J Evol Econ (2003) 13: 469–490
DOI: 10.1007/s00191-003-0166-8

Journal of Evolutionary Economics

Schumpeter, product innovation and public policy: the case of cigarettes*

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Introduction

Perhaps the most fundamental proposition advanced by Joseph Schumpeter is that competition drives innovation and innovation drives progress. Strangely, although "competition" was a key ingredient to the processes of his capitalistic world, Schumpeter was not concerned about private monopolies and evidently had little stomach for the antitrust policy practiced over the past 50 years in the United States, or for the rather aggressive policy that is emerging currently in the European Common Market.[1] At the same time, a careful reading of his writings discloses that Schumpeter's benign view of monopolies and restraints of trade was limited to **product markets**; he expressed a definite concern about monopoly and restraints of trade in **R & D-innovation markets**. Schumpeter also displayed a very prophetic insight about R & D/innovation and public policy, observing: "*... Surely nothing can be more plain or even more trite common sense than the proposition that innovation ... is at the center of practically all the phenomena, difficulties, and problems of economic life in capitalist society*."[2]

As keen a vision as Schumpeter displayed about economic processes and public policy, he could not have imagined that his theories of innovation and "creative destruction" would become a centerpiece during the 1990s for the widespread antitrust prosecutions by several states against U.S. tobacco companies alleging a conspiracy in restraint of trade and other types of unlawful conduct, and for recovery

* The author gratefully acknowledges helpful comments and suggestions of Joel B. Dirlam, James T. McClave, Paul A. Samuelson, David Sappington, and Thomas R. Saving.

[1] "... There is no general case for indiscriminate 'trust busting' or for the prosecution of everything that qualifies as a restraint of trade... Pure cases of long-run monopoly must be of the rarest occurrence..." Joseph A. Schumpeter, Capitalism, Socialism, and Democracy, 3rd edn. (Harper & Bros, New York, 1950; orig. pub. 1942).

[2] Joseph A. Schumpeter, Business Cycles: A theoretical, historical, and statistical analysis of the capitalist process (McGraw Hill, New York, 1939), p. 87.

of damages resulting from health-care costs incurred. In what ranks as the largest product liability case in U.S. history, in 1998, the tobacco companies entered into a multi-billion settlement with the states for Medicaid costs attributed to treatment of tobacco-related illnesses.[3]

The complaints contend that in 1953 the tobacco companies agreed not to compete with one another on R & D covering smoking and health effects, and not to develop "safer" cigarette products.[4] To support the constrained R & D contention, plaintiff economists testified that the conspiracy resulted in lower research and development expenditures by the tobacco companies; and that, absent the conspiracy, higher levels of R & D expenditures would have been made, resulting in a much "safer," or even a completely "safe" cigarette product.[5]

This paper addresses the major hypothesis underlying the antitrust complaint, namely that the new cigarette products introduced by the tobacco companies between 1955 and 1995 do not meet the Schumpeterian standard for innovation. First, we briefly review Schumpeter's concept of innovation and creative destruction. Second, we examine findings of earlier studies on non-price competition in the cigarette industry since the 1950s *vis a vis* the "constrained R & D" contention. Third, we present data on R & D activities of the tobacco companies, on cigarette products which lowered tar and nicotine levels, and on programs promoting the sale of new products. Fourth, we discuss the nature of R & D processes generally, and the tobacco companies' role in basic medical research on tobacco-related diseases. Fifth, we examine the plaintiff experts' delineation of the product and geographic markets relevant to the antitrust complaint.

1 The meaning of innovation and "creative destruction" in Schumpeter's world

In *Capitalism, Socialism and Democracy,* Schumpeter explained that the fuel which propels capitalism is the constant injection of new innovations in the form of new consumer goods, new production techniques, new modes of transportation, and

[3] An estimated $206 billion is projected to be distributed to 46 states by 2025, unless tobacco sales decline, in which case that figure will be reduced. The other four states – Florida, Minnesota, Mississippi and Texas – entered into separate settlements with the leading tobacco companies.

[4] Our analysis of the merits of the complaint is based upon an examination of the economic reports, depositions and trial testimony of the following experts: Jeffrey M. Harris and Keith Leffler on behalf of the State of Washington; Adam B. Jaffe on behalf of the State of Minnesota, and John L. Solow on behalf of the State of Iowa. Jeffrey E. Harris, one of several economists who testified on behalf of the plaintiff states in support of these allegations contended that there was "...a conspiracy to mutually avoid health claims about cigarettes, to avoid admissions about the risks of smoking, not to develop innovative products..."Harris deposition, p. 208, State of Washington v. American Tobacco Co., and "Health-Care Spending Attributable to Cigarette Smoking and To Cigarette Manufacturers' Anti-Competitive Conduct: State of Washington Medicaid Program, 1997–2001", Damage Expert's Disclosure in: State of Washington v. American Tobacco, Inc., et al., Jeffrey E. Harris, MD PhD, November 3, 1997. See State of Texas v. American Tobacco Co., et al.; State of Washington v. American Tobacco Co., et al., 96-2-15056; State of Connecticut v. Phillip Morris, Inc., et al., CV-96-0072414-S; and State of Minnesota and Blue Cross & Blue Shield of Minnesota v. Phillip Morris, Inc., et al., C1-94-8565; State SEA.

[5] See Harris, op. cit.

new forms of industrial organization. He argued further that the innovations which emerge from this process "revolutionize ... the economic structure from within, incessantly destroying the old one, incessantly creating a new one" – a process he described as *"creative destruction*" – creative in the sense that it creates new value [i.e.,what contemporary economics characterizes as increased consumer welfare] and destructive in the sense that the economic returns to capital/labor producing obsolete products are lowered or eliminated entirely.

Schumpeter evidently was not of a monolithic mind on what it takes to meet his innovation test. His theory of creative destruction treats innovation in both a "broad" and a "narrow" context. For example, the innovation discussion in his 1939 work on business cycles mentions "big" developments that trigger sweeping economic effects, to wit: *"... Individual innovations imply, by virtue of their nature, a'big' step and 'big' change. A railroad through a new country, i.e., a country not yet served by railroads, as soon as it gets into working order upsets all conditions of location, all cost calculations, all production functions within its radius of influence; and hardly any 'ways of doing things' which have been optimal before remain so afterward.*[6] Later [1950] Schumpeter narrowed his model, describing innovations as: "*... These revolutions periodically reshape the existing structure of industry by introducing new methods of production – the mechanized factory, the electrified factory, chemical synthesis and the like; new commodities, such as railroad service, motorcars, electrical appliances ...*"[7]

Accordingly, in order to determine whether the changes made in cigarette products introduced by the tobacco companies satisfy either of the Schumpeter innovation and creative destruction criteria, and to assess the validity of the conspiracy allegation, the paper first addresses these questions: (1) What constitutes "*innovation*" and "*creative destruction* " in the JAS sense? (2) Can the process be measured in some systematic manner? (3) What level of credibility should be accorded to expert testimony in the antitrust cases that none of numerous innovations relative to improvements in cigarette filtration designs, tobacco content, and papers qualify as Schumpeterian innovations? (4) In an economic sense, if sales of existing products are significantly affected [adversely] by the introduction and sale of a new cigarette product, is it fair to conclude that new value [i.e., higher consumer welfare] has been created, and Schumpeterian "innovation/creative destruction" has occurred? (5) Likewise, if the sales of new cigarette products increase significantly, displacing sales of existing products, does that constitute innovation/creative destruction in the Schumpeterian sense?

2 Non-price competition in the cigarette industry

Economic studies published in the 1950's and 1960's disclose that the nature of competition in the post-World War II cigarette industry was undergoing fundamental change, with product competition assuming increasingly greater importance in

[6] Business cycles, p. 101.

[7] Capitalism, socialism and democracy, p. 68.

the mix of competitive strategies pursued by the tobacco companies. This literature casts doubts on the validity of the basic antitrust complaint – that the tobacco companies were engaged in a non-compete agreement to stifle innovation and non-price (product) competition. More specifically, these studies make two important disclosures: (1) that up until the 1940's, the leading cigarette brands were so similar physically that blindfold tests revealed experienced smokers could not distinguish among them, and (2) following World War II, there was a dramatic change in tobacco companies' product policies: product differentiation (non-price competition) emerged as the major competitive weapon for maintaining or increasing company market share, and traditional industry leadership yielded to the new challenges.[8]

These studies also make clear that no single company was able to dominate the cigarette market across the board. In the non-filtered products category, American Tobacco Company maintained the leadership role, while Reynolds was the leader on filter tips. However, by the 1970s, after Marlboro became the world's best-selling cigarette, Philip Morris became the industry leader. The changing character of competition among the tobacco companies led to a proliferation of brands, featuring both filtered and non-filtered products, king-size, extra-long, mentholated, and low-tar. In consequence, following standard oligopoly theory, economists consistently cited the cigarette industry as a leading example of intensive product differentiation and strong advertising-promotions campaigns to increase or protect market share.[9]

Notwithstanding this historical record, various economists testified that product competition stopped, or was severely retarded after the Hill & Knowlton meeting in 1953.[10] At the same time, a fair assessment of the purpose of the meeting of tobacco company representatives with officials of Hill & Knowlton would recognize the increasing contemporaneous public concern about smoking and health that emerged in the 1950's, which posed a challenge of such fundamental importance to all the tobacco companies to justify both an *industry response* and development of a defensible *industry* position on smoking and health. Thus, the creation of Tobacco Institute Research Committee and its successor, the Council on Tobacco Research to deal on an *industry-wide* basis with the scientific issues involved in the emerging controversy over smoking and health was a legitimate activity, consistent with the *Noerr-Pennington* doctrine [that activities designed to influence legislative, judicial, or administrative decisions or actions are exempt from U.S. antitrust laws, even if the effect of the actions is to limit competition]. Finally, the tobacco companies

[8] See, for example, William Nicholls, Price policies in the cigarette industry (Nashville, 1951); R. B. Tennant, The cigarette industry, in: Walter Adams, The structure of American industry, 3rd edn. (New York, 1961); M. A. Alemson, Advertising and the nature of competition in oligopoly over time, Economic Journal, vol. 80 (June 1970); Lester G. Telser, Advertising and cigarettes, Journal of Political Economy, vol. 70 (October 1962); and James L. Hamilton, The demand for cigarettes, advertising, the health scare, and the cigarette advertising ban, Review of Economics and Statistics, vol. 54 (November 1972).

[9] Ibid.

[10] On cross-examination, however, these same witnesses acknowledged that the "gentlemen's agreement" was honored more in the breach, as the tobacco companies continued to work on the development of new products with improved filters and other designs to lower tar and nicotine levels. See the testimony of Professor Adam B. Jaffe in the Minnesota case, relative to Plaintiff Exhibit 18905 [Background material on the cigarette industry client, dated December 15, 1953], Trial transcript, pp. 8170–8179.

began to factor the health concerns into their overall market strategy, and at the same time undertake appropriate competitive actions necessary to maintain their commercial viability against rivals.[11]

3 Cigarette product innovations, 1955–1995

Court records and company documents disclose that the tobacco companies did not abandon competitive product strategies, including R & D and the development of "safer" products with lower tar and nicotine levels. Notable examples were the RJR "Premier"and the Phillip Morris "Saratoga," which represent perhaps the most dramatic change in cigarette design in the history of the industry.[12] These new products, and many others introduced over the 30-year period alleged in the complaint [e.g., Lark, Merit, Parliament, Next, Salem, and Viceroy] as well as special product development projects "Ariel", "Janus" and "Batflake," were characterized by plaintiffs' economic experts as "aberrational defections" from the alleged "gentlemen's agreement" to constrain R & D efforts and not legitimate product competition.

Once again, a fair assessment of the "constrained R & D" allegation would have to acknowledge that no tobacco company, no scientific laboratory, nor any other research organization, has been able to unlock the secrets for the design and development of a completely "safe" cigarette, mainly because the basic biomedical and technical knowledge needed to produce such a product did not exist in the decades covered by the complaints, nor does it exist today. At the same time, numerous products with lower and lower tar and nicotine levels were introduced by tobacco companies prior to and during the 1954-1995 time span covered by the state complaints. Companies continuously experimented with and introduced new products with improved filters, resulting in lower tar and nicotine levels.[13]

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[11] In his supplemental report, Professor Harris acknowledged that "...As mounting scientific evidence led to increasing consumer demand for less harmful products, the explicit agreement not to perform independent biological research became increasingly difficult to enforce. From the standpoint of the economics of imperfect competition, such a development should come as no surprise... in a cartel to stifle innovation, at least one member firm may need to retain an inventory of research techniques and findings, as well as potential new products, as insurance against a deviant firm's introduction of a risk-reducing cigarette or tobacco substitute." Damage expert's supplementry disclosure, in: State of Washington v. American Tobacco, Inc., et al.," Jeffrey E. Harris, Md, Phd, January 5, 1998, pp. 17–18.

[12] Physiologically the "Saratoga" constituted an outstanding innovation in health properties as a cigarette, as did RJR's "Premier." However, test marketing disclosed that these "non-burning" products did not have good taste, were unacceptable to the public, and consequently were not commercially-viable products. See: Operations Department Presentation to the Phillip Morris Board of Directors, October 28, 1964: Research and Development, pp. 1–2.

[13] As of 1964, it was common knowledge in the industry that all tobacco companies were engaged in some forms of chemical research, with most directed to commercial and quality purposes. Also, the companies had allied themselves with biological research laboratories. Dr. Helmut Wakeham reported to the Phillip Morris board that the company's "...Research and Development Department is working to establish a strong technological base with both defensive and offensive capabilities in the smoking and health situation. Our philosophy is not to start a war, but if war comes, we aim to fight well and to win." Operations Department Presentation Phillip Morris Board of Directors, October 28, 1964: Research and Development, p. 6.

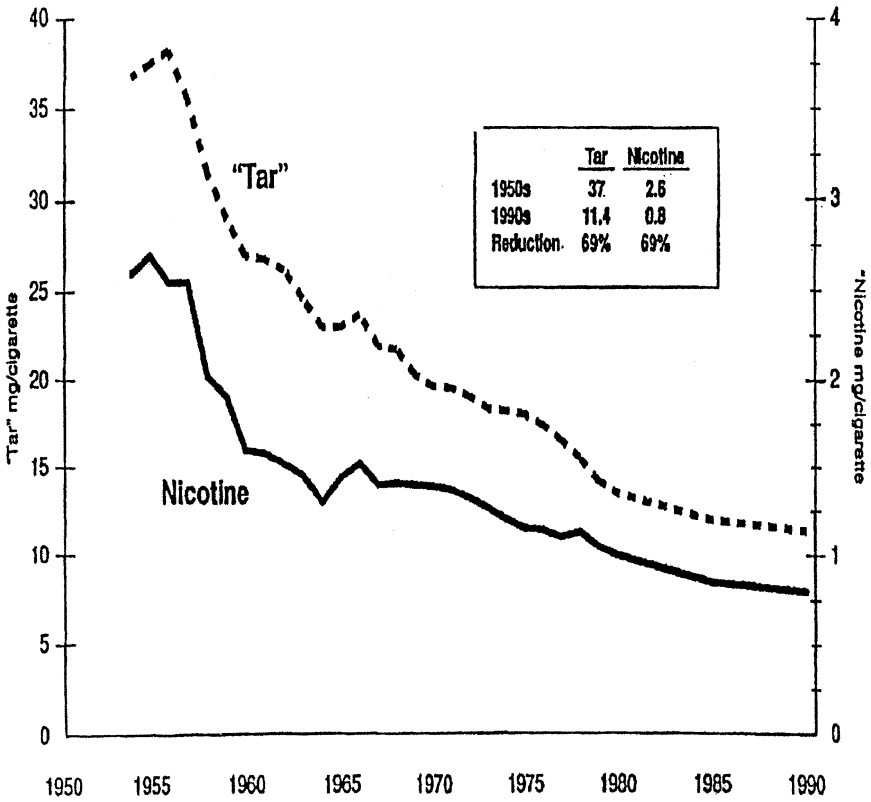

Fig. 1. "Tar" and nicotine yields of U.S. cigarettes sales weighted average basis, 1954–1990. Source: Same as Figure 2

A. Reduction of emissions: tar and nicotine levels

Tar and nicotine levels generally have been regarded by medical researchers and the U.S. Surgeon General as the prime indicators of the toxic content of cigarettes.[14] Figure 1 displays the reduction in tar and nicotine levels in cigarettes between 1954 and 1990, the time period covered by the antitrust actions. Tar content was reduced by 69% [37 mg per cigarette in 1954 to 11.4 mg in 1990]; and nicotine levels were reduced by 69% [2.6 mg per cigarette to 0.8 mg]. These reduction were made possible by new designs incorporated in cigarette products over the past 45 years, including filtration, reconstituted tobacco, paper porosity, reduced tobacco, expanded tobacco, and filter ventilation. Reductions in tar and nicotine levels were attained principally by new types of filters [e.g., (a) the 'micronite' filter in Lorillard's Kent, Newport Lights, Old Gold, and True; (b) the charcoal filter in Phillip Morris' Marlboro, Merit, Parliament, Next; (c) RJR's Winston, Salem, Premier, Eclipse and projects "Premier" and "Eclipse;" (d) Brown & Williamson's Viceroy and Kool; (e) projects "Ariel," "Janus," and "Batflake;" and L & M's Lark]

[14] See Surgeon General's Report of 1964.

plus research on filtration devices, nicotine analogs, and other products having "low" or no-ignition properties.[15]

A review of internal documents released by the tobacco companies, memorializing various company R & D activities over the 50-year period, discloses that while some of the new products represented largely "cosmetic" changes, many others involved significant "health-related" features, including (a) dozens of experiments with filtration materials, varieties of tobacco, and temperature reduction, with the target of reducing harmful emissions; (b) experiments with at least 10 different radical design concepts involving "non-burning" products; (c) just under 100 design and brand changes [including filter design, filtration materials, tobacco, paper type, and other features to reduce nicotine, tar and other emissions], and (d) at least 40 new products incorporating the new designs, improved filtration and lower toxic emissions (tar, nicotine and phenols). By any reasonable standard, this volume of product competition on new designs, improved filtration, and lowering of harmful emissions provide clear economic evidence of innovations containing health-related changes.

B. Public disclosure of product quality improvements regarding health effects: the "tar derby" and "Ad Wars" of the 1950's and 1960's

The antitrust complaints also allege that the conspiracy constrained advertising to smokers on health benefits associated with their respective improved products. However, Lorillard company documents disclose that within the five-year period coincident with the introduction of the new lower tar and nicotine products, more than 50 "health-related" messages were placed in advertisements announcing improved products with lower tar and nicotine content.[16] Similar ads were placed by Phillip Morris and other companies. Moreover, during the 1950's, tobacco companies engaged in an aggressive "tar derby" and intensive ad war, highlighting reductions in tar and nicotine levels. In 1960, the Federal Trade Commission halted competitive advertising based on tar and nicotine levels and health effects of smoking various brands. In 1967, the FTC began publishing the tar and nicotine levels of each brand of cigarettes, as determined by FTC labs, and all cigarette company ads were required to include the tar and nicotine content levels based on the FTC tests. Thus, the foregoing evidence undermines the contention that cigarette companies

[15] A chronology of significant tobacco industry product developments and related events for the 1953–1995 period is displayed in Figure 7.

[16] For example, Lorillard ads featuring "True," "Kent," and "Newport" contain the following kinds of health-related claims:
"Here's proof Kent gives greater filter protection than any other cigarette"
"True: America's no. One low tar and nicotine cigarette –
Fact is that True is lower in both tar and nicotine than 98% of all other cigarettes sold"
"Another development from Lorillard research: Kent's 'micronite' filter reduces phenol, as well as tars and nicotine in cigarette"
"The American medical association voluntarily conducted in their own laboratory a series of independent tests of filters and filter cigarettes, as reported in the journal of the American Medical Association. The tests proved that of all the filter cigarettes tested, one type was the most effective for removing tar and nicotine. This type filter is used by Kent ... and only Kent"

had an agreement not to compete using informational ads about improved cigarette products, lower tar and nicotine levels, and less risky health effects.

Aside from those ads placed by the tobacco companies, additional information on lower tar and nicotine levels in cigarettes was published in the Surgeon General's Reports of 1964, 1972, and1979, the FTC annual reports on the ratings of cigarette brands, as well as articles in various medical journals, popular magazines, and newspapers.[17] In view of these different independent sources providing information to the public about cigarettes and health effects, it is difficult to accept at face value the contention that consumers were not receiving up-to-date information on improved filtered cigarettes. Moreover, given the high degree of cynicism expressed by plaintiffs about the credibility of tobacco company research and development activities, it stands to reason that reports on cigarette product innovations and health effects issued by organizations and agencies independent of the tobacco companies would be expected to have greater credibility with the public.

C. Demand side effects of new cigarette products

Figure 2 displays some selected product innovations that lowered tar and nicotine levels (shown in mg/cigarette): namely, reconstituted tobacco sheet, porous papers, expanded tobacco, and filter ventilation. Between the early 1950's and 1990, competition among the new brands containing improved filtration, lower tar and lower nicotine levels almost completely displaced older, standard cigarettes. In consequence, there was significant year-to-year variations in the market shares among the brands of major producers, notably RJR's "Winston" and "Salem" *vis a vis* Phillip Morris' "Marlboro" and "Merit", Brown & Williamson's "Kool", and Lorillard's "Newport," as shown in Figure 3.

Cigarette production and sales statistics disclose the rather dramatic response of consumers (smokers) to the introduction of new filtered cigarette products with lower health risks. Between 1954,when the first filtered cigarettes were marketed, and 1959, the market share of filter-tip products [Winston, Pall Mall, Viceroy, Kent, Marlboro and L & M] rose from a mere 3% to almost 50%, as shown in Figure 4.[18] Likewise, there was a dramatic shift of smokers to "low-tar" cigarettes (i.e., products with 15 mg tar or less, per cigarette, as measured by the FTC method) after the FTC began issuing public reports of its tar and nicotine ratings of all brands, beginning

[17] See, for example, Cigarette smoking and lung cancer, Consumer Reports, 1954 (February), pp. 54–92; C. W. Lieb, Can poisons in cigarettes be avoided? Readers Digest, 1953 (December), pp. 45–47; J. Monahan and L. M. Miller, The facts behind the cigarette controversy, Readers Digest, 1954 (July), pp. 1–6; E. L. Wynder, E. A. Graham and A. B. Croninger, Experimental production of carcinoma with cigarette tar, Cancer Research, 1953, pp. 855–864; R. Doll and A. B. Hill, A study of the aetiology of carcinoma of the lung, British Medical Journal, 1952, pp. 1271–1286; Smoking and health: a report of the Advisory Committee to the Surgeon General of the Public Health Service, U.S. Department of Health, Education and Welfare, Washington, D.C., 1964; and D. Hoffman and I. Hoffman, The changing cigarette, 1950–1995, Journal of Toxicology and Environmental Health, 1997, pp. 307–364.

[18] The data in Figure 4 reflect Department of Agriculture production statistics for filter-tip products, rather than sales data. However, Maxwell and Wooten sales reports confirm identical trends for production and sales. See: H.M. Wooten, Cigarette sales turn up again in '55 as filters boom, Printers Ink, December 30, 1955; and Cigarette output up 4.8% – filters up 59.8%, Printers Ink, December 28, 1956.

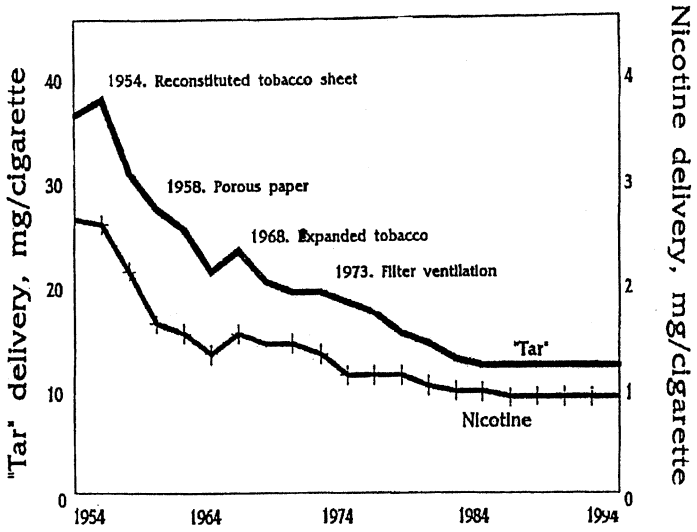

Fig. 2. 1954–1994 sales-weighted average "tar" and nicotine deliveries. Source: 1957–1987 reducing the health consequences of smoking, a report of the Surgeon General, 1989; prior to 1957 and subsequent to 1987, numbers calculated based on information similar to that used in the 1989 Surgeon General report

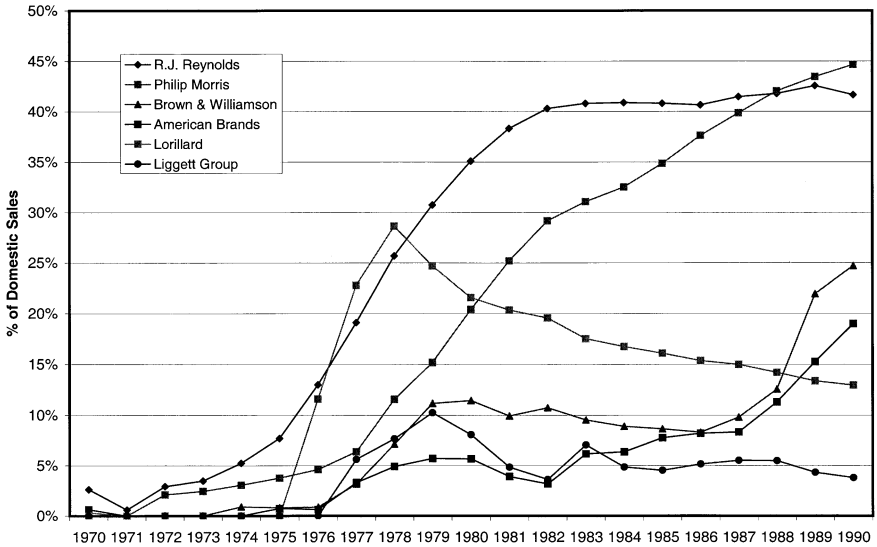

Fig. 3. Percentage of domestic sales from "light" (low tar) brands, by company 1970–1990. Source: Maxwell data produced in Minnesota case

in 1967.[19] Figure 5 shows the steady growth of low-tar cigarette products' market share between 1967 and 1981, which amounts to a compound annual growth rate of approximately 25%. The FTC reported that by 1995, low-tar cigarettes accounted

[19] See: Federal Trade Commission Report to Congress for 1995 Pursuant to the Federal Cigarette Labeling and Advertising Act (Washington D.C.: Federal Trade Commission, 1997).

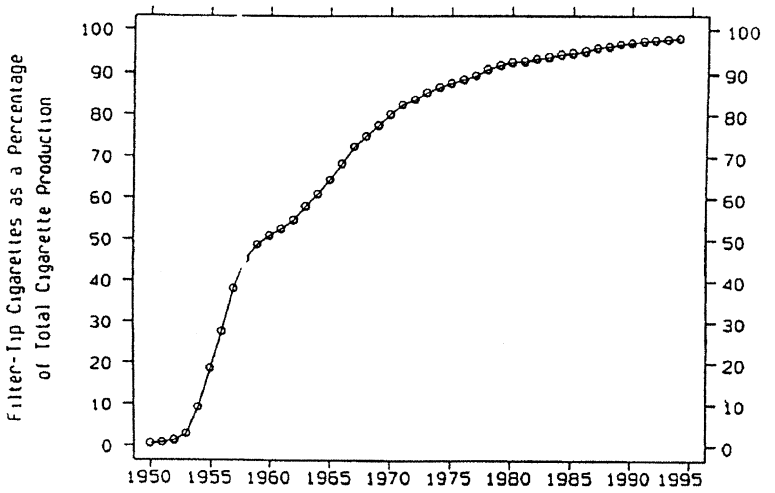

Fig. 4. Filter cigarette share of total cigarette production, 1950–1994. Source: U.S. Department of Agriculture, Economic Research Service. Archived at: http//mann77.mannlib.cornell.edu/datasets/specialty/94012/1/TAB003.WK1

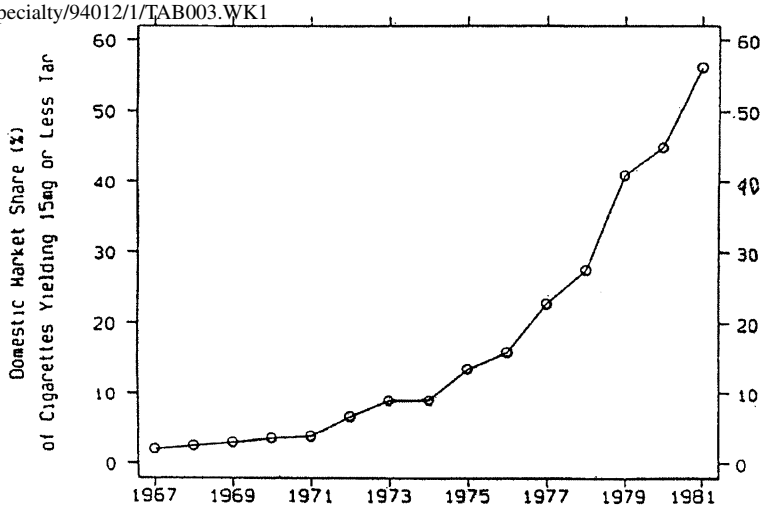

Fig. 5. U.S. market share of low-tar cigarettes, 1967–1981. Source: Federal Trade Commission Report to Congress for 1994 Pursuant to the Federal Cigarette Labeling and Advertising Act. Washington DC: Federal Trade Commission, 1996: Table 6

for approximately 73% of total cigarette sales.[20] In short, the demand side effects of new products vs. old products provide strong economic evidence of innovation.

The importance of this rather rich product innovation history was discounted in testimony by plaintiff economists, apparently because no company was able to design and produce the ultimate, ideal "safe" cigarette, which plaintiffs argue was the "public obligation" of the tobacco companies. In leveling this charge, plaintiff economists implicitly assumed (a) that the state of medical science had advanced

[20] Ibid.

beyond the possible adverse effects of "high" tar and nicotine levels on the lungs; (b) that scientists would have discovered and identified, with greater precision, at the time of the Surgeon General's Report of 1964 and thereafter, a deeper knowledge about the relationship between smoking and particular health effects; (c) the specific cigarette ingredients and cigarette emissions responsible for the suspected adverse health effects; and (d) the discovery and design of alternative products that minimized the risk of adverse health effects, while still providing the commercial requirements of an acceptable product from the standpoint of consumers.[21]

4 The nature of the R & D process

Economic reports and testimony presented by plaintiff economists, do not cite any references or literature dealing with innovation models, nor to a credible research and development model, which supports the assertion that tobacco companies *could have* developed "safer" cigarettes much sooner. Their analysis and conclusions are based on a theory of innovations and technological change driven principally by the level of research and development expenditures. By contrast, the literature on innovation models discloses that technological innovation is a far more complicated process than that described by plaintiff economists, and clearly not a process driven simply by the size of R & D expenditures.[22] Court records confirm that the tobacco companies did not abandon competitive product strategies, including the development of "safer" products with lower tar and nicotine levels, as previously noted.[23]

Nonetheless, plaintiff economists characterized these products and others introduced over the 30-year period alleged in the complaints [e.g., Lark, Merit, Parliament, Next, Salem, Viceroy and product development projects "Ariel", "Janus" and "Batflake"] as "aberrational defections" from the alleged "gentlemen's agreement" regarding R & D on cigarette products. Moreover, the analysis of cigarette product innovation proffered by plaintiff economic experts suffers from several other weakness:

[21] Of course, today's more advanced biomedical knowledge and technology (including the use of sophisticated "transgenic" biochemical manipulation and such animals as the famous "oncomouse") might permit improved testing and more precise identification of specific toxic substances in cigarette smoke, when identified as the proximate causes of lung, throat, and mouth cancers, might be eliminated in product composition and design. However promising these new avenues for cancer research, it is important to acknowledge that transgenics and the notion of transgenic pharmaceutical research were not available until the late 1980s. See Albert Rosenfeld, New breeds down on the pharm, Smithsonian, July, 1998, pp. 23–30.

[22] See, for example, the writings of Joseph Schumpeter, John Jewkes, David Sawyers, Richard Stillerman, Edwin Mansfield, Robert Solow, Edward Dennison, F. M. Scherer, D. Ross, and David Audretsch, among others, cited in footnote 24, below.

[23] Notable examples include the RJR "Premier"and the Phillip Morris "Saratoga," which represent perhaps the most dramatic change in product concept in the history of the industry. Physiologically the "Saratoga" was an outstanding cigarette, as was RJR's "Premier." However, as test marketed these products did not have good taste and consequently were unacceptable to the public. See: Operations department presentation to the Phillip Morris Board of Directors, October 28, 1964: Research and Development, pp. 1–2.

(1) The analysis glosses over the extensive time requirements involved in the complex multi-stage process that characterizes break-through bio-medical discoveries, beginning with the basic research stage to discover the keys for unlocking the doors to cellular biological mysteries, followed by the development of substitute ingredients, process, and finally the product development and the market test stages. To argue that higher levels of R & D expenditures alone would have resulted in "safer" products, sooner, without specifying with any precision at which stage(s) of the R & D process the shortfall existed, incorrectly implies that the research problem was largely a matter of product development.

(2) In contrast to the naive innovation model used by plaintiff economists, many scholars in this field note that there is a substantial random component in the discovery of an initial scientific break-through or innovation. Even though hundreds or thousands of researchers in private and government research laboratories may recognize the presence of an unsolved problem or unmet need [e.g., development of the components and design of a "safe" cigarette], only a fraction of those groups possess the technical skill and ability to devote serious effort to the basic research required and the ingenuity (and often, just sheer good luck) to develop the correct insight for solving the basic problem. The amount of resources devoted to R & D undoubtedly is an important variable in this equation, but the amount of private resources allocated will not necessarily insure success in solving difficult scientific problems, especially those dealing with human physiology, cellular biology, immunology and epidemiology.
Innovation theorists also explain that after the necessary conceptual advances have emerged and the scientific correctness of a concept [e.g., a "safe cigarette"] has been certified through test models or other demonstrations, the development process must next confront various uncertainties associated with perfecting the innovation and the development of prototypes, including:[24] (1) What is likely to be the composition, design and detailed configuration of the target product? (2) Will the prototype be commercially feasible [i.e., what are likely to be the development costs for perfecting the product, how long is the perfecting process likely to take]? (3) Will the product be acceptable to consumers in that form [e.g., the non-burning "Premier" and "Eclipse"]? (4) At what price can the new innovation be sold? (5) What is likely to be the market demand at that price?

(3) Plaintiff economists also testified that the tobacco companies should have spent much more, on the order of 10% of their sales volume, as is done in the ethical drug and pharmaceutical industry.[25] Close examination of data on industry expenditures on R & D reveals that this is an arbitrary proposition. According

[24] See, for example, F. M. Scherer and David Ross, Industrial structure and economic performance, 3rd edn. (Houghton Mifflin, Boston, 1990), pp. 614–660; John Jewkes, David Sawers and Richard Stillerman, The sources of invention, 2nd edn. (Norton, New York, 1969; Abbott P. Usher, A history of mechanical inventions, rev. edn. (Harvard University Press, Cambridge, 1954; N. R. Hansen, Patterns of discovery (Cambridge University Press, Cambridge, 1958); Thomas S. Kuhn, The structure of scientific revolutions (University of Chicago Press, Chicago, 1962); Edwin Mansfield et al., Research and innovation in the modern corporation (Norton, New York, 1971; Edwin Mansfield, Industrial Research and Technological Innovation (Norton, New York, 1968; and Edwin Mansfield, Samuel Wagner, et al., The production and application of new industrial technology (Norton, New York, 1977).

[25] See especially the Harris, Jaffe and Leffler depositions and trial testimony in the cases cited above.

to a study by the Federal Trade Commission, the median ratio of company-financed R & D-to-sales for all U.S. manufacturing industries was 1% or less.[26] Moreover, the central focus and business of the ethical drug and pharmaceutical companies traditionally has been grounded in both "basic" and "applied" research projects. By contrast, other industries, including those akin to the tobacco industry [e.g., the S.I.C. category, "*food and food products, beer, wine, liquor soft drinks and confections*"] are entirely different types of businesses, which historically have spent approximately 1% of sales revenues on R & D. Also, their research traditionally has been "applied" [product experimentation and development]; they typically have not engaged in bio-medical research, nor have they operated basic research laboratories such as those found in the ethical drugs and pharmaceutical industries.

(4) Plaintiff economists also contend that after the Surgeon General's Report of 1964, the tobacco companies should have re-invented themselves and directed a larger fraction of their sales revenues into basic bio-medical research. If this reasoning were valid, it would imply that beverage companies [beer, liquor and soft drinks], as well as candy, confections and snack food companies, should be allocating a substantial fraction of their sales dollars to basic medical research on alcoholism, obesity, and diabetes. Moreover, should they fail to do so would make them liable for adverse heath effect damages – a rather arbitrary, if not radical economic mandate for firms operating in a free enterprise economy. In short, economists testifying for plaintiffs contend that the tobacco companies should have reorganized themselves as bio-medical research companies and health advisory service businesses, promoting substitute cigarette products which focus groups found unacceptable. Thus, carried to its logical conclusion, this contention implies that any firm making legitimate products that meet consumer tastes and preferences has an obligation to issue health-advisory ads urging buyers to switch to other less-acceptable, or non-acceptable, foods, beverages or kindred products.

(5) Finally, one plaintiff economist apparently wants to have it both ways: He testified that the companies had a "gentleman's agreement" not to conduct in-house research for developing a safer product, and not to compete in advertising and promotion of safer products. At the same time, he contended that Phillip Morris' charcoal filtered "Saratoga" and "Next," BATco's prototype non-burning product "Ariel" [1964] and "Airbus" project [1980's], RJR's non-burning product "Premier," and its successor "Eclipse" [1987] – all developed from in-house research by Phillip Morris, RJR's biological research facilities in North Carolina, and various similar R & D projects – were isolated defections from the conspiracy, not serious R & D efforts to develop safer products. Thus, by asserting that (a) the research which developed new "safer" [lower tar and nicotine products] proves the companies had the ability to develop a safer cigarette, but (b) the products which evolved from that research really do not qualify as product

[26] See Federal Trade Commission, Statistical report: annual line of business report, 1977 (Washington, 1985) based on a study using "line of business data" for 238 manufacturing industries.

competition in the Schumpeterian sense, he turned his original argument on its head.[27]

5 Basic medical research and the tobacco companies

The contention that but for the alleged agreement to restrict R & D competition, the tobacco companies could have developed a safe cigarette product is based on several questionable assumptions: (1) that the companies' laboratories were sufficiently experienced in conducting bio-medical research; (2) that the cigarette companies were experienced in bio-medical research studies; (3) that they had established research laboratories dedicated to basic cellular biological research studies in-house, with an experienced staff of MDs and PhDs conducting basic biological studies; (5) that they had on-going contracts with private research laboratories covering basic research in cellular biology; or (6) they could have reorganized and re-directed their R & D into bio-medical research.

Prior to and after the 1964 Surgeon General's Report, the tobacco companies engaged in chemical research studies, principally for commercial and quality purposes,[28] focusing their R & D on the chemical composition of emissions, filtration, and product design. However, the companies did very little, if any laboratory biological research, e.g., RJR conducted some smoking exposure studies with rats, Liggett had a research contract with Arthur D. Little in the mid-1950's, and the industry's Council on Tobacco Research was familiar with Dr. Auerbach's research on "smoking dogs," sponsored by the National Cancer Institute. These in-house research efforts were more "applied" than basic, focusing on product development, e.g., re-designed filters to reduce nicotine and tar content, ventilating designs, treated and expanded tobacco, tobacco substitutes, and improving techniques for measuring nicotine and tar levels.[29]

It is speculative to argue that had the tobacco companies re-directed their research into basic bio-medical studies, their research scientists would have had any

[27] See testimony of Adam Jaffe in State of Minnesota, et al. v. Phillip Morris, et al. Trial transcript, pp. 8200–8226, and 8615–8695, especially pp. 8694–8695, which includes the following nonsensical assertion: "Well, I don't believe that's directly relevant, because they did research on filters, but they never made an attempt, other than the ones we have talked about, with specific products to figure out whether those products with improved filtration were in fact safer... So although that effort was, I believe, motivated by an attempt to respond to consumers' demand for safer products, I wouldn't characterize filter cigarettes as an attempt to develop a safer cigarette that really was the kind of thing that in terms of creative destruction would have been expected."

[28] The following was reported in 1964: All of the manufacturers are doing chemical research. Most of it is for commercial and quality purposes. Nevertheless, some of it is for smoking and health purposes – e.g., to enable them to alter quickly the constituents of the smoke if this should be required. Report on policy aspects of the smoking and health situation in USA (October, 1964), p. 15.

[29] The research limitation of the tobacco companies was confirmed in the letter dated December 15, 1968, from the head of the Operations Department of Phillip Morris, Dr. Helmut Wakeham, to President Goldsmith, in which he straightforwardly acknowledged that the tobacco companies did not have the expertise within their own research departments to carry out basic biological research studies on smoking and health, and urged that the research should be conducted by biological experts, not the tobacco companies. See Plaintiff Exhibit 10257 in the Minnesota case.

greater success in unlocking the unknowns than researchers and research laboratories with long-established reputations in this field. Moreover, given the highly-charged environment which emerged after the 1964 Surgeon General's report on smoking and health, it is highly doubtful that the tobacco companies could have escaped the charges leveled against them in the recent litigation [notwithstanding whatever biological research undertaken]. In short, the assertion that development of the prototype of a "safe" cigarette was largely a matter of expending more R & D dollars is simplistic and unrealistic from the standpoint of the scientific research, because it implicitly assumes that the basic epidemiological relationships regarding smoking and specific health effects had been established, and that all the tobacco companies had to do was to spend more money for product development.

On this score, in 1964, when the Surgeon General's Report was published, no scientific medical studies were extant identifying the direct connections regarding health effects and the specific ingredients that should or should not be used to produce a "safe" consumer-acceptable product [papers, filters, tobacco types, etc.] . Hence, if one seriously pursues the argument that all that was lacking to achieve the "safe product" goal were higher R & D budgets by the tobacco companies, one must identify, with some precision, the state of medical knowledge demonstrating scientifically-verified connections between cigarette products' ingredients and health effects, which might provide direction to product development efforts.[30]

6 Theoretical issues: defining the relevant product and geographic markets

The Sherman Act places the burden on plaintiffs to correctly identify the relevant product and geographic markets restrained by an alleged agreement. In addressing this issue, the economic reports and trial testimony in the cigarette litigation contain a common analytical error, namely that "cigarettes" constitute the relevant product market restrained by an alleged "gentlemen's agreement." One economist defined the relevant product market as the "United States cigarette market,"[31] and that the relevant geographic market was the United States [because of entry barriers, particularly the importance of brand names, product differentiation, and advertising expenditures]. Since the tobacco companies manufacture cigarettes, he assumed that "the cigarette market" is the product market relevant to the restraint alleged in the antitrust count. It is undisputed that the tobacco companies manufacture and distribute cigarette products. However, the Minnesota Complaint contends there was a restraint of trade not in cigarettes, but *"... in the R & D market for basic*

[30] The contention that production of a safe product was feasible, if only more R & D expenditures had been made by the tobacco companies, could be tested using a theory of innovation and data on the actual "success rates" of R & D expenditures in industries routinely involved in *applied research*. However, such a model implicitly assumes that *basic research* studies already had solved the puzzle regarding the particular cancer-causing agent(s) or the process triggered by specific constituents of smoke that are associated with the formation of carcinomas in human beings.

[31] State of Minnesota, et al. V. Phillip Morris, et al., Trial Volume Number 42, March 18, 1998, p. 8131.

research on smoking and health, and the discovery of the components and design of a "safer" cigarette product."[32]

The alleged conspiracy purportedly was designed to block research efforts to discover the ingredients and the development of an optimal cigarette product, risk-free of possible adverse health effects. No theoretical or empirical analysis and data were offered to support the allegation that the tobacco companies possessed and were capable of exercising *monopoly power* to restrain competition among entities engaged in biomedical and bio-technical research on smoking and health effects, and design elements for a "risk-free" product. Plaintiff economists argued that (a) because the concentration ratios for the *production of cigarettes* are high, a comparable level of concentration exists in the conduct of basic medical research and development related to smoking and health, and (b) the tobacco companies had the requisite *market or monopoly power* to restrain research activities in that market. This heroic leap from *cigarette production* to supply of *research services on smoking and health* constitutes a major flaw in plaintiffs economic analysis of the relevant product market.

A. The R & D market supplying discoveries on smoking and health effects

The economic market supplying research services on neoplasms of the respiratory system and the thoracic organs, discoveries on smoking and health effects, and other bio-tech research consists of a broad complex of institutions, laboratories and researchers, that is international in geographic scope. This market includes public and private scientists and laboratories conducting directed and non-directed research on the causes and treatments of all sorts of diseases. The laboratories are funded by public and private universities, government agencies, for-profit corporations, and non-profit entities, including the National Institutes of Health [National Cancer Institute], Sloan-Kettering, Battelle Institute, among others. Although they have engaged in applied research on chemical emissions of cigarettes, filtration, and product design, the tobacco companies are not competitors with entities conducting basic biomedical research. Indeed, no tobacco company, or any other company, laboratory or institute has a dominant share of the market supplying research studies on the causes, prevention and treatment of various forms of cancer, nor do tobacco companies individually, or as a group, have the "market power" to block or retard scientific research dealing with basic medical knowledge about smoking and health.

Therefore, the reports of plaintiff economic experts are flawed analytically because they gloss over fundamental economic differences between the cigarette product market and the market supplying biomedical and bio-technical research services on smoking and health effects. The tobacco companies have an obvious interest in research findings on diseases associated with cigarettes and health, which may provide new information that could be useful for cigarette product improvements. However, it is quite a stretch to argue that the cigarette companies as a group

[32] Ibid.

exercised *market or monopoly power* over the supply of biomedical and bio-tech research studies dealing with smoking and health effects. In short, (1) plaintiffs failed to correctly identify and define the relevant product and relevant geographic market which the various state complaints allege was restrained; (2) failed to present any economic analysis or data measuring the degree of market power the tobacco companies had in the correctly-defined market; and thus (3) failed to demonstrate how the tobacco companies could have restrained competition in the correctly-identified market.

The diverse market supplying basic and applied biomedical research in ethical drugs, pharmaceuticals, chemicals, new metals and alloys, plastics, and diverse consumer and producer goods: aircraft, autos, television, electronics, computers, satellites and communications does not have any artificial entry barriers, geographical or otherwise. The principal economic barrier essentially lies in scientists' ability to surmount existing frontiers of medical knowledge through basic research, which has very little to do with the tobacco companies. The tobacco companies are not players in this market, but rather are buyers, potential creators, and end-users of new materials, new processes and new components for cigarette manufacturing.

B. Why have scientific laboratories failed to develop a "safe" cigarette?

Research publications by various scientists working in the field of smoking and health effects disclose that medical technology, especially that concerned with cellular biology and the application of that knowledge to the development and production of a risk-free product was not fully known and not available to scientists inside and outside the tobacco industry during the alleged conspiracy period.[33] Moreover, it is questionable whether the tobacco companies could unilaterally retard the development of cigarette-making technology, because very limited, precise medical knowledge existed disclosing the connections between cigarette smoking and health effects during the alleged conspiracy period, and the design and specifications for manufacturing a risk-free product. Likewise, today there still does not exist any cigarette-making technology based on firm medical knowledge that can guarantee a risk-free product, beyond what already has been introduced via competitive innovations of cigarette companies, i.e., advanced designs utilizing improved filters, better papers, and other components.

1) R & D expenditures by the tobacco companies. Would a higher level of R & D expenditures by cigarette companies beginning in the 1960's and thereafter have produced a "safe" product? The answer to this question is not simply a matter of throwing large sums of money into tobacco companies' research activities *per se*. Rather, the answer is largely a function of the then current, and present state of bio-medical scientific knowledge, particularly in cellular biology, epidemiology, and pharmacology regarding the formation of carcinomas in human beings, and the attendant scientific knowledge about how to prevent those formations, including

[33] See citations listed in footnote 17, supra.

the composition and design of a product that provides the features smokers enjoy without risk of adverse health effects.[34]

The contention that the discovery and development of a "safe" cigarette [or, more precisely, the ingredients, components and manufacturing process for making a "safer" cigarette] was/is purely a function of higher and higher R & D expenditures thus is simplistic and questionable analytically. If such a straightforward, linear relationship existed for the development of innovations that depend upon solving biological and chemical unknowns that are associated with the formation of cancer, given the higher and higher levels of public and private R & D expenditures on various diseases over the past several decades, by now scientists also should have discovered the causes and prevention of many other serious diseases, such as AIDS, ALS (Amyotropic Lateral Sclerosis, popularly known as "Lou Gehrig disease"), DIABETES, ARTHRITIS, and ALZHEIMER's DISEASE, among others,

2) Why not a government "mandate" to develop a "safe" cigarette. For the sake of argument, assume an extreme regulatory scenario, namely that following the issuance of the 1964 Surgeon General's Report on Smoking the U.S. Congress passed a statute, effective in 1965, which *mandated* that cigarette companies produce "a safe cigarette" by the year 1970 – i.e., one that would not cause carcinomas in mice or men – which is essentially equivalent to the assumption underlying Professor Harris' analysis, which he states: "...The evidence reviewed in the previous section supports the conclusion that U.S. cigarette manufacturers had the technical capability to achieve present-day tar levels by the late 1960s..."[35]

Using regression analysis, Harris determined that the tobacco companies actually achieved an average rate of reduction in tar delivery per cigarette (as measured by the FTC method) between 1955 and 1995 of 3.4 mg per year, and then concluded that the average rate of reduction should have been 7.0 mg per year. Figure 6 displays the slope of the regression line Harris fitted to the *actual* tar levels achieved by manufacturers [−0.034]. Harris contends "... that innovation in the tobacco industry was no more than one-half as rapid as it could have been ..." and the tobacco companies should have achieved lower tar levels twice as fast, but for the alleged agreement to restrain innovation [namely, a slope $= -0.07$, as displayed in Fig. 6].[36]

The Harris slope represents one plausible alternative innovation scenario, given his assumption that the companies could have reduced tar levels at twice the actual rate "... had a competitive market prevailed."[37] The product development history reviewed earlier indicated a fairly brisk competition among tobacco companies to

[34] In short, the research process that will lead to the design and production of a "safe" cigarette depends crucially upon (a) the state of scientific knowledge, (b) the technical feasibility of developing the desired materials, design, and manufacturing process for the target product, and (c) the availability of supporting innovations of greater or lesser magnitude to make the basic innovation commercially viable.

[35] See Jaffe Supplementary disclosure statement (January 5, 1998), p. 36.

[36] In this connection, Harris assumes a linear regression correctly fits the data displayed in Figure 6. However, a "goodness-of-fit" test indicates that there is good reason to believe the correct fit is non-linear (if all the data are used, including figures for 1985–1995), in which case the slope is not nearly as steep as Harris reports.

[37] Ibid.

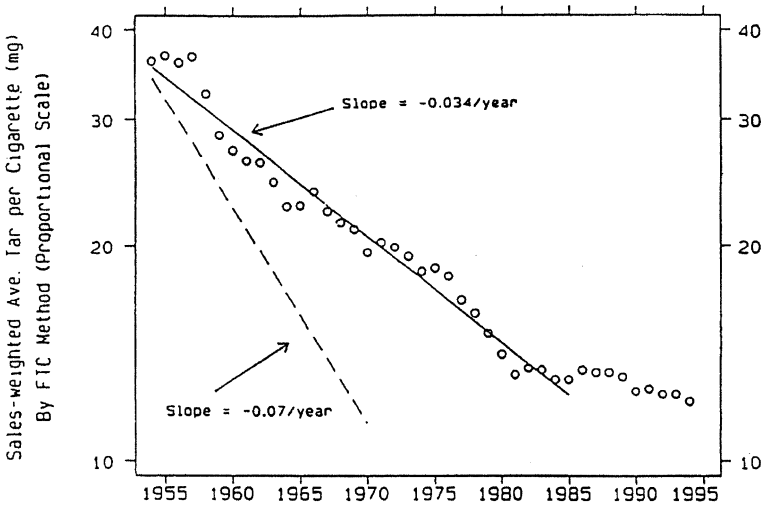

Fig. 6. Average sales-weighted tar delivery per cigarette by the FTC method, United States, 1954–1994

reduce tar levels, which raises serious doubts about the validity of Harris' contention that innovation should have been "at least twice as rapid."[38] Such a rate might have been attained under a government-approved, cooperative industry program, but it is speculative to argue that mandated legislation could have guaranteed either a more rapid rate of reduction in tar levels or the development of a "safe" cigarette product by Harris' arbitrary date of 1970.

Thus, the argument – that had the cigarette companies demonstrated the "will," or had they been "mandated" by federal statute – a "safe" cigarette would be available today, makes sense only if the necessary scientific research had been completed, as was true in the case of various other U.S. "mandates" – e.g., on the auto companies [to develop "safer" bumpers, passenger restraints, and cleaner emissions], on utilities [to add scrubbers to stacks for cleaner emissions from coal-burning plants], and on sewage treatment facilities [to develop systems for cleaner effluents].[39] In the case of autos, utilities, and sewage treatment plants, however, the necessary scientific knowledge for developing those target products was extant, i.e., the mandates were feasible because requisite underlying electrical and mechanical engineering know-how existed, was available, or clearly developable at a predictable cost.. In fact, it was cost, not availability of technical knowledge, that was responsible for the delay in developing these innovations. Companies simply did not have any incentive to internalize these economic externalities until the government mandates

[38] Although concern about health effects of smoking is not limited to the U.S., it is instructive to note that the improvements in cigarette quality has largely been made by U.S. tobacco companies.

[39] It should be noted that if, under a mandated scenario, individual tobacco firms believed that any health-related discovery would unavoidably be made available to competitors, thereby rendering their own R & D unprofitable, they understandably would have refrained from reaching "ideal" levels of R & D, even without a conspiracy. Although this outcome would not be ideal from a social perspective, such behavior is not uncommon in industry, certainly not illegal under the antitrust laws.

were promulgated, after which some of the development and production costs were shifted to consumers.

By contrast, developing a "safe" cigarette represents a world of difference from the above examples, principally because the scientific knowledge and technology regarding how various cigarette ingredients and components affect the development of carcinomas in rats and human beings was not and still is not known. Ever since the publication of the Surgeon General's Report of 1964 and thereafter, we know that there is a higher incidence of carcinomas in persons who smoke versus non-smokers, but no one to date has been able to identify *how* they develop, nor the particular ingredient(s) responsible, which is the basic scientific knowledge required to produce a completely "safe" product.

Even if one accepts the argument that the tobacco companies did not have an interest in discovering how cigarette smoking and cancer are related, the companies surely would have commercial interest in a "safe" product innovation that would make existing products obsolete, whether developed by current or potential new competitors. Economic analysis and Schumpeterian logic instructs us that if the scientific knowledge were extant and there for the R & D expenditure, the innovations would have emerged in the U.S. or elsewhere, and exported to the U.S.. The economic returns to such an innovation would be huge, because the latent demand is large and patently inelastic. Moreover, given the imperfect nature of the U.S. patent system, once the new design, ingredients, components, and manufacturing process were patented, there would be "leakage" of information, and others would use the patent disclosure to immediately undertake further research to develop products providing similar or even improved results.

One corollary to this proposition is that tobacco companies would be eager to compete for head-start advantages, through outright purchase of patent rights, acquisition of licenses to produce the ultimate completely "safe" cigarette that would make most existing cigarette products obsolete. However, no evidence was presented by during the trial demonstrating that after the release of the 1964 Surgeon General's Report the tobacco companies had the market power to prevent the development or introduction of such an innovation. This follows from the fact that U.S. tobacco companies do not have a monopoly on the supply of scientists doing research in this field, nor of basic research on health effects of smoking. Numerous independent researchers in private and public laboratories around the world are engaged continually in research on various diseases, including cancer. It is silly to argue that the tobacco companies individually, or as a group, are able to stifle this activity, even if they wished to engage in some sort of "gentlemen's agreement" not to compete on product development. The design of a "safe" cigarette will be discovered and developed when the basic research issues have been solved, an innovation process over which the tobacco companies have very little, if any, control.

Conclusion

The drive by tobacco companies to develop and market new products would appear to be incontrovertible: "new" [i.e., post-1953] products virtually completely displaced "old" [pre-1953] products. The data displayed in Figure 3 (sales growth

of new brands), in Figure 4 (the dramatic shift of smokers to filtered products), and the spectacular growth in the sales of low-tar products (Fig. 5) on their face provide a strong market test refutation of the contention in the *Minnesota* case that the new products marketed by the tobacco companies during the 1954–1995 period really did not meet the "innovation/creative destruction" standard promulgated by Schumpeter.[40] On their face, therefore, these data on shifts in cigarette product sales would appear to provide ample evidence to meet the Schumpeterian test for innovation and creative destruction, namely the continual development and introduction of improved cigarette product design and the inter-firm non-price (quality) competition which ensued over several decades.

Appendix A

Chronology of significant tobacco industry product developments, 1953–1995

Date	product development, innovation or related event
1953	Sloan-Kettering report on carcinogenicity of cigarette tars. American Cancer Society report issued on dangers of smoking. Reader's Digest publishes article on dangers of smoking.
1954	Tobacco Industry Research Committee ["TIRC"] is formed. 1st successful filtered cigarette [RJR's "Winston"] is marketed. Competitors response: American's "Pall Mall," B & W's "Viceroy," Lorillard's "Kent," Phillip Morris' "Marlboro," and L & M's "L&M."
1957–1960	Cigarette product competition ["tar derby" and advertising "war"] leads to one-third reduction in average tar levels of cigarettes.
1958	The Tobacco Institute formed by cigarette manufacturers.
1960	FTC tar/nicotine regulations promulgated; tobacco companies cease advertisements containing tar & nicotine levels.
1960	Batco launches project to develop a "smokeless" cigarette [project "Ariel"].
1964	1st Report of U.S. Surgeon General states smoking is "habituation," not "addiction," and smoking is causally-related to lung cancer.
1966	Surgeon General reports that low tar and low nicotine cigarettes provide benefits to smokers by reducing the probability of disease.

[40] See this colloquy: "Q. ...The defendants did research on the development of filter cigarettes, right? A. Well, I don't believe that's directly relevant, because they did research on filters, but they never made an attempt other than the ones we talked about with specific products to figure out whether those products with improved filtration were in fact safer products... I wouldn't characterize filter cigarettes as an attempt to develop a safer cigarette that really was the kind of thing that in terms of creative destruction would have been expected." Trial Transcript, State of Minnesota, et al. V. Phillip Morris, et al., pp. 8694–8695.

1967	FTC measures & publishes tar and nicotine levels for all cigarette brands.
1968–1979	L&M develops a smokeless cigarette from "Project XA"/decides marketing product is not commercially feasible.
1970	Tobacco companies voluntarily agree to include tar/nicotine levels in ads.
	RJR terminates "Mouse House" research.
1970–1979	B&W launches project "Janus" to isolate & remove harmful substances in tobacco.
1972	Surgeon General Report states smoking is "associated" with a list of diseases.
1979	Surgeon General Report reports: nicotine is addictive; smoking is associated with substance-abuse dependency; and smoking reduces life expectancy.
1982	Merrill Dow introduces nicotine gum.
1980–1981	RJR experiments with "smokeless" cigarette "Premier."
1986	Average tar & nicotine levels reduced by 69% from 1954 levels.
1987–1988	RJR test markets "Premier"/FTC regulations prohibit advertising as "safer" product.
1991	Phillip Morris introduces "nicotine-free products [$<$ 1mg]: "Next," "Merit Free," & Benson & Hedges "De Nic"/ nicotine "patch" marketed.
1992	Phillip Morris develops safer cigarette ["Table"].
1994	Brown & Williamson internal documents leaked to public.