic worth must remain subject to analysis. However, the provenance accumulated by an issue (particularly an older collectable) is a product of the above market development.

In that prices increase with time, whereas the explanatory variables remain constant for an issue, we would expect coefficients to increase with time. Where this is not the case, the price increase may be attributed to the addition of the new factors; these new selling points must be brought in to accommodate the price rise. The mechanism by which a new factor becomes significant has not been researched; it is here speculated that they were introduced (a) to distinguish between otherwise similar issues and (b) were defined on the demand side as collectors made their preferences known.

## 6 Conclusions

The model confirms the expected importance of the industry variables cited and demonstrates the consistency of these throughout the period of the development of



the market, from at least 1980 onwards. In that these retained significance after a very destructive bubble suffered by the market in the mid-1990s (Roach and Wyburn 2009), it is not anticipated that these will lose significance in the foreseeable future.

The use of the hedonic model as a means for pricing comic-books is problematic. For the 14 variable model, the standard error of the estimate is 0.827; this is reduced to 0.733 when the variable “non-specialist media presence” is included. However, the number of comic-books with media presence outside the specialist market is small and includes precisely those atypical cases that are beyond the scope of any predictive mechanism (if this were not so, the auction of, say, a copy of Action Comics #1 would not be a media event, and the sale price would not be a surprise).

When the comic-book to be priced is a new item, it might be expected that issues of provenance are no longer pertinent. However, what constitutes a “new” item in this context is a difficult matter. New issues of long-running comic-books clearly inherit provenance by association with earlier issues. New comic-books featuring well-established characters, or drawn by established artists, likewise inherit provenance, as their success is attached to high-profile sales of prior comic-books. Moreover, the post-bubble adjustment from the mid-1990s is unlikely to have been fair to all prices. [This post-bubble adjustment was referred to as a “period of correction” and manifested itself by “noticeable decreases (of price) in lower grades” following a period of 3 years of high growth (Overstreet 1998) and was attributed to external economic factors including unemployment and stock market performance (Overstreet 1999).]

Further, since the 1970s, the attrition rate of new comic-books has greatly decreased, and it is questionable whether such recent issues will ever attain the scarcity required of a top-class collectable. However, a new comic-book could reasonably be priced according to the above model; the Overstreet prices are themselves often taken as bases for negotiation, since the import of different factors may be assessed differently by buyer and seller.

The particular success of the hedonic model is in disaggregating those factors intrinsic to the worth of a comic-book. As such, the coefficients may be used to inform a “prestige” or “intrinsic value” quantifier in a system dynamics model, and this is the intention of the authors.

The predictive model, however, successfully addresses the issues of provenance and employs fewer variables, one of which (the previous price) is the first “port of call” for industry retailers reappraising a comic-book. The standard error of the estimate is here reduced to 0.081, suggesting at least a useful “rule of thumb” for the estimate of future prices.

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