AGE-PRICE PROFILES FOR CANADIAN PAINTERS AT AUCTION

Douglas J. Hodgson
Université du Québec à Montreal
C.P. 8888, succ. Centre-Ville
Montreal, Quebec, Canada
hodgson.douglas-james@uqam.ca

PRELIMINARY

Abstract

We conduct an empirical analysis of the effect on the auction price of a Canadian painting of the age of the painter at the time of creation of the painting. We consider several hundred artists, active over the entire history of Canadian art, who are pooled in the estimation of a hedonic regression in which a polynomial function in age enters as a regressor along with several other control variables. A semilinear version of the same regression is also estimated, with the age effect being treated nonparametrically. The sample of artists is then partitioned for the separate consideration of three broad "generations" of Canadian artists - those of the colonial and immediate post-colonial period (born before 1880), those with a strong nationalist orientation, born between 1880 and 1920, and those born after 1920 and coming of age in the world of post-war "contemporary art". Our principal result is that members of this third group tend to "peak" earlier in their careers than those of previous generations, consistent with the findings of Galenson (2000) in the context of the market for U.S. modern art. The judgement of the art market tends to be supported by that of the "experts", as reflected in the choices of curators of two major Canadian museums as to which paintings from their permanent collections should be hung in their public galleries.

1. INTRODUCTION

It is widely recognized that both the productivity and earnings of a working person will vary over the course of the person's career for a variety of reasons, some of which are idiosyncratic to the individual, but many of which stem from systematic factors having bases in biology, history, culture, and society. Biological factors are important, as the time required to learn and perfect a trade suggest increasing productivity over one's career, with the decline in mental and physical vigour which commences beyond a certain age producing a contrary tendency. The relative strength of these two factors will vary across individuals, trades, societies, and historical periods, for many reasons, but it seems reasonable as a preliminary hypothesis that the "learning" factor will be predominant in the early years of a person's life, so that one's productive capacity increases more or less steadily for a period, until one reaches a "peak" period of productivity, beyond which productive capacity decreases, as the effects of aging come to predominate. A person's realized productivity will depend also on the degree of effort expended, which can depend on economic and societal influences in ways that may vary across individuals and time periods.

There exists a substantial econometric literature that attempts to measure productivity variations over the life cycle through the application of non-linear or nonparametric functions relating a worker's salary or wages to their age, education, or experience. The quadratic specification of these functions has a long history, and is most closely associated with Jacob Mincer (1974). Other investigators have examined the functional form more closely (e.g. Heckman and Polachek (1974)), and some have found that more highly parameterized or nonparametric models can explain features of the data not well captured by the quadratic. Murphy and Welch (1990), for example, find that a quartic specification (fourth-order polynomial) can lead to improvements, while Pagan and Ullah (1999, pp.152-157)) and Pudney (1993) estimate nonparametric regressions.

This line of enquiry has recently been extended to consider career effects on productivity for fine artists, in particular painters, as is well illustrated by a series of publications authored or co-authored by David Galenson (including Galenson (2000, 2001) and Galenson and Weinberg (2000, 2001)). This line of research attempts to empirically implement and study the notion that the quality and importance of the work produced by a significant artist is generally not constant over the artist's career, but will have its ups and downs depending on the various "periods" of that career. Periods where the quality or importance tend to be higher should, by this reasoning, be associated with higher prices, as reflected, for example, in auction results. This sort of analysis can be undertaken at the level of the individual artist, as has been done in the case of Picasso by Czujack (1997), who obtained the not-unexpected result that the most highly valued Picassos at auction tend to be those from the Blue, Rose, and Cubist periods (1902-1915), while the least valuable are those produced after 1944.

However, it is also of interest to go beyond the career of an individual artist, which can exhibit any number of idiosyncracies, to investigate the presence of general tendencies in the age-price profiles of artists. The questions implied by such an exercise are numerous. What is the "typical" age-price profile for a painter? To what extent do the career profiles of individual artists vary from this? To what extent does the typical profile itself vary across historical periods, generations, and societies? What are the possible effects on these profiles of art historical phenomena, the nature of the art market, or even of critical aesthetic

judgements? How do career profiles of prices at auction for artists belonging to the past compare to the career profiles of the incomes actually earned by these artists in their own lifetimes? How do both of these types of career profile compare to the judgements of art historians regarding the importance of the various periods of an artist's output? Many more interesting questions along these lines can no doubt be imagined.

Several of these questions are addressed in one way or another in the recent work of Galenson (2000, 2001) and Galenson and Weinberg (2000, 2001), where the principal focus is on the change in age-price profiles for different cohorts whose careers overlap during a moment of particular art historical importance. Two examples of such moments are studied – viz. the period around 1900 in Paris, and the early post war period in New York. The first of these periods saw a revolution in which the prevailing impressionist and post-impressionist styles, associated with such artists as Manet, Cézanne, Monet, and Gauguin, gave way to the fast-moving diversity of styles known as early modernism, as represented by, for example, Matisse, Dufy, Picasso, and Miro. The second period saw the birth of the contemporary New York "Art World", where an earlier generation of abstract expressionists, including Philip Guston, Jackson Pollock, and Barnett Newman, also gave way to a cohort characterized by a quickly-evolving diversity of styles, represented by painters such as Joan Mitchell, Andy Warhol, Sol LeWitt, and Philip Pearlstein, among many others.

The basic findings in these studies are that, in both historical periods, we find that the earlier generation is characterized by an age-price profile well to the right of that of the younger generation, that is to say, that the earlier generation "peaks" later in its career than does the younger generation. These econometric results are obtained from the estimation of hedonic regressions which include polynomials in painters' ages. Galenson (2000, 2001) and Galenson and Weinberg (2000, 2001) find that these results, obtained from auction prices, are consistent with the judgements of art historians as measured by the age distribution of pictures illustrated in art history textbooks for different artists.

The present study investigates the nature of the age-price profile in the auction market for Canadian painting. This market is of significant size, with several dozen auctions in the 2004-2005 auction season accounting for some C$40 million in sales (Westbridge (2006)). Painting in Canada has a long history, extending back to the seventeenth century (Reid (1973)), most Canadians are familiar with the names of several Canadian painters from a variety of historical periods and regions, there are many museums of Canadian art across the country, and major sales of art works (often in seven-digit figures) sometimes make headlines. The market for the work of Canadian artists is, with a handful of exceptions, primarily limited to Canada. The evolution of the Canadian auction market between 1968 and 2001 is studied in detail by Hodgson and Vorkink (2004).

There is reason to suspect that generational shifts in the age-price profile, such as those found by Galenson (2000, 2001) and Galenson and Weinberg (2000, 2001) for France and the United States, may also have occurred in Canada. In particular, one can point to at least two major revolutionary moments in Canadian painting, shortly following each of the two world wars, that could potentially be associated with such shifts. To see why, it helps to have some background knowledge of Canadian art history, and of Canadian history generally.

In 1867, the Dominion of Canada was founded through the confederation of four British colonies in North America which had not participated in the previous century's American Revolution. One of these, Lower Canada (now known as Quebec) had been, until 1760, a

colony of France, and had maintained French as its principal language and Roman Catholic as its major religion. As the new Dominion's creation was in no way violent or revolutionary, it continued to maintain close political and economic ties to Great Britain, up to World War I, into which Canada entered at the same time as its former colonial master. Canadian troops played a major role in the war, dying in great numbers and contributing significantly to the victory of the western allies. This led to a strengthened sense of national identity, confidence, and independence among Canadians in general. The loosening of British ties to Canada continued over the following decades, until, by the end of the Second World War, the new position of global dominance occupied by the United States, coupled with that country's geographical proximity to Canada, led to its replacement of Britain as Canada's principal economic and political partner. These factors emphasized, in Canada's case, a phenomenon that the whole world was experiencing as a result of growing international travel, communications, and economic integration: the cultural influence of the United States.

These general historical developments are clearly reflected in Canadian art history, where the colonial and early confederation periods are characterized by painters generally working in styles heavily influenced by European academicism, old-fashioned by the standards of contemporary European advanced painting, and often having as principal purchasers of their work British colonial administrators or military officers. The growing development of a nationalistic Canadian consciousness during the 1910-20 period and after can be associated with a generation of Canadian painters who were consciously trying to create a distinctively indigenous idiom of painting, directly influenced by the Canadian landscape and not dependent on European styles. This outlook is most closely associated with the Group of Seven, who started painting together shortly before the war, in which many served as war artists, and who had their first formal group exhibition in 1920. During and after World War Two, the development of the most advanced Canadian artists came to parallel that of their American counterparts. In Montreal, a group of young artists influenced by European modernism, especially surrealism, were developing a form of abstract art not dissimilar from American abstract expressionism. The post-war development of the New York art world, with its associated critics and periodicals, had a rapid impact in Canada, not only in Montreal, where a number of avant-garde movements quickly blossomed, but across the country, in such places as Toronto, London (Ontario), and Regina (Saskatchewan).

The present paper works with a sample of data obtained for Canadian auctions over the period 1968-2005 and estimates hedonic regressions for the auction price of paintings in which polynomials in the age of the painter at the time of the execution enter among the set of explanatory variables. A semiparametric version of the model is also estimated, with age entering nonparametrically. We begin by estimating a model in which a general age-price function is estimated, with all generations being pooled together. We then consider the estimation of separate profiles for three separate groups of painters: those born in or before 1880, those born between 1880 and 1920, and those born after 1920. The rationale for this partition of painters stems from our discussion in the preceding paragraph, where we distinguished three broad periods of Canadian art, namely, the colonial and early confederation period, corresponding with our first "cohort", the interwar nationalist period, corresponding with the second, and, thirdly, the post-war "International Contemporary" period.

Our basic findings are comparable to those of Galenson (2000, 2001) and Galenson and Weinberg (2000, 2001), in that there has been a general decline in the peak age for painters with the advance of time, and a progressive displacement to the left of the age-price profile.

We supplement the regression results with an analysis of the age distribution of paintings exhibited at major Canadian museums, which provides a measure of the opinion of experts regarding the importance of paintings from the periods of the careers of individual artists. Here, we find that the age distribution for the most recent generation is indeed to the left of those for the earlier generations.

2. DATA AND ECONOMETRIC MODEL

2.1 Data

Records of sales of Canadian paintings at auction from 1968 to 2005 were collected from Campbell (1970-75, 1980), Sotheby's (1975, 1980) and Westbridge (1981-2006). Our data set includes results on sales for painters judged to be of significant interest from the standpoint of Canadian art history, this criterion being satisfied if a painter is mentioned in one of the major histories of Canadian art written by Harper (1977) or Reid (1973, 1988). We consider only oil and acrylic paintings, and only sales for which the auction house provides a secure attribution. For each painting, we recorded , in addition to the identity of the artist, the height and width, the medium and support, the auction house, the date of sale, the genre of the picture, and, when available, the date of execution of the painting. The prices we use are hammer prices as reported in the aforementioned publications. The resulting data set, an expanded version of that used by Hodgson and Vorkink (2004), contains 22,163 sales, of which date of execution was available for 8073. These latter form the sample on which the hedonic regressions reported below are based. We are left with 245 painters for which at least one dated painting is recorded, and they are listed in Appendix 1 in chronological order according to date of birth.

Our assessment of expert opinion is based on the collection of paintings exhibited in the permanent Canadian art galleries of two leading museums with comprehensive holdings of Canadian art: the National Gallery of Canada (NGC), in Ottawa, and the Montreal Museum of Fine Arts (MMFA). The author visited the NGC on August 27, 2005, and recorded the painter and date of execution of every painting on display, the same exercise having been undertaken at the MMFA on August 17, 2005. There were a total of 487 Canadian paintings on display at the two museums on these dates. Museums generally own collections whose numbers far exceed the space available to display everything, so that a substantial proportion, often easily exceeding fifty per cent, of the collection remains unexhibited at any given time. Thus, the set of paintings actually hanging in the public galleries reflects the museum curators' opinions regarding the most important works in the collection.

2.2 Econometric Model

We estimate three different specifications of a hedonic regression model, in all of which log price is regressed on the various painting-specific characteristics listed in the preceding subsection, with the fashion in which age enters the regression differing in the three cases. Firstly, age is included through a parametric polynomial function, where all painters are pooled together, regardless of date of birth. The pooled model is then repeated, but now in the form of a semilinear econometric specification in which age enters nonparametrically. Finally, we return to the parametric polynomial model, but now with the painters partitioned according to the three cohorts described in the Introduction, with separate parameter estimates being computed for each cohort.

Each of the three specifications can be written as special cases of the following general model:

$$(1) \qquad y_i = x_i{}'\beta + g(z_i, \gamma) + u_i,$$

for $i = 1, \ldots, n$, where y_i is the log price for sale i, the number of sales is n (equal to 8073 in our case), x_i is a vector of observations of k control variables (other than age), β is an unknown k-vector of parameters, z_i is the age at time of execution of the painter of painting i, g is a function whose form will be discussed in more detail below, γ is an unknown parameter vector, and u_i is a zero-mean disturbance, assumed to be independent of the regressors. The 229 regressors contained in the vector x include annual time period dummies, dummy variables for painter, auction house, medium and support, and genre, along with height, width, and surface area measures. Our concern in this paper is with the estimation and analysis of g, so we treat β as a nuisance parameter (see Hodgson and Vorkink (2004) for a more complete analysis of a hedonic regression similar to the one considered here).

The first specification we consider for g is a fourth-order polynomial in age:

$$(2) \qquad g(z_i, \gamma) = \gamma_1 z_i + \gamma_2 z_i{}^2 + \gamma_3 z_i{}^3 + \gamma_4 z_i{}^4$$

where $\gamma = (\gamma_1, \gamma_2, \gamma_3, \gamma_4)'$. In this version of the model, it is assumed that the parameters of the functional form are the same for all generations of Canadian painters, so that the function linking price to age is presumed constant across generations. Galenson and Weinberg (2000,2001) estimate fourth-order polynomials in age for early twentieth century French artists, as well as for postwar American ones. We find the parameter on the last term to be statistically insignificant in a fifth-order polynomial, whereas the final parameter is significantly different from zero in a fourth-order polynomial. This model will be estimated by ordinary least squares (OLS), assuming homoskedastic and uncorrelated errors.

The second specification maintains the assumption of the first one that functional form is unchanging across generations but the function g is now treated nonparametrically, i.e.

$$(3) \qquad g(z_i, \gamma) = g(z_i),$$

where the functional form of g is left unspecified and will be estimated nonparametrically. This specification implies that (1) is a semilinear semiparametric regression model, which will be estimated using kernel methods as described by Pagan and Ullah (1999, p.199) and in Appendix 2.

Finally, we estimate a fourth-order polynomial in age, where the parameters are permitted to differ for the three cohorts of painters described in the Introduction. We therefore have

$$(4) \qquad g(z_i, \gamma) = \sum_{j=1}^{3} \left(\gamma_{j1} z_i + \gamma_{j2} z_i{}^2 + \gamma_{j3} z_i{}^3 + \gamma_{j4} z_i{}^4 \right) I(i \in gen(j)),$$

where $I(i \in gen(j))$ is an indicator function equal to one if the painter of painting i belongs to generation j, and equal to zero otherwise. This specification is also estimated by OLS.

3. EMPIRICAL RESULTS

We will begin by examining our results for the pooled group of all painters before looking at the breakdown by cohort. We can see from the first row of Table 1 that the average age of the painter at time of execution for the 8073 sold paintings in our sample is just over 50, with a standard deviation of 16. The distribution is roughly symmetric, as can be seen by the kernel density estimate plotted in Figure 1. The parameter estimates of the fourth-order polynomial in age, along with standard errors, are reported in the first row of Table 2, and a graph of the implied age-price profile is given in Figure 5. The function rises rapidly to a peak age of 34, after which it gradually declines in an approximately linear fashion, with each additional year bringing about a decrease in the value of a painting of about 1.3%. The semiparametric estimate of this function, presented in Figure 9, tops out at the younger age of 30, but also thereafter declines linearly at a rate of about 1% per year (the different levels for the curves in Figures 5 and 9 is due to the fact that the semiparametric estimator employed here estimates the function only up to addition by a constant). The "peak" age as measured by expert opinion is somewhat higher than those indicated by the regression, at 40, but is still considerable lower than the average age of all paintings appearing at auction (Table 3, Figure 10).

When we break down these results by generation, we obtain some interesting, if not wholly unexpected, patterns. The age distribution of paintings that are sold at auction (Table 1, Figures 2-4) differs significantly for the most recent generation (mean of 40.4 and standard deviation of 10.9), compared with the earlier ones (respective means of 48.9 and 53.8, with standard deviations of about 16). Although this result could be due in part to bias arising from the fact that some members of this latest cohort were alive and active for all or part of our sample period, it is robust to the joint truncation of the set of artists included to those born before 1935 and of the dates of sale to those after 1995. It suggests a number of hypotheses consistent with the notion that the generation born after 1920 is more likely to do its best work at a relatively early stage of life: (i) a decline in quality, originality, or financial remuneration of an artist's work will tend to lead to a decline in productivity measured by number of works painted; (ii) an early period of frenetic productivity could lead to burnout; (iii) later works, if of lesser quality or historic interest, will be less demanded in the secondary (auction) market.

The age distribution of paintings exhibited in museums displays a similar tendency (Table 3, Figures 11-13), with the earlier two historical cohorts averaging 40.0 and 41.5 years (with standard deviations of about 10), respectively, and the post-1920 cohort averaging 35.4, with standard deviation of 8.9. A comparison of Figure 13 with Figures 11 and 12 shows clearly that the age distribution of exhibited paintings for the latter cohort is well the left of those of the other two cohorts.

It is when we consider the estimated age-price profiles on a cohort basis, plotted in Figures 6-8, and based on parameter estimates reported in Table 2, that the most striking differences emerge. For the pre-1880 cohort (Figure 6), prices increase rapidly with age until about 35, after which they slowly increase to a peak age of 43, and then gradually decline thereafter, at a rate of about one half of a percentage point per year. For the second cohort, born between 1880 and 1920, the function, plotted in Figure 7, peaks at 35 and then declines fairly rapidly, with a fall off of value of nearly 35% between the ages of 40 and 60. Again, the results for the post-1920 cohort are the most unique of the three. Here, we see that prices peak much

earlier, at the age of 23, and then drop rapidly, by almost 75%, between the ages of 25 and 55. There is a second old age "peak" at 72, representing a recovery in price of nearly 9% in comparison with the trough that occurs at age 57.

4. ANALYSIS AND ART HISTORICAL CONSIDERATIONS

On the whole, the results presented above indicate that there has been change, across generations, in the nature of the age-price profile in the Canadian art market. Furthermore, this change has been in accord with what *a priori* reasoning, based on considerations of the history of Canadian art, would suggest. In particular, the function has had a tendency to shift to the left, most markedly for the cohort of painters born after 1920 and coming of age in the atmosphere of the post-war contemporary art world. However, this tendency was already present for an earlier generation, namely that born between 1880 and 1920. In terms of Canadian art history considered as a whole, this group of painters, particularly those forming the Group of Seven, were the ones who most aggressively attempted to bring about revolutionary change in the way Canadian art should be produced and thought about. This "home-grown" revolution in the market was followed by the post-war revolution which had its sources in the United States.

The most distinctive feature of the age-price profile for the group of artists born before 1880 is the slow rate with which it declines after its peak has been reached, although the peak itself arrives somewhat later than for other cohorts. Such a profile is consistent with the characterization of these artists as being principally craftsmen, achieving a mastery of their métier over a lengthy period of apprenticeship, and then reliably and competently practicing their craft over a period of many years. The output of such an artist would not be characterized by great innovation, nor would this be expected by the market. A painter who, after years of preparation at foreign academies, under the tutelage of leading academic masters, could establish himself as, say, the leading portraitist of a major colonial city, could count on patronage among the local economic elite for some time to come. Without getting into the details of the careers of specific artists, which will be left for future work, this sort of generalization fits many of the leading Canadian artists of this period. Most were educated in European academies, often spending several years abroad, and achieved a significant degree of technical competence before returning (or immigrating) to Canada. The resulting art was conservative by European standards, and heavily influenced by prevailing academic norms. Although some were able to make a living in Canada through the development of a niche clientele among wealthy merchants or colonial administrators, most had to rely on other sources of income, including, but certainly not limited to, teaching.

The following cohort, what we term the nationalist generation, born between 1880 and 1920, has a profile which peaks earlier, and then declines much more rapidly, than for the first cohort. This cohort was characterized by various explicitly organized groups of painters, formed relatively early in their members' careers, and with the intention of somehow promoting a consciously new approach to painting. By far the most famous painters of this generation are the Group of Seven, the oldest of whom, J.E.H. MacDonald (1873-1932), belongs to the earlier cohort, but of which the remaining six founding members were all born between 1880 and 1890[1]. The group was formed with the stated objective of creating an authentically Canadian style of landscape painting that represented a true reflection of the distinctive nature of the of both the Canadian terrain and the Canadian personality. The art itself was thus accompanied by a polemic that called for the rejection of prevailing European-

based academic painting as being inherently unsuitable for the projection of uniquely Canadian themes. Most of the members of the Group were commercial artists in Toronto who met and started developing their artistic program shortly before the outbreak of World War I. Some of them served in the war, and the Group was formally established and had its first exhibition in 1920, at which time the average age of the members of the group was 36.5 (and the average age of the six members born after 1880 was 34.8). The most important works by all members of the group are generally considered to be those painted around 1920, and the paintings of this period are still widely considered by many Canadians to represent the most heroic and original achievements of Canadian art. Most of these artists continued to paint in the style developed during this period, with their later work being of less general interest (this is clear from a perusal of the reproductions in comprehensive catalogues devoted to the group, such as Hill (1995) and Silcox (2003)).

The estimated profile for the post-1920 cohort is a bit strange. Without an analysis at the artist level, it would be hard to account for the hump that occurs at advanced ages. However, the result that the profile peaks earlier, and drops off faster, than for the other cohorts, can be explained along similar lines to those provided by Galenson (2000) and Galenson and Weinberg (2000) for comparable empirical findings in the market for U.S. painters. Canadian painters of this generation were generally in tune with the global, and especially the U.S., contemporary art scene, for a variety of reasons laid out in the Introduction. Canadian post-war art is characterized by the same rapid sequence of styles, often varieties of painterly or geometric abstraction, as one finds elsewhere at the same period. Canadian artists were familiar with the works of the leading critics and theorists of the time, and these latter, in particular Clement Greenberg, followed developments in Canada and maintained communications with a variety of Canadian artists. The upshot is that a newly developing and expanding art market, driven by post-war prosperity and confidence, was also to some extent present in Canada, and that this market, and overall international trends in painting, promoted a spirit of rapid innovation, and even novelty, which tended to heavily favour younger artists arriving on the market with the hot new style.

NOTES

1. The other six members were Fred Varley (1881-1969), A.Y. Jackson (1882-1974), Lawren Harris (1885-1970), Arthur Lismer (1885-1969), Franz Johnston (1888-1949), and Franklin Carmichael (1890-1945).

Table 1 – Average age at time of execution for paintings sold at auction, by cohort

Cohort	Number obs.	Average age	Standard deviation
All	8073	50.3	16.0
Pre-1880	2241	48.9	15.6
1880-1920	4459	53.8	16.4
Post-1920	1373	41.4	10.9

Table 2 – Hedonic regression: estimates of parameters of fourth-order polynomial in age, by cohort (standard errors in parentheses)

Cohort	Age	Age^2	Age^3	Age^4
All	0.232 (.0494)	-6.44×10^{-3} (1.54×10^{-3})	7.31×10^{-5} (2.03×10^{-5})	-3.02×10^{-7} (9.62×10^{-8})
Pre-1880	0.208 (.0889)	-4.98×10^{-3} (2.77×10^{-3})	5.05×10^{-5} (3.65×10^{-5})	-1.89×10^{-7} (1.73×10^{-7})
1880-1920	0.269 (.0676)	-7.15×10^{-3} (2.08×10^{-3})	7.70×10^{-5} (2.72×10^{-5})	-3.00×10^{-7} (1.28×10^{-7})
Post-1920	0.343 (.188)	-1.28×10^{-2} (6.65×10^{-3})	1.83×10^{-4} (1.00×10^{-4})	-9.01×10^{-7} (5.46×10^{-7})

Table 3 – Average age at time of execution for paintings displayed in two major museums, by cohort

Cohort	Number obs.	Average age	Standard deviation
All	487	40.0	10.1
Pre-1880	218	40.0	10.2
1880-1920	200	41.5	10.0
Post-1920	69	35.4	8.9

APPENDIX 1 – LIST OF PAINTERS INCLUDED

(the painters included in our empirical study are listed here in chronological order according to year of birth, the latter being provided in parentheses along with the number of observed sales for each painter)

George Heriot (1766, 2), Antoine Sebastien Plamondon (1804, 3), James Duncan (1805, 1), Robert Whale (1805, 5), George Theodore Berthon (1806, 3), Robert Todd (1809, 1), Daniel Fowler (1810, 1), Paul Kane (1810, 3), Otto Jacobi (1812, 75), Cornelius Krieghoff (1815, 128), Theophile Hamel (1817, 3), William Sawyer (1820, 8), William Armstrong (1822, 2), William Cresswell (1822, 20), A.S. Falardeau (1822, 7), Napoleon Bourassa (1827, 1), Henri Perre (1828, 3), Ludger Ruelland (1828, 1), John O'Brien (1831, 2), Charles Caleb Ward (1831, 8), Lucius R. O'Brien (1832, 10), William Raphael (1833, 42), Marmaduke Matthews (1837, 9), John A. Fraser (1838, 5), Thomas Mower Martin (1838, 38), Frederick Arthur Verner (1839, 83), Henry Sandham (1841, 13), John Hammond (1843, 118), Frederic Martlett Bell-Smith (1846, 48), Allan Edson (1846, 15), John C. Forbes (1846, 7), Henri Julien (1846, 1), Robert Gagen (1847, 4), Wyatt Eaton (1849, 2), Robert Harris (1849, 42), William Cruikshank (1849, 2), J.W.L. Forster (1850, 8), William Brymner (1855, 23), Charles Huot (1855, 8), Homer Watson (1855, 29), Percey Woodcock (1855, 6), F.S. Coburn (1871, 227), Julian Seavey (1856, 4), Franklin Brownell (1857, 45), Adolph Vogt (1858, 34), William Blair Bruce (1859, 14), Paul Peel (1860, 58), George Reid (1860, 132), Laura Muntz Lyall (1860, 22), J.M. Barnsly (1861, 25), Robert Holmes (1861, 1), William Atkinson (1862, 76), Archibald Browne (1862, 26), Henri Beau (1863, 18), William R. Hope (1863, 1), Carl Ahrens (1863, 16), Ozias Leduc (1864, 12), James Wilson Morrice (1865, 11), H. Ivan Neilson (1865, 2), Maurice Cullen (1866, 49), Joseph Franchere (1866, 9), Curtis Williamson (1867, 5), Ludger Larose (1868, 22), Joseph Saint-Charles (1868, 3), William Beatty (1869, 87), C.W. Jeffreys (1869, 4), Sophie Pemberton (1869, 9), Marc-Aurèle de Foy Suzor-Coté (1869, 123), Georges Delfosse (1869, 8), Emily Carr (1871, 56), Charles Gill (1871, 10), Edmund Morris (1871, 8), Fred Brigden (1871, 6), J.E.H. Macdonald (1873, 225), Tom Thomson (1877, 21), W.J. Wood (1877, 2), W.H. Clapp (1879, 30), W.P. Weston (1879, 100), Helen MacNicoll (1879, 7), John Russell (1879, 14), Clarence Gagnon (1881, 102), Fred Varley (1881, 32), Albert Robinson (1881, 90), A.Y. Jackson (1882, 655), W.J. Phillips (1884, 1), David Milne (1882, 69), Mabel May (1884, 25), Lawren S. Harris (1885, 98), Arthur Lismer (1885, 260), John Lyman (1886, 15), Charles H. Scott (1886, 11), Hortense Gordon (1887, 10), Mabel Lockerby (1887, 4), Bertram Brooker (1888, 8), Randolph Hewton (1888, 11), Frank Johnston (1888, 115), Marc-Aurèle Fortin (1888, 65), Frank Carmichael (1890, 46), Lemoine Fitzgerald (1890, 21), Eric Goldberg (1890, 1), Adrien Hebert (1890, 29), Sarah Robertson (1891, 6), Rodolphe Duguay (1891, 23), Edwin Holgate (1892, 50), Aleksandre Bercovitch (1893, 2), Kathleen Morris (1893, 10), Fritz Brandtner (1896, 13), Louise Gadbois (1896, 64), Prudence Heward (1896, 5), Lilias Torrance Newton (1896, 4), Andre Bieler (1896, 42), Ernst Lindner (1897, 8), J.W.G. Macdonald (1897, 36), Anne Savage (1898, 16), A.J. Casson (1898, 409), Paraskeva Clark (1898, 22), Yvonne McKague Housser (1898, 36), Robert W. Pilot (1898, 234), Charles Comfort (1900, 58), Jack Humphrey (1901, 14), Alexandra Luke (1901, 1), Will Ogilvie (1901, 3), Isabel McLaughlin (1903, 10), Carl Schaefer (1903, 26), Jean-Paul Lemieux (1904, 107), Louis Muhlstock (1904, 10), Goodridge Roberts (1904, 124), Pegi Nichol Macleod (1904, 9), Paul-Emile Borduas (1905, 45), William Leroy Stevenson (1905, 11), Illingworth Kerr (1905, 178), Maxwell Bates (1906, 128), Alfred Pellan (1906, 28), Marian Scott (1906, 14), Jori Smith (1907, 46), Henri Masson (1907, 197), Ernst Neumann (1907, 15), B.C. Binning (1909, 14), Jack Bush (1909, 41), Jack Shadbolt (1909, 90), Gordon Webber (1909, 6), Marion Nicholl (1909, 8),

Lawren P. Harris (1910, 3), Philip Surrey (1910, 28), Leon Bellefleur (1910, 111), Stanley Cosgrove (1911, 222), Miller Brittain (1912, 4), Kate Graham (1913, 4), E.J. Hughes (1913, 79), John Korner (1913, 6), John Hall (1914, 6), Jean Dallaire (1916, 45), Fernand Leduc (1916, 7), Albert Dumouchel (1916, 11), Walter Yarwood (1917, 5), Louis de Niverville (1917, 1), Jacques de Tonnancour (1917, 44), Gordon Smith (1919, 40), Michael Snow (1919, 3), William Perehudoff (1919, 9), Alex Colville (1920, 7), Gershon Iskowitz (1921, 18), Ray Mead (1921, 9), Clark McDougall (1921, 7), Pierre Gauvreau (1922, 11), Robert Varvarande (1922, 4), Jean McEwen (1923, 78), Jean-Paul Riopelle (1923, 177), Bruno Bobak (1923, 12), Donald Jarvis (1923, 4), Marcelle Ferron (1924, 56), Tom Hodgson (1924, 9), Harold Town (1924, 74), Marcel Barbeau (1925, 25), Ronald Bloore (1925, 4), Patterson Ewen (1925, 14), Denis Juneau (1925, 2), Rodolphe de Repentigny (1926, 6), Roy Kiyooka (1926, 2), Kenneth Locchead (1926, 12), Arthur McKay (1926, 1), Kazuo Nakamura (1926, 24), William Ronald (1926, 43), Gerald Scott (1926, 1), Takao Tanabe (1926, 31), Tony Tascona (1926, 1), Dorothy Knowles (1927, 39), Jean-Paul Mousseau (1927, 5), William Kurelek (1927, 55), Jean-Paul Jerome (1928, 18), Francoise Sullivan (1928, 1), Jean Goguen (1928, 2), Hugh Mackenzie (1928, 1), Daphne Odjig (1928, 13), Toni Onley (1928, 56), Louis Belzile (1929, 15), Rita Letendre (1929, 53), Allen Sapp (1929, 58), Suzanne Bergeron (1930, 1), Fernand Toupin (1930, 52), Jack Chambers (1931, 3), Graham Coughtry (1931, 7), Joyce Wieland (1931, 3), Edmund Alleyn (1931, 41), Claude Tousignant (1932, 3), Norval Morriseau (1932, 107), Dennis Burton (1933, 12), John Meredith (1933, 18), Guido Molinari (1933, 13), Ted Godwin (1933, 10), Charles Gagnon (1934, 2), Tony Urquhart (1934, 10), Yves Gaucher (1934, 1), Richard Gorman (1935, 10), Christopher Pratt (1935, 5), Gordon Rayner (1935, 3), Ivan Eyre (1935, 5), Alex Janvier (1935, 8), Mary Pratt (1935, 12), Otto Rogers (1935, 6), Tom Forrestall (1936, 9), Doug Haynes (1936, 7), Christiane Pflug (1936, 1), Claude Breeze (1938, 1), Guiy Monpetit (1930, 2), Brian Fisher (1939, 1), Jacques Hurtubise (1939, 8), Paul Fournier (1939, 8), Ken Danby (1940, 1), Joseph Drapell (1940, 3), John Boyle (1941, 1), Esther Warkov (1941, 2), Michael Morris (1942, 3), Harold Klunder (1943, 1), Ron Martin (1943, 4), Carl Ray (1943, 3), Michael Forster (1943, 17), David Bolduc (1945, 14), Daniel Solomon (1945, 2), Bruce St. Clair (1945, 2), Ric Evans (1946, 1), Alex Cameron (1947, 1), Erik Gamble (1950, 1)

APPENDIX 2 – ESTIMATION OF SEMIPARAMETRIC SEMILINEAR MODEL

We describe here the semiparametric estimation of the function g in the following regression equation, which is a combination of equations (1) and (3):

(A.1) $$y_i = x_i'\beta + g(z_i) + u_i,$$

where $g(.)$ is of unknown functional form. A consistent estimator of the value of this function at a given point z, $g(z)$, is described by Pagan and Ullah (1999, p. 199), and is computed as follows:

(A.2) $$\hat{g}(x) = \hat{m}_y(z) - \hat{m}_x(z)'\hat{\beta},$$

where $\hat{m}_y(z)$, $\hat{m}_x(z)$, and $\hat{\beta}$, are estimators, described below, of the respective quantities $m_y(z) = E[y|z]$, $m_x(z) = E[x|z]$, and β. The latter is estimated by

(A.3)
$$\hat{\beta} = \left[\sum_{i=1}^{n} (x_i - \hat{m}_x(z_i))(x_i - \hat{m}_x(z_i))' \right]^{-1}$$
$$\times \left[\sum_{i=1}^{n} (x_i - \hat{m}_x(z_i))(y_i - \hat{m}_y(z_i))' \right].$$

The nonparametric conditional expectations are estimated by the kernel method of Nadaraya (1964) and Watson (1964):

(A.4) $$\hat{m}_x(z) = \left(\sum_{i=1}^{n} K\left(\frac{z_i - z}{h} \right) x_i \right) \Big/ \left(\sum_{i=1}^{n} K\left(\frac{z_i - z}{h} \right) \right),$$

and

(A.5) $$\hat{m}_y(z) = \left(\sum_{i=1}^{n} K\left(\frac{z_i - z}{h} \right) y_i \right) \Big/ \left(\sum_{i=1}^{n} K\left(\frac{z_i - z}{h} \right) \right),$$

where K is a kernel function (we use the standard normal density in our empirical application) and h is a bandwidth parameter that converges to zero as the sample size n goes to infinity (in practice, we use the rule-of-thumb plug-in bandwidth mentioned by Silverman (1986, p. 45)).

REFERENCES

Campbell, H. 1970-1975. *Canadian Art Auction Record 1969-1974, vols 1-6.* Toronto: Canadian Antiques and Fine Arts; and Montreal: Bernard Amtmann.

Campbell, H. 1980. *Canadian Art Auctions, Sales, and Prices, 1976-1978.* Don Mills, Ont.: General.

Czujack, C. 1997. Picasso paintings at auction, 1963-1994. *Journal of Cultural Economics* 21:229-247.

Galenson, D.W. 2000. The careers of modern artists. *Journal of Cultural Economics* 24:87-112.

Galenson, D.W. 2001. *Painting Outside the Lines.* Harvard.

Galenson, D.W., and Weinberg, B.A. 2000. Age and quality of work: The case of modern American painters. *Journal of Political Economy* 108:761-777.

Galenson, D.W., and Weinberg, B.A. 2001. Creating modern art: The changing careers of painters in France from impressionism to cubism. *American Economic Review* 91:1063-1071.

Harper, J.R. 1977. *Painting in Canada: A history (2nd ed.).* Univ. of Toronto.

Heckman, J. and Polachek, S. 1974. Empirical evidence on the functional form of the earnings-schooling relationship. *Journal of the American Statistical Association* 69:350-354.

Hill, C.C. 1995. *The Group of Seven: Art for a Nation.* Toronto: McClelland and Stewart.

Hodgson, D.J. and Vorkink, K. 2004. Asset pricing theory and the valuation of Canadian paintings. *Canadian Journal of Economics* 37:629-655.

Mincer, J. 1974. *Schooling, Experience, and Earnings.* Columbia University Press.

Murphy, K.M. and Welch, F. 1990. Empirical age-earnings profiles. *Journal of Labor Economics* 8:202-229.

Nadaraya, É.A. 1964. On estimating regression. *Theory of Probability and its Applications* 9:141-142.

Pagan, A. and Ullah, A. 1999. *Nonparametric Econometrics.* Cambridge.

Pudney, S. 1993. Income and wealth inequality and the life cycle: A non-parametric analysis for China. *Journal of Applied Econometrics* 8:249-276.

Reid, D. 1973. *A Concise History of Canadian Painting.* Toronto: Oxford.

Reid, D. 1988. *A Concise History of Canadian Painting (2nd ed.).* Toronto: Oxford.

Silcox, D.P. 2003. *The Group of Seven and Tom Thomson.* Toronto: Firefly.

Silverman, B.W. 1986. *Density Estimation for Statistics and Data Analysis.* London: Chapman and Hall.

Sotheby's. 1975. *Canadian Art at Auction, 1968-1975.* Toronto: Sotheby's.

Sotheby's. 1980. *Canadian Art at Auction, 1975-1980.* Toronto: Sotheby's.

Watson, G.S. 1964. Smooth regression analysis. *Sankhya Series A* 26:359-372.

Westbridge, A.R. 1981-2006. *Canadian Art Sales Index, 1977-2005.* Vancouver: Westbridge.

Fig. 1 — Age Dist. of Sales (all)
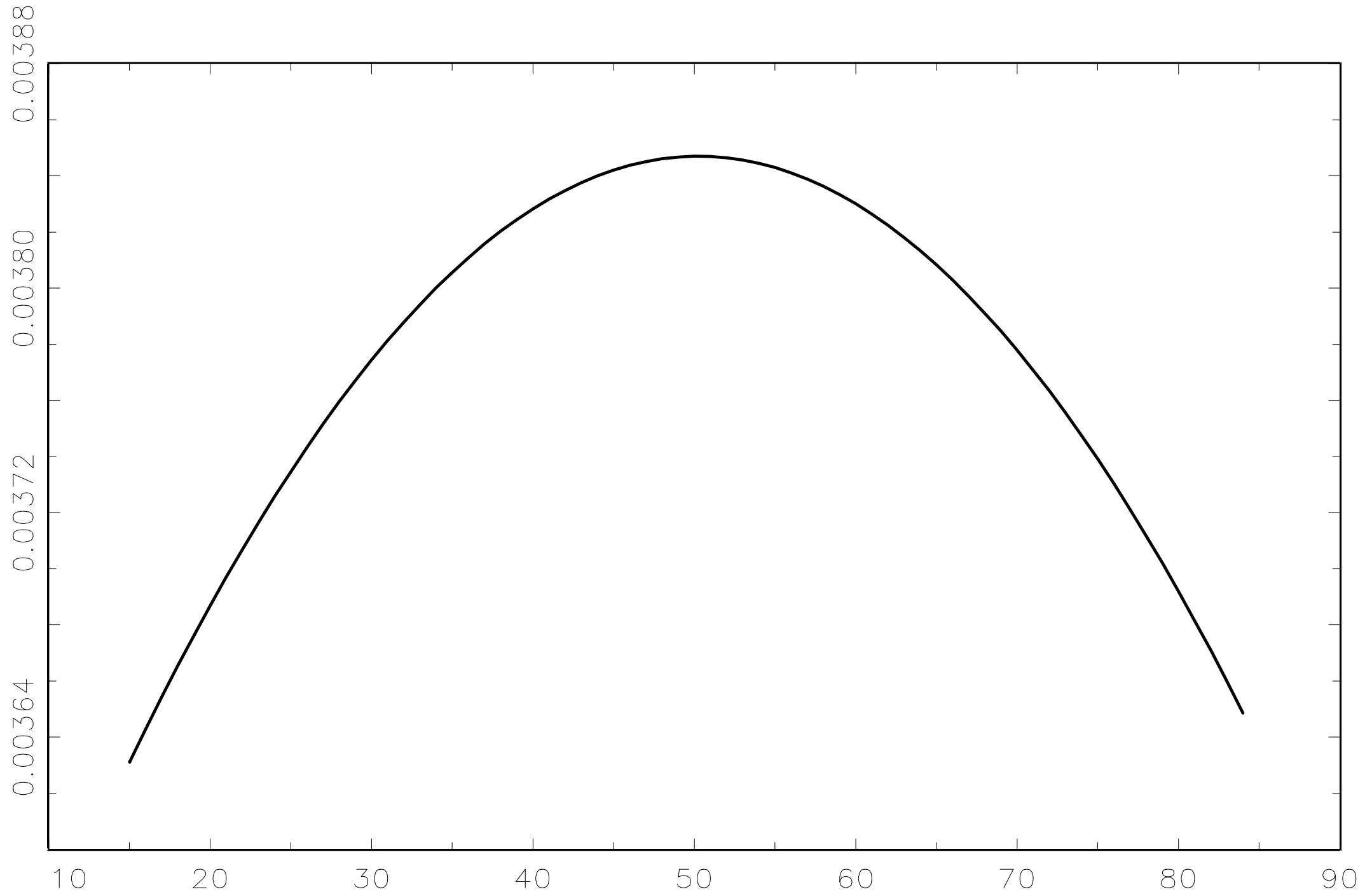
Fig. 2 — Age Dist. of Sales (pre—1880)
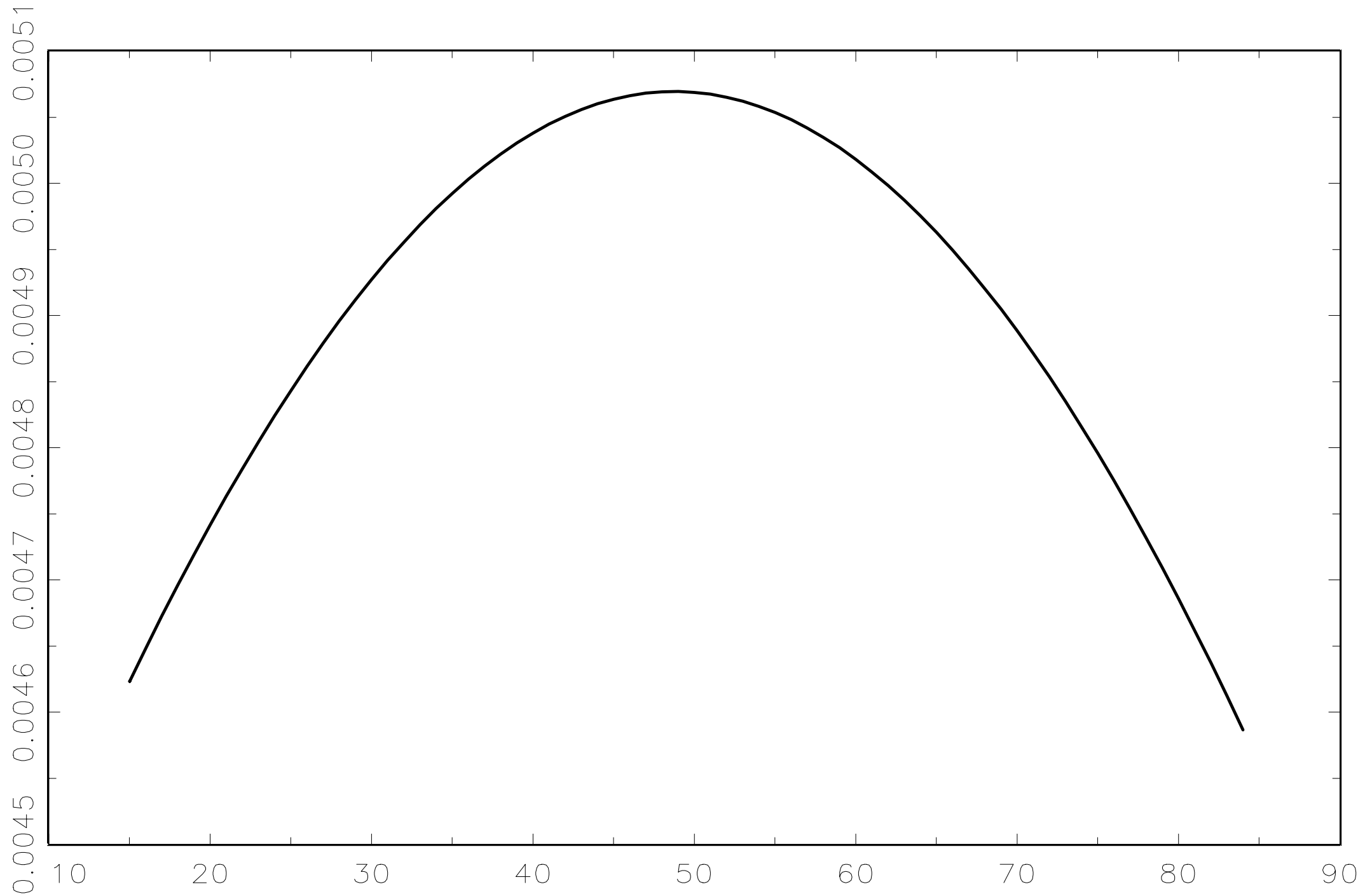
Fig. 3 — Age Dist. of Sales (1880—1920)
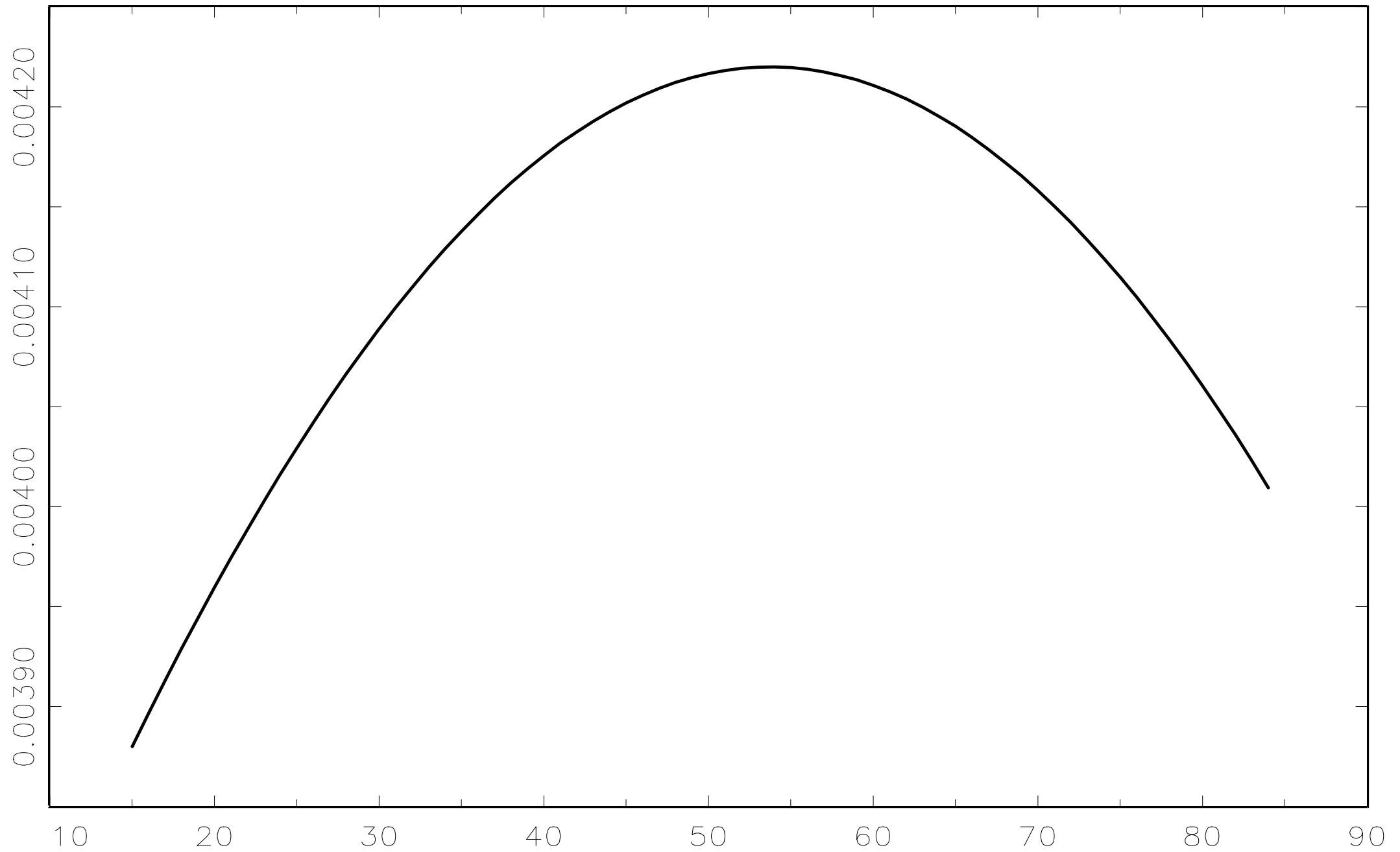
Fig. 4 — Age Dist. of Sales (post—1920)
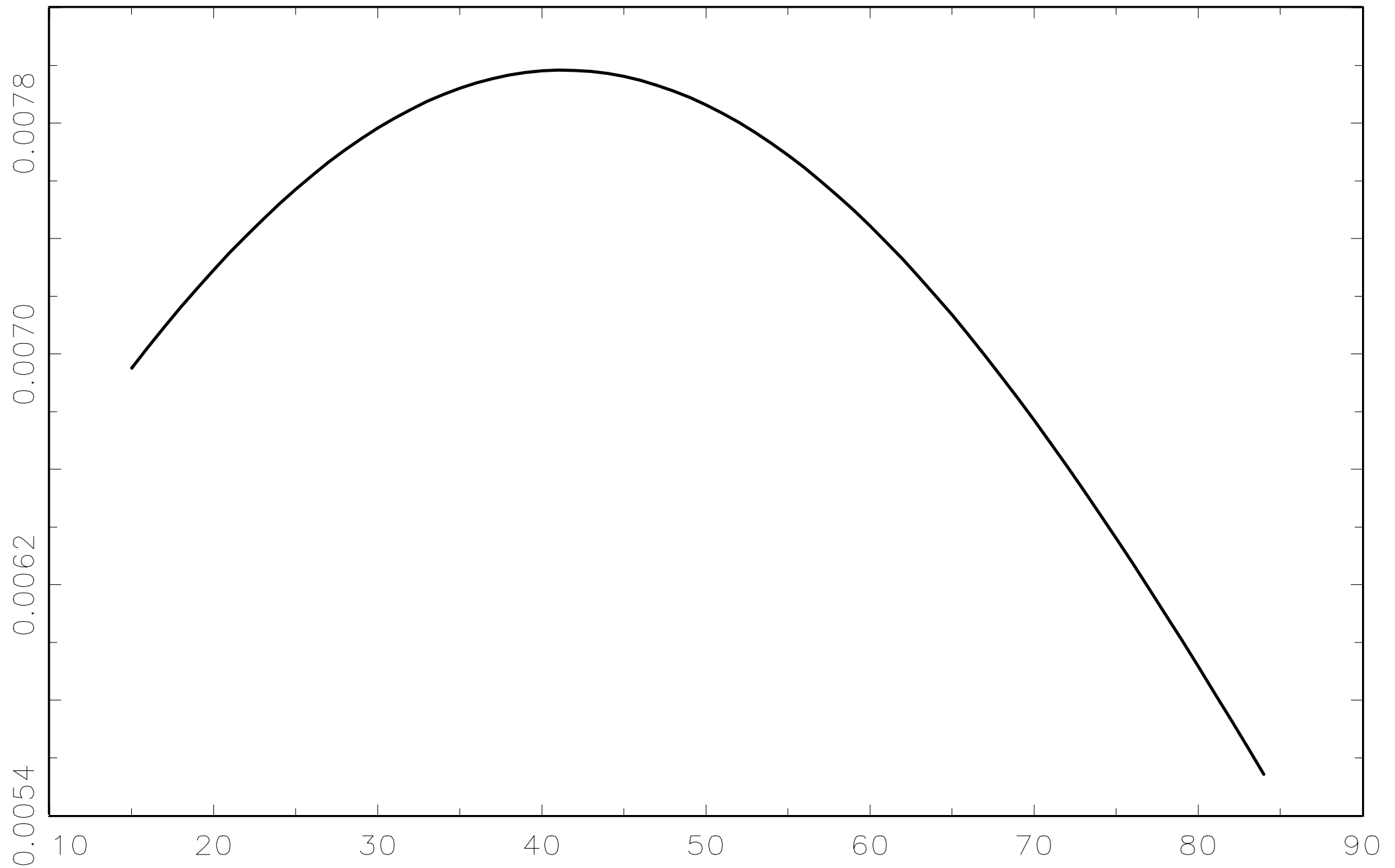
Fig. 5 – Age–Price Profile (all)
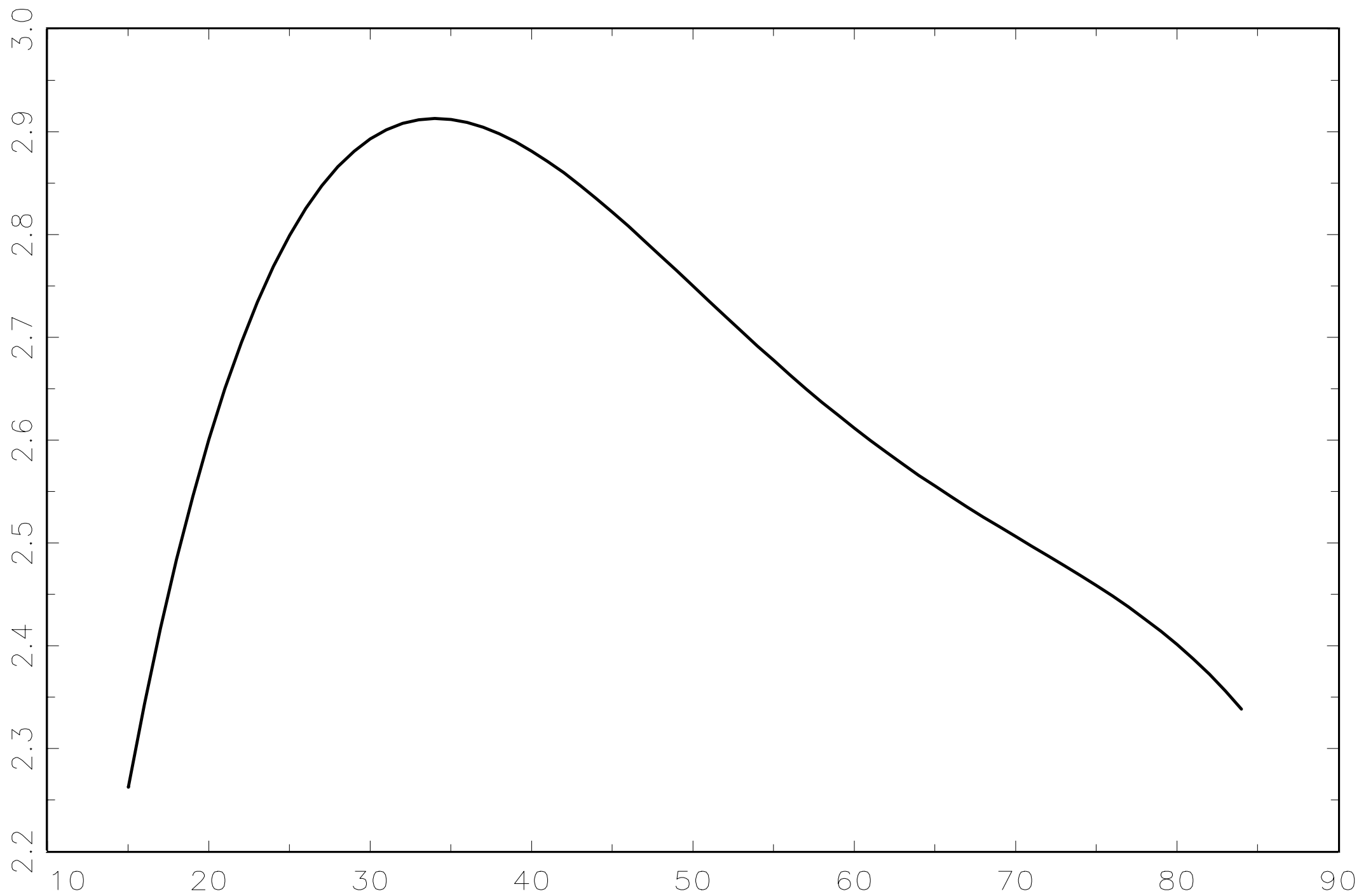
Fig. 6 – Age-Price Profile (pre-1880)
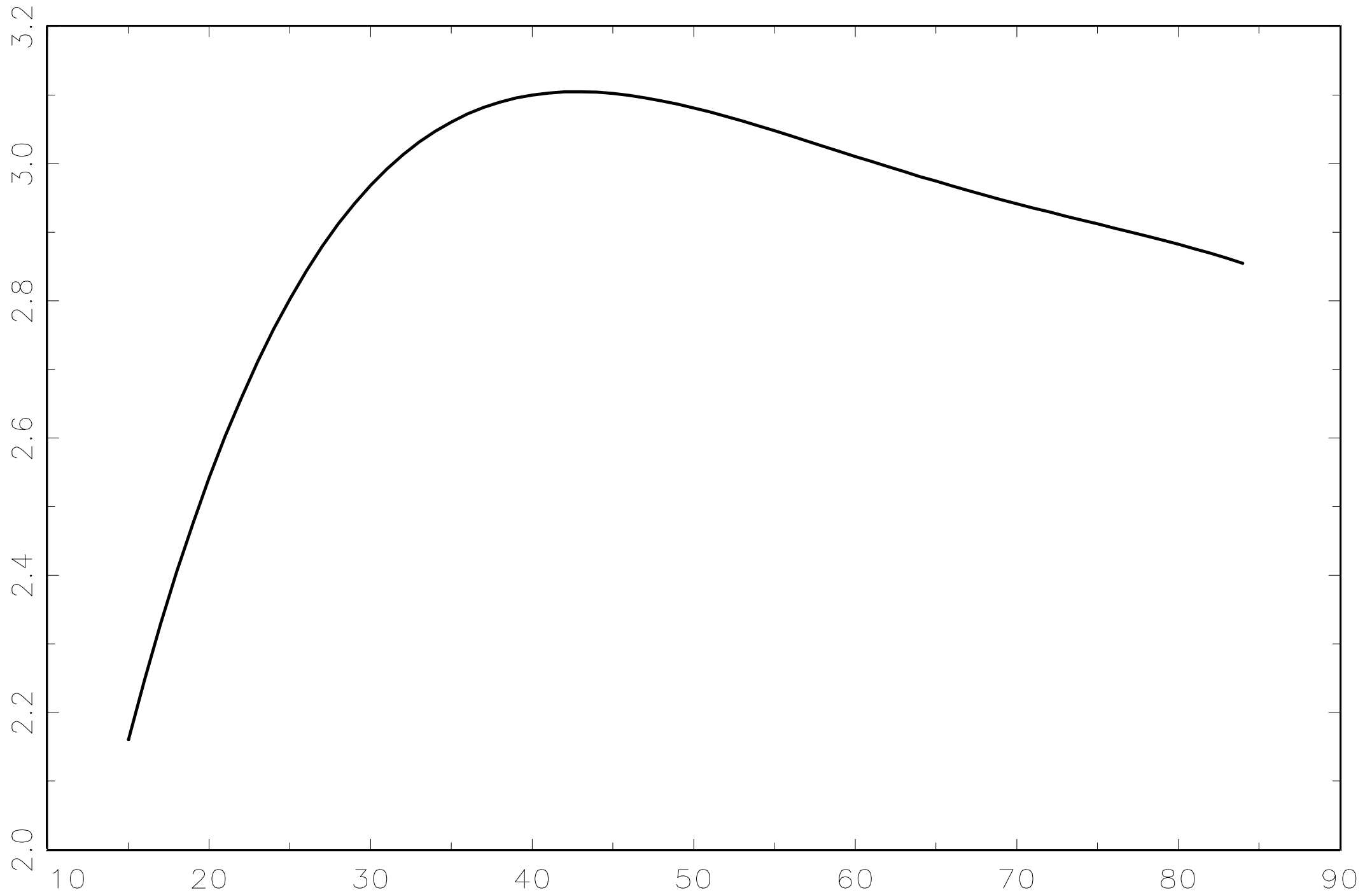
Fig. 7 — Age−Price Profile (1880−1920)
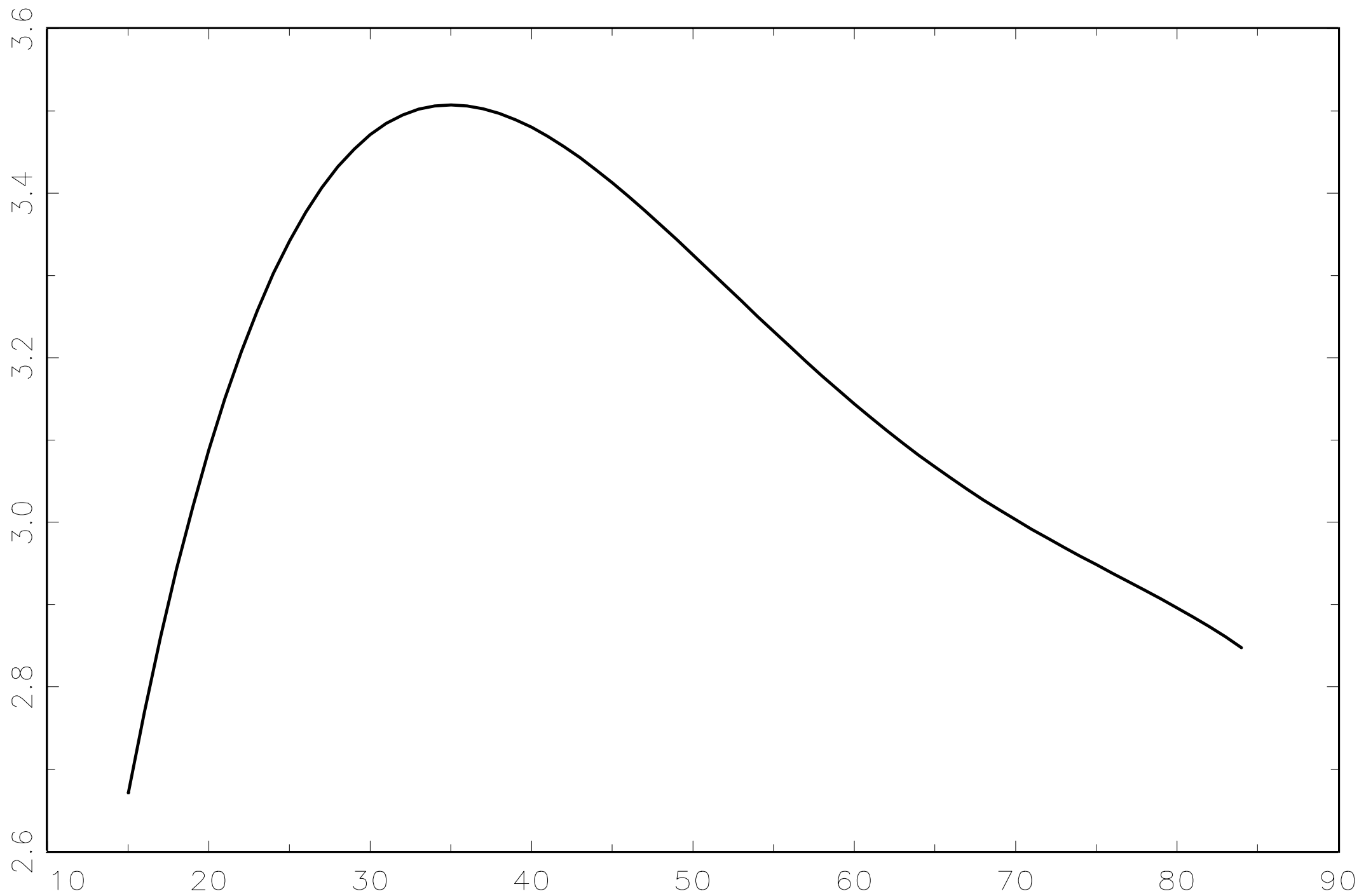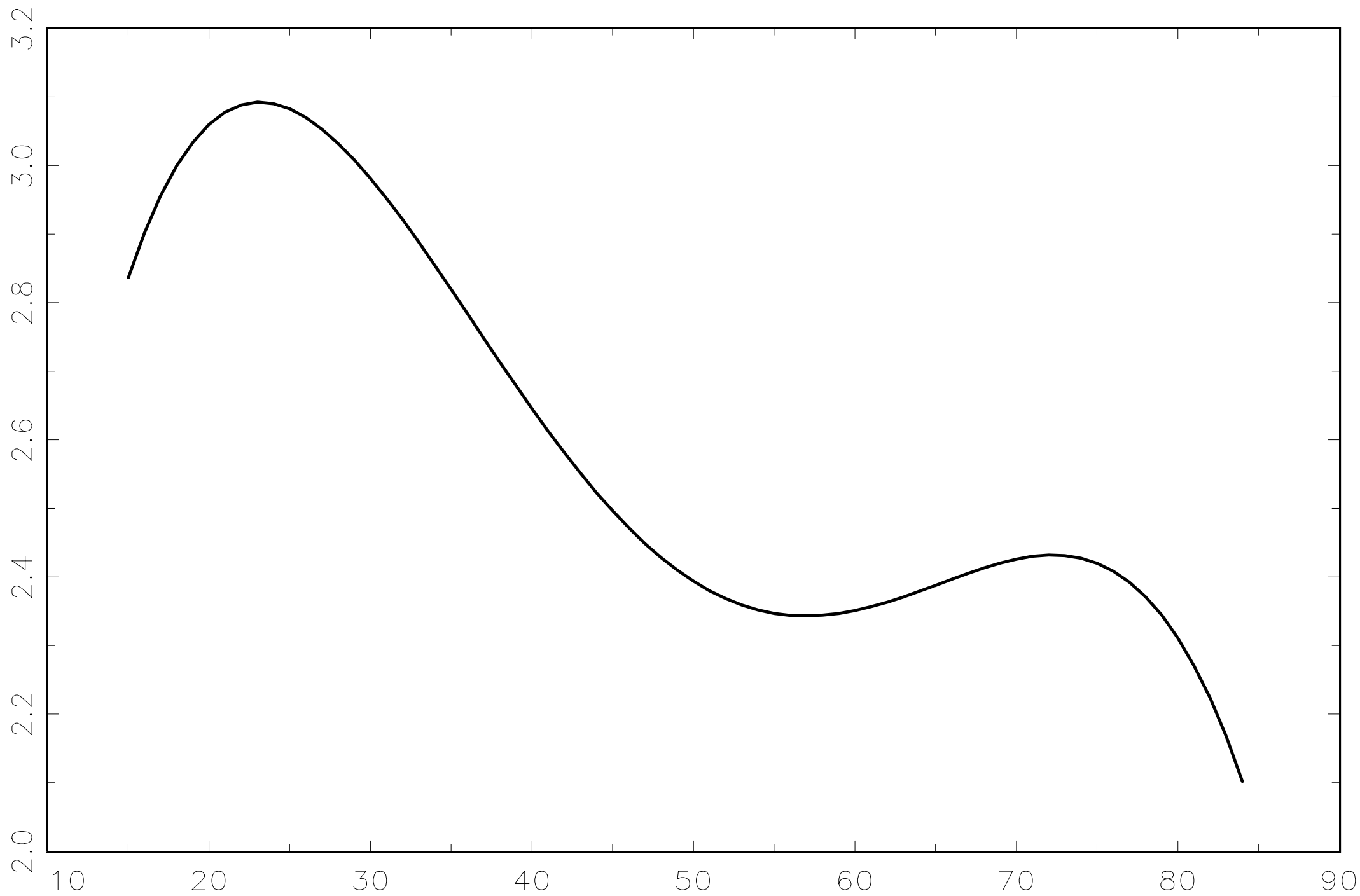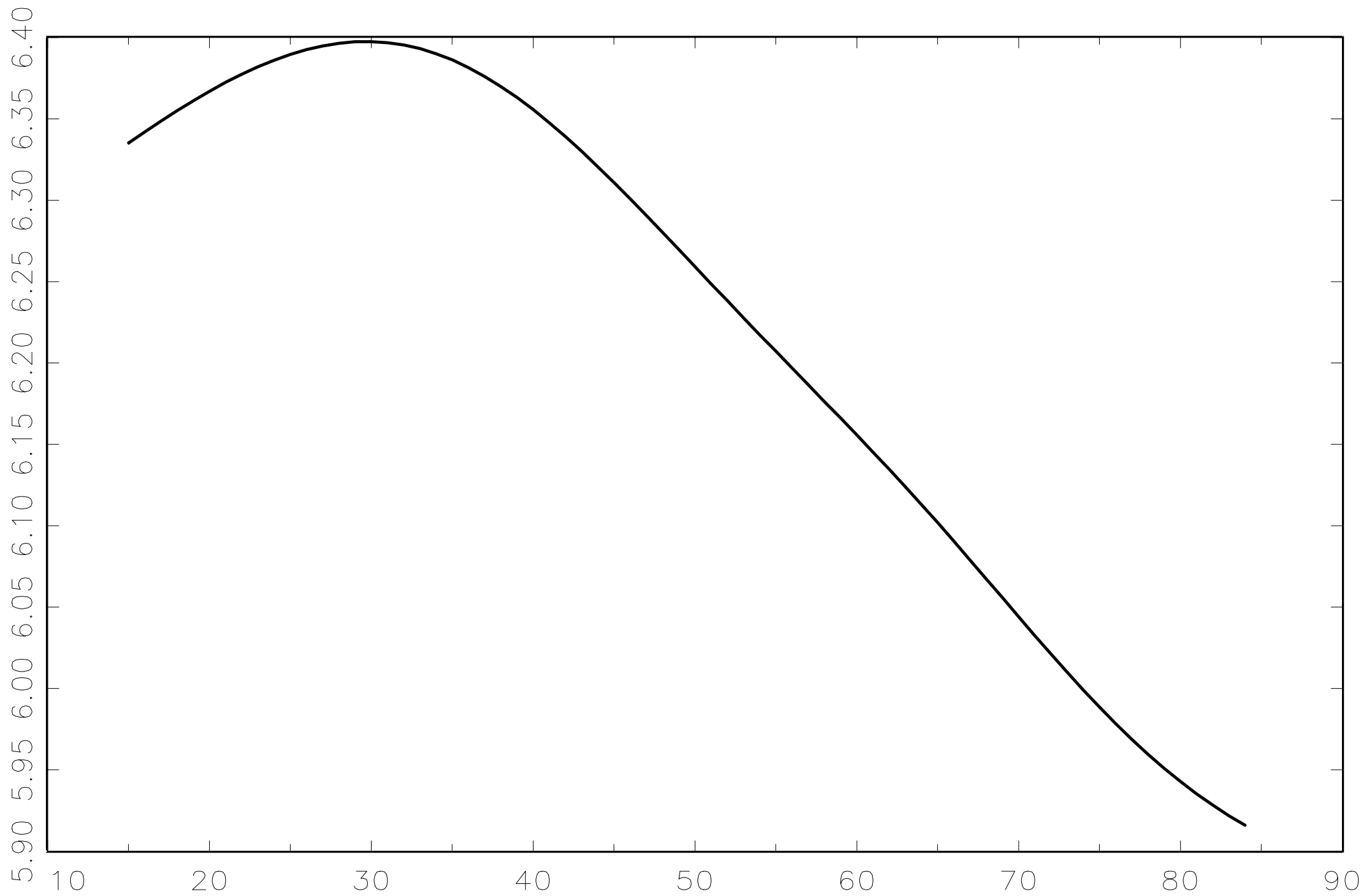
Fig. 8 — Age-Price Profile (post-1920)

Fig. 9 — Nonparametric Age—Price Profile (all)
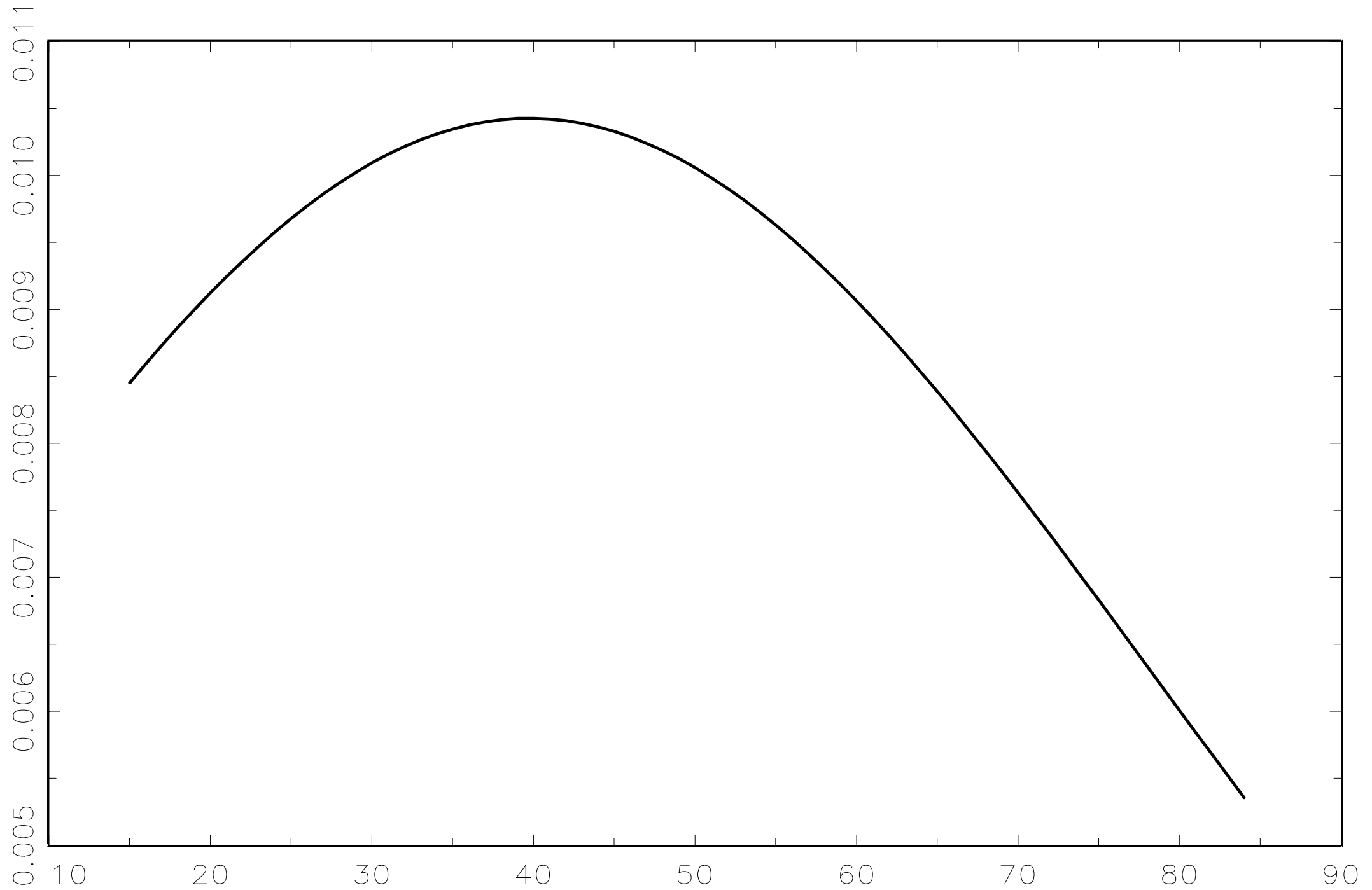
Fig. 10 — Age Dist. of Exhibited Paintings (all)
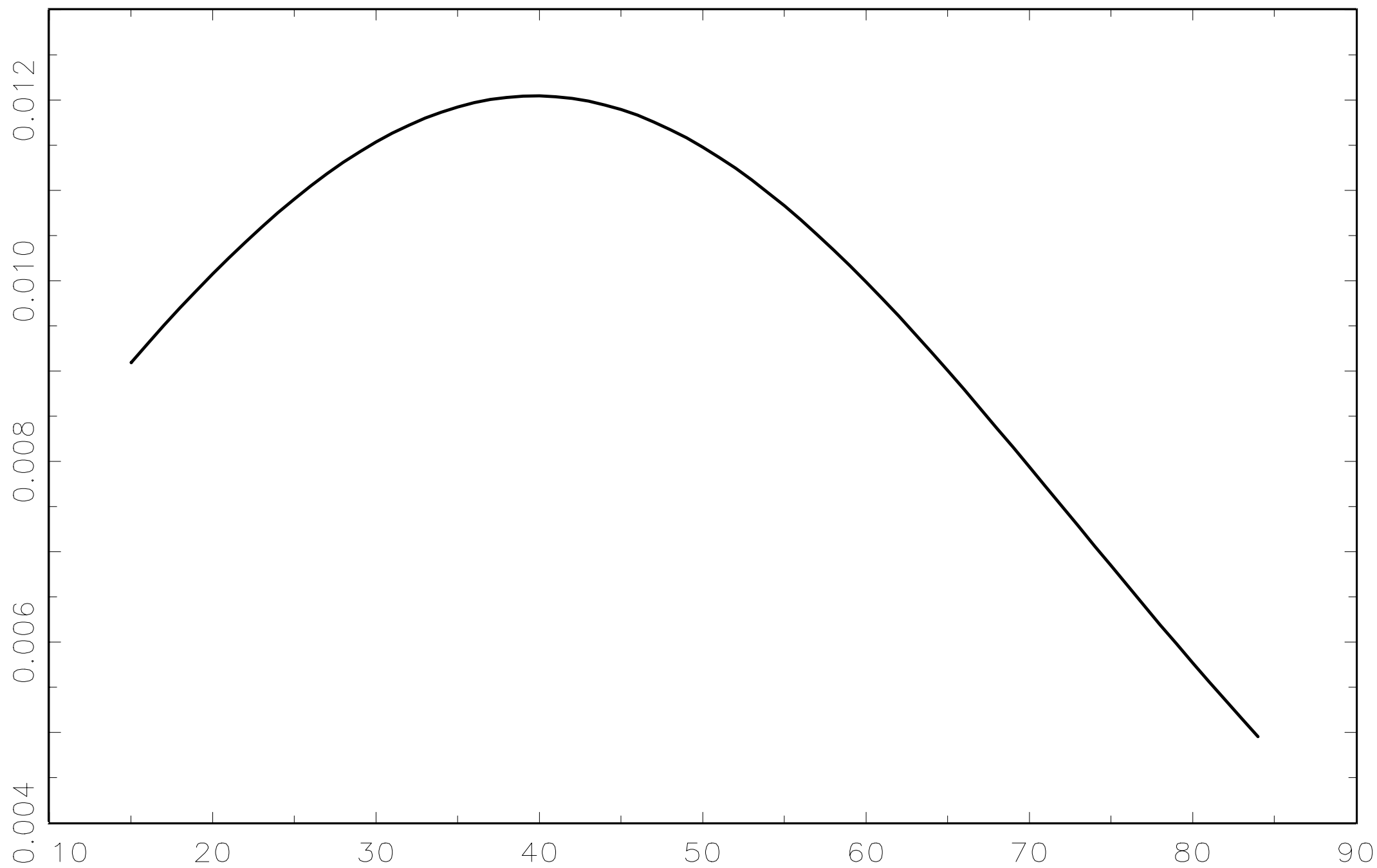
Fig. 11 — Age Dist. of Exhibited Paintings (pre—1880)
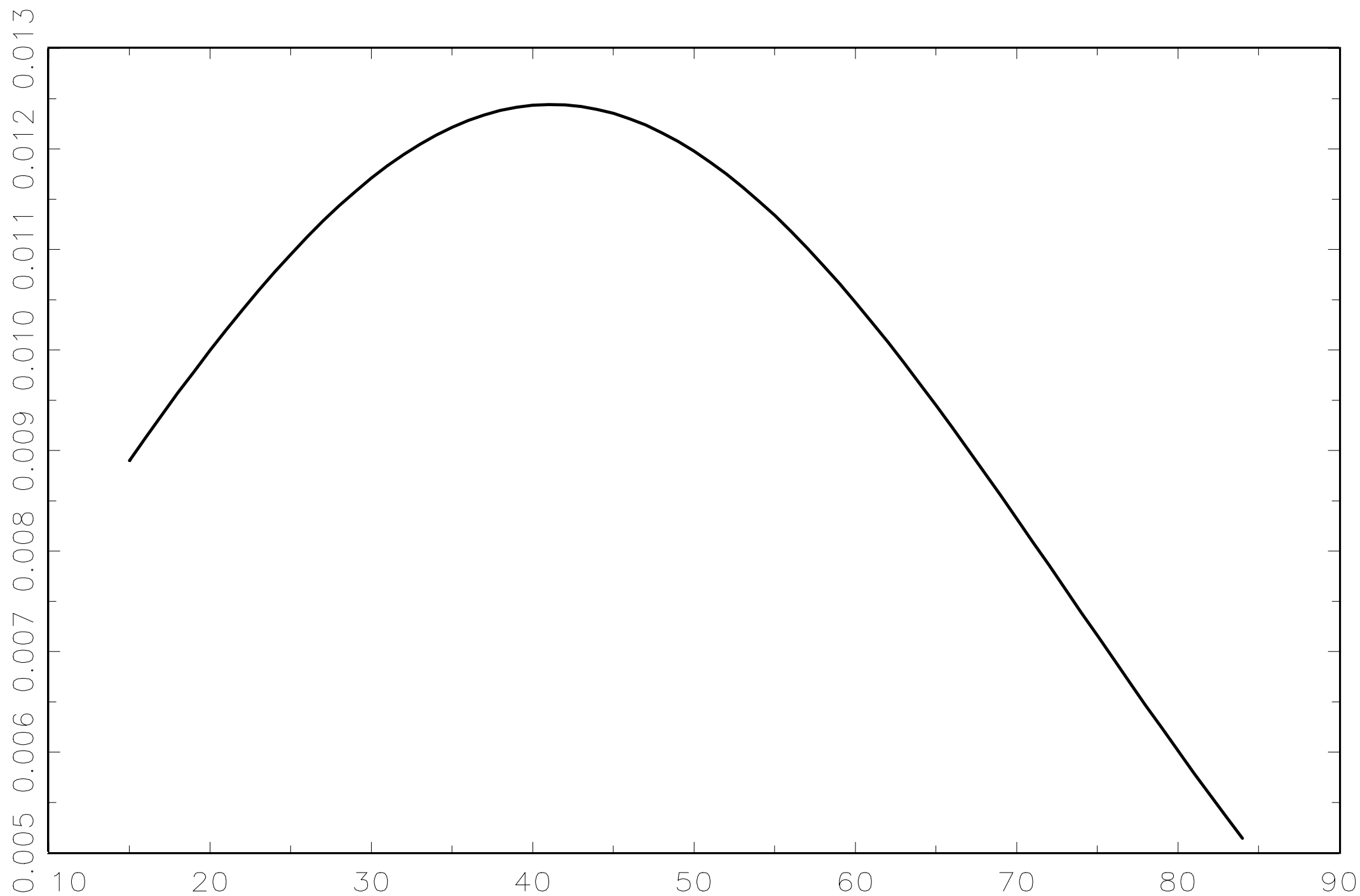
Fig. 12 — Age Dist. of Exhibited Paintings (1880−1920)

Fig. 13 — Age Dist. of Exhibited Paintings (post—1920)