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American Home Furnishings Alliance, National Home
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Action Council

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An Evaluation of the CPSC Staff Preliminary Regulatory Analysis of the Draft Upholstered Furniture Flammability Standard

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ABOUT CRA

For forty years, CRA has been a preferred source of expertise in economics, finance, and business strategy consulting. CRA's range of capabilities and industry expertise is broad, ranging from expert testimony for complex lawsuits to designing global business strategies. This range of expertise allows CRA to take an interdisciplinary approach to certain engagements, combining economists and experts in various disciplines to provide clients with innovative solutions that cross industry and company boundaries.

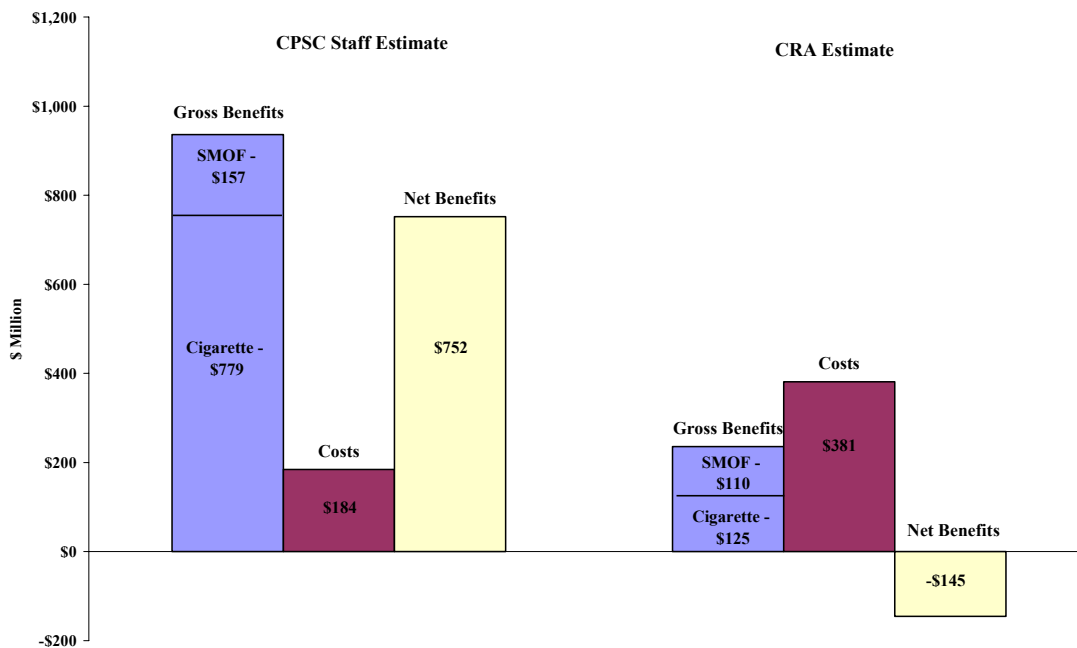
This report was prepared by Mark Berkman, Ph.D., a CRA vice president, with assistance from Nicole Hildebrandt and Sean Tyan. Dr. Mark Berkman is a regulatory economist with over twenty years of experience in the evaluation of environmental, health and safety regulations on behalf of public and private clients. He holds a B.A. in economics and urban affairs from George Washington University, a Master's degree in planning and policy analysis from Harvard University, and a Ph.D. in public policy analysis from the University of Pennsylvania. He is the principle author of the 2001 report "Assessing the Need for a Federal Small Open Flame/Cigarette Ignition Upholstered Furniture Standard," submitted to the U.S. CPSC in connection with the present rulemaking.

EXECUTIVE SUMMARY

At the request of the American Home Furnishings Alliance (AHFA), the National Home Furnishings Association (NHFA), and the Upholstered Furniture Action Council (UFAC), CRA International (CRA) has reviewed the Consumer Product Safety Commission staff's (CPSC) draft upholstered furniture flammability standard.¹ CRA is a private consulting firm with substantial experience regarding the evaluation of public policies and regulations.

Based on its review, CRA concludes that the CPSC staff's preliminary regulatory analysis fails to support the draft standard. The staff overstates the expected benefits of the draft standard and understates the cost. CRA calculates that costs will exceed benefits by at least \$145 million annually. Initial benefits will be very modest because the draft standard will affect only new furniture. New furniture represents less than 10 percent of the existing furniture population. Further, net benefits will fall over time as smoking prevalence falls and other fire reduction regulations take effect. Executive Summary Figure 1 compares our results to the CPSC staff's.

Executive Summary Figure 1: CPSC Staff Estimates v. CRA Estimates of the Net Benefits of the Staff's Draft Standard



¹ We refer to the staff's draft upholstered furniture flammability standard as the "draft standard" hereafter. (See *CPSC Staff Draft Standard for Upholstered Furniture Flammability*, "Description of Draft Standard Performance Test Requirements," Working Draft, May 2005, (hereafter "*Draft Standard*").

The CPSC staff overestimates benefits by assuming substantial reductions in both cigarette- and small open flame-ignited fire fatalities that are not supported by laboratory testing results and indeed are inconsistent with actual experience. In particular, the reductions are much higher than those observed in the United Kingdom where similar standards have been in place for almost two decades. The staff also overstates benefits because it fails to adequately account for the expected continued decline in upholstered furniture fire fatalities resulting from expected reductions in smoking prevalence and the contribution of other regulations to fire reduction.

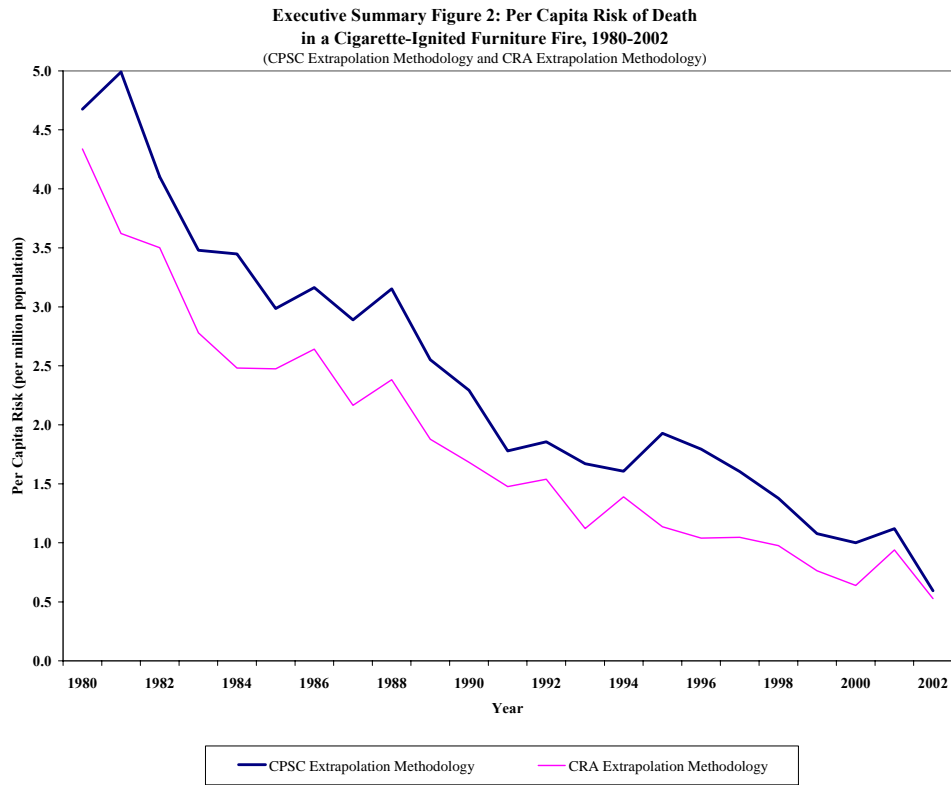
The CPSC staff understates costs because it fails to recognize several factors that will increase manufacturing costs. For example, industry experts anticipate that foam density will have to approach levels used in public occupancy furniture in order to pass the flammability tests proposed. Higher density results in substantially higher costs. The staff also did not recognize the productivity losses that result from the addition of barriers. Cutting and installing a fire barrier, whether fabric or fiber, reduces the number of furniture units produced per person hour.

The CPSC staff implicitly targets a risk level (fatalities per million) well below what is generally considered *de minimis*. The death rate from a cigarette-ignited upholstered furniture fire is already about 0.72 per million, equal or below many daily risks most people commonly accept. This rate is projected to fall to 0.37 without further regulation. The death rate from a small open flame-ignited fire is also low: from 1999-2002, this rate was 0.16 per million annually. In contrast, the death rate for pedestrians was 17 per million in 2002. The decline in upholstered furniture related fire deaths is shown in Executive Summary Figure 2 (cigarette-ignited) and Executive Summary Figure 3 (small open flame-ignited) with both CPSC staff and CRA interpretations of the National Fire Incidence Reporting database.

Finally, the CPSC staff fails to account for other regulations and policies to reduce upholstered furniture fire fatalities and injuries that are likely to be more effective, better targeted, and provide a more immediate benefit. The staff does not recognize the impact of fire-safe cigarette regulations. Several states have already enacted such regulations and several others are actively considering them. These regulations are expected to greatly reduce the number of cigarette-related fires. They also impose the costs on the source of fire risk – smokers. Since such regulations affect all smokers, the impacts will be more immediate and widespread than an upholstered furniture standard because they will reduce the ignitions of many products. In contrast, the draft standard imposes costs on many consumers to reduce a risk they do not face. Consumers will pay at least \$42 more for a furniture unit covered in certain fabrics even if their upholstered furniture fire risk is very low because they don't smoke and maintain their smoke detectors.

In sum, these findings do not support the draft standard. Should the Commission decide that an alternative federal standard is desirable, it must carefully consider whether the standard effectively targets the source of the risk, accounts for the impacts of other existing and potential regulations, minimizes the cost to industry, and provides the basis

for effective enforcement domestically and with respect to imports – a rapidly growing source of upholstered furniture.



**Executive Summary Figure 3: Per Capita Risk of Death
in a Small Open Flame-Ignited Furniture Fire, 1980-2002**
(CPSC Extrapolation Methodology and CRA Extrapolation Methodology)

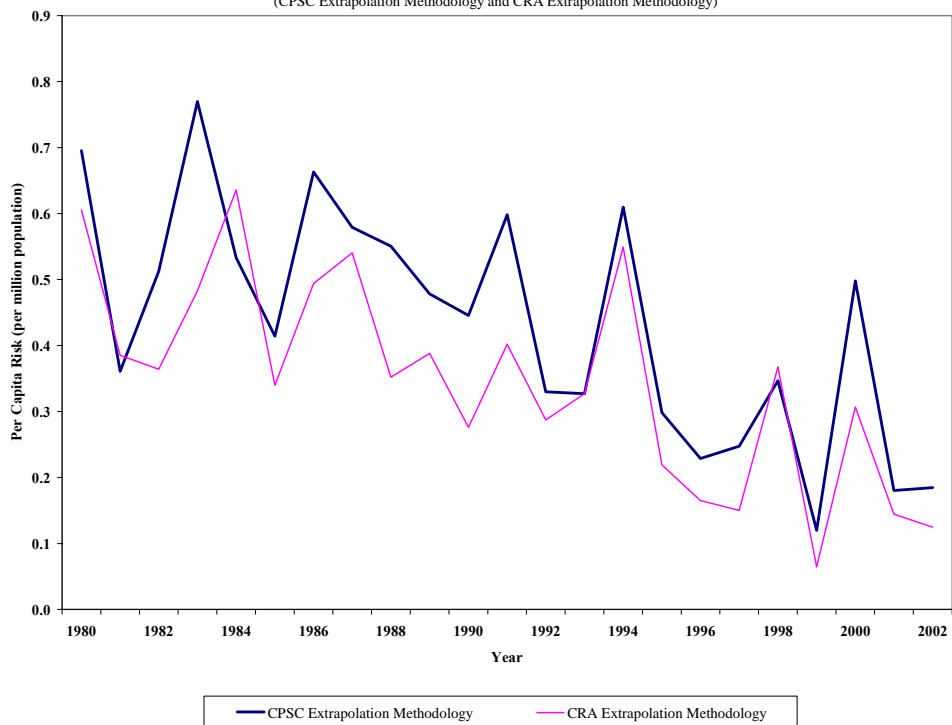


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I. INTRODUCTION

A. Purpose and Summary

At the request of the American Home Furnishings Alliance (AHFA), the National Home Furnishings Association (NHFA), and the Upholstered Furniture Action Committee (UFAC), CRA International (CRA) has conducted a review of the Consumer Product Safety Commission (CPSC) staff's draft upholstered furniture flammability standard and the preliminary regulatory analysis supporting the draft standard.² Based on this review, CRA has concluded that the draft standard is not supported by the underlying benefit-cost analyses. In particular, the staff finding that the benefits of the standard greatly exceed the costs is seriously flawed. Benefits are substantially overstated and costs are notably understated. The staff dismisses an alternative regulation that will not only be more effective more quickly, but more accurately impose costs on those who benefit. In addition, potential negative consequences for the domestic furniture industry are ignored.

Current risks associated with upholstered furniture fires are already very low: from 1999-2002, the risk of death in a cigarette-ignited furniture fire was 0.72 per million population and the risk of death in a small open flame-ignited furniture fire was 0.16 per million population. These risks are well below what is considered reasonable in many instances of daily life, as well as by the CPSC in establishing other product standards and the EPA in establishing environmental regulations. In addition, the risk has been steadily falling in the absence of a standard and can be reasonably expected to fall further without intervention. The current risk level is already quite low on average and extremely low for non-smoking households with working smoke detectors, which represent at least 60 percent of U.S. households.

The CPSC staff overstates benefits for several reasons. First, the staff relies on effectiveness rates that are not based on thorough or recent testing and that are inconsistent with rates recently reported in the United Kingdom where similar standards have been in place for almost two decades. Moreover, the staff interpretations of some testing results directly contradict earlier interpretations. Second, the cost-benefit analysis fails to fully account for the expected continued downward trend in fatal cigarette-ignited furniture fires resulting from further declines in smoking prevalence, fire-safe cigarette regulation, and further market penetration of furniture meeting UFAC voluntary fire safety standards. Third, the staff does not consider whether the distribution of smokers among furniture buyers could affect benefits. For example, highly smolder-prone, heavy cellulosic fabrics – which according to CPSC staff assumptions account for a large fraction of fatal fires – may be less likely to be purchased by smokers. These fabrics tend to be expensive and smoking prevalence falls with income. This would reduce benefits because the standard would affect consumers with already very low risk of fatal fires.

² See Charles L. Smith, "Preliminary Regulatory Analysis of a Draft Proposed Rule to Address Cigarette and Small Open Flame Ignitions of Upholstered Furniture," U.S. Consumer Product Safety Commission Staff Report, November 2005.

Fourth, the staff relies on a very low discount rate and a relatively high statistical value of life to value future benefits.

The CPSC staff understates costs according to industry data provided to us and discussions with manufacturers. There are several causes of this understatement. First, the staff assumes that foam cost increases will be modest, but industry testing indicates that more costly reformulation is required to reliably pass the draft standard. Second, the staff cost estimates do not fully account for additional labor or efficiency losses associated with adding barriers. Third, the staff appears to underestimate the costs associated with FR treatment of cover fabrics.

The CPSC staff does conduct a sensitivity analysis as required by Office of Management and Budget (OMB), but it is incomplete. The staff reports results varying one important factor at a time including the discount rate, compliance cost, effectiveness, and the statistical value of life. There is no reason to consider these factors separately unless they are mutually exclusive. They are not. Consequently, the sensitivity analysis should have reviewed all of the combinations of these factors. In addition, the sensitivity analysis should have addressed the potential for further declines in furniture fire fatalities in the absence of the standard. The need for this is underscored by the substantial reduction in estimated benefits by the CPSC staff when two more years of data revealed a continued decline in the number of fire fatalities.

Moreover, even if benefits were convincingly found to exceed costs, the standard should be considered relative to other standards or regulations that would reduce upholstered furniture fire risk. The draft standard is poorly targeted, resulting in substantial expenditures from those who face *de minimis* risk – non-smokers – and thus little, if any, benefit from the standard. The draft standard will also take time to take effect. Only new furniture, representing about 10 percent of furniture in use in a given year, will be affected. In contrast, fire-safe cigarette regulations, which have been passed in three states and are under active consideration in at least three others, are very targeted. They will impose costs and reduce risk immediately for those who face the most risk – smokers. Thus, the cost burden falls on those who benefit directly. Fire-safe cigarette regulations will also reduce fires associated with other products, including bedding and mattresses, providing further benefits at no additional cost.

Finally, the CPSC staff also dismisses any substantial economic impacts from the draft standard by assuming that price increases associated with compliance will be modest and unlikely to deter purchases in the long term. There is no rigorous analysis behind this assumption. The upholstered furniture industry operates with very thin margins and faces increasing competition from foreign manufacturers, especially China. Consequently, to the extent that costs cannot be passed through to consumers, many domestic firms could be at risk. Even though foreign manufacturers must legally meet the draft standard, they may be able to do so at lower costs because of lower labor and materials costs. Foreign manufacturers may also exhibit lower levels of compliance.

B. Outline

This report is organized in eight sections and three appendices. Section II provides background. Section III presents a critical review of the CPSC staff's benefits estimates. Section IV presents a critical review of the CPSC staff's cost estimates. Section V presents CRA's cost-benefit results after correcting for problems with the staff's analysis. Section VI identifies alternative regulations that the CPSC staff should have considered more carefully. Section VII reviews the economic impacts of the draft standard. Section VIII presents our conclusions. Appendix 1 addresses concerns regarding the NFIRS database. Appendix 2 presents the technical results of a panel data regression analysis of cigarette-related losses and smoking prevalence, and Appendix 3 outlines the structure and assumptions of our cost-benefit estimation model.

II. BACKGROUND

In 1993, the National Association of State Fire Marshals (NASFM) petitioned the CPSC to promulgate a mandatory standard to address hazards associated with upholstered furniture fires started by cigarettes, small open flame ignition sources, and large open flame sources. Specifically, the NASFM proposed that the CPSC adopt regulations similar to those in place in California, which establish ignition-resistance requirements for cover fabrics and filling materials used in the construction of upholstered furniture. The CPSC consequently voted to initiate a rulemaking proceeding to assess the need for a mandatory regulation to reduce small open flame-ignited furniture fires, but decided to defer action on cigarette-related fires pending assessment of the effectiveness of a voluntary flammability standard.

In October 2003, the CPSC issued an Advance Notice of Proposed Rule Making (ANPR) asserting that cigarette-ignited furniture fires, in addition to small open flame-ignited furniture fires, might constitute an unreasonable risk to the public, despite the presence of the voluntary industry standard. In October 2004, the CPSC staff drafted a standard addressing both upholstered furniture ignitions by cigarettes and ignitions by small open flames. The current draft standard, issued in May 2005, revises that prospective regulation. An economic analysis of the proposed rule was released in October 2005 and updated in November 2005. The draft standard and the economic analysis justifying its implementation are described below in greater detail.

A. Description of Draft Standard

1. Overview

The CPSC staff's draft standard establishes several compliance options, among them tests for cover fabrics and filling materials used in the manufacture of residential upholstered

furniture.³ Residential upholstered furniture includes articles of furniture that are primarily intended for indoor use in residences and are constructed with an upholstered seating area comprised of a contiguous upholstered seat and back and/or arm(s). The draft standard pertains to all residential upholstered furniture produced or reupholstered after the standard's effective date, including imported furniture.⁴

The standard offers manufacturers four alternative methods of compliance:

- *Type I upholstered furniture: Furniture constructed with a compliant interior fire barrier. Type I furniture may have noncompliant cover materials and filling materials.*
- *Type II upholstered furniture: Furniture constructed with a cover material that qualifies as a barrier. Type II furniture may contain noncompliant filling materials.*
- *Type III upholstered furniture: Furniture constructed with compliant cover materials and filling materials. Furniture that has a compliant interliner may contain noncompliant filling materials and still qualify as Type III furniture.*
- *Type IV upholstered furniture: Furniture made of combinations of upholstered materials that pass the end-product smoldering and open flame ignition resistance tests required by the standard.*

2. Test Methods

The draft standard includes fourteen ignition resistance tests: seven testing cigarette (“smoldering”) ignition resistance and seven testing small open flame ignition resistance. Each furniture type is required to pass certain test methods, as shown in Table 1. Manufacturers (or importers, in the case of imported furniture) are responsible for ensuring that furniture complies with the requirements of the standard, and must have an “objectively reasonable basis” for ensuring compliance. Examples of “objectively reasonable basis” include 1) possession of guarantees from manufacturers of upholstered furniture components that components (fabrics, fillings, *etc.*) meet the requirements of the standard, or 2) records of “reasonable and representative” tests performed by the furniture manufacturer that demonstrate compliance.⁵

³ *Draft Standard*, p. 5.

⁴ Only furniture reupholstered for resale is subject to the standard. The draft standard considers the “manufacturer” to be “any entity that produces or reupholsters upholstered furniture” or “the importer of the upholstered furniture.” Similarly, the draft defines “produced” as “manufactured or imported.” (*Draft Standard*, p. 9.)

⁵ *Draft Standard*, pp. 132-137.

In general, the cigarette ignition resistance tests involve assembling an L-shaped mockup – mimicking the shape of a chair or sofa – using the material being tested along with other standardized testing materials. A lit cigarette is placed in the mockup’s crevice and allowed to burn its entire length. The tester observes the mockup for thirty minutes, and repeats the process with two additional mockups. If, for all three test specimens, the substrate (*i.e.*, the innermost material of the mockup’s “seating area”, which represents the filling material used in upholstered furniture) has a mass loss of 10 percent or less, and no specimen “transitions to open flaming,” the test material passes.⁶ Otherwise, the material being tested fails and is considered noncompliant with the standard.

The small open flame ignition resistance tests follow a slightly different methodology. One L-shaped mockup is created, and a small open flame is applied to the mockup’s crevice. The flame is applied for 20 seconds (plus or minus one second), removed, and the mockup is observed for 45 minutes. If the mockup does not ignite, the flame is reapplied for 20 seconds, and again observed for 45 minutes.⁷ This process is repeated a third time. To comply, the sample must pass at least three successive ignition impingements, must have a weight loss of 20 percent or less during the 45-minute test duration, and must not exhibit “excessive combustion.”⁸

Of note, the current draft standard does not require that cover fabrics be small open flame-ignition resistant, unless a manufacturer chooses Type II compliance.

⁶ *Draft Standard*, p. 41.

⁷ Ignition, for small open flame tests, is “continuous, self-sustaining combustion...characterized by the presence of any visible flaming, glowing, or smoldering after removal of the ignition source.” (*Draft Standard*, p. 11.)

⁸ Excessive combustion is “the presence of flaming or smoldering that may compromise the safety of test personnel.” (*Draft Standard*, p. 15.) It is unclear whether mass loss is measured after each 45-minute observation period, or after the third 45-minute observation period.

Table 1: Tests Required for Various Furniture Types Under the Draft Standard

TEST	TYPE I	TYPE II	TYPE III	TYPE IV
<i>Cigarette-Related (Smoldering) Ignition Resistance Testing:</i>				
1. Upholstery Cover Fabric		x	x	
2. Fibrous Filling Material			x	
3. Loose Filling Material ⁹			x	
4. Loose Filling Interliner Material			x	
5. Resistant Filling Material ¹⁰			x	
6. Interior Fire Barrier Material	x			
7. End Product Materials				x
<i>Small Open Flame-Related Ignition Resistance Testing:</i>				
8. Fibrous Filling Material			x	
9. Loose Filling Material			x	
10. Loose Filling Interliner Material			x	
11. Resilient Filling Material			x	
12. Upholstery Fabric as a Fire Barrier		x		
13. Interior Fire Barrier Material	x			
14. End Product Materials				x

B. Description of CPSC Staff Supporting Analysis

In November 2005, the CPSC staff produced a cost-benefit analysis evaluating the draft standard from an economic perspective.¹¹ In the report, the CPSC staff evaluates the

⁹ Loose filling materials are “materials...not formed into batts or cellular pads,” including shredded polyurethane and other cellular foams, feathers and down, etc. (*Draft Standard*, p. 12.)

¹⁰ Resilient filling materials are “resilient, cellular polymeric materials,” including polyurethane foam, synthetic latex, rubber, and other types of resilient cellular polymer or copolymer material used to provide resiliency. (*Draft Standard*, p. 12.)

¹¹ The November 2005 report superseded a previous report issued in October 2005, which relied on NFIRS data from 1995 to 1999 to estimate the annual societal costs of cigarette- and small open flame-ignited fires. The November 2005 report relies on NFIRS data from 1999 to 2002, the most recent data available. (See Charles L. Smith, “Preliminary Regulatory Analysis of a Draft Proposed Rule to Address Cigarette and Small Open Flame Ignitions of Upholstered Furniture,” U.S. Consumer Product Safety Commission Staff Report, October 2005; Charles L. Smith, “Preliminary Regulatory Analysis of a Draft Proposed Rule

expected costs and benefits of the draft standard on a “per product in use basis.” Because certain types of furniture are more likely to burn, the CPSC staff attempts to estimate costs and benefits for five types of upholstery fabric covering:

1. a category of cellulosic fabrics that the CPSC staff calls “severely ignition-prone cellulose,”
2. a category of cellulosic fabrics that the CPSC staff calls “moderately ignition-prone cellulose,”
3. a category of lightweight cellulosic fabrics that the CPSC staff calls “less ignition-prone cellulose,”
4. thermoplastic materials, and
5. ignition-resistant materials (leather, vinyl-coated fabrics, and wool).¹²

Expected benefits are calculated as the reduction in societal costs of cigarette- and small open flame-ignited upholstered furniture fires that is attributable to the draft standard. Relying on NFIRS data from 1999 to 2002, the CPSC staff determines the total annual costs of cigarette-ignited fires addressed by the standard amounts to \$1,692 million, while the total annual costs of small open flame-ignited fires addressed by the standard amounts to \$397 million.¹³ The staff divides these costs among furniture units in use to assess costs on a per-unit basis, and then uses annual per-unit costs to estimate lifetime per-unit societal costs. Lifetime per-unit costs are calculated as the present value of annual costs for each year of a product’s life multiplied by the probability that the product will be in use in that year, discounted at a 3 percent annual rate. For cigarette-ignited fires, lifetime societal costs are adjusted downwards for a continued decline in smoking over time. Following this methodology, the staff concludes that the lifetime societal costs of cigarette-ignited fires are between \$5.62 to \$194.76 per unit of furniture, depending on fabric type, and that the lifetime societal costs of small open flame-ignited fires range between \$12.86 and \$13.05 per unit of furniture, depending on fabric covering type.

The staff then makes assumptions about the standard’s likely effectiveness to estimate the annual benefits associated with a year’s worth of furniture production manufactured after the standard’s effective date. For cigarette-ignited fires, the staff believes benefits would range from \$3.78 to \$155.48 on a per-unit basis, or \$779.2 million for all furniture produced in one year. For small open flame ignited fires, the staff estimates that benefits

to Address Cigarette and Small Open Flame Ignitions of Upholstered Furniture,” U.S. Consumer Product Safety Commission Staff Report, November 2005 (hereafter *Staff Cost-Benefit Analysis*).

¹² Cellulose are fibers produced from organic materials, including cotton and rayon, while thermoplastics are synthetic materials like polyester, polypropylene, and nylon.

¹³ In contrast, relying on NFIRS data from 1995 to 1999, the CPSC estimated annual societal costs to be \$2,303 million for cigarette-ignited furniture fires, and \$361 million for small open flame-ignited fires. (Charles L. Smith, “Preliminary Regulatory Analysis of a Draft Proposed Rule to Address Cigarette and Small Open Flame Ignitions of Upholstered Furniture,” U.S. Consumer Product Safety Commission Staff Report, October 2005, pp. 14 and 24.)

would range from \$6.43 to \$10.81 on a per-unit basis, or \$156.8 million for all furniture produced in one year. The staff therefore expects the societal costs of cigarette-ignited fires and small open flame-ignited fires to fall by 75 percent and 55 percent, respectively, as a result of the draft standard.

The staff also estimates the manufacturing, compliance, and distribution costs resulting from the draft standard. As with benefits, costs are calculated on a per-unit basis and scaled upward to calculate the costs associated with furniture produced in a year. In total, the staff estimates costs would be \$6.65 to \$18.33 per unit, or between \$175 and \$194 million for a year's worth of production. Comparing costs and benefits, the staff predicts that the net benefits of the draft standard would equal \$751.8 million per year.

III. CRITICAL REVIEW OF CPSC STAFF BENEFITS ANALYSIS

In this section, after providing a detailed overview of the CPSC staff's methodology in estimating the expected benefits of the draft standard, we present several criticisms of the CPSC staff's estimates. More specifically, we have concluded that the CPSC staff:

- ignores the potential issues surrounding the use of NFIRS data to evaluate the societal costs of cigarette- and small open flame-ignited fires;
- incorrectly defines the losses addressable by the standard;
- does not adequately acknowledge the low and declining level of risk associated with cigarette- and small open flame-ignited upholstered furniture fires;
- fails to account for trends and impacts of other policies on furniture fire losses;
- does not appropriately account for a furniture unit's rate of exposure to ignition sources;
- relies on unsupported assumptions about the expected effectiveness of the draft standard; and
- relies on discount rate and statistical value of life assumptions that inflate the benefits calculation.

These concerns imply that the staff has substantially overstated the benefits of the draft standard. After correcting for these criticisms, we find that the expected lifetime benefits for a year's worth of furniture production are in the range of \$197 million to \$308 million. When relying on our base case assumptions (which we outline in this section), our estimate of gross benefits is \$235.7 million, considerably less than the CPSC staff's estimate of \$936 million.¹⁴

¹⁴ \$936 million is the sum of staff's estimated benefits from cigarette-ignited fires (\$779.2 million) and small open flame-ignited fires (\$156.8 million).

A. Description of CPSC Staff Benefit Calculations

1. Estimation of Societal Costs of Cigarette- and Small Open Flame-Ignited Furniture Fires

a. Estimation of Annual Societal Costs

In order to calculate benefits, the CPSC staff first estimates the annual societal costs of cigarette- and small open flame-ignited furniture fires. The CPSC staff uses fire loss figures estimated by the CPSC Division of Hazard Analysis as the basis for this calculation. In making fire loss estimates, the Division of Hazard Analysis relies on fire loss data acquired from the National Fire Protection Association (NFPA) annual survey and the U.S. Fire Administration National Fire Incident Reporting System (NFIRS). In the November 2005 report, the CPSC staff relies on fire loss data from the 1999-2002 time period.

According to the Division of Hazard Analysis there were, on average, 300 *addressable* deaths, 480 *addressable* nonfatal civilian injuries, and \$102 million in *addressable* property damage annually from *furniture fires ignited by smoking materials* during the 1999-2002 time period.¹⁵ Similarly, there were, on average, 60 *addressable* deaths, 260 *addressable* nonfatal injuries, and \$48 million in *addressable* property damage annually from *small open flame-ignited* furniture fires.

Assigning a statistical value of \$5 million for each death and \$187,449 for each injury, the staff concludes that annual societal costs of *cigarette-ignited* furniture fires were \$1,692 million during the 1999-2002 time period ($\$5 \text{ million} \times 300 \text{ deaths} + \$187,449 \times 480 \text{ injuries} + \$102 \text{ million in property damage}$). For *small open flame-ignited* furniture fires, annual societal costs were \$397 million from 1999 to 2002 ($\$5 \text{ million} \times 60 \text{ deaths} + \$187,449 \times 260 \text{ injuries} + \$48 \text{ million in property damage}$).¹⁶

¹⁵ Figures are for deaths and injuries that are addressable under the draft standard, *e.g.*, exclusive of arson losses and losses from fires involving electrical appliances. (CPSC Staff Memorandum from Mark S. Levenson (Division of Hazard Analysis) to Dale Ray (Directorate for Economic Analysis), "Upholstered Furniture Addressable Fire Loss Estimates for 1999 – 2002, November 21, 2005.)

The staff relies on smoking materials-related loss figures, rather than cigarette-related loss figures (smoking materials includes cigarettes, pipes, and cigars). However, the staff uses the term "cigarette-ignited" furniture fatalities and injuries throughout the analysis. We adopt this misnomer for the remainder of this report.

¹⁶ The staff's statistical values for deaths and injuries are based on: W. Kip Viscusi, "The Value of Risks to Life and Health," *Journal of Economic Literature*, Vol. XXXI, December 1993, pp. 1912-1946; Ted R. Miller, *et al.*, "Societal Costs of Cigarette Fires," prepared for the U.S. Consumer Product Safety Commission under the Cigarette Safety Act of 1984, August 1993; William W. Zamula, "Costs for Non-Fatal, Addressable Residential Civilian Injuries Associated with Upholstered Furniture Fires," (Memorandum to Gregory B. Rodgers, AED, EC) Directorate for Economic Analysis, CPSC, November 22, 2005.

b. Estimation of Per-Unit Lifetime Societal Costs

After calculating annual cost figures, the CPSC staff attempts to allocate these costs on a per-unit (of furniture in use in U.S. households) basis. Assuming a 16-year expected life of a piece of upholstered furniture and relying on *Economic Census* sales data, the staff estimates that there were 441 million upholstered furniture units in use during the 1999-2002 time frame. However, rather than calculate an average per-unit cost for all upholstered furniture by dividing annual societal costs by 441 million units, the staff aims to “develop more precise estimates of per unit societal costs by accounting for the fabric cover” of an upholstered furniture unit.¹⁷

With regard to *cigarette-ignited fires*, the CPSC staff observes that furniture covered in fabrics woven predominately from cellulosic fibers has a higher likelihood of igniting than furniture covered in fabrics woven predominately from thermoplastic fibers. Additionally, furniture covered in leather, vinyl-coated fabrics, and wool fabrics are “resistant” to ignition from cigarettes.¹⁸ Because different fabric types have different cigarette ignition propensities, some types of furniture “would be expected to result in greater societal costs from fires.”¹⁹ The staff accounts for this by estimating per-unit societal costs for five types of upholstery cover materials. We have adopted our own terminology as follows:

1. A category of cellulosic fabrics that the staff calls “*severely ignition-prone cellulose*s.” The staff defines “severely ignition-prone cellulose” as consisting of UFAC Class II and UFAC Class I/NBS Class D fabrics. In general, these fabrics tend to be heavyweight cellulosic fabrics. We refer to the staff’s “severely ignition-prone cellulose” category as “*heavyweight cellulose*s” for the remainder of this report.²⁰

¹⁷ *Staff Cost-Benefit Analysis*, p. 14.

¹⁸ *Ibid.*, p. 15.

¹⁹ *Ibid.*

²⁰ The Upholstered Furniture Action Council’s (UFAC’s) voluntary cigarette-ignition safety standard classifies all upholstery fabrics into one of two classes according to char length on the vertical surface when tested over standard non-flame resistant polyurethane foam. Class I fabrics, which are less likely to ignite from cigarettes, are generally those fabrics that contain at least 50 percent thermoplastic fibers. All other fabrics are likely to be grouped into Class II. (FindLaw for the Public, “CPSC Grants Furniture Industry One Year to Substantially Reduce Cigarette Fire Hazard,” November 30, 1979, available at <http://injury.findlaw.com/defective-dangerous-products/recall/recall.feeds/cpsc/1979/11/79067.html>, site visited February 27, 2006.)

In the 1970’s the National Bureau of Standards (NBS) developed a draft furniture flammability standard fabric test method which grouped fabrics into four classes based on cigarette-ignited char length when tested over a glass fiberboard structure, Class A being the most resistant and Class D being the least resistant. Class D fabrics included heavyweight cottons, rayons and linens, Class C included medium-weight cottons, rayons, and linens, and Class B included medium-weight synthetics and some lightweight cottons, rayons, and linens. (FindLaw for the Public, “CPSC Staff Recommends Safety Standard for Flammable Upholstered Furniture,” November 1978, available at <http://print.injury.findlaw.com/defective-dangerous-products/recall.feeds/cpsc/1978/11/78092.html>, site visited February 27, 2006.)

2. A category of cellulosic fabrics that the staff calls “*moderately ignition-prone cellulose*s.” The staff defines “moderately ignition-prone celluloses” as consisting of UFAC Class I/NBS Class C fabrics. In general, these fabrics tend to be medium weight cellulosic fabrics and cellulosic/thermoplastic blends. We refer to the staff’s “moderately ignition-prone celluloses” category as “*medium weight cellulose*s and blends” for the remainder of this report.
3. A category of cellulosic fabrics that the staff calls “*less ignition-prone cellulose*s.” The staff defines “less ignition-prone celluloses” as consisting of UFAC Class I/NBS Class B fabrics. In general, these fabrics tend to be lightweight cellulosic fabrics and cellulosic/thermoplastic blends. We refer to the staff’s “less ignition-prone celluloses” category as “*lightweight cellulose*s and blends” for the remainder of this report.
4. A category for furniture covered in thermoplastic materials, and
5. A category for furniture covered in leather, vinyl-coated, and wool fabrics.

Unlike with cigarettes, the staff argues that small open flame ignition propensities for cellulosic fabrics and thermoplastic fabrics are nearly equivalent (though leather, vinyl-coated, and wool fabrics are assumed to be highly resistant to small open flames), but maintains the fabric covering distinctions mentioned above for its analysis of small open flame-ignited fires. We have information to suggest that heavy celluloses may be more small open flame ignition resistant than lighter celluloses and thermoplastics.²¹ However, we lack sufficient data to alter the staff’s assumptions.

To estimate per-unit annual costs for each of the five types of fabric coverings, the staff multiplies a covering type’s market share during the 1999-2002 time frame by the covering’s propensity to burn. Market shares are based on survey and sales data as well as information on the relative shares of fabrics used in CPSC lab analyses, while ignition propensities are based on CPSC lab tests performed in 1980, 1984, 1994, and 1996.²² The result of this calculation is the covering’s “weighted ignition propensity,” which is then divided by the sum of all weighted ignition propensities to calculate the “percent of overall risk” associated with a given furniture covering. “Percent of overall risk” is essentially the percentage of annual societal costs assigned to a particular furniture covering by the CPSC staff. The staff uses the covering’s “percent of overall risk” and market share to calculate the per-unit, annual societal costs for that covering, using the following equation: (Annual Societal Cost x Percent of Overall Risk) / (441.5 Million

²¹ U.S. Consumer Product Safety Commission, "Briefing Package on Upholstered Furniture Flammability: Regulatory Options," October 2001, p. 6.

²² We have concerns with the outdated nature of the lab studies relied upon to estimate ignition propensity, and the small number of chairs tested in these analyses. There are many reasons, including increased UFAC compliance as acknowledged by the CPSC and improvements in FR chemicals and treatments, which may have caused average ignition propensities to decline over time. (See U.S. Consumer Product Safety Commission, “Regulatory Options for Small Open Flame & Smoking Material Ignited Fires,” October 1997, pp. 56 and 65.) Thus, by using old data, the CPSC may be overstating actual ignition propensities of furniture currently in use.

Furniture Units x Market Share). Per-unit costs related to cigarette- and small open flame-ignited fires are calculated separately.

After calculating per-unit annual costs, the staff attempts to estimate lifetime per-unit societal costs for each furniture covering type. Lifetime costs are “the present value of the estimated annual societal costs over the expected product life of the item of furniture.”²³ Annual societal costs are assumed to apply to each year that a furniture item remains in use – the staff uses the CPSC’s “Product Population Model” to calculate the likelihood that furniture items would remain in use in years after purchase. To obtain lifetime costs, the staff multiplies per-unit annual costs by the estimated probability of survival in subsequent years and discounts the stream of future expected costs using a discount rate of 3 percent.

The staff concedes that other factors, including reduced smoking prevalence and increased presence of smoke detectors, have contributed and will continue to contribute to declines in cigarette-ignited fires independent of the draft standard. The staff therefore adjusts its present-value estimates to account for a future decline in smoking-related fire incidents by forecasting future fire deaths using data from 1980-1998 and “reducing the expected societal costs of cigarette ignited fires by the projected percentage reduction.”²⁴ The staff provides no further explanation of how future fire deaths were forecasted; stating only that this adjustment reduces expected lifetime societal costs by about 13 percent for cigarette-ignited fires. The staff does not mention adjustments for any other factors that may contribute to declines in cigarette-ignited fires. Also, though small open flame-ignited fire fatalities may fall with a decline in smoking prevalence, the staff does not discuss adjusting societal costs associated with small open flame ignited-fires downwards to account for smoking declines.²⁵

c. Estimation of Per-Unit Lifetime Societal Costs Associated with a Year’s Worth of Current Furniture Production

The staff acknowledges that the types of upholstery materials used in furniture production have changed over the years. Since the draft standard would impact current production, the staff states that the projection of societal benefits “requires estimating the societal

²³ *Staff Cost-Benefit Analysis*, p. 18.

²⁴ *Ibid.*, p. 19.

²⁵ We examined the relationship between lighter- and match-ignited furniture fire fatality rates and smoking prevalence over time, but failed to find strongly statistically significant results to warrant incorporating downward adjustments in these types of fatalities in our corrected cost-benefit analysis. As in the 2001 NERA report, we did not find a statistically significant relationship between lighter-ignited fatality rates and smoking prevalence over time. We found a statistically significant relationship between match-ignited fatality rates and smoking prevalence, but this relationship was not as strong as the relationship we found between cigarette-ignited fatality rates and smoking.

costs associated with materials now being used to manufacture furniture.”²⁶ To accomplish this, the staff estimates market shares reflective of current production for the five furniture coverings, relying on a 2001 survey of furniture manufacturers conducted by Cyprus Limited, a market research firm with experience in building, design and construction, industrial products, and commercial products.²⁷ Using these market shares, the staff calculates the number of units manufactured annually for each covering type, assuming that a total production of 31.5 million upholstered furniture units per year. This production figure is consistent with industry data that we have been provided.

The staff then multiplies annual units produced for each fabric covering by the lifetime per-unit costs calculated earlier in the report (adjusted for the expected decline in smoking for cigarette-ignited fires) to obtain the total present value of expected lifetime costs from cigarette- and small open flame-ignited fires attributed to furniture produced in one year in the absence of a standard. Based on these calculations, the total present value of societal costs from cigarette-ignited fires is \$1,039.4 million for furniture produced in one year, while the total present value of societal costs from small open flame-ignited fires is \$285.1 million for furniture produced in one year in the absence of a standard.

2. Societal Benefits of Draft Standard

According to the staff, data are unavailable that would allow for a direct comparison of the ignition propensities of furniture made with current fabrics and filling materials *versus* furniture made in compliance with the draft standard. In place of such data, the staff makes assumptions – which are not firmly based on any scientific studies or lab results – about the likely effectiveness of the standard.

The staff first estimates the effectiveness of the draft standard with regard to *cigarette-ignited fires*. Rather than estimate effectiveness rates based on fire testing or other empirical evidence, the staff takes a roundabout approach, making assumptions about the expected cost reductions resulting from the standard. For heavyweight cellulose, the staff assumes that the standard would result in a reduction in societal per-unit costs to the level of cost estimated for lightweight cellulose and blends. This reduction would be a result of “improved ignition performance of FR-treated fabrics and improved ignition performance of filling materials, or from the use of qualifying barriers.”²⁸ As a result of this cost decline, from \$194.76 to \$39.28, the staff obtains a 79.8 percent hazard reduction rate for heavyweight cellulose. The staff similarly assumes that the societal per-unit cost for medium weight cellulose and blends will fall to the level of cost for lightweight cellulose and blends, resulting in a 67.4 percent hazard reduction, and that lightweight cellulose and blends and thermoplastics will also realize a 67.4 percent hazard reduction, due to the use of compliant filling materials:

²⁶*Ibid.*, p. 19.

²⁷ Cyprus Limited website, available at <http://www.cyprus.com/experience.html#commercial>, site visited October 24, 2005.

²⁸ *Staff Cost-Benefit Analysis*, pp. 21-22.

“The staff’s draft standard requires that materials that are tested shall not have less than 90 percent non-smolder residue of the substrate or filling material at 30 minutes when tested in accordance with the appropriate test method. Materials that comply with the smoldering tests should present a much lower likelihood that smoldering ignitions would progress to hazardous conditions.”²⁹

The staff employs a different methodology for estimating the standard’s effectiveness with regard to *small open flame-ignited fires*. The staff assumes that, as a result of the standard, 60 percent of heavyweight cellulosics would be made with fabrics treated with FR chemicals to enable them to pass the upholstery cover fabric smoldering ignition-resistance test. The staff relies on a 2001 review of two CPSC lab studies, conducted in 1996 and 2000, that concluded that FR treatment of fabrics complying with a 2001 draft small open flame standard would result in an 88 percent reduction in small open flame fire losses. However, because the current draft standard specifically addresses cigarette-ignition performance of fabrics – not small open flame resistance – the effectiveness rate of the standard is expected to be less than 88 percent. The staff notes that “the major intent of the staff’s draft standard is limiting the burning rate of many filling materials” to slow fire growth, an intention largely fulfilled by the inclusion of requirements that limit the mass loss of interior filling materials over time.³⁰ The staff believes that these requirements, which were not a part of the 2001 small open flame draft standard, should allow additional escape time for household members, thereby reducing deaths and injuries. The staff concludes that the hazard reduction for furniture treated with FR fabrics and complying interior filling materials is about 80 percent.

The staff also assumes that the 40 percent of heavyweight cellulosics not covered with FR treated materials would be made with barrier materials to comply with the draft standard. The staff believes that barriers would reduce the societal costs of small open flame ignitions by 90 percent, “based on previous estimates of the benefits of barriers used under the draft standard for small open flame ignition of furniture.”³¹ The resulting average small open flame hazard reduction estimate for heavyweight cellulosics is 84 percent (60 percent of furniture x 80 percent hazard reduction + 40 percent of furniture x 90 percent hazard reduction).

The staff assumes a 50 percent hazard reduction with respect to small open flame-related fires for medium weight cellulosics and blends, lightweight cellulosics and blends, and thermoplastics. This reduction is due to the use of complying filling materials *only*; as noted previously, the staff has assumed that furniture covered in these types of materials would pass the staff’s draft standard with regard to fabric covering. The 50 percent figure appears to be the result of discussions with Directorate for Engineering Sciences staff, and is subject to revision.

²⁹ *Ibid.*, p. 22.

³⁰ *Ibid.*, p. 27.

³¹ *Ibid.*

The staff multiplies a furniture covering's lifetime societal costs by its hazard reduction rate to obtain per-unit benefits of the draft standard. The staff then multiplies per-unit benefits by the total units produced to obtain total estimated benefits for a furniture covering type. These calculations result in a \$779.2 million overall benefit related to reductions in cigarette-ignited fire costs, and \$156.8 million overall benefit related to reductions in small open flame-ignited fire costs as a result of the draft standard.

B. Criticism of CPSC Staff Methods and Assumptions

We present several criticisms relating to the CPSC staff's assumptions and methodology. First, the CPSC staff fails to acknowledge the potential unreliability of NFIRS-based fire loss estimates, and incorrectly defines the losses addressable by the standard in its fire loss calculations. Second, the staff does not adequately acknowledge the low and declining level of risk associated with cigarette- and small open flame-ignited upholstered furniture fires. Third, the staff fails to fully account for trends and impacts of other regulations on furniture fire losses. Fourth, the staff does not appropriately account for a furniture unit's rate of exposure to ignition sources. Fifth, the staff relies on unsupported assumptions about the expected effectiveness of the draft standard. Finally, the staff uses a discount rate and statistical value of life that inflate the true benefits of the draft standard.

1. The CPSC Staff Fails to Address the Potential Issues Surrounding the Use of NFIRS Data to Evaluate Societal Costs, And Does Not Correctly Define Addressable Losses of the Draft Standard

A major concern with the CPSC staff analysis is that it fails to address the problems inherent in relying on NFIRS data to calculate the societal costs of cigarette- and small open flame-ignited upholstered furniture fires.³² NFIRS represents a non-random sample of reporting fire departments across the U.S., and is generally regarded as the most comprehensive data source on the U.S. fire experience. However, in order to estimate national-level fatalities, injuries, and property damage resulting from specific types of fires using NFIRS, one must make two adjustments to raw NFIRS figures. These adjustments – which are necessary to deal with the large number of unknowns in the data and to extrapolate NFIRS counts to a nationally-representative level – can generally lead to over- or understatement of actual deaths and losses, which the CPSC staff never concedes in its analysis.

Our concerns primarily relate to the staff's methodology for adjusting for the large number of unknowns in the NFIRS data. To avoid undercounting of specific types of fires, one must allocate fires with unknown characteristics (for our purposes, fires where heat source and/or item first ignited is unknown) to distinct fire categories. The CPSC

³² The CPSC staff has addressed some earlier criticisms presented by the GAO and NERA (*e.g.*, removing arson-related losses from addressable losses), but continues to ignore the central issue of imprecision surrounding any NFIRS-based fire loss estimates. For a more detailed discussion, see Appendix 1.

staff does this through a technique called “raking,” a method of allocating unknown observations to known categories. Raking relies on the assumption that fires with unknown characteristics have the same proportions as fires with known characteristics. For example, if 10 percent of cigarette-ignited fires where item first ignited is known and reported are upholstered furniture fires, raking allocates 10 percent of cigarette-ignited fires where item first ignited is unknown to the upholstered furniture fire category.³³ As acknowledged by the CPSC staff, the raking adjustment “cannot appropriately produce raked results when cell values are zero or very low.”³⁴ Since very few cigarette- and small open flame-ignited upholstered furniture fire deaths and injuries are actually reported in NFIRS in any given year, raking is thus likely to provide unreliable estimates of furniture fire losses addressable by the draft standard.

We contend that the methodology the CPSC staff employs to account for unknowns may **substantially overstate** the true losses from cigarette- and small open flame-ignited furniture fires. Appendix 1 provides greater detail into the problems associated with the assumptions made by the CPSC staff in this regard. However, we present two different estimations of NFIRS-based fire loss figures in this section to illustrate the imprecision of NFIRS-based loss estimates, and to support the contention that the staff has overstated losses that could be prevented by the draft standard.

Tables 2a and 2b present nationally-representative fire loss figures for cigarette- and small open flame-ignited fires for 1980 to 2002, calculated using NFIRS and NFPA data.³⁵ In Table 2a, national figures are calculated following the CPSC staff’s raking methodology, while in Table 2b, we employ an alternate method of estimating national-level fire loss figures based on NFIRS reporting. As discussed more in Appendix 1, our method (referred to as the “CRA Extrapolation Methodology” in our tables and figures) relies on the raking technique to extrapolate the number of fires and deadly fires in the U.S..³⁶ These figures are then multiplied by the average number of deaths per deadly fire (average number of injuries per fire) in the raw NFIRS data to calculate national-level death (injury) estimates. The number of deaths resulting from cigarette- and small open flame-ignited upholstered furniture fires is much lower using this method of extrapolation. (See Figures 1a and 1b for graphical representation.)

³³ This is a stylized example; raking involves iterative adjustments to marginal counts in the data, and is performed *via* a SAS macro written specifically for the NFIRS data.

³⁴ Risana Chowdhury, Michael Greene, David Miller, and Linda Smith, "1999 Revised - 2002 Residential Fire Loss Estimates," CPSC Division of Hazard Analysis, Directorate for Epidemiology, November 2005, p. 34.

³⁵ NFPA survey data is used to extrapolate NFIRS counts to a nationally-representative level. The process for this extrapolation is discussed further in Appendix 1.

³⁶ We do not actually rake deadly fires; instead, we rake fires and multiply our result by the percent of relevant fires (*e.g.*, cigarette-ignited upholstered furniture fires) with known heat source and item first ignited that are deadly.

Table 2a: Estimated Total U.S. Residential Upholstered Furniture Fires and Related Losses, by Source of Ignition
(CPSC Extrapolation Methodology)

Year	Cigarettes			Candles			Matches			Lighters			Total Small Open Flames		
	Fires [1]	Injuries [2]	Deaths [3]	Fires [4]	Injuries [5]	Deaths [6]	Fires [7]	Injuries [8]	Deaths [9]	Fires [10]	Injuries [11]	Deaths [12]	Fires [13]	Injuries [14]	Deaths [15]
1980	22,180	1,601	1,059	551	26	7	2,718	186	91	1,212	165	59	4,481	377	157
1981	20,937	1,538	1,145	578	66	58	2,546	178	25	945	109	0	4,069	353	83
1982	16,445	1,225	950	464	32	7	1,965	153	45	923	156	66	3,353	342	119
1983	13,739	1,726	813	471	80	7	1,839	146	106	943	212	66	3,252	437	180
1984	13,597	1,396	813	484	50	43	1,908	196	65	975	185	18	3,366	431	126
1985	12,473	1,410	710	547	70	10	1,770	145	64	1,004	190	24	3,321	404	99
1986	11,992	1,274	759	535	84	37	1,807	247	98	965	174	24	3,307	505	159
1987	11,053	1,346	700	531	77	10	1,602	224	73	1,123	147	57	3,256	448	140
1988	10,520	1,377	771	517	41	6	1,568	186	83	1,031	184	46	3,116	412	135
1989	9,124	1,140	630	560	61	26	1,383	199	46	924	200	46	2,867	460	118
1990	8,206	1,180	572	391	88	7	1,230	221	77	802	156	27	2,423	465	111
1991	7,900	1,068	449	431	57	21	1,099	183	42	893	256	88	2,423	497	151
1992	6,864	851	474	470	43	32	1,308	147	31	1,108	272	21	2,886	462	84
1993	6,548	1,020	431	434	70	23	1,075	144	34	1,044	221	28	2,552	436	84
1994	6,150	941	418	628	104	52	1,043	149	43	1,129	228	64	2,799	480	159
1995	6,003	831	507	641	85	0	943	148	28	1,005	234	51	2,588	467	78
1996	5,618	907	476	688	108	24	896	99	31	757	185	6	2,341	392	61
1997	5,129	726	430	885	159	17	784	145	14	807	222	35	2,477	526	66
1998	5,020	729	372	1,070	179	38	728	166	0	773	107	56	2,571	451	94
1999	4,126	545	294	941	174	13	486	22	7	569	129	12	1,997	326	33
2000	3,822	492	282	929	182	30	385	38	0	538	119	110	1,852	339	140
2001	3,685	481	320	1,115	184	21	323	33	11	406	78	20	1,845	294	51
2002	3,176	328	171	1,103	153	13	367	39	12	469	101	28	1,940	293	53
Average															
1980-2002	9,318	1,049	589	651	95	22	1,295	148	45	885	175	41	2,830	417	108
1995-1998	5,443	798	446	821	133	20	838	139	18	836	187	37	2,494	459	75
1999-2002	3,702	461	266	1,022	173	19	390	33	8	496	107	42	1,908	313	69

Notes:

All figures are extrapolations using the total number of residential structure fires, injuries, or deaths, as reported in the annual NFPA national fire loss surveys, divided by the total number of residential structure fires, injuries, or deaths, as reported in the annual NFIRS databases.

Counts are adjusted for the allocation of fires with unknown material first ignited and/or unknown heat source. Adjustments were made using a raking algorithm.

The raking algorithm is used by the U.S. CPSC in their analyses and is described in: M. Battaglia, D. Hoaglin, and D. Izrael, "A SAS Macro for Balancing a Weigh SAS Users Group International (SUGI) 25th Annual Conference, April 9-12, 2000, Paper #258-25.

Figures do not include fires with "incendiary" or "suspicious" ignition factors (*i.e.*, arson-related fires).

Sources:

1980-2002 NFIRS data, 1980-2002 NFPA national fire experience surveys.

Table 2b: Estimated Total U.S. Residential Upholstered Furniture Fires and Related Losses, by Source of Ignition
(CRA Extrapolation Methodology)

Year	Cigarettes			Candles			Matches			Lighters			Total Small Open Flames		
	Fires [1]	Injuries [2]	Deaths [3]	Fires [4]	Injuries [5]	Deaths [6]	Fires [7]	Injuries [8]	Deaths [9]	Fires [10]	Injuries [11]	Deaths [12]	Fires [13]	Injuries [14]	Deaths [15]
1980	22,180	4,078	983	551	89	9	2,718	471	65	1,212	444	63	4,481	1,003	137
1981	20,937	3,474	831	578	200	59	2,546	458	29	945	274	0	4,069	932	88
1982	16,445	2,805	811	464	86	6	1,965	368	36	923	352	43	3,353	806	84
1983	13,739	2,127	650	471	83	5	1,839	172	62	943	252	46	3,252	507	113
1984	13,597	1,271	585	484	46	46	1,908	190	88	975	180	16	3,366	416	150
1985	12,473	1,760	589	547	112	4	1,770	207	55	1,004	236	22	3,321	555	81
1986	11,992	1,707	634	535	99	13	1,807	351	86	965	239	20	3,307	689	119
1987	11,053	1,591	525	531	90	12	1,602	271	67	1,123	181	52	3,256	543	131
1988	10,520	1,521	583	517	52	4	1,568	219	50	1,031	206	32	3,116	477	86
1989	9,124	1,302	464	560	63	8	1,383	231	52	924	230	36	2,867	523	96
1990	8,206	1,278	420	391	99	4	1,230	256	47	802	181	18	2,423	535	69
1991	7,900	1,154	372	431	59	8	1,099	196	26	893	286	68	2,423	541	101
1992	6,864	967	392	470	45	24	1,308	185	20	1,108	329	29	2,886	559	73
1993	6,548	1,064	289	434	69	12	1,075	155	51	1,044	235	22	2,552	459	84
1994	6,150	1,025	362	628	116	58	1,043	173	23	1,129	271	62	2,799	560	143
1995	6,003	942	299	641	115	0	943	185	30	1,005	258	27	2,588	558	58
1996	5,618	1,021	276	688	139	22	896	125	18	757	234	4	2,341	497	44
1997	5,129	799	281	885	183	10	784	162	12	807	240	18	2,477	585	40
1998	5,020	769	264	1,070	211	29	728	177	25	773	122	45	2,571	510	99
1999	4,126	566	208	941	182	9	486	22	0	569	128	9	1,997	332	18
2000	3,822	494	180	929	179	15	385	39	0	538	105	71	1,852	323	86
2001	3,685	546	268	1,115	197	16	323	35	10	406	85	15	1,845	318	41
2002	3,176	451	152	1,103	204	11	367	52	0	469	136	25	1,940	391	36
<hr/>															
Average															
1980-2002	9,318	1,422	453	651	118	17	1,295	204	37	885	226	32	2,830	549	86
1995-1998	5,443	883	280	821	162	15	838	162	21	836	213	24	2,494	538	60
1999-2002	3,702	514	202	1,022	190	13	390	37	3	496	114	30	1,908	341	45

Notes:

Fire figures are extrapolations using the total number of residential structure fires as reported in the annual NFPA national fire loss surveys, divided by the total number of residential structure fires as reported in the annual NFIRS databases.

Counts are adjusted for the allocation of fires with unknown material first ignited and/or unknown heat source. Adjustments were made using a raking algorithm. The raking algorithm is used by the U.S. CPSC in their analyses and is described in: M. Battaglia, D. Hoaglin, and D. Izrael, "A SAS Macro for Balancing a Weighted SAS Users Group International (SUGI) 25th Annual Conference, April 9-12, 2000, Paper #258-25.

In order to estimate deaths and injuries at a national level while adjusting for unknowns, the average number of injuries per fire (deaths per deadly fire) in raw NFIRS was multiplied by the number of raked fires (deadly fires) in the U.S. based on the CPSC methodology.

Figures do not include fires with "incendiary" or "suspicious" ignition factors (*i.e.*, arson-related fires).

Sources:

1980-2002 NFIRS data, 1980-2002 NFPA national fire experience surveys.

Figure 1a: Cigarette-Ignited Upholstered Furniture Fire Deaths, 1980-2002
 (CPSC Extrapolation Methodology v. CRA Extrapolation Methodology)

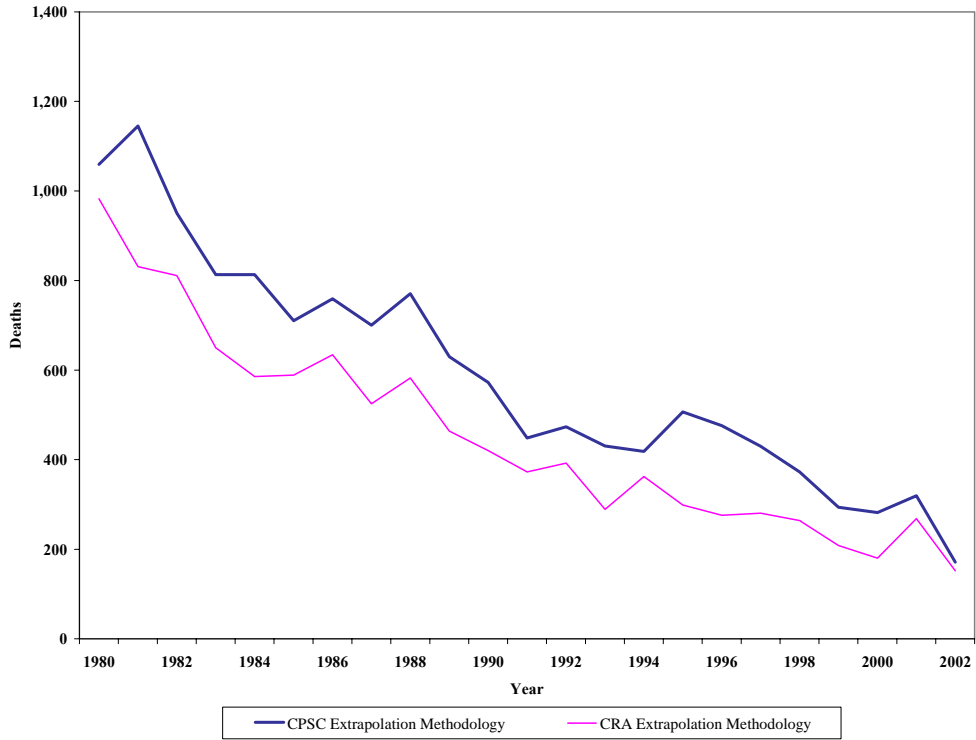
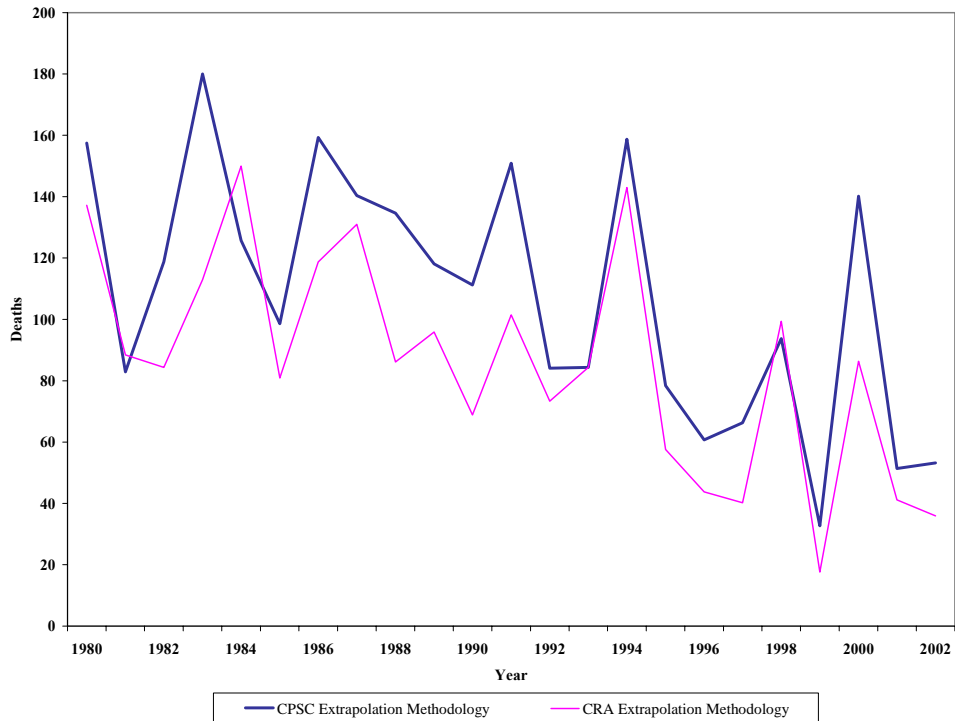


Figure 1b: SMOF-Ignited Upholstered Furniture Fire Deaths, 1980-2002
 (CPSC Extrapolation Methodology v. CRA Extrapolation Methodology)



We draw attention to the fact that, for the period from 1999 to 2002, the death and injury figures we obtained using the CPSC's raking methodology are somewhat different than the figures reported by the CPSC staff for the same period. This difference is likely due, in part, to the fact that the CPSC staff made adjustments to the NFIRS data prior to raking, while we did not. Also, as previously noted, the CPSC staff estimates *smoking materials*-related and small open flame-related *addressable* deaths and injuries, and relies on several criteria for identifying addressable fires.³⁷ In contrast, we estimate *all cigarette- and small open flame-ignited fire losses*.

A comparison of Tables 2a and 2b reveals that the death estimates obtained using CRA's extrapolation methodology are considerably lower than the estimates obtained using the CPSC staff's methodology. Using our methodology, we estimate that there were 202 cigarette-related furniture fire deaths annually in the 1999-2002 time period, while using the staff's methodology, we estimate that there were 266 cigarette-related furniture fire deaths annually over the same period. In the cost-benefit analysis, the CPSC staff estimates that there were 300 addressable smoking materials-related deaths annually in the 1999-2002 time period. Thus, the figures estimated using our extrapolation methodology are *at least* 24 percent lower than the figures relied on by the CPSC staff, or estimated by CRA using the staff's methodology. (Had we attempted to estimate *addressable* losses only, our estimates would be even lower.) We contend that the estimates obtained using our methodology more accurately reflects the true U.S. fire experience, as we do not rely on raking the small number of NFIRS-reported deaths and injuries to obtain our results.

Note that regardless of which method is employed, the number of cigarette and small open flame ignited furniture fires has declined dramatically despite increases in population and furniture in use. Cigarette fires, for example have fallen from 22,180 in 1980 to 3,176 in 2002. Though the CPSC has argued that one cannot compare pre-1999 and post-1998 NFIRS data, the magnitude of this decline is unlikely to be sensitive to recent changes in NFIRS reporting.

In addition to failing to acknowledge the potential imprecision of its cost estimates, the CPSC staff also mis-defines the addressable losses of the draft standard. Instead of estimating the number of deaths and injuries from *cigarette-ignited* furniture fires, the CPSC staff calculates the number of deaths and injuries from furniture fires started by *all types of smoking materials*.³⁸ While the standard may prevent fires started by other types of smoking materials aside from cigarettes, the staff has provided no evidence to support this assumption. The standard only tests resistance to cigarettes and no lab data are cited to support the assertion that the standard extends to cigars, pipes, or other smoking materials. Incidentally, the staff report mislabels loss estimates as pertaining to cigarette-ignited fires only.

³⁷ See footnote 13.

³⁸ See CPSC Staff Memorandum from Mark S. Levenson (Division of Hazard Analysis) to Dale Ray (Directorate for Economic Analysis), "Upholstered Furniture Addressable Fire Loss Estimates for 1999-2002," November 21, 2005.

2. The CPSC Staff Does Not Adequately Acknowledge the Low and Declining Level of Risk Associated with Cigarette- and Small Open Flame-Ignited Upholstered Furniture Fires

The CPSC staff's analysis does not fully acknowledge the already low and falling risk associated with cigarette- and small open flame-ignited upholstered furniture fires. Regardless of the extrapolation method used to estimate national level death and injury figures, the risk level associated with death or injury in a cigarette- or small open flame-ignited furniture fire is lower than many other risks commonly accepted by individuals without concern. Tables 3a and 3b and Figures 2a and 2b display the annual number of injuries and deaths per million population from 1980 to 2002, based on NFIRS data extrapolated using the CPSC staff's methodology and our revised methodology. The risk associated with death or injury from these types of fires has fallen dramatically over the past two decades. In recent years, the risk has been extremely low: from 1999-2002, the death rate for cigarette fires was around 0.72 per million population, while the death rate for small open flame fires is approximately 0.16 per million population (using our extrapolation methodology). The small open flame fire risk is already in the range that CPSC has found acceptable for its child-resistant cigarette lighter standard.³⁹ A risk level of under 1 per million is considered by many experts to be *de minimis*, below many everyday risks that are essentially unavoidable.⁴⁰ For example, the death rate for pedestrians was 17 per million in 2002, and the death rate for motor vehicle occupants was 153 per million in the same year.⁴¹ Similarly, EPA requirements of chemical concentrations at Superfund sites imply a lifetime risk of death not to exceed 1 in 10,000, or 100 in 1 million. This corresponds to an annual risk of about 1 in 1 million. Current risk rates for upholstery fires caused by cigarettes and small open flames are already at or below the 1 per million level, and as discussed in the next section, will likely continue to fall in the future without the introduction of a furniture flammability standard.

³⁹ The CPSC expected its cigarette lighter standard to reduce the number of lighter-related deaths from 150 to between 40 and 70 annually. This translates to risk of between 0.17 and 0.26 per million.

⁴⁰ See W. Kip Viscusi, *Rational Risk Policy*, Oxford: Clarendon-Oxford University Press, 1988. See also, John J. Cohn and Vincent T. Covello, *Risk Analysis: A Guide to Principles and Methods for Analyzing Health and Environmental Risks*, Washington, D.C.: White House Council on Environmental Quality, 1989, p. 25.

⁴¹ Arialdi Minino, et al., "Deaths: Injuries 2002," Table 5, National Vital Statistics Reports, Center for Disease Control, vol. 54, no. 10, January 31, 2006.

Table 3a: U.S. Residential Upholstered Furniture Injuries and Deaths Per Million Population, by Source of Ignition
(CPSC Extrapolation Methodology)

Year	Cigarettes		Small Open Flames	
	Injuries (per million)	Deaths (per million)	Injuries (per million)	Deaths (per million)
[1]	[2]	[3]	[4]	[5]
1980	7.07	4.68	1.66	0.70
1981	6.70	4.99	1.54	0.36
1982	5.29	4.10	1.48	0.51
1983	7.38	3.48	1.87	0.77
1984	5.92	3.45	1.83	0.53
1985	5.93	2.99	1.70	0.41
1986	5.31	3.16	2.10	0.66
1987	5.56	2.89	1.85	0.58
1988	5.63	3.15	1.69	0.55
1989	4.62	2.55	1.86	0.48
1990	4.73	2.29	1.86	0.45
1991	4.24	1.78	1.97	0.60
1992	3.34	1.86	1.81	0.33
1993	3.96	1.67	1.69	0.33
1994	3.61	1.61	1.84	0.61
1995	3.16	1.93	1.78	0.30
1996	3.42	1.79	1.48	0.23
1997	2.71	1.60	1.96	0.25
1998	2.70	1.38	1.67	0.35
1999	2.00	1.08	1.20	0.12
2000	1.75	1.00	1.20	0.50
2001	1.69	1.12	1.03	0.18
2002	1.14	0.59	1.02	0.18
<hr/>				
Average				
1980-2002	4.25	2.40	1.66	0.43
1995-1998	3.00	1.68	1.72	0.28
1999-2002	1.64	0.95	1.11	0.25

Notes:

Figures are extrapolated to a national level following the raking methodology employed by the CPSC. Extrapolation is based on the NFPA national fire experience survey. Figures do not include fires with "incendiary" or "suspicious" ignition factors (*i.e.*, arson-related fires).

Sources:

1980-2002 NFIRS data, 1980-2002 NFPA national fire experience surveys.
US Census Bureau population estimates.

Table 3b: U.S. Residential Upholstered Furniture Injuries and Deaths Per Million Population, by Source of Ignition
(CRA Extrapolation Methodology)

Year	Cigarettes		Small Open Flames	
	Injuries (per million)	Deaths (per million)	Injuries (per million)	Deaths (per million)
[1]	[2]	[3]	[4]	[5]
1980	18.00	4.34	4.43	0.61
1981	15.14	3.62	4.06	0.39
1982	12.11	3.50	3.48	0.36
1983	9.10	2.78	2.17	0.48
1984	5.39	2.48	1.76	0.64
1985	7.40	2.47	2.33	0.34
1986	7.11	2.64	2.87	0.49
1987	6.56	2.17	2.24	0.54
1988	6.22	2.38	1.95	0.35
1989	5.27	1.88	2.12	0.39
1990	5.12	1.68	2.15	0.28
1991	4.58	1.48	2.14	0.40
1992	3.79	1.54	2.19	0.29
1993	4.13	1.12	1.78	0.33
1994	3.94	1.39	2.15	0.55
1995	3.58	1.14	2.12	0.22
1996	3.85	1.04	1.87	0.17
1997	2.98	1.05	2.18	0.15
1998	2.85	0.98	1.89	0.37
1999	2.08	0.76	1.22	0.06
2000	1.76	0.64	1.15	0.31
2001	1.91	0.94	1.12	0.14
2002	1.57	0.53	1.36	0.12
Average				
1980-2002	5.84	1.85	2.21	0.35
1995-1998	3.32	1.05	2.02	0.23
1999-2002	1.83	0.72	1.21	0.16

Notes:

Figures are extrapolated to a national level following the CRA raking methodology.

Extrapolation is based on the NFPA national fire experience surveys.

Figures do not include fires with "incendiary" or "suspicious" ignition factors (*i.e.*, arson-related fires).

Sources:

1980-2002 NFIRS data, 1980-2002 NFPA national fire experience surveys.

US Census Bureau population estimates.

Figure 2a: Per Capita Risk of Death in a Cigarette-Ignited Furniture Fire, 1980-2002
 (CPSC Extrapolation Methodology and CRA Extrapolation Methodology)

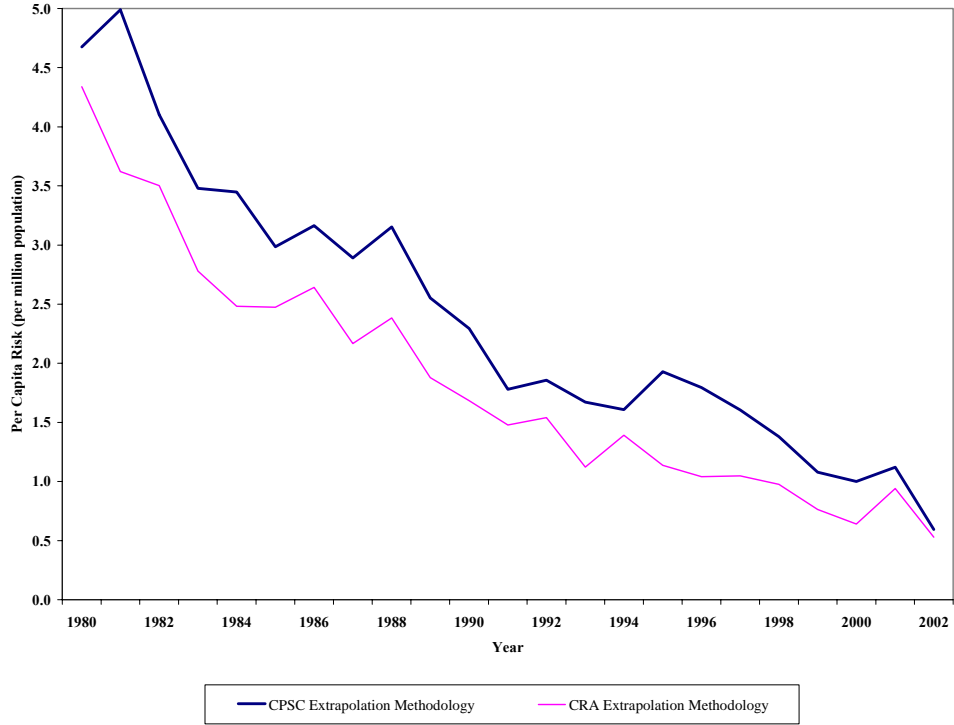


Figure 2b: Per Capita Risk of Death in a Small Open Flame-Ignited Furniture Fire, 1980-2002
 (CPSC Extrapolation Methodology and CRA Extrapolation Methodology)



3. The CPSC Staff Does Not Properly Account for Downward Trends in Smoking and the Impact of Other Policies

The CPSC staff adjusts its estimates of the per-unit lifetime societal costs of cigarette-ignited furniture fires downward by approximately 13 percent to account for the impact of future declines in smoking on these types of fires.⁴² We agree that societal costs should be adjusted to account for a future decline in smoking, but find that the staff's adjustment is not sufficient.

As Table 4 shows, smoking prevalence and cigarette consumption have steadily declined since the 1980s. As acknowledged by the CPSC staff, the reduction in smoking in the U.S. over the past two decades can at least partially explain the simultaneous decrease in the number of cigarette-ignited upholstered furniture fires and related losses. Causation between a decline in smoking and a decline in smoking-related fires makes sense intuitively, and many fire experts – including NFPA and University of Surrey researchers – support the notion that a causal relationship exists.⁴³ For instance, the NFPA recently calculated that smoking-related upholstered furniture fires have declined by 80 percent since 1980, attributing this decline to the voluntary UFAC cigarette ignition-resistance standard, the decline in smoking prevalence, and the growth in the use of smoke detectors, among other factors.⁴⁴

Table 4 also indicates that the rate of decline in smoking prevalence and cigarette consumption has not diminished over time, supporting the contention that these trends will continue in the near future. Declines in smoking are likely to persist due to the continuance of aggressive anti-smoking campaigns including smoking bans and as well as increased education about the dangers of smoking. Smoking prevalence should also continue to decline in reaction to increasing insurance costs and taxes. Future declines in smoking prevalence are likely to result in a continued reduction in cigarette-related fire losses. Figure 3 indicates, based on the historical relationship between smoking prevalence and cigarette-related fire deaths, that if the U.S. meets the Department of Health and Human Services' smoking rate target of 12 percent in 2010, the cigarette-ignited furniture fire fatality rate could fall to below 0.5 per million population.⁴⁵

⁴² The staff provides limited explanation of its process in making this adjustment.

⁴³ John R. Hall, Jr., "The Smoking-Material Fire Problem," Fire Analysis and Research Division, National Fire Protection Association, November 2004, p. 29; Alan Emsley, Linda Lim, Gary Stevens and Peter Williams, "International Fire Statistics and the Potential Benefits of Fire Counter-Measures," University of Surrey, Polymer Research Centre, May 18, 2005, Executive Summary.

⁴⁴ John R. Hall, Jr., "The Smoking-Material Fire Problem," Fire Analysis and Research Division, National Fire Protection Association, November 2004, p. 4.

⁴⁵ U.S. Department of Health and Human Services, *Healthy People 2010: Volume II*, November 2000, Part 27, available online at <http://www.healthypeople.gov/Document/tableofcontents.htm#volume1>, site visited January 26, 2006.

Table 4: Cigarette Consumption and Smoking Prevalence in the U.S., 1980-2003

Year	Cigarette Consumption		Smoking Prevalence	
	Millions of Packs	% Change	Percent	% Change
[1]	[2]	[3]	[4]	[5]
1980	29,184.4	1.4%	33.2%	-0.9%
1981	29,979.7	2.7%	32.8%	-1.1%
1982	29,977.7	0.0%	32.5%	-1.1%
1983	29,243.4	-2.4%	32.1%	-1.1%
1984	28,461.7	-2.7%	31.1%	-3.1%
1985	28,464.2	0.0%	30.1%	-3.2%
1986	28,044.6	-1.5%	29.5%	-2.2%
1987	27,547.3	-1.8%	28.8%	-2.2%
1988	27,008.7	-2.0%	28.1%	-2.4%
1989	26,166.3	-3.1%	26.8%	-4.6%
1990	25,014.2	-4.4%	25.5%	-4.9%
1991	24,216.1	-3.2%	25.7%	0.8%
1992	23,776.2	-1.8%	26.5%	3.1%
1993	23,368.5	-1.7%	25.0%	-5.7%
1994	22,995.6	-1.6%	25.5%	2.0%
1995	23,245.1	1.1%	24.7%	-3.1%
1996	22,973.2	-1.2%	24.7%	0.0%
1997	23,044.5	0.3%	24.7%	0.0%
1998	22,759.8	-1.2%	24.1%	-2.4%
1999	21,972.3	-3.5%	23.5%	-2.5%
2000	21,404.8	-2.6%	23.3%	-0.9%
2001	20,727.0	-3.2%	22.8%	-2.1%
2002	20,434.6	-1.4%	22.5%	-1.3%
2003	19,336.2	-5.4%	21.6%	-4.0%

Notes:

Smoking prevalence estimates are of U.S. adults, age 18 and older. Since 1992, smoking prevalence estimates have incorporated some-day smokers: people that do not smoke every day.

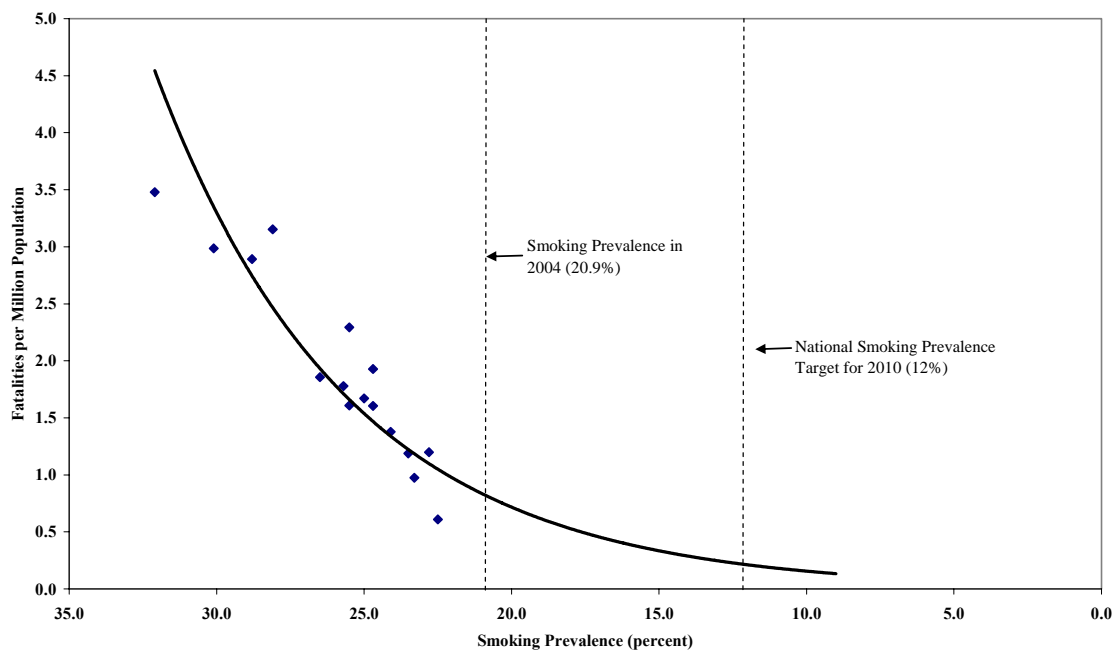
Smoking prevalence rates in the following years are linearly interpolated from the nearest available data: 1981, 1982, 1984, 1986, 1989, and 1996.

Sources:

[2]: Orzechowski and Walker, *The Tax Burden on Tobacco, Historical Compilation*, Volume 38, 2003.

[4]: CDC smoking prevalence rates, 1980-2003, available at http://www.cdc.gov/tobacco/research_data/adults_prev/prevali.htm.

Figure 3: Projected Fatality Rate from Cigarette-Ignited Furniture Fires Given a Continued Decline in Smoking Prevalence



Unfortunately, the CPSC staff fails to fully account for the expected reduction in cigarette-ignited fire losses resulting from a future decline in smoking. Tables 5 and 6 present our own analysis of the likely future reduction in cigarette-ignited furniture fire losses. In our analysis, we forecast deaths and injuries through 2021, the sixteenth year of the draft standard if it is implemented in 2006.⁴⁶ Smoking prevalence through 2021 is projected based on a log-linear regression of historical smoking prevalence on time. Based on this regression (results are shown in Table 5c), we predict that smoking prevalence will reach 15.9 percent by 2021, approximately 5 percentage points below the 2004 smoking rate of 20.9 percent.⁴⁷

Cigarette-ignited furniture fire deaths and losses are forecasted based on predicted smoking prevalence rates and log-linear regressions of historic deaths and injuries (from NFIRS data) on smoking prevalence. As shown in Tables 5a-5b, the R^2 for both of these

⁴⁶ We forecast through the sixteenth year of the standard under the assumption that the average lifetime of a furniture unit is 16 years. We realize that it highly unrealistic that the draft standard would be implemented in 2006; however, we adopt this starting year as a “best-case” scenario. In other words, the earlier the draft standard is implemented, the greater the gross benefits due to the declines in cigarette-related losses independent of the standard.

⁴⁷ Center for Disease Control, Tobacco Information and Prevention Source, “Smoking Prevalence Among U.S. Adults,” November 2005, available at http://www.cdc.gov/tobacco/research_data/adults_prev/prevali.htm, site visited January 26, 2006.

regressions is 0.79 – a high value – indicating that smoking prevalence can be used to predict the number of cigarette fire losses.⁴⁸

⁴⁸ The R^2 indicates the degree to which the independent variable (smoking prevalence) explains the dependent variable (cigarette-ignited furniture fire deaths/injuries). An R^2 of 0.79 indicates that 79 percent of the variation observed in the dependent variable is explained by the equation. Note that a high R^2 does not necessarily prove causality, and that the relationship found here between smoking and fires may also reflect the impact of other time-dependent variables such as increased smoke detector penetration and increased use of UFAC-compliant furniture. We could not control for these factors as annual data were not available.

Table 5a: Robust Linear Regression: $\ln(\text{cig fatalities}) = \alpha + \beta(\text{smoking prevalence})$ *Dependent Variable = $\ln(\text{cigarette-ignited furniture fatalities per million})$*

	β	SE	t	Pr > t
smokeprev	15.67	2.63	5.97	0
_cons	-3.50	0.69	-5.06	0

N	16	RMSE	0.22545
R-squared	0.79		

Notes:

Cigarette-ignited fatality figures are obtained with raked NFIRS data scaled to the national level using data from the annual NFPA survey.

Regression relies on data from 1983-2002, exclusive of 1984, 1986, 1989 and 1996, for which smoking prevalence figures were unavailable.

Robust standard errors are reported.

Table 5b: Robust Linear Regression: $\ln(\text{cig injuries}) = \alpha + \beta(\text{smoking prevalence})$ *Dependent Variable = $\ln(\text{cigarette-ignited furniture injuries per million})$*

	β	SE	t	Pr > t
smokeprev	17.16	2.55	6.72	0
_cons	-3.23	0.68	-4.78	0

N	16	RMSE	0.24625
R-squared	0.79		

Notes:

Cigarette-ignited injury figures are obtained with raked NFIRS data scaled to the national level using data from the annual NFPA survey.

Regression relies on data from 1983-2002, exclusive of 1984, 1986, 1989 and 1996, for which smoking prevalence figures were unavailable.

Table 5c: Robust Linear Regression: $\ln(\text{smoking prevalence}) = \alpha + \beta(\text{year})$ *Dependent Variable = $\ln(\text{smoking prevalence})$*

	β	SE	t	Pr > t
year	-0.02	0.00	-31.86	0
_cons	33.49	1.09	30.62	0

N	22	RMSE	0.02633
R-squared	0.98		

Notes:

Regression relies on data from 1970-2003, exclusive of 1971-1973, 1975-1977, 1981-1982, 1984, 1986, 1989 and 1996, for which smoking prevalence figures were unavailable.

The regressions also indicate that as smoking prevalence declines in the future, which we expect it to given, the reasons above, the number of cigarette-ignited fire losses will continue to decline without the introduction of a CPSC flammability standard. Based on the regressions and forecasted smoking rates, we predict that there will be approximately

235 deaths and 421 injuries from cigarette-ignited upholstered furniture fires in 2006 – the first year of the standard if it is implemented immediately – and 125 deaths and 209 injuries in the year 2021 *without implementation of the draft standard*. Table 6 presents these results.⁴⁹

Table 6: Forecast of Cigarette-Ignited Furniture Fire Losses, 2005-2021

Year	Forecast of Smoking	Forecast of Deaths		% Change, Deaths per	Forecast of Injuries per	% Change, Injuries per	
	Prevalence	Per Million	Implied Deaths	Million	Million	Implied Injuries	Million
2005	21.0%	0.83	247	-	1.50	444	-
2006	20.7%	0.79	235	-5.5%	1.41	421	-6.1%
2007	20.3%	0.74	-	-5.5%	1.32	-	-6.0%
2008	19.9%	0.70	-	-5.4%	1.25	-	-5.9%
2009	19.6%	0.67	-	-5.3%	1.18	-	-5.8%
2010	19.3%	0.63	196	-5.2%	1.11	343	-5.7%
2011	18.9%	0.60	-	-5.1%	1.05	-	-5.6%
2012	18.6%	0.57	-	-5.0%	0.99	-	-5.5%
2013	18.3%	0.54	-	-4.9%	0.94	-	-5.4%
2014	18.0%	0.52	-	-4.8%	0.89	-	-5.3%
2015	17.7%	0.49	-	-4.8%	0.84	-	-5.2%
2016	17.3%	0.47	-	-4.7%	0.80	-	-5.1%
2017	17.0%	0.45	-	-4.6%	0.76	-	-5.0%
2018	16.7%	0.43	-	-4.5%	0.72	-	-4.9%
2019	16.5%	0.41	-	-4.4%	0.69	-	-4.9%
2020	16.2%	0.39	131	-4.4%	0.65	219	-4.8%
2021	15.9%	0.37	125	-4.3%	0.62	209	-4.7%

Notes:

Smoking prevalence was forecasted based on the results of a log-linear regression of smoking prevalence (dependent variable) on year (independent variable) from 1970-2003, exclusive of some years (1971-1973, 1975-1977, 1981, 1982, 1984, 1986, 1989, 1996).

Deaths and Injuries per million were forecasted based on the results of log-linear regressions of cigarette-ignited furniture fire deaths or injuries (dependent variables) on smoking prevalence (independent variable) from 1983-2002, exclusive of some years (1984, 1986, 1989, 1996). Loss figures are NFIRS-based national estimates (using raked NFIRS data).

Implied deaths and implied injuries are the product of a year's forecasted deaths (injuries) per million population multiplied by the projected population in or around that year. For 2005, 2004 estimated population was used; for 2021, 2020 predicted population was used. Population projections are from the Census bureau, and were only available for 2010 and 2020. Thus, we did not calculate implied deaths and injuries for most years.

Sources:

- NFIRS data, 1983-2002.
- NFPA national fire experience surveys, 1983-2002.
- CDC smoking prevalence data, 1970-2003.
- Census Bureau population estimates and projections.

Assuming that losses will fall to these levels in 2021, and without modifying any of the staff's other assumptions, we estimate that the staff's lifetime, per-unit societal cost estimate should be reduced by approximately 20 percent to account for the expected

⁴⁹ As further support for this method of forecasting cigarette-related losses, the 2001 NERA report employed similar regression techniques using data from the 1980-1998 time period, and predicted that the risk of death in a cigarette-ignited furniture fire would be 0.60 per million population in 2003. Based on NFIRS data and CRA's extrapolation methodology, the risk of death in a cigarette-ignited furniture fire was 0.53 in 2002, in line with the NERA prediction for 2003. Thus, if anything, our methodology provides conservative estimates of future fire losses. (Mark Berkman, "Assessing the Need for a Federal Small Open Flame/Cigarette Ignition Upholstered Furniture Flammability Standard," National Economic Research Associates, prepared for the Upholstered Furniture Action Council, February 21, 2001, p. 43.)

future decline in smoking.⁵⁰ This reduction is much greater than the 13 percent assumed in the staff's analysis. Additionally, while the staff appears to use average loss figures from the 1999-2002 time period as a starting point for estimating lifetime societal costs, we contend that the 2006 figures mentioned above – 235 deaths and 421 injuries – are a more appropriate starting point. Assuming that these figures accurately represent cigarette-ignited fire losses in 2006, and that losses would fall to the predicted levels in 2021, we estimate that cigarette-ignited furniture fire deaths would decline by about 4.1 percent annually and injuries would decline by about 4.4 percent annually over the first sixteen years of the standard. As a result, the lifetime societal costs (of cigarette-ignited furniture fires) associated with a year's worth of current furniture production would be \$771 million, approximately \$270 million less than the CPSC staff's estimate of \$1,039.4 million.⁵¹

As a caveat to these results, it should be noted that our predicted death rates for the early years of the draft standard (if implemented in 2006) are actually greater than the death rates we calculated using NFIRS data for the 1999-2002 time period. This is due to our use of a logarithmic model, rather than a linear model, to predict future fire losses. We adopt a logarithmic model to reflect the likelihood that the death rate will never fall to zero, despite the fact that cigarette-related deaths have exhibited more of a linear trend in the past two decades. Thus, our predicted death rates are conservative, and may substantially overstate the actual death rate from cigarette-ignited furniture fires, especially in more recent years.

a. The Effects of Other Trends and Policies on Upholstery Fires

Additionally, the CPSC staff failed to account for the impact of other policies on the frequency of cigarette-ignited furniture fires and related fatalities. Recently approved laws, such as the fire-safe cigarette requirements passed in New York, California, and Vermont, and laws under active consideration in other states will clearly reduce fire deaths and injuries. Additionally, state and local programs designed to promote fire detector maintenance are likely to contribute to continued declines. A mandatory cigarette lighter performance safety standard currently under review by the CPSC will also likely lead to further declines in the number of cigarette- and small open flame-ignited upholstered furniture fires.⁵²

⁵⁰ We assume a 16-year lifespan for a piece of furniture, and a 3 percent discount rate. In making this calculation, we replicated the CPSC staff's assumptions to the best of our abilities, but may not have re-created their model exactly.

⁵¹ This amount is calculated using a discount rate of 3 percent and a \$5 million statistical value of a life.

⁵² In late 2004, the CPSC voted to start development of a mandatory safety standard for cigarette lighters based on the current voluntary standard (ASTM F-400) to prevent mechanical malfunction of lighters. (U.S. Consumer Product Safety Commission Press Release, "CPSC Votes to Start Development of Mandatory Standard for Cigarette Lighters," December 1, 2004, available at <http://www.cpsc.gov/library/foia/foia05/petition/light1.pdf>, site visited January 26, 2006.)

In particular, the inception of the “fire-safe” or “self-extinguishing” cigarette is likely to substantially decrease the number of cigarette-ignited furniture fires and related fatalities in the near future. Cigarettes are typically rendered “fire-safe” through the addition of ultra-thin paper bands to the length of the cigarette, which cause a cigarette to self-extinguish if the smoker does not inhale for a prolonged period of time (usually several minutes).⁵³ Three states – New York, California, and Vermont – have already passed laws mandating tobacco companies to sell only self-extinguishing cigarettes, and numerous other states – including Illinois, Alabama, and New Jersey – are in the process of passing similar laws.⁵⁴

Several studies of fire-safe cigarettes have found them to be effective at reducing the risk of accidental upholstered furniture ignition. In 1987, a study conducted by the National Bureau of Standards’ (NBS) Center for Fire Research evaluated five different experimental fire-safe cigarette designs, including a banded cigarette paper design, and found that fire-safe cigarettes caused fewer upholstered furniture ignitions than regular cigarettes.⁵⁵ The study exposed furniture and small-scale furniture mockups to experimental fire-safe cigarettes and standard control cigarettes, and found that ignition propensity was reduced from 96 percent to 100 percent in the control cases to 20 percent to 66 percent with the patented fire-safe designs. The design using banded cigarette paper, the method employed in cigarettes currently sold in New York, was the least ignition-prone.⁵⁶

Also in 1987, an NFPA report utilized the NBS test data on experimental fire-safe cigarettes to estimate the reduction in cigarette-ignited fires and related losses that would result from the use of fire-safe designs.⁵⁷ Based on the test data, the NFPA predicted that the complete replacement of standard cigarettes with fire-safe cigarettes would lead to a 58 percent to 78 percent reduction in cigarette-ignited furniture and bedding fire fatalities and a 76 percent to 96 percent reduction in cigarette-ignited upholstered furniture fires

⁵³ Paul Nowell, “Fire-Safe Cigarettes Coming Soon,” CBS News Online, June 11, 2004, available at <http://www.cbsnews.com/stories/2004/06/11/health/main622695.shtml>, site visited January 26, 2006.

⁵⁴ Office of Assemblyman Paul Koretz, 42nd Assembly District of California, News Release, “Fire Safe Cigarettes Coming to California,” October 7, 2005, available at http://democrats.assembly.ca.gov/members/a42/press_pdf/press_100.pdf, site visited January 26, 2006; Office of Vermont Governor Jim Douglas, News Release, “Governor Signs Professional Firefighter Protection Act of 2005 – Also Signs Fire-Safe Cigarette Bill,” June 17, 2005, available at <http://www.vermont.gov/tools/whatsnew2/index.php?topic=GovPressReleases&id=1349&v=Article>, site visited January 26, 2006. (Information on pending fire-safe regulations was found at statenet.com.)

⁵⁵ Richard G. Gann, Richard H Harris, Jr., John F. Krasny, Robert S. Levine, Henri E. Mitler, and Thomas J. Ohlemiller, “The Effect of Cigarette Characteristics on the Ignition of Soft Furnishings,” Center for Fire Research, National Bureau of Standards, October 1987.

⁵⁶ *Ibid.*, p. 86-87.

⁵⁷ John R. Hall, Jr., “Expected Changes in Fire Damages from Reducing Cigarette Ignition Propensity,” Fire Analysis and Research Division, National Fire Protection Association, October 1987.

within one year.⁵⁸ (These values were derived from tests on the most-ignitable furniture fabrics.⁵⁹)

More recently, a 2001 study published by the National Institute of Standards and Technology (NIST) confirmed the effectiveness of banded cigarettes in reducing cigarette ignition propensity.⁶⁰ Comparing a conventional cigarette to a banded cigarette, the NIST study found that, on three of four substrates, conventional cigarettes caused ignition in 100 percent of applications, while fire-safe, banded cigarettes caused ignition in 38 percent to 59 percent of applications. On the fourth substrate, conventional cigarettes caused ignition 19 percent of the time while banded cigarettes caused ignition 3 percent of the time. A different test method yielded similar results: conventional cigarettes caused ignition 100 percent of the time, while banded cigarettes caused ignition only 13 percent to 38 percent of the time.⁶¹

New York is the only state where fire-safe cigarette laws have actually been put into effect. In order to conform to the New York fire safety performance standard, a cigarette brand must exhibit full-length burns in no more than 25 percent of 40 tested cigarettes. A recent study by researchers at the Harvard School of Public Health found that four out of five compliant New York brands tested exhibited full-length burns in 10 percent or less of tests, well exceeding the required compliance rate, while the same brands sold in Massachusetts and California (where cigarettes are not yet required to be fire-safe) exhibited between 98 percent and 100 percent full length burns.⁶²

Preliminary evidence from New York shows that the fire-safe cigarette regulation has been effective in preventing deaths. In September 2005, ABC News reported that, in 2004, 28 people died in New York due to cigarette-related incidents, down from 43 in 2000, 44 in 2001, 38 in 2002, and over 30 in 2003.⁶³ Assuming an average pre-regulation value of 38 deaths, the number of cigarette-related deaths has fallen by 26 percent, and since the New York law came into effect in June 2004, the above decline only incorporates one-half of a year's effect of the standard. We would expect that the number of fire fatalities to decline even further given a full year's worth of data. Given a few years, as fire-safe cigarette laws are implemented in California (in January 2007) and

⁵⁸ *Ibid.*, pp. 27-34.

⁵⁹ *Ibid.*, p. 27.

⁶⁰ Richard G. Gann, Kenneth D. Steckler, Schuyler Ruitberg, William F. Guthrie, and Mark S. Levenson, "Relative Ignition Propensity of Test Market Cigarettes," National Institute of Standards and Technology, January 2001.

⁶¹ *Ibid.*, pp. 14-16.

⁶² Connolly, G.N., H.R. Alpert, V. Rees, C. Carpenter, G.F. Wayne, D. Vallone, and H. Koh, "Effect of the New York State Cigarette Fire Safety Standard on Ignition Propensity, Smoke Constituents, and the Consumer Market," *Tobacco Control*, 14 (2005):321-327.

⁶³ Michael Gormley, "'Fire-Safe' Cigarette Law Yields Results," ABC News Online, September 20, 2005, available at <http://abcnews.go.com/Health/wireStory?id=1143718>, site visited January 26, 2006. (New York state did not, at press time, have complete data for losses in 2003.)

Vermont (in May 2006) and more states pass similar bills, the effects of fire-safe cigarettes on national cigarette-related fire losses should become more pronounced.⁶⁴

Based on the studies cited above, along with the encouraging evidence from New York, we believe that fatalities from cigarette-ignited upholstered furniture fires may be reduced by at least 50 percent in states where a fire-safe cigarette standard has been enacted. According to NFIRS data for 1999-2002, cigarette-ignited furniture fire fatalities in New York, California, and Vermont have recently accounted for about 12 percent of the national total of these types of fatalities.⁶⁵ We therefore estimate that, in 2006, cigarette-ignited fire fatalities will experience an overall one-time decline of 3.5 percent from fire-safe cigarettes, and in 2007, fatalities will experience another one-time decline of about 2.6 percent.⁶⁶ Once this one-time adjustment is incorporated, our estimate of the lifetime societal costs (of cigarette-ignited furniture fires) associated with one year's worth of current production declines by another \$38 million, from \$771 million to \$733 million.⁶⁷ Further adjustments will be necessary as other states enact similar regulations.

Other policy changes could also have a downward effect on injuries and deaths addressed by the standard. In particular, attempts to increase the presence of working smoke detectors would likely lead to a decline in residential cigarette- and small open flame-ignited furniture fires. Though smoke detectors are currently nearly ubiquitous in U.S. homes, many are non-operational: one recent study estimated that in one-fifth of home with smoke detectors, none were working.⁶⁸ An NFPA report on smoke detectors recently reported that homes with smoke alarms have historically had a death rate that is 40 percent to 50 percent less than homes without any warning device, and that if every home had working smoke alarms, U.S. home fire deaths would fall by approximately 36 percent.⁶⁹ Therefore, efforts to increase awareness about the importance of working smoke alarms could lead to a further reduction in future furniture fire losses.

⁶⁴ *Ibid.*; Office of Assemblyman Paul Koretz, 42nd Assembly District of California, News Release, "Fire Safe Cigarettes Coming to California," October 7, 2005, available at http://democrats.assembly.ca.gov/members/a42/press_pdf/press_100.pdf, site visited January 26, 2006.

⁶⁵ This value of 12 percent is derived from the NFIRS data by extrapolating state fire fatalities using CDC death certificates data to account for variation in the number of fire departments reporting.

⁶⁶ We assume that cigarette-related deaths will experience a 3.5 percent decline in 2006, due to fire-safe regulations in New York (where 7 percent of fire deaths have historically occurred), and another 2.6 percent decline in 2007, due to fire-safe regulations in California and Vermont (where 5.2 percent of fire deaths have historically occurred).

⁶⁷ Assuming a 3 percent discount rate and a \$5 million statistical value of a life.

⁶⁸ Marty Ahrens, "U.S. Experience with Smoke Alarms and Other Fire Detection/Alarm Equipment," Fire Analysis and Research Division, National Fire Protection Association, November 2004, p. 16.

⁶⁹ *Ibid.*, p. 2.

4. Failure to Appropriately Account for Exposure

A critical flaw with the CPSC staff's benefits analysis is that it equates a furniture covering's ignition propensity with its risk of involvement in a fire. The CPSC staff fails to account for the fact that certain furniture coverings may be systematically more exposed to cigarettes and small open flames than others. The risk of fire associated with a furniture covering would only be equal to the covering's ignition propensity if furniture coverings were uniformly distributed across U.S. households. Since smoking is central to the actual risk of cigarette-ignited furniture fatalities, the relationship between smokers and fabrics should be considered. Additionally, smokers may also account for a nontrivial fraction of lighter- and match-related exposures.

To illustrate this point, imagine that 100 percent of furniture covered in heavyweight cellulosic furniture was located in non-smoking households with no children. The fire risk associated with heavyweight cellulosic furniture would be close to zero, regardless of the fact that this furniture has the highest propensity to ignite. While this is an extreme example, the relatively higher average cost of furniture covered in heavyweight cellulosic material suggests that this furniture may disproportionately reside in lower risk households. In relying only on ignition propensity to estimate the percent of overall risk borne by each type of furniture covering, the CPSC staff overestimates the societal costs associated with more ignition prone furniture, the furniture most likely to capture the greatest benefits from the standard.

a. The Relationship Between Household Income and Fire Risk

It is generally accepted that lower income households are more susceptible to residential fires than higher income households. Studies have repeatedly shown a negative correlation between adequate income and fire risk, a relationship partially explained by certain characteristics of low income households.⁷⁰ Poorer households are more likely to have a single-parent head of household which means children may be left unattended to play with fire more often.⁷¹ They are also more likely to contain smokers: a recent academic paper estimated that the smoking rate among low-income individuals was approximately 35.5 percent, while the smoking rate among high-income individuals was

⁷⁰ Papers establishing the relationship between smoking and income include: Joni Hersch, "Gender, Income Levels, and the Demand for Cigarettes," Harvard Law School, Discussion Paper No. 299, October 2000; Greg Coleman and Dahlia K. Remler, "Very High Cigarette Tax Increases: If the Poor Are the Ones Smoking, How Could Cigarette Tax Increases be Progressive?" NBER Working Paper No. 10906, November 2004. See also, U.S. Fire Administration, Federal Emergency Management Agency, "Socioeconomic Factors and Fires," June 1997.

⁷¹ Several of the In-Depth Investigations (IDIs) conducted by the CPSC describe the role of child's play in small open flame-ignited upholstered furniture fires. See, for example, IDIs 8801020CEN0116, 951006HCC1005, and 961114HCC5048.

approximately 17 percent.⁷² Finally, they are also likely to own older, less ignition-resistant furniture.⁷³

The NFIRS database demonstrates the relationship between risk and income. Though NFIRS does not usually contain data on household demographics such as income, the educational status of adults, or family structure, NFIRS does typically report the zip code where a particular fire occurred. Using Census data, it is possible to match up residential structure fire incidents with the demographics of their respective zip codes. We performed two separate analyses of recent NFIRS data, supplemented with demographic information from the most recent Census. First, we estimated the risk of a deadly upholstered furniture fire by income level, using the median income of households within the pertaining zip code as a proxy for the income of the residence where a fire occurred. For 1999 to 2001, no deadly fires occurred in zip codes with median income below \$10,000; however, across all other income groups, there was a strong negative relationship between deadly fire risk and income. In 2000, for example, the risk of deadly fire was 2.7 per million households in zip codes with median income between \$10,000 and \$19,999, while the risk of a deadly fire was between 0.99 and 0.68 per million households for zip codes with median income greater than \$20,000. Results of this analysis are displayed in Table 7.

⁷² Joni Hersch, "Gender, Income Levels, and the Demand for Cigarettes," Harvard Law School, Discussion Paper No. 299, October 2000, p. 24. (High income was defined as having household income above \$54,000 per year, while low income was defined as household income less than \$17,400.)

⁷³ IDI's conducted by the CPSC also find that many deadly furniture fires involve older furniture. See IDIs 941206HWE5004 and 950303HCC2046.

**Table 7: NFIRS-Reported Deadly Cigarette and SMOF Upholstered Furniture Fires
1999-2001, By Income Level**

1999 NFIRS Data

Median Income of ZIP Code	# Households in Reporting Zip Codes, # Deadly Fires in ZIP Code, 1999		Risk of Deadly Fire in ZIP Code (per one million households), 1999
	1999	Code, 1999	1999
Under \$10,000	11,159	0	0.000
Between \$10,000 and \$19,999	652,492	2	3.065
Between \$20,000 and \$29,999	7,000,000	9	1.282
Between \$30,000 and \$39,999	17,000,000	18	1.078
Between \$40,000 and \$74,999	26,000,000	18	0.680
Above \$75,000	3,300,000	2	0.612
	<i>53,963,651</i>	<i>49</i>	<i>0.908</i>

2000 NFIRS Data

Median Income of ZIP Code	# Households in Reporting Zip Codes, # Deadly Fires in ZIP Code, 2000		Risk of Deadly Fire in ZIP Code (per one million households), 2000
	2000	Code, 2000	2000
Under \$10,000	12,155	0	0.000
Between \$10,000 and \$19,999	733,992	2	2.725
Between \$20,000 and \$29,999	8,100,000	8	0.993
Between \$30,000 and \$39,999	19,000,000	15	0.808
Between \$40,000 and \$74,999	28,000,000	19	0.680
Above \$75,000	3,300,000	0	0.000
	<i>59,146,147</i>	<i>44</i>	<i>0.744</i>

2001 NFIRS Data

Median Income of ZIP Code	# Households in Reporting Zip Codes, # Deadly Fires in ZIP Code, 2001		Risk of Deadly Fire in ZIP Code (per one million households), 2001
	2001	Code, 2001	2001
Under \$10,000	13,138	0	0.000
Between \$10,000 and \$19,999	821,247	1	1.218
Between \$20,000 and \$29,999	9,100,000	7	0.770
Between \$30,000 and \$39,999	21,000,000	20	0.973
Between \$40,000 and \$74,999	30,000,000	20	0.656
Above \$75,000	3,500,000	1	0.287
	<i>64,434,385</i>	<i>49</i>	<i>0.760</i>

Notes:

NFIRS data from 1999-2001 was merged with Census 2000 data at the ZIP code level to allocate fires to households in different income groups.

of Households represents the number of households in the zip codes represented in NFIRS data, by income group. *I.e.*, in 2001 there were 13, 172 households in zip codes reporting to NFIRS with median income under \$10,000.

Sources:

NFIRS data from 1999-2001, Census 2000 data.

As an alternate means of analysis, we compared the demographics of households where deadly fires occur with U.S. averages. We found that average median income among homes experiencing a deadly cigarette- or small open flame-ignited furniture fire was about 10 percent lower than the U.S. average in 2000. Households experiencing a deadly cigarette- or small open flame-ignited fire were 87 percent more likely to have a single-parent head of household, and individuals in these households were 18 percent less likely to have completed college.⁷⁴ Thus, it is apparent that higher risk households are often lower income.

b. Evidence Indicating that Furniture Coverings are not Evenly Distributed Across U.S. Households

Evidence suggests that furniture covered in thermoplastic, cellulosic, and leather/wool/vinyl-coated materials is not evenly distributed across U.S. households. The primary reason for this relates to average price differences among furniture covered in different types of upholstered fabric. As acknowledged by the CPSC in previous briefing packages, furniture covered in heavy cellulosic materials tends to be more expensive than furniture covered in thermoplastic materials.⁷⁵ Information from the Decorative Fabric Association (DFA), a membership consisting of higher-end fabric manufacturers, supports this assertion: according to the DFA, most of its members sell heavy cellulosic fabric to consumers through interior designers and typically, these consumers are from high-income households (over \$200,000 in annual income on average).⁷⁶

Since higher income households are less likely to include smokers and more likely to have working smoke detectors, the highest risk households may not be purchasing the highest risk furniture. This calls into question the CPSC staff's assumption that furniture fire risks are distributed proportionately to a fabric's weighted ignition propensity. Violating this assumption has very important implications for the staff findings. The staff estimates that the draft standard will have the greatest impact on heavy cellulosic furniture because of its higher propensity to burn. However, if most of the consumers of this type of furniture are high income, the standard will have a much smaller impact, as this group of consumers has a lower death and injury risk than other consumers. The staff simply assigns too much risk, and therefore too much of the total social cost of addressable losses, to the heavy cellulose fabric category. After all, in terms of cigarette-ignited fires, a fabric's greater ignition propensity means little if that fabric is not often exposed to cigarettes.

Consumer survey data also supports the hypothesis that lower-income households tend to purchase less expensive upholstered furniture than higher-income households. Each year, the trade publication *Furniture/Today* surveys a nationally-representative group of U.S.

⁷⁴ These figures were calculated using NFIRS data for the 1999-2001 time period, NFPA survey results, and Census 2000 data.

⁷⁵ U.S. Consumer Product Safety Commission, "Briefing Package on Upholstered Furniture Flammability: Regulatory Options," October 2001, p. 63.

⁷⁶ Decorative Fabrics Association, "CPSC/DFA Meeting," June 28, 2000, pp. 2-3.

households on their furniture shopping and purchasing patterns in the current year and their buying plans for the following year. In 2005, the survey estimated that only 5 percent of stationary sofas priced at \$1,100 or more would be purchased by households with income less than \$30,000 in 2005. In contrast, nearly 40 percent of stationary sofas priced below \$599 were estimated to be purchased by households with incomes less than \$30,000.⁷⁷ Recliner chairs exhibit a similar, if not more pronounced, pattern.

c. Correction for Omission of Exposure Rate in Calculation of Societal Costs

Correcting for the apparently erroneous assumption that heavy cellulosic furniture represents a share of furniture deaths proportional to its weighted ignition propensity would notably reduce the net benefits of the draft standard. This is the case because the CPSC staff allocates over 60 percent of cigarette-related losses to the heavy cellulose category, which has a significantly greater effectiveness rate than the other furniture categories in the staff's report. If very little heavy cellulosic furniture is actually exposed to smokers, then a large fraction of the CPSC staff's benefit estimate disappears.⁷⁸ More fully accounting for the relationship between upholstery fabric covering and income would likely result in substantially lower benefits of the draft standard. Lacking sufficient data on the prices of different types of furniture, we are unable to make this adjustment in our calculations. However, we believe that this would have a large impact on our net benefits figures.

5. Evaluation of the CPSC Staff Estimated Effectiveness Rates

The CPSC staff assumes that the draft standard would be 67 percent to 80 percent effective (depending on fabric covering type) in reducing cigarette-ignited upholstered furniture fire losses and 50 percent to 84 percent effective (depending on fabric covering type) in reducing small open flame-ignited upholstered furniture fire losses. These hazard reduction rates imply a 75 percent overall reduction in cigarette-ignited furniture fire losses and a 55 percent overall reduction in small open flame-ignited furniture fire losses attributable to the standard.⁷⁹ For all furniture except heavyweight cellulose, this hazard reduction is entirely attributable to the use of ignition-resistant foam and fibrous fillings, which are assumed to slow the growth rate of a furniture fire. For heavyweight cellulosic furniture, the hazard reduction is explained by FR-treated fabrics and barriers in addition to treated filling materials.

⁷⁷ Dana French, "Consumers Budgeting Less for Purchases in '05," *Furniture/Today*, October 3, 2005.

⁷⁸ It is true that later in the lifetime of a piece of furniture, heavy cellulosic furniture may be owned by smokers because of second-hand sales and donations. However, the potentially positive impact of the standard will be considerably delayed.

⁷⁹ Overall reduction in cigarette-related societal costs = $\$779.2/\$1,039.4=75$ percent; overall reduction in small open flame-related societal costs = $\$156.8/\$285.1=55$ percent. (See *Staff Cost-Benefit Analysis*, Tables 2 and 4.)

The staff provides little specific evidence to support these hazard reduction rates. For cigarette-ignited fires, the staff's estimates are based solely on "reasonable judgments about improvements in ignition performance that would result from the use of complying materials," while, for small open flame-ignited fires, assumptions are based on "preliminary estimates of effectiveness...based on discussions with Directorate for Engineering Sciences staff," as well as a few CPSC laboratory studies.⁸⁰ Though the staff contends that insufficient laboratory test data exist to support any estimation of effectiveness, we identified several studies that suggest the staff has overestimated the standard's potential to reduce fire losses. Many of these studies compare the ignition rates of furniture currently manufactured and sold in the U.S. with the ignition rates of furniture manufactured and sold in the United Kingdom, where a mandatory cigarette and small open flame standard similar to the CPSC staff's draft standard has been in place for more than a decade.⁸¹ Additionally, we contend that lab studies measuring a reduction in ignition propensity may not be a good predictor of actual effectiveness, and present macro-level data from the U.K. to support this contention. Finally, we point out several factors related to the likely effectiveness of the standard that remains unaccounted for by the CPSC staff.

We have concluded that the CPSC staff has not demonstrated that the draft standard would be as effective as assumed, and that it has not taken into account laboratory data and real world experience that imply substantially reduced effectiveness estimates. Based on our evaluation, the standard is more likely to reduce cigarette-ignited furniture fire losses by 22 percent and small open flame-ignited furniture fire losses by 48 to 50 percent, rather than the 75 percent and 55 percent effectiveness rates respectively assumed by CPSC staff.

a. Effectiveness Rates for Small Open Flame-Ignited Fires

The CPSC staff assigns different effectiveness rates to furniture covered in heavyweight cellulosics and furniture covered in all other types of cellulosic and thermoplastic covering types. We evaluate each of these effectiveness rates below.

(1) Heavyweight Cellulosic Furniture (FR Fabrics and Compliant Filling Materials or FR Barriers)

The CPSC staff assumes that the draft standard would lead to a small open flame hazard reduction of 84 percent for furniture covered in heavyweight cellulosic fabrics, under the assumption that 60 percent of this furniture would be made compliant with FR-treated cover fabrics and filling materials, and the remaining 40 percent would be made compliant with FR barriers. The staff assumes that FR-treated cover fabrics and filling materials would reduce the small open flame ignition propensity of heavyweight

⁸⁰ *Staff Cost-Benefit Analysis*, pp. 21 and 25-27.

⁸¹ Both the draft standard and the U.K. standard require some FR treatment of cover fabrics along with combustion-modified foam, or barriers.

cellulosic fabrics by 80 percent, while FR barriers would reduce small open flame ignition propensity by 90 percent.⁸²

The staff's hazard reduction rate for FR fabrics and filling materials is derived from full-scale small open flame tests performed in 1995 and 2000, which were used by the CPSC Division of Hazard Analysis in 2001 to estimate the effectiveness of the small open flame standard proposed by the CPSC staff at that time.⁸³ The Division of Hazard Analysis compared full-scale small open flame test results for two classes of furniture intended to represent U.S. furniture with and without the 2001 draft standard, which required cover fabrics to pass a small open flame-ignition resistance test. Nine chairs manufactured and intended for sale in the U.S., tested in 1995, were meant to represent U.S. furniture without the standard, and 21 chairs manufactured and intended for sale in the U.K., tested in 2000, were meant to represent furniture with the standard.

In the Division of Hazard Analysis investigation, the U.S. furniture was found to have an average ignition propensity of 100 percent (all nine chairs ignited each time they were subjected to a small flame; each chair had only one flame application), while the U.K. chairs had an ignition propensity of 12 percent (each chair was subjected to six flame applications lasting twenty seconds each, and the individual chair ignition rates were averaged to obtain an overall average ignition rate of 12 percent). Comparing the relative small open flame ignition rates of these two groups, the CPSC staff concluded that the small open flame standard proposed in 2001 could result in an 88 percent reduction in small open flame fire losses, with a 95 percent confidence interval of plus-or-minus 12 percent.⁸⁴ Because the current draft standard does not require cover fabrics to be small open flame resistant, only *cigarette resistant*, the CPSC staff expects the effectiveness of the new standard to be slightly less than 88 percent, or 80 percent.⁸⁵

There are a number of concerns with the CPSC staff's assumption about the hazard reduction attributable to FR-treated fabrics, most of which relate to the Division of Hazard Analysis calculations relied upon by the CPSC staff. First, the Division of Hazard Analysis only considered lab results from two studies, both of which tested a relatively small number of chairs which may have not accurately represented U.S.

⁸² (80 percent reduction x 60 percent) + (90 percent reduction x 40 percent) = 84 percent.

⁸³ See CPSC Staff Memorandum from Mark Levenson (Division of Hazard Analysis) to Dale Ray (Directorate for Economic Analysis), "Statistical Estimation of the Reduction in Fire Losses from the Adoption of the CPSC Draft Small Open-Flame Standard," September 14, 2001; relying on test data from Linda Fansler, John Murphy, Andrew Bernatz, Lakshmi Mishra, Gail Stafford, and William Keenan, "Upholstered Furniture Flammability Testing: Full Scale Open Flame Data Analysis," CPSC Directorate of Laboratory Sciences Engineering Laboratory, February 26, 1996; CPSC Staff Memorandum from Linda Fansler (Division of Electrical Engineering) to Dale Ray (Directorate for Economic Analysis), "UK Chair and Mockup Test Results," October 2000.

⁸⁴ CPSC Staff Memorandum from Mark Levenson (Division of Hazard Analysis) to Dale Ray (Directorate for Economic Analysis), "Statistical Estimation of the Reduction in Fire Losses from the Adoption of the CPSC Draft Small Open-Flame Standard," September 14, 2001, p. 6.

⁸⁵ *Staff Cost-Benefit Analysis*, pp. 25-27.

furniture with and without the 2001 draft small open flame standard.⁸⁶ The Division could have attempted to corroborate these test results with other data on U.S. and U.K. small open flame furniture flammability, but failed to do so. In fact, the 1995 study relied upon by Division of Hazard Analysis to estimate the ignition propensity of U.S. furniture also tested nine chairs manufactured and intended for sale in the U.K., and in this study, all nine U.K. chairs ignited in twenty seconds or less when exposed to a small flame.⁸⁷ These lab results reveal the uncertainty of the Division of Hazard Analysis estimation.

Second, the 2000 study relied on by the Division of Hazard Analysis tested 27 chairs manufactured in the U.K., all of which were made to comply with the mandatory U.K. furniture standard.⁸⁸ Of these 27 chairs, 11 ignited at least once when exposed to an open flame for twenty seconds in full-scale testing using a U.K. test method. After the full-scale testing, fabric from each chair was subjected to the CPSC staff draft standard small open flame mockup test, which also exposed fabrics to a twenty-second open flame. In this mockup test, 21 of 27 fabrics did not ignite. The Division of Hazard Analysis *only considered the full-scale results from these 21 chairs* in its calculations, apparently under the assumption that the six fabrics failing the mockup test would not be used to comply with a U.S. open flame standard. The Division of Hazard Analysis was not justified in excluding these six chairs, as the mockup test was not more stringent than the full-scale U.K. test: in fact, the lab study attributes differences in the results of the full-scale tests and mockup tests to the “limited number of tests performed and/or that the fabrics on these chairs [were] borderline,” not differences in the test methods.⁸⁹ If the entire sample of 27 chairs had been used to estimate the ignition propensity of chairs with a CPSC small open flame standard, the effectiveness rate obtained by the Division of Hazard Analysis would have been 74 percent, with a 95 percent confidence interval of plus-or-minus 14 percent.⁹⁰ However, even this estimate is based on the assumption that

⁸⁶ There are also questions about the transferability of the U.K. experience to the U.S., but we do not address that issue here.

⁸⁷ Each chair was tested in two areas – the back of the seating area and the side of the seating area – and each chair ignited in twenty seconds or less from both flame applications. The study noted that, unlike the U.S. chairs, the U.K. chairs had fire-resistant interliner fabrics directly under the upholstery fabric in the seating area, so the interior components were protected from the flame. (Linda Fansler, John Murphy, Andrew Bernatz, Lakshmi Mishra, Gail Stafford, and William Keenan, “Upholstered Furniture Flammability Testing: Full Scale Open Flame Data Analysis,” CPSC Directorate of Laboratory Sciences Engineering Laboratory, February 26, 1996, p. 191.)

⁸⁸ This statement assumes that none of the manufacturers were knowingly producing furniture that did not adhere to the standard.

⁸⁹ CPSC Staff Memorandum from Linda Fansler (Division of Electrical Engineering) to Dale Ray (Directorate for Economic Analysis), “UK Chair and Mockup Test Results,” October 2000, p. 18. In fact, another CPSC study from 2001 found that the wood crib used in U.K. small open flame tests was a “more severe ignition source” than the small butane flame used in the 2001 CPSC staff draft standard. (CPSC Staff Memorandum from Linda Fansler (Division of Electrical Engineering) to Dale Ray (Directorate for Economic Analysis), “Alternate Barrier Tests,” October 23, 2001, p. 2.)

⁹⁰ Averaging the individual ignition propensities of all 27 U.K. chairs, we obtain an average ignition rate of 26 percent. $1 - (0.26/1) = .74$, where it is assumed that the pre-standard ignition rate of furniture is 100 percent. For an explanation of how confidence intervals were calculated for effectiveness rate estimates,

furniture without the standard has an ignition propensity of 100 percent, greater than that assumed in the CPSC staff analysis. If we instead assume a pre-standard ignition propensity of 93 percent, the hazard reduction resulting from the FR-treatment of fabrics made to comply with a small open flame standard is only 72 percent, with a 95 percent confidence interval of plus-or-minus 15 percent.⁹¹

Based on these adjustments to the Division of Hazard Analysis calculations, we believe a more realistic effectiveness rate to draw from this study is 57 percent, the lower bound of the ignition propensity reduction attributable to FR-treated fabrics that are small open flame resistant.⁹²

With regard to heavy cellulosics and the use of barriers, the CPSC staff does not cite any lab studies to support its 90 percent effectiveness rate, but several CPSC lab studies suggest that this estimate is too high. For example, one lab study from 2000 found that, while a barrier worked well in reducing the ignition propensity of lightweight cotton fabrics, certain barriers had a slightly lower effectiveness rate when combined with heavyweight cotton fabrics.⁹³ In the study, when a non-adhesive barrier material was placed under a lightweight cotton cover fabric, the cover fabric ignited and self-extinguished in five of five small open flame applications; in contrast, a heavyweight cotton cover fabric ignited and self-extinguished in five of six applications (83 percent of the time) when used with the same barrier.⁹⁴ Both of these cover fabrics ignited and had to be manually extinguished when used without a barrier.

Another study from 2001, subsequently updated in 2004, tested eight different FR barriers in combination with several types of cover materials, including a heavyweight cotton twill and a heavyweight cotton corduroy.⁹⁵ In various tests with the eight barriers, the cotton twill ignited and did not self-extinguish in 12 out of 23 flame applications (52 percent), while the cotton corduroy ignited and did not self-extinguish in 2 out of 27 flame applications (7 percent). Combined, these two heavyweight cotton fabrics ignited

see CPSC Staff Memorandum from Mark Levenson (Division of Hazard Analysis) to Dale Ray (Directorate for Economic Analysis), "Statistical Estimation of the Reduction in Fire Losses from the Adoption of the CPSC Draft Small Open-Flame Standard," September 14, 2001.

⁹¹ $1 - (0.26/0.93) = 0.72$.

⁹² $0.72 - 0.15 = 0.57$.

⁹³ CPSC Staff Memorandum from Dean LaRue (Laboratory Sciences) to Dale Ray (Directorate for Economic Analysis), "Small Open Flame Ignition Test Results of Flame Retardant Upholstery Fabrics and Intumescent Barrier Fabrics," May 30, 2000. (The study tested a barrier fabric made of corespun cotton covering a glass core that is treated with a chemical that is "intumescent in its vapor phase" (p. 1))

⁹⁴ The fabric did not self-extinguish in one of six flame applications. (*Ibid.*, pp. 11-12.)

⁹⁵ CPSC Staff Memorandum from Linda Fansler (Division of Electrical Engineering) to Dale Ray (Directorate for Economic Analysis), "Alternate Barrier Tests," October 23, 2001; updated report: CPSC Staff Memorandum from Linda Fansler (Division of Electrical and Flammability Engineering) to Dale Ray (Directorate for Economic Analysis), "Exploratory Tests of Barrier Materials," October 25, 2004.

and did not self-extinguish about 29 percent of the time.⁹⁶ In this study, even when the fabrics self-extinguished, the barrier often did not protect the foam filling in the mockups. The lab report itself does not express an overwhelming support for the ignition performance of barrier materials:

“Mockups covered with either the cellulosic/thermoplastic blend fabric, or the cotton twill fabric tended to have sustained combustion...the small open flame test procedure is designed to test the ability of mockups to self-extinguish. In general, the barriers did not accomplish this. The fuel load of the burning cover fabric was such that the barrier could not always provide protection to the foam.”⁹⁷

In general, these lab studies suggest that the CPSC staff’s estimated effectiveness rate associated with barriers might be too high. Assuming that heavyweight cellulose have an ignition propensity of 0.93 without barriers, and an ignition propensity ranging from 0.07 to 0.52 with barriers, the ignition reduction rate of barriers could range from 44 percent to 92 percent, depending on fabric covering and barrier characteristics. Relying on the results of the 2001 study for the heavyweight cotton twill and cotton corduroy specimens, we obtain an ignition reduction rate of 68 percent, with a 95 percent confidence interval of plus-or-minus 22 percent.⁹⁸

Taken together, our adjustments to the CPSC staff’s assumptions result in a more conservative estimate of the hazard reduction rate for heavyweight cellulosic fabrics of about 62 percent (60 percent of furniture x 57 percent effectiveness + 40 percent of furniture x 68 percent effectiveness) plus-or-minus *at least* 14 percent.⁹⁹ We consider a more realistic small open flame effectiveness rate for heavy cellulosic furniture to be approximately 48 percent, the lower bound of our estimate.

(2) Furniture Covered in Medium Weight Cellulosics, Lightweight Cellulosics, Cellulosic/Thermoplastic Blends, and Thermoplastics (Compliant Filling Materials Only)

The CPSC staff assumes that furniture covered in medium weight cellulosics, lightweight cellulosics, and thermoplastic materials would experience a small open flame hazard reduction rate of 50 percent due to the use of compliant foam and fibrous filling materials. This rate is not based on any scientific evidence, as there are no CPSC lab data

⁹⁶ CPSC Staff Memorandum from Linda Fansler (Division of Electrical and Flammability Engineering) to Dale Ray (Directorate for Economic Analysis), “Exploratory Tests of Barrier Materials,” October 25, 2004, p. 21.

⁹⁷ *Ibid.*, p. 15.

⁹⁸ Combining the results for the cotton twill and cotton corduroy fabrics, we obtain an ignition rate of 29 percent with the use of an FR barrier (29 percent is the mean of the individual ignition rates of each fabric-barrier combination). $1-(0.294/0.930) = 0.684$.

⁹⁹ This confidence interval is calculated assuming a variance of 0 for the ignition propensity of furniture without a standard (assumed to be 0.93).

available on how much treated filling materials would actually slow small open flame-ignited fire growth.

Lab studies testing FR-treated foam made in accordance with California's TB117 standard – which requires resistance to the application of a gas flame for component foam and fabric – suggest that the regulation has generally proven ineffective in reducing furniture fire fatalities in California.¹⁰⁰ California has proposed a revision to its TB117 standard, which would set higher standards for polyurethane foam, and the CPSC staff believes that foam passing this revised TB117 standard would also pass its draft standard. However, given the failure of the previous TB117 standard, we are troubled by the CPSC staff's assumption that treated foam and fibrous fillings would dramatically reduce small open flame-ignited fire fatalities without any scientific evidence in support of this claim.

Consider that, in 2001, the CPSC felt that even furniture produced with heavily modified U.K. - and California-type foams used in conjunction with non-FR fabrics and non-FR barriers would not lead to significant declines in small open flame- or cigarette-related fire losses. In the Regulatory Options Briefing Package for its then-proposed small open flame standard – the standard involved FR treatment of cover fabrics and not FR foam – the CPSC stated that:

“Previous laboratory testing (described in the 1997 staff briefing package) demonstrated that FR polyurethane foam, as used in either California or the U.K., will ignite and continue to burn when a small open flame ignites its cover fabric. While FR filling materials may burn somewhat more slowly (on the order of several seconds) than non-FR fillings, the use of FR foam alone would not be expected to provide a significant increase in safety. With respect to cigarette ignitability, laboratory tests show that conventional, untreated polyurethane foam is cigarette resistant, especially when used in conjunction with thermoplastic-content cover fabrics or thermoplastic (typically polyester) batting between the cover fabric and the foam. Thus, the staff disagrees with the petitioner's implication that non-FR foam would present a significantly greater risk than treated foam.”¹⁰¹

Given these findings, we believe the CPSC staff should have used a more conservative estimate of the effectiveness of treated filling materials. However, lacking sufficient information to adjust this rate, in our analysis we continue to use the staff's 50 percent effectiveness rate.

¹⁰⁰ CPSC Staff Memorandum from Mark Levenson (Division of Hazard Analysis) to Dales Ray (Directorate for Economic Analysis), “Comparison of Upholstered Furniture Fire Deaths in California and the U.S.,” November 15, 2000.

¹⁰¹ U.S. Consumer Product Safety Commission, “Briefing Package on Upholstered Furniture Flammability: Regulatory Options,” October 2001, p. 64.

b. Effectiveness Rates for Cigarette-Ignited Fires

(1) Heavyweight Cellulosic Furniture (FR Fabrics and Compliant Filling Materials or FR Barriers)

Without any specific evidence, the CPSC staff assumes that furniture currently made with heavyweight cellulosic fabrics would realize a reduction in cigarette-related societal costs to the equivalent of that estimated for less ignition-prone cellulosic fabrics, a 79.8 percent hazard reduction. This reduction is attributed to FR-treated fabrics and barriers as well as improved ignition performance of filling materials.

The same Division of Hazard Analysis report relied upon by the CPSC staff to estimate the small open flame hazard reduction associated with FR fabrics and barriers also compared the cigarette ignition propensities of a sample of U.S. furniture and U.K. furniture. In the study, data on U.S. furniture flammability was taken from testing conducted in 1984 and 1996, while data on U.K. furniture flammability was taken from the 2000 study discussed above. The Division of Hazard Analysis compared ignition propensities of the two groups and determined that the 2001 draft small open flame standard would lead to a 74 percent reduction in the ignition propensity of furniture covered in predominately cellulosic fabrics, with a 95 percent confidence interval of plus-or-minus 30 percent.¹⁰² Again, the Division only considered 21 of 27 U.K. chairs tested in the 2000 study, which may overstate the likely impact of a standard requiring cigarette-resistance in fabric coverings and filling materials. Including all 27 chairs in the U.K. study, the ignition reduction associated with a U.K.-type furniture standard is estimated to be 63 percent for furniture covered in cellulosic fabrics, with a 95 percent confidence interval of 41 percent. However, even this hazard reduction rate is based on data for U.S. furniture from ten to twenty years ago, which may not reflect the ignition rate of currently produced furniture.¹⁰³ If we use the CPSC staff's ignition propensity rate of 52 percent for heavyweight cellulose, and compare this rate to the average ignition propensity of the four U.K. chairs tested in 2000 that were made of heavyweight, 100 percent-cellulosic fabrics, we obtain an estimated hazard reduction of only 42 percent, plus or minus 46 percent.¹⁰⁴

¹⁰² CPSC Staff Memorandum from Mark Levenson (Division of Hazard Analysis) to Dale Ray (Directorate for Economic Analysis), "Statistical Estimation of the Reduction in Fire Losses from the Adoption of the CPSC Draft Small Open-Flame Standard," September 14, 2001, pp. 9-10.

¹⁰³ There are several reasons to believe that the average ignition rate of currently produced furniture is less than the rate found in these outdated reports: UFAC compliance has grown steadily since the 1970s, there have likely been improvements in FR treatments, and the share of cellulose that are extremely ignition-prone has been in decline.

¹⁰⁴ The five U.K. chairs examined had the following fabric coverings: cotton, 12.5 ounces per square yard; linen/cotton, 9.8 oz per square yard; cotton, 9.5 ounces per square yard; and cotton, 12.5 ounces per square yard. In making this calculation, we assume a standard error of zero for the pre-standard ignition propensity. (CPSC Staff Memorandum from Linda Fansler (Division of Electrical Engineering) to Dale Ray (Directorate for Economic Analysis), "UK Chair and Mockup Test Results," October 2000, p. 14.)

In terms of barriers, the 2001 (and updated in 2004) study of barriers cited above actually found that heavyweight cellulosic materials (*i.e.*, the cotton twill and cotton corduroy fabrics) were *more cigarette-ignition prone* when used in conjunction with a barrier, which suggests that barriers may not be very effective in reducing cigarette-ignited fires started by furniture covered in heavyweight cellulosic materials.¹⁰⁵

Based on this comparison, the staff's 76 percent hazard reduction rate may substantially overestimate the potential effectiveness of the draft standard. Taking a weighted average of the expected ignition reduction rates of barriers and FR fabrics, we estimate that the standard may reduce the cigarette-related losses attributed to furniture covered in heavyweight cellulose by only 26 percent.¹⁰⁶ However, because of the lack of consistent and reliable results, the confidence interval associated with this estimate is large, and includes both 0 percent and 100 percent effectiveness. We are therefore unable to estimate a precise cigarette effectiveness rate for heavyweight cellulosic furniture. Consequently, we rely on the actual effectiveness rates observed in the U.K. (adjusted for smoke detectors and smoking prevalence) in our corrected cost-benefit calculations. This is based on the observation that predominantly cellulosic fabrics are generally used in conjunction with barriers under the U.K. flammability law.¹⁰⁷

**(2) Furniture Covered in Medium Weight Cellulosics,
Lightweight Cellulosics, Cellulosic/Thermoplastic Blends, and
Thermoplastics (Compliant Filling Materials Only)**

For furniture covered in all other types of material, the CPSC staff assumes a 67.4 percent reduction in societal costs from cigarette-ignited fires. Again, this reduction is entirely attributed to the use of compliant filling materials, which would purportedly slow the rate of fire growth. As mentioned in the previous section, the only other U.S. standard requiring filling materials to comply with a flammability standard – California's TB117 regulation – has generally proven ineffective in reducing furniture fire losses. Even though the CPSC staff's draft standard is believed to be more stringent than this regulation as it exists in its current form, the California experience illustrates the possibility for failure in a filling material standard. Because the staff has no scientific data estimating how much the standard would slow the rate of fire growth – or how many additional lives are saved for a given slowdown in a fire's growth rate – we believe a more conservative estimate is appropriate. A lower rate of effectiveness is supported by the NFPA observation that "smoking-material fires often smolder for a significant period

¹⁰⁵ The fabrics were each tested once without a barrier, and neither ignited. When the fabrics were tested with the eight different barriers, the cotton twill ignited 10 out of 23 times (43 percent of the time) and the cotton corduroy ignited 18 out of 25 times (72 percent of the time). (CPSC Staff Memorandum from Linda Fansler (Division of Electrical and Flammability Engineering) to Dale Ray (Directorate for Economic Analysis), "Exploratory Tests of Barrier Materials," October 25, 2004, pp. 16 and 21.)

¹⁰⁶ (60 percent of furniture x 42 percent effectiveness) + (40 percent of furniture x 0 percent effectiveness) = 26 percent.

¹⁰⁷ Furniture and Furnishings (Fire) (Safety) Regulations 1988 (as amended in 1990 and 1993).

before the first flame.”¹⁰⁸ Smoke detectors, rather than less ignition-prone furniture filling materials, may therefore be a more effective way to address fires started by a smoldering source. Though we disagree with the CPSC staff’s estimate, we again lack sufficient information to calculate our own cigarette effectiveness rate for this group of furniture, and rely on the CPSC’s estimate in our analysis.

c. Further Evidence from the U.K.

The CPSC staff has only conducted limited testing on the ignition resistance of FR-treated fabrics and barriers, and has not thoroughly studied the impact of FR-treated foam and fibrous filling materials on upholstered furniture fire growth rates. In the absence of such studies, we contend that examining the U.K. experience over the past few decades can provide some insight into the likely effectiveness of the draft standard. Since 1990, furniture sold in the U.K. has been required to be manufactured with covers that are cigarette resistant and are capable of passing a small open flame test; for some furniture items, a fire-resistant interliner can be used to compensate where a fabric cover is non-match resistant. Furniture must also be made with treated foam and non-foam filling materials that can meet certain test specifications. The U.K. standard is therefore similar, though admittedly not identical, to the draft standard being recommended by the CPSC staff.¹⁰⁹

Since the introduction of furniture flammability regulations in 1988, both upholstered furniture fires and residential structure fires as a whole have steadily declined. In 1999, researchers at the University of Surrey published a report predicted that the effectiveness rate of the U.K. standard would reach between 70 and 90 percent, once furniture produced post-standard replaced all furniture manufactured prior to 1988. In the 1999 report, all of the reduction in upholstered furniture fires and related fatalities over the period from 1988 to 1997 was attributed to the standard.¹¹⁰

However, in 2005, the researchers published an updated report that acknowledged that some of the reduction in residential fire losses since 1988 may be the result of other important changes in the U.K. Specifically, the report concluded that up to 50 percent of the decline in residential fire losses post-standard is due to increased prevalence of effective smoke alarms in homes. Consequently, the standard is believed to explain at

¹⁰⁸ John R. Hall, Jr., “The Smoking-Material Fire Problem,” Fire Analysis and Research Division, National Fire Protection Association, November 2004, p. 45.

¹⁰⁹ The U.K. standard and the CPSC staff draft standard are similar in terms of the compliance methods used to meet the two regulations, but differ in terms of the specific test methods used to ensure flammability reductions.

¹¹⁰ University of Surrey, “Effectiveness of the Furniture and Furnishings (Fire) (Safety) Regulations 1988 (as amended in 1990 and 1993),” published by the UK Ministry of Trade and Industry (DTI), refs. URN/783, June 2000, available at http://www.dti.gov.uk/homesafetynetwork/bs_rfffr.htm, site visited November 30, 2005.

least 50 percent of the decline in residential fires losses over the same period.¹¹¹ The U.K. regulation may therefore have led to a 35 to 45 percent decline in furniture fire losses in Britain (*i.e.*, 50 percent of the estimated 70 to 90 percent decline in furniture fire losses since 1988), prior to any acknowledgement of the effect of reduced smoking prevalence on deaths.

The Surrey researchers did not attribute any of the decline in U.K. fires post-standard to reduced smoking prevalence, arguing that smoking in the U.K. has not declined since 1988. However, an examination of smoking statistics compiled by the U.K.'s Department of Health suggests that, between 1988 and 2001, smoking prevalence in the U.K. *did* decline by 3 to 4 percent.¹¹² Among the age groups that buy the most furniture – those between ages 40 to 60 – smoking prevalence fell even more, between 6 and 8 percent.¹¹³ Given our finding of a statistically-significant, positive relationship between smoking prevalence and cigarette-ignited furniture fatalities, this decline was likely to also play some part in reducing fire losses in Britain. In fact, based on our regression analysis of U.S. fire data, over 30 percent of the decline in U.K. fires can be attributed to a decline in smoking.¹¹⁴ Taking the impact of reduced smoking prevalence into account would even further diminish the observed impact of the U.K. standard on furniture fires and related losses.

The NERA report estimated the true effectiveness of the U.K. standard – after declines in smoking, increased smoke detector prevalence, and other relevant factors were taken into account – to be approximately 18 percent to 22 percent.¹¹⁵ This range is supported by the recent Surrey study and our adjustment for continued declines in smoking prevalence. Therefore, for our purposes, we adopt 22 percent as a more accurate effectiveness rate *vis a vis* cigarette-ignited fires for furniture covered in cellulosic and thermoplastic materials.

¹¹¹ Alan Emsley, Linda Lim, Gary Stevens and Peter Williams, "International Fire Statistics and the Potential Benefits of Fire Counter-Measures," University of Surrey, Polymer Research Centre, May 18, 2005.

¹¹² U.K. Department of Health, National Statistics, "Statistics on Smoking: England, 2003," November 2003, Table 1.a., available at http://www.dh.gov.uk/PublicationsAndStatistics/Statistics/StatisticalWorkAreas/StatisticalPublicHealth/StatisticalPublicHealthArticle/fs/en?CONTENT_ID=4082243&chk=f0URB7, site visited December 13, 2005.

¹¹³ *Ibid.*; Information on furniture purchases by age group are from the annual consumer survey performed for *Furniture Today*. The survey collects data from U.S. consumers, but we assume that U.S. and U.K. consumption of upholstered furniture exhibits many of the same characteristics. (Dana French, "Upholstery Buying Trends," *Furniture/Today*, October 3, 2005.)

¹¹⁴ Smoking prevalence in the U.K. dropped from 31 percent in 1988 to 28 percent in 2001. Plugging these values into our regression results, we predict that this 3 percent decline in smoking prevalence would have caused a 37 percent drop in the death rate and a 40 percent drop in the injury rate for cigarette-ignited upholstery furniture fires. Note that we are using U.K. data on a U.S. model. However, there is no reason to suspect that the two countries differ dramatically in this regard. The death rate falls from 3.98 per million to 2.49 per million, while the injury rate falls from 8.31 per million to 4.96 per million.

¹¹⁵ Mark Berkman, "Assessing the Need for a Federal Small Open Flame/Cigarette Ignition Upholstered Furniture Flammability Standard," National Economic Research Associates, prepared for the Upholstered Furniture Action Council, February 21, 2001, p. 59.

It should be noted that even this rate may overstate true effectiveness for less ignition prone cellulose and thermoplastics, since the cover materials of furniture covered in these materials would undergo no modifications under the draft standard.

d. Other Reasons to Question the CPSC Staff's Effectiveness Rates

There are a number of other issues that cast doubt on the CPSC staff's estimated effectiveness rates. First, the CPSC staff has not accounted for three factors which may compromise effectiveness: compliance shortfalls, possible diminution of flame retardant effectiveness over time, and consumer response to increases in the retail price of furniture.

Inadvertent noncompliance is likely to occur, given the complexity of the draft test methods and the proven variability of FR treatments for cover materials, fillings, and barriers. CPSC lab reports have concluded that "not all barrier/cover fabric combinations may be effective," and, based on the U.K. experience; cover fabrics and filling materials treated with FR chemicals can often fail to comply with expected flammability standards.¹¹⁶ The CPSC staff has not developed any formal compliance or enforcement plan, and only allocates funds to visit 250 manufacturers (about 13 percent of U.S. establishments) each year. Further, the CPSC staff acknowledges that the costs associated with these compliance visits could not be sustained on a long term basis.¹¹⁷ Consequently, effectiveness rates may fall as manufacturers struggle to comply with the standard without sufficient CPSC enforcement. The CPSC staff also does not account for possibility of diminished effectiveness of FR treatments over time, which may also reduce effectiveness rates in future years.

Compliance by foreign firms may also present an obstacle to reach the assumed effectiveness rates. CPSC staff has observed that compliance by Chinese firms, in particular, may pose problems.¹¹⁸ China is rapidly becoming a major exporter of furniture to the United States.

Higher new furniture prices could also work against the intention of the draft standard. Consumers may delay the purchase of new furniture, or even hold off on purchasing used, reupholstered furniture, in response to an increase in retail furniture prices. This could be particularly important because the highest risk households tend to be low income and therefore the most sensitive to cost increases. The CPSC staff expects that retail prices would increase by about \$15 for furniture covered in thermoplastic materials

¹¹⁶ CPSC Staff Memorandum from Linda Fansler (Division of Electrical Engineering) to Dale Ray (Directorate for Economic Analysis), "Alternate Barrier Tests," October 23, 2001, p. 3; CPSC Staff Memorandum from Linda Fansler (Division of Electrical Engineering) to Dale Ray (Directorate for Economic Analysis), "UK Chair and Mockup Test Results," October 2000, p. 14.

¹¹⁷ *Staff Cost-Benefit Analysis*, p. 40.

¹¹⁸ Office of International Programs and Intergovernmental Affairs, U.S. Consumer Product Safety Commission, "International Consumer Product Safety Program Plan- China," May 2005.

and less-ignition prone cellulosic materials, and \$37 to \$48 for furniture covered in heavyweight cellulosic fabrics. Given the lack of information on the price elasticity of demand for furniture products, we cannot determine the exact response in demand to such a price increase, but greater research into consumer response may be fruitful before imposing the draft standard. It is worth noting that the anticipated retail price increase could also lead to an even greater reduction in furniture fire losses, as consumer switch from purchasing more ignition-prone furniture – which will face the greatest retail price increase – to less expensive, less ignition-prone furniture covered in leather, thermoplastic, and less ignition-prone cellulosic materials.

e. Summary

In summary, the CPSC staff estimates that the use of FR cover fabrics and compliant filling materials *or* FR barriers in furniture covered in heavyweight cellulose will reduce cigarette-related losses by 79.8 percent and small open flame-related losses by 84 percent. In contrast, we estimate the effectiveness rate for heavyweight cellulose to be 22 percent with respect to cigarettes, and 48 percent with respect to small open flames. For all other types of furniture, the CPSC staff predicts that the use of compliant filling materials will reduce cigarette-related losses by 67.4 percent and small open flame-related losses by 50 percent. Based on the U.K. experience, we anticipate that the effectiveness rate with respect to cigarettes for these types of furniture will be, at most, 22 percent. We are unable to estimate a small open flame effectiveness rate for this furniture, due to a lack of consistent and reliable data. We thus rely on the CPSC staff's estimate in our cost-benefit analysis, but we maintain that this estimate may substantially overstate the expected reduction in small open flame-related losses resulting from the use of FR-treated foam and fibrous fillings.

6. The CPSC Staff Relies on Discount Rate and Statistical Value of Life Assumptions that Inflate the Benefits Calculation

The CPSC staff also relies on assumptions regarding the discount rate and the statistical value of life in its benefit calculation that are subject to challenge. The staff presents results using a 3 percent discount rate. This is only one of the rates required by the Office of Management and Budget (OMB) for cost-benefit studies conducted by federal agencies.¹¹⁹ In fact, OMB considers a 7 percent discount rate to be the base-case for regulatory analyses. The staff, however, treats 7 percent as an alternative in its sensitivity analysis. OMB also suggests that a higher rate may be appropriate when substantial uncertainty exists regarding a proposed regulation. Application of a 7 percent or higher discount rate will reduce the base case benefits estimate presented by CPSC staff. In our own analysis, we rely on a 7 percent discount rate for the base case, and use 3 percent and 10 percent rates in our sensitivity analysis.

¹¹⁹ Office of Management and Budget, "Circular A-4," September 17, 2003 refines OMB's best practices regarding regulatory analyses.

The Staff relies on a \$5.0 million statistical value of life citing to two studies completed in the mid 1990's.¹²⁰ More recent studies suggest that this figure is too high.¹²¹ For example, a meta-study published in 2002, which relies on a statistical analysis of numerous previous studies, found a statistical value of life of between \$1.75 and \$2.92 million. A more recent study, published in 2004, found the statistical value of life to be \$2.7 million. This study relied on state regulations of highway speed limits to infer the value of life assumed by state legislatures and regulators. Reliance on this lower value will reduce the base case benefits estimate presented by CPSC staff. We maintain a \$5 million statistical value of a life in our base case assumptions, but use \$2.9 million in our sensitivity analysis.

C. Corrected Benefits Estimates

Overall, we make four modifications to the CPSC staff's assumptions to develop a more accurate estimate of the draft standard's benefits. Our base case assumptions are:

- Relying on our national-level regressions of cigarette-related losses on smoking prevalence and projected smoking prevalence figures, we use lower starting figures for cigarette-related deaths and injuries in our calculation of societal costs. We assume that in the first year of the standard (2006), cigarette-related deaths and injuries will be 235 and 421, respectively. In comparison, the staff assumes that cigarette-related deaths and injuries would start out at 300 and 480, respectively, the average annual figures for the 1999-2002 time period. We rely on the CPSC staff's starting figures for the amount of property damage from cigarette-ignited fires, and for losses from small open-flame ignited fires.
- Also based on the national-level regression results, we decrease cigarette-related losses over time to account for a future decline in smoking and the impact of fire-safe cigarette standards in California, New York, and Vermont. Specifically, we assume that cigarette-related deaths will experience a 3.5 percent decline in 2006, due to fire-safe regulations in New York, and another 2.6 percent decline in 2007, due to fire-safe regulations in California and Vermont. We also assume that cigarette deaths and injuries will fall to 125 and 209, respectively, in 2021, the sixteenth year of the draft furniture standard if it is implemented in 2006. Our

¹²⁰ W. K. Viscusi, "Discounting Health Effects for Medical Decisions," in *Valuing Health Care: Costs, Benefits, and Effectiveness of Pharmaceuticals and Medical Technologies*, F.A. Sloan Ed., New York: Cambridge University Press 1995, and Marhe R. Gold, et. al., *Cost-Effectiveness in Health and Medicine*. New York: Oxford University Press, 1996.

¹²¹ Janusz Mrozek and Laura Taylor, "What Determines the Value of Life? A Meta Analysis," *Journal of Policy Analysis and Management*, Vol. 21, No.2, 2000, pp 253-230; Orley Ashenfelter and Michael Greenstone, "Estimating the Value of a Statistical Life: The Importance of Omitted Variables and Publication Bias," *American Economic Association Papers and Proceedings*, May 2004. (The Mrozek values were presented in 1998 dollars and the Ashenfelter values were presented in 1997 dollars. They are escalated to 2006 assuming a 2% annual inflation rate.)

downward adjustments to cigarette-related societal costs are substantially larger than the CPSC staff's.

- We adopt lower cigarette and small open flame effectiveness rates, based on the U.K. experience and our analysis of CPSC lab data. We assume that cigarette-related losses would decline by 22 percent, and that small open flame-related losses would decline by 48 percent (for heavyweight cellulosics) and 50 percent (for all other fabric coverings) as a result of the draft standard. The staff's assumed effectiveness rates are substantially higher, especially for cigarette-related fires, which make up most of the societal costs addressable by the standard.
- Finally, we adopt a 7 percent discount rate, based on OMB best practices. In contrast, the staff relies on a discount rate of 3 percent. Though we believe the staff's \$5 million statistical value of a life may be too high, we rely on this figure in our base case scenario.

With our base case assumptions, we obtain a total lifetime *gross* benefits figure of \$235.7 million, approximately one quarter of the CPSC staff's estimate of \$936 million. (To calculate gross and net benefits, we relied on a cost-benefit estimation model we created for this analysis. The model is described in greater depth in Appendix 3.)

To test the sensitivity of our assumptions, we also calculate gross benefits and net benefits using more conservative effectiveness rate figures and varying discount rates. Specifically, we estimate gross and net benefits using discount rates of 3 percent and 10 percent, and rely on the CPSC staff's effectiveness rates as well as cigarette effectiveness rates based on the new Surrey report (40 percent for all types of fabric coverings). In our benefits tables, we refer to the CPSC staff's rates as "high effectiveness" rates, our rates as "low effectiveness" rates, and the Surrey report rates as "medium effectiveness" rates. A table displaying these rates is included in Appendix 3.

As shown in Table 8, even when we rely on more conservative effectiveness rate figures and lower discount rates, we obtain total benefits that are noticeably less than the staff's. Even with a 3 percent discount rate and the CPSC staff's assumed effectiveness, we only obtain gross benefits of \$713 million, over \$200 million less than the staff. These results underscore the likelihood that the staff has grossly overstated the gross benefits associated with the draft standard.

Table 8 : Total Benefits Using CRA Assumptions

	High Effectiveness (CPSC Rates)	Medium Effectiveness (New Surrey Report Rates for Cigarettes)	Low Effectiveness (CRA Rates)
3%	\$712,525,977	\$440,614,568	\$308,604,430
7%	\$548,238,580	\$337,973,331	\$235,721,370
10%	\$461,216,989	\$283,733,738	\$197,327,732

Notes:

Figures are calculated using a \$5 million statistical value of a life.

We assume that cigarette-related deaths and injuries are 235 and 421, respectively, in the first year of the standard (2006), and that these figures will fall to 125 and 209, respectively, by 2021, the sixteenth year of the proposed standard. Cigarette losses will also experience a 3.5 percent decline in 2006, and a 2.6 percent decline in 2007, due to fire-safe cigarette regulations implemented in New York, California, and Vermont.

We rely on the CPSC staff's figures for cigarette-related property damage and small open flame deaths, injuries, and property damage. We do not assume that small open flame losses will experience future declines.

The figure obtained based on our base case assumptions is bolded.

IV. CRITICAL REVIEW OF CPSC STAFF COST ESTIMATES

A. Summary of CPSC Staff Cost Calculations

After calculating benefits, the staff estimates the expected manufacturing costs, compliance costs, and distribution costs of the draft standard. As with expected benefits, the staff calculates costs on a per-unit basis for furniture produced in one year, and assumes that 31.5 million units would be produced annually.

The staff calculates per-unit costs to be \$6.65 for furniture covered in medium weight cellulose and blends, less ignition-prone cellulosic fabrics, and thermoplastic fabrics. Furniture covered in heavyweight cellulosic fabrics is expected to incur higher per-unit costs, since this furniture would require FR-treated cover fabrics or FR barriers to comply with the standard. The staff estimates per-unit costs to range from \$15.44 to \$21.23 for furniture covered in heavyweight cellulosic materials. Based on these per-unit figures, the staff anticipates cost increases resulting from the draft standard to be \$174.8 million to \$193.6 million per year.

1. Manufacturing Costs: FR Cover Fabrics and FR Barriers

As previously stated, the staff believes that *only* furniture covered in heavyweight cellulosic fabrics would require flame resistant (FR) treatment of cover materials or the

addition of an acceptable FR barrier between the fabric cover and interior materials to comply with the draft standard. The staff assumes 60 percent of furniture covered in heavyweight cellulosic fabric (or 6.2 percent of all furniture) would be treated with FR chemicals and 40 percent of furniture covered in heavyweight cellulosic fabric (or 4.1 percent of all furniture) would be made compliant through the use of FR barriers.¹²²

The CPSC staff estimates that the use of FR-treated fabric would increase cover material costs by \$0.62 to \$1.05 per linear yard for manufacturers. Testing, which would be done to provide guarantees to furniture manufacturers, would increase costs by an additional \$0.03 to \$0.06 per linear yard of fabric. On a per-unit basis, the staff anticipates that manufacturing cost increases related to FR cover fabrics would range from \$4.55 to \$7.77 for chairs and from \$8.45 to \$14.43 for sofas and loveseats.¹²³ Assuming that chairs comprise 47.3 percent of upholstered living room furniture produced in one year and that sofas comprise the remaining 52.7 percent, the weighted average cost increase is therefore between \$6.61 and \$11.28 per unit. In total, assuming that 6.2 percent of all furniture coverings are treated with FR chemicals to comply with the standard, the cost increase would range between \$12.9 million and \$22.0 million.

Based on barrier-related compliance costs in the United Kingdom, the staff estimates that manufacturers would likely pay \$2.00 to \$2.47 per linear yard for standard FR barrier material, plus an additional \$0.01 per linear yard to cover compliance testing.¹²⁴ However, the staff believes that these costs would be offset by the replacement of non-FR interliner materials currently used in higher-end furniture. The staff assumes that FR barrier material would replace non-FR interior materials covering the seat cushions of all furniture made to comply *via* an FR barrier. At a cost of \$0.30 per yard for standard non-FR interliner fabric, the net material cost increase would therefore range from \$1.71 to \$2.18 per seat cushion.¹²⁵ For all other parts of a furniture unit, barrier materials are calculated to range from \$4.02 to \$4.96 for chairs and \$8.04 and \$9.92 for sofas and loveseats.¹²⁶

¹²² The addition of a barrier is a more costly remedy than FR treatment of cover materials. According to the staff, the use of barriers is more economically feasible with more expensive fabrics, such as those produced by the members of the Decorative Fabrics Association (DFA). In 2000, the DFA estimated that their fabrics made up only 1.5 percent of all upholstered fabrics used to cover furniture. (The CPSC staff cites “information provided to the staff at a June 29, 2000, public meeting” as the source for this figure.) Based on this figure, the staff believes that the assumption that 40 percent of heavyweight cellulose (or 4.1 percent of all furniture) would use FR barriers is conservative.

¹²³ The staff assumes that a chair would require 7 linear yards of fabric and a sofa would require 13 linear yards of fabric.

¹²⁴ Testing costs are lower for barrier material than for FR fabrics due to “expected large production runs of barrier and the greater degree of uniformity of barrier materials compared to cover fabrics.” (*Staff Cost-Benefit Analysis*, p. 31.)

¹²⁵ The staff assumes that one cushion would require one linear yard of barrier material. ($\$2.48 - \$0.30 = \$2.18$; $\$2.01 - \$0.30 = \$1.71$.)

¹²⁶ The staff assumes that all other parts of a chair would require two yards of barrier material, and that all other parts of a sofa would require four yards of barrier material. Barrier material would not replace non-

Additionally, the staff expects manufacturers to face higher labor costs related to adding FR barriers to parts of the furniture that are not currently made with interliner fabrics. Assuming that barriers require an additional 15 to 20 minutes of labor per item, and hourly wages are between \$25 and \$30 (including benefits), the staff estimates labor costs to range from \$6.25 and \$10 per item.

In total, the increase in material and labor costs from the inclusion of FR barriers is therefore between \$11.98 and \$17.14 per unit for chairs and \$19.42 and \$26.46 per unit for sofas and loveseats. Assuming a 52.7 percent/47.3 percent breakdown between sofas and chairs, average per-unit cost increases for a furniture unit would range from \$15.90 to \$22.05. If 4.1 percent of furniture would be manufactured with an FR barrier, total costs lie between \$20.7 million and \$28.7 million annually.

2. Manufacturing Costs: Polyurethane Foam Cushioning

The CPSC staff assumes that approximately 66 percent of furniture produced annually would require FR-treated foam filling materials to comply with the draft standard (the staff assumes that the remaining 34 percent of furniture would contain an FR barrier or have an ignition-resistant covering (*e.g.*, leather), and would therefore not be subject to this requirement).

In calculating cost increases related to FR foam, the staff estimates that 25 percent of foam would pass the CPSC staff draft standard without modification. This assumption is based on the belief that 25 percent of foam currently produced complies with TB 117, and that higher density foam (1.4 pcf and greater) that complies with TB 117 would pass TB 117+ as well as the CPSC staff draft standard without modification.¹²⁷

The cost of treating foam with FR chemicals varies depending on foam density, with less dense foams subject to greater incremental costs per board foot than denser foams. The staff therefore makes assumptions about the relative shares of lower-density, average-density, and higher-density foam in order to calculate costs. Costs attributable to FR foam in seat cushions and all other parts of a furniture unit are calculated separately. In brief, relying on pricing data from the Polyurethane Foam Association, the staff estimates that the use of FR foam would increase manufacturing costs by \$3.41 per unit of furniture: \$0.60 from the use of FR foam in seat cushions and \$2.81 from the use of FR foam in all other parts of a furniture unit. Though unconfirmed by the PFA, the staff assumes that these cost increases are inclusive of compliance testing costs. The total cost associated with foam cushioning compliance is therefore estimated to be \$71 million (31.5 million units x 66 percent x \$3.41 = \$71 million).

FR interliners in non-seat cushion areas. (Chairs, Low Estimate: \$2.01 x 2 = \$4.02; Chairs, High Estimate: \$2.48 x 2 = \$4.96; Sofas, Low Estimate: \$2.01 x 4 = \$8.04; Sofas, High Estimate: \$2.48 x 4 = \$9.92.)

¹²⁷ *Staff Cost-Benefit Analysis*, p. 34. (According to members of the Polyurethane Foam Association (PFA), it is unlikely that 25 percent of foam currently produced complies with TB 117; the PFA believes this figure to be overstated.)

3. Manufacturing Costs: Fibrous Filling Materials

The draft standard also includes tests of fibrous filling materials, such as those that may exist in seat back cushions. As with foam filling requirements, furniture that is not covered in an ignition-resistant material or made with an FR barrier is required to use treated fibrous fillings.

The staff observes that fiberfill formulations that blend siliconized polyester and FR fibers (and would, supposedly, meet the draft standard) are available at \$1.00 or more per pound more than the cost of non-compliant slickened polyester currently used in furniture. The staff assumes that this cost would fall over time as these products became more widely used, estimating the increase in material costs for compliant fiberfill at \$0.75 per pound. Assuming a back cushion contains three pounds of fiberfill, the increased cost would total \$2.25 per chair and \$6.75 per sofa, and average per-unit costs based on the proportions of chairs and sofas would be \$4.88. The staff assumes that 50 percent of units are currently made with blown slickened polyester fiber, reducing the average per unit cost over all furniture to \$2.44. The staff projects that 20.7 million units would require the more expensive fiberfill, resulting in an aggregate cost of \$50 million annually.

4. Compliance Costs

The staff anticipates three types of compliance costs related to the draft standard. First, the standard requires manufacturers to keep records that provide information related to product compliance. The staff estimates that average annual costs would be \$2,000 per firm, resulting in aggregate costs of \$3.4 million (based on an estimated 1,700 manufacturers of upholstered furniture). Second, the standard requires firms to place labels containing compliance information on all products. The staff estimates this would cost a few cents per item. Finally, the standard would require the CPSC to inspect establishments to ensure compliance. According to the staff, the Commission has not developed formal compliance and enforcement plans, but estimates that 250 establishments may be inspected annually under the standard. The total costs of these visits are expected to be as much as \$1,358,500. The staff concedes that these costs could most likely not be sustained by the CPSC on a long term basis.

5. Distribution Costs

The staff does not anticipate that storage and transportation costs would increase from the standard, but expects an increase in inventory financing costs. Inventory financing costs “will increase by the average cost of borrowing money, applied to the increase in the wholesale price of a furniture item over the average inventory holding time period.”¹²⁸ The staff believes that this additional cost would not exceed 10 percent of the increase in

¹²⁸ This section summarizes Section 6.5 of *Staff Cost-Benefit Analysis*.

manufacturing costs because “most furniture producers use just-in-time production and have small inventories of finished items.” This yields a cost averaging between \$1.40 and \$1.93 per furniture item made with FR-treated fabrics or barriers, and \$0.60 per unit for other furniture items, for a total cost increase of \$15.9 to \$17.6 million annually.

B. CRA Revised Cost Estimates

Based on the CPSC staff’s assumptions, the average per-unit cost for furniture covered in cellulosic and thermoplastic materials is approximately \$8.38, substantially less than the per-unit benefits anticipated by the Commission’s staff.¹²⁹ However, the CPSC staff appears to have underestimated many of the cost increases borne by manufacturers as a consequence of the draft standard. Based on data provided by furniture manufacturers and the Polyurethane Foam Association, we believe that the true costs of the standard may be closer to \$17.34 to \$21.82 per unit, 200 higher to 260 percent higher than the amount calculated by the CPSC staff. We describe our own cost calculations below.

1. FR-Treated Cover Fabrics

Based on information provided by several large U.S. treatment and fabric manufacturers in 2001, the costs of using FR-treated cover fabrics may be substantially higher than those reported in the staff report. These industry sources estimate the cost of treating cellulosic materials to be between \$1.80 and \$3.15 per linear yard.¹³⁰ Without altering any of the CPSC staff’s other assumptions, these higher treatment figures increase per-unit costs to \$12.81 to \$22.47 for chairs (\$1.83 per linear yard x 7 linear yards or \$3.21 per linear yard x 7 linear yards) and \$23.79 to \$41.73 for sofas and loveseats (\$1.83 per linear yard x 13 linear yards or \$3.21 per linear yard x 13 linear yards). The weighted average cost increase may therefore range between \$18.60 and \$32.62 per unit, nearly three times greater than the CPSC staff’s estimate.

2. FR Barriers

The CPSC staff similarly appears to underestimate the costs of adding a flame resistant barrier to a unit of furniture. Data provided by a mid-range furniture manufacturer on several styles of upholstered chairs and sofas indicate that the raw materials cost increase incurred by the use of FR barriers may be closer to \$26.82 per unit. (This figure takes into account the reduction in costs due to the replacement of non-FR batting materials by the FR barrier.) In contrast, the CPSC staff’s cost increase for raw materials ranges from \$9.65 to \$12.05 per unit. Data provided by the mid-range manufacturer further suggest that increased labor costs associated with adding barriers are closer to \$17.86 per unit, compared to \$6.25 to \$10.00 per unit as estimated by the CPSC staff. Our estimate is

¹²⁹ (\$184.2 million / (31.5 million x 69.76 percent) = \$8.38)

¹³⁰ Mark Berkman, “Assessing the Need for a Federal Small Open Flame/Cigarette Ignition Upholstered Furniture Flammability Standard,” National Economic Research Associates, prepared for the Upholstered Furniture Action Council, February 21, 2001, p. 77.

greater as a consequence of higher hourly wage figures, as upholsterers are among the highest-paid workers in a furniture plant. In total, the mid-range manufacturer data suggest that FR barriers may increase per-unit costs by approximately \$44.68, nearly three times the upper bound of the cost increase estimated by the CPSC staff. It is worth noting that this cost does not include additional warehousing costs associated with storing barrier materials, costs associated with additional space need to cut FR fabric, or reduction in productivity resulting from the need to cut barriers on the same machine used to cut fabric coverings.

Data obtained from a high-end furniture manufacturer imply an even higher labor cost increase due to the addition of FR barriers. These data estimate the labor cost of cutting and sewing in an FR barrier to be \$40 to \$100 per sofa, four to ten times the labor cost increase estimated by the CPSC staff. This may reflect the greater reliance on hand cutting (rather than equipment) and the higher aesthetics demanded by high-end customers. Since higher-end furniture manufacturers are most likely to choose to use barriers to comply with the standard, these labor costs could more accurately reflect the additional labor cost incurred from FR barriers. However, to remain conservative in our cost estimates, we use the mid-range manufacturer estimate in the rest of our analysis.

3. Foam Fillings

The information provided by the mid-range furniture manufacturer mentioned above also provides insight into the cost increases resulting from the draft standard's foam filling ignition resistance tests. According to the calculations made by the manufacturer, the cost increase associated with replacing standard FR foam with UK-type foam (which is treated to be cigarette- and small open flame-resistant) may be \$4.76, 40 percent greater than the cost increase estimated by the CPSC staff. However, even this estimate appears to underestimate the costs incurred from the standard's foam requirements, based on data provided by the Polyurethane Foam Association (PFA).

The PFA provided average bulk prices for standard FR foam, CA 117-compliant foam, and foam assumed to meet the draft CA 117+ standard. Assuming for the moment that foam that passes CA 117+ would also comply with the CPSC staff draft standard, the PFA data suggest that foam costs would increase by \$0.086 per board foot for 1.4 pcf foam and \$0.083 for 1.8 pcf foam. The PFA anticipates that 1.0 pcf foam would have to be replaced with denser foam to comply with the standard, and that the cost increase associated with this replacement would be about \$0.138 per board foot.¹³¹ These costs are 4.8 to 8.2 cents greater per board foot than the costs estimated by the staff. In total, relying on the CPSC staff's assumptions, per-unit costs of FR foam may be \$7.99 per unit.

¹³¹ The CPSC staff similarly notes that since lower density foams may not "have acceptable physical properties with added FR chemical loadings needed to pass the CPSC staff's draft tests," manufacturers may have to substitute lower density foams with denser foams, which would contribute to greater incremental costs than those reflected in its analysis. (*Staff Cost-Benefit Analysis*, p. 34)

However, according to the PFA, even these costs underestimate the impact of the standard, as the open flame tests prescribed by the draft standard are “extremely unpredictable,” and would require the use of an SW type foam grade, typically used to meet the CA 133 test requirement.¹³² The minimum density of this type of foam is estimated to be about 2.2 pcf, and cost increases would range from 22 cents per board foot for lower-density foam to 11 cents per board foot for higher-density foam. If manufacturers chose to ensure compliance through the use of SW type foam, per-units costs related to treated foam would increase to \$12.49 per unit.

It is also worth noting that the costs of chemicals used to treat polyurethane foam are affected by petroleum costs, and that if petroleum costs continue to increase in future years, the cost of treated foam will increase as well.¹³³

4. Fibrous Filling Materials

Finally, the CPSC staff may have underestimated the costs associated with the use of FR fibrous filling materials. Information provided by a high-end furniture manufacturer indicates the CPSC staff may have understated the amount of filling in a typical upholstered chair or sofa. According to the manufacturer, a typical sofa may use 14.5 pounds of polyester fiberfill, while a typical chair may use 4.8 pounds of fiberfill.¹³⁴ Using these greater quantities and the CPSC staff’s estimate of the costs of treated fiberfill, the per-unit cost of treated filling materials may be \$3.72, more than one dollar greater than the CPSC staff’s \$2.44 figure.

The draft standard also allows manufacturers to use a complying barrier interliner to encase non-compliant fibrous filling materials, and the staff assumes that the per-unit costs of this alternative are similar to those estimated for FR modifications to loose polyester fiber. However, the material and labor costs related to barriers discussed above suggest that this method of compliance would be substantially more costly than the use of treated polyester fiberfill.

C. Corrected Cost Estimates

Overall, we anticipate cost increases resulting from the draft standard to range from \$17.34 per unit to \$21.82 per unit for furniture covered in cellulosic and thermoplastic materials. The lower figure (\$17.34) assumes that manufacturers could use CA 117+ foam to comply with the standard’s foam requirements, while the higher cost estimate

¹³² SW type foam is an industry term referring to combustion modified foam that assists compliance with public occupancy flammability requirements such as TB 133. The term derives from a business and institutional furniture manufacturer, which was among the first manufacturers contract for the development of such foam.

¹³³ This information is from discussions with PFA representatives.

¹³⁴ In contrast, the CPSC assumed that a sofa contained 9 pounds of fiberfill, and a chair contained 3 pounds of fiberfill.

(\$21.82) assumes that manufacturers would instead have to rely on high density, SW type foam, as maintained by the PFA. Tables 9a and 9b breaks down both of our revised cost estimates alongside the CPSC staff's figures.

**Table 9a: Comparison of CPSC and CRA Estimates of Expected Costs of Draft Standard
Assuming CA 117+ Foam Would Be Used to Comply**

Category	Manufacturing Costs Increases per Unit, by Material Affected				Compliance Verification Costs per Unit [5]	Distribution Costs per Unit [6]	Range of Total Costs Per Unit [7]	Annual Units Produced [8]	Aggregate Costs (mil.) [9]
	FR Fabric [1]	Barriers [2]	Urethane Foam [3]	Fibrous Filling [4]					
<i>CPSC Estimates</i>									
Heavy Cellulosics	\$6.61-\$11.28 (60% of type)	\$15.90-\$22.05 (40% of type)	\$2.05	\$1.46	\$0.20	\$1.40-\$1.93	\$15.44-\$21.23 (\$18.33)	3,250,306	\$50.2-\$69 (\$59.6)
Mediumweight Cellulosics and Blends	-	-	\$3.41	\$2.44	\$0.20	\$0.60	\$6.65	1,557,614	\$10.40
Lightweight Cellulosics and Blends	-	-	\$3.41	\$2.44	\$0.20	\$0.60	\$6.65	3,634,433	\$24.20
Thermoplastics	-	-	\$3.41	\$2.44	\$0.20	\$0.60	\$6.65	13,532,327	\$90.00
Leather, wool, vinyl-coated	-	-	-	-	-	-	-	9,525,321	-
All Furniture	-	-	-	-	-	-	-	31,500,000	\$174.8-\$193.6 (\$184.2)
<i>Revised Estimates</i>									
Heavy Cellulosics	\$18.60-\$32.62 (60% of type)	\$44.68 (40% of type)	\$4.79	\$2.23	\$0.20	\$3.61-\$4.45	\$36.77-\$46.92 (\$41.85)	3,250,306	\$119.5-\$152.5 (\$136.0)
Mediumweight Cellulosics and Blends	-	-	\$7.99	\$3.72	\$0.20	\$1.17	\$13.08	1,557,614	\$20.37
Lightweight Cellulosics and Blends	-	-	\$7.99	\$3.72	\$0.20	\$1.17	\$13.08	3,634,433	\$47.54
Thermoplastics	-	-	\$7.99	\$3.72	\$0.20	\$1.17	\$13.08	13,532,327	\$177.01
Leather, wool, vinyl-coated	-	-	-	-	-	-	-	9,525,321	-
All Furniture	-	-	-	-	-	-	-	31,500,000	\$364.4-\$397.4 (\$380.9)

**Table 9b: Comparison of CPSC and CRA Estimates of Expected Costs of Draft Standard
Assuming 2.2 pcf Foam Would Be Used to Assure Compliance**

Category	Manufacturing Costs Increases per Unit, by Material Affected				Compliance Verification Costs per Unit [5]	Distribution Costs per Unit [6]	Range of Total Costs Per Unit [7]	Annual Units Produced [8]	Aggregate Costs (mil.) [9]
	FR Fabric [1]	Barriers [2]	Urethane Foam [3]	Fibrous Filling [4]					
<i>CPSC Estimates</i>									
Heavy Cellulosics	\$6.61-\$11.28 (60% of type)	\$15.90-\$22.05 (40% of type)	\$2.05	\$1.46	\$0.20	\$1.40-\$1.93	\$15.44-\$21.23 (\$18.33)	3,250,306	\$50.2-\$69 (\$59.6)
Mediumweight Cellulosics and Blends	-	-	\$3.41	\$2.44	\$0.20	\$0.60	\$6.65	1,557,614	\$10.40
Lightweight Cellulosics and Blends	-	-	\$3.41	\$2.44	\$0.20	\$0.60	\$6.65	3,634,433	\$24.20
Thermoplastics	-	-	\$3.41	\$2.44	\$0.20	\$0.60	\$6.65	13,532,327	\$90.00
Leather, wool, vinyl-coated	-	-	-	-	-	-	-	9,525,321	-
All Furniture	-	-	-	-	-	-	-	31,500,000	\$174.8-\$193.6 (\$184.2)
<i>Revised Estimates</i>									
Heavy Cellulosics	\$18.60-\$32.62 (60% of type)	\$44.68 (40% of type)	\$7.49	\$2.23	\$0.20	\$3.88-\$4.72	\$38.56-\$48.70 (\$43.63)	3,250,306	\$125.3-\$158.3 (\$141.8)
Mediumweight Cellulosics and Blends	-	-	\$12.49	\$3.72	\$0.20	\$1.62	\$18.03	1,557,614	\$28.09
Lightweight Cellulosics and Blends	-	-	\$12.49	\$3.72	\$0.20	\$1.62	\$18.03	3,634,433	\$65.54
Thermoplastics	-	-	\$12.49	\$3.72	\$0.20	\$1.62	\$18.03	13,532,327	\$244.03
Leather, wool, vinyl-coated	-	-	-	-	-	-	-	9,525,321	-
All Furniture	-	-	-	-	-	-	-	31,500,000	\$463.0-\$496.0 (\$479.5)

V. CORRECTED COST/BENEFIT ANALYSIS

Tables 10a-10d show CRA’s estimates of the likely net benefits of the draft standard. We present estimates with varying discount rates and effectiveness rates as well as a \$5 million statistical value of a life and a \$2.9 million statistical value of a life, and our two sets of cost estimates.

Based on our base case assumptions (outlined in section III.C, and relying on our lower cost estimates), which correct for the CPSC staff’s understatement of the costs and overstatement of the benefits attributable to the draft flammability standard, we have concluded that the costs of the standard will substantially exceed the benefits. According to our analysis, costs will exceed benefits by \$145 million annually. This is in sharp contrast to the CPSC staff estimate of \$752 million in net benefits annually. Sensitivity analyses showed that in 29 out of 36 scenarios we considered, costs exceeded benefits. Six of the scenarios exhibiting net benefits did so because the CPSC staff effectiveness rate estimates were adopted. As discussed above, we do not think that these estimates can be supported by the available evidence from testing and actual experience. Thus, among the scenarios we consider supportable, only 1 of 24 produced a net benefit (see Table 10a, with a 3 percent discount rate and “medium effectiveness”).

The 36 scenarios were designed to consider the combined impacts of several key assumptions regarding effectiveness, compliance costs, discount rate and the statistical value of life. Figures 4a and 4b summarize the figures shown in Tables 10a-10d.

Table 10a: CRA Net Benefits Estimates
\$5 Million Statistical Value of a Life and Lower CRA Cost Estimates

	High Effectiveness (CPSC Rates)	Medium Effectiveness (New Surrey Report Rates for Cigarettes)	Low Effectiveness (CRA Rates)
3%	\$331,575,309	\$59,663,900	(\$72,346,238)
7%	\$167,287,912	(\$42,977,337)	(\$145,229,298)
10%	\$80,266,321	(\$97,216,930)	(\$183,622,936)

Table 10b: CRA Net Benefits Estimates
\$5 Million Statistical Value of a Life and Higher CRA Cost Estimates

	High Effectiveness (CPSC Rates)	Medium Effectiveness (New Surrey Report Rates for Cigarettes)	Low Effectiveness (CRA Rates)
3%	\$233,107,065	(\$38,804,344)	(\$170,814,482)
7%	\$68,819,668	(\$141,445,581)	(\$243,697,542)
10%	(\$18,201,923)	(\$195,685,174)	(\$282,091,180)

Table 10c: CRA Net Benefits Estimates
\$2.9 Million Statistical Value of a Life and Lower CRA Cost Estimates

	High Effectiveness (CPSC Rates)	Medium Effectiveness (New Surrey Report Rates for Cigarettes)	Low Effectiveness (CRA Rates)
3%	\$85,869,840	(\$90,632,013)	(\$176,054,605)
7%	(\$22,332,119)	(\$158,589,029)	(\$224,643,203)
10%	(\$79,576,630)	(\$194,460,641)	(\$250,215,282)

Table 10d: CRA Net Benefits Estimates
\$2.9 Million Statistical Value of a Life and Higher CRA Cost Estimates

	High Effectiveness (CPSC Rates)	Medium Effectiveness (New Surrey Report Rates for Cigarettes)	Low Effectiveness (CRA Rates)
3%	(\$12,598,404)	(\$189,100,257)	(\$274,522,849)
7%	(\$120,800,363)	(\$257,057,273)	(\$323,111,447)
10%	(\$178,044,874)	(\$292,928,885)	(\$348,683,526)

Notes:

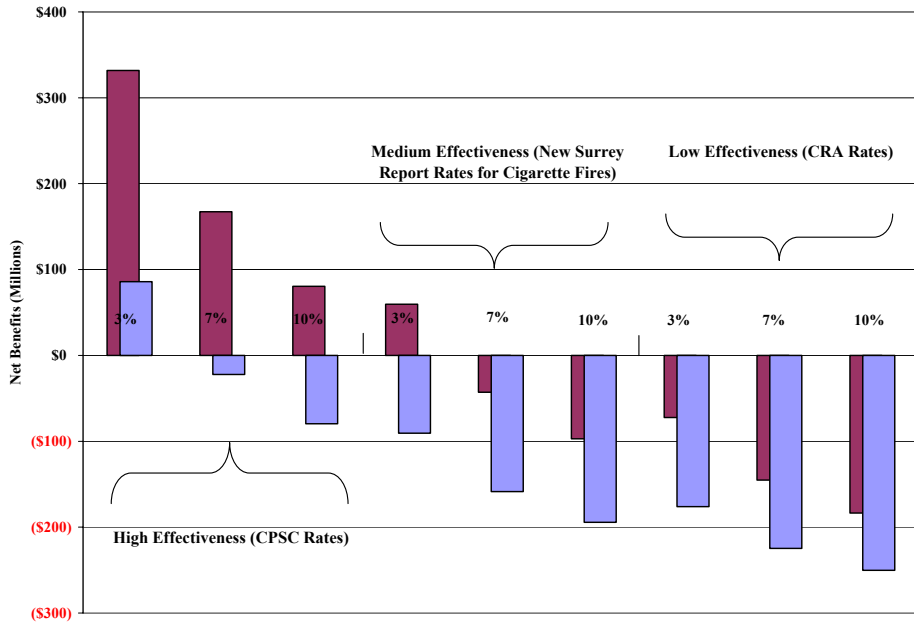
We assume that cigarette-related deaths and injuries are 235 and 421, respectively, in the first year of the standard (2006), and that these figures will fall to 125 and 209, respectively, by 2021, the sixteenth year of the proposed standard. Cigarette losses will also experience a 3.5 percent decline in 2006, and a 2.6 percent decline in 2007, due to fire-safe cigarette regulations implemented in New York, California, and Vermont.

We rely on the CPSC staff's figures for cigarette-related property damage and small open flame deaths, injuries, and property damage. We do not assume that small open flame losses will experience future declines.

The figure obtained based on our base case assumptions is bolded.

Lower cost estimates are based on the assumption that manufacturers will use CA 117+ foam to comply with the standard, while higher cost estimates assume that manufacturers will use SW type foam to ensure compliance.

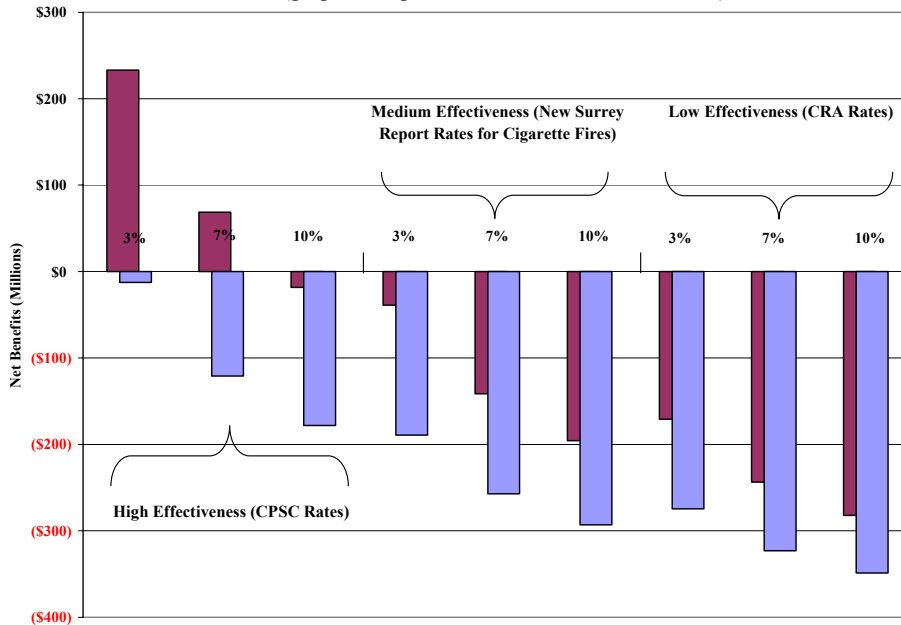
Figure 4a: CRA Net Benefits Estimates, Lower Foam Costs
(graphical representation of Tables 10a and 10c)



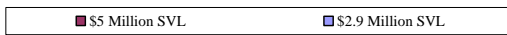
Notes: Discount rates are displayed on x-axis.



Figure 4b: CRA Net Benefits Estimates, Higher Foam Costs
(graphical representation of Tables 10b and 10d)



Notes: Discount rates are displayed on x-axis.



As noted in the introduction, the CPSC staff performs a cursory sensitivity analysis, modifying only one assumption at a time. From that analysis, the staff concludes that its \$752 million net benefits estimate is fairly consistent across varying assumptions. However, when several of the CPSC staff's assumptions are modified at once, the result is quite different. Tables 11a and 11b show these figures. If effectiveness is half of what the staff assumes, and costs are doubled at the same time, then benefits exceed costs only at the 3 percent discount rate. As shown, 3 of 8 scenarios created by considering the combined impacts of CPSC staff sensitivity assumptions result in large negative net benefits (holding costs at double the CPSC staff's estimates). Adding additional scenarios to reflect a higher discount rate and lower effectiveness results in 10 of 18 scenarios with negative net benefits (again, holding costs at double the CPSC staff's estimates; these figures are not shown here). Note that all of these results reflect a doubling of CPSC staff's cost estimates: of the eight possible scenarios where the staff's costs are not doubled, zero result in negative net benefits. Our cost estimates are, however, more than double the staff estimates.

Table 11a: Adjustments to CPSC Staff's Sensitivity Analysis

\$3 Million Statistical Value of a Life and Doubled CPSC Costs

	High Effectiveness (CPSC Rates)	Medium Effectiveness (50% of CPSC Rates)
3%	\$251,402,671	(\$58,397,768)
7%	\$105,098,403	(\$131,549,902)

Table 11b: Adjustments to CPSC Staff's Sensitivity Analysis

\$5 Million Statistical Value of a Life and Doubled CPSC Costs

	High Effectiveness (CPSC Rates)	Medium Effectiveness (50% of CPSC Rates)
3%	\$568,005,911	\$99,903,852
7%	\$348,083,165	(\$10,057,522)

VI. CONSIDERATION OF ALTERNATIVE STANDARDS AND POLICIES

A. Upholstered Furniture Flammability Regulations

The CPSC staff identified several alternative flammability regulations in its preliminary economic report, but did not present detailed analyses of these alternatives. These alternatives included the 2001 draft small open flame-only standard, a standard characterized as an “industry proposal,” and a cigarette- or smoldering-only standard. While the staff concluded that all of these alternatives resulted in net benefits, the recommended draft standard provided the largest net benefits according to the staff’s assumptions and calculations. We have not evaluated these alternatives at the same level of detail as we have the recommended standard, but based on our analysis and the previous NERA analysis we have concluded that the costs are likely to exceed the benefits for these alternatives as well.¹³⁵

In the recent cost-benefit analysis, the CPSC staff estimates that the 2001 small open flame draft standard would result in almost identical net benefits as the current draft standard, despite estimating much lower net benefits in 2001. The 2001 NERA report demonstrated that this small open flame proposal would result in annual net *costs* of \$286 million, since the standard would impose substantial fabric treatment costs on the industry and was likely to have a low effectiveness rate.¹³⁶ A small open flame regulation is, in general, a poorly-targeted regulation, as the risk of death in a small open flame fire is already so low. In fact, most of the net benefits estimated by the staff related to cigarette-ignited fires, which were likely overstated as the staff failed to account for declines these types of losses in the absence of furniture regulation (due to declines in smoking prevalence over time).

The cigarette- or smolder-only alternative as proposed by CPSC staff would also result in net costs rather than net benefit under our assumptions. Like the CPSC staff, we assume that a smolder-only alternative would only affect heavy cellulosic furniture, as current foam would already likely pass the necessary smolder tests. Again, the benefits associated with reductions in cigarette-ignited fires must be adjusted to reflect for expected declines resulting from falling smoking prevalence, introduction of fire-safe cigarette regulations, and the poor targeting. For cigarette-related losses, we assume that the application of either FR-treated fabric or a barrier would be 22 percent effective based on the U.K. experience, adjusted for both smoke detector and smoking prevalence changes. Though the standard would only include cigarette-ignition tests, we assume that the standard would also reduce small open flame related losses, since manufacturers

¹³⁵ We have not examined what has been characterized as an industry alternative, because we have been advised by AHFA and UFAC that the alternative does not accurately represent an industry proposal.

¹³⁶ Mark Berkman, “Assessing the Need for a Federal Small Open Flame/Cigarette Ignition Upholstered Furniture Flammability Standard,” National Economic Research Associates, prepared for the Upholstered Furniture Action Council, February 21, 2001.

would continue to use barriers that are both small open flame- and cigarette-ignition resistant. We use the small open flame effectiveness rate calculated in Section III, 48 percent, in our analysis of a smolder-only standard. We have heard from industry experts that there are smolder-only barriers currently on the market that are less expensive than SMOF- and cigarette-resistant barriers, but we have no information on the cost or effectiveness of these barriers, so we cannot use these types of barriers in our analysis.

For costs, we use the same compliance costs for FR fabric treatment and barriers as we presented in Section IV. However, it is important to note that the *total* costs for a smolder-only standard would be substantially less than those attributable to the draft standard because the smolder-only standard would not require modification to foam and filling materials, at least under the staff's assumptions.

As shown in Table 12a, annual costs exceed annual benefits by \$2 million for the smolder-only standard, assuming a 22 percent cigarette effectiveness rate, a 48 percent small open flame effectiveness rate, a \$5 million statistical value of life, and a 7 percent discount rate. If the smolder-only standard could actually achieve a 40 percent cigarette effectiveness rate and 66 percent SMOF effectiveness rate, as assumed by the CPSC staff, then annual benefits would exceed costs by \$40 million to \$88 million. These results hold when we make a further adjustment to reflect the lower smoking rates associated with consumers of heavy cellulosic furniture. (See Table 12b for an explanation of this adjustment.)¹³⁷ The staff's effectiveness rates are not based on any laboratory testing, although the staff's cigarette effectiveness rate is consistent with the U.K. experience unadjusted for the impact of smoking prevalence reductions. (See Section III.B.)

¹³⁷ We attempted to correct for the fact that smokers may not be evenly distributed across furniture categories using limited data on smoking prevalence by income. In Table 12b, we assume that 50% of heavy cellulosic furniture is owned/purchased by high-income households, and that the smoking prevalence among high-income households is 16.8%. We also examined two other scenarios: 1) that 10% of heavy cellulosic furniture is owned/purchased by high-income households; and 2) that 100% of heavy cellulosic furniture is owned/purchased by high-income households. In our exposure adjustment, we allow smoking prevalence differences across furniture categories to directly impact the percent of overall societal costs attributed to heavy cellulosic furniture, which impact net benefits. Under our base case assumptions, the two scenarios mentioned above resulted in net costs of \$28.3 million (10% assumption) and \$38.5 (100% assumption).

**Table 12a: CRA Net Benefits Estimates
of a Smolder-Only Standard
Without Correction for Exposure**

	High Effectiveness (CPSC Rate = 40% for Cigarette, 66% for SMOF)	Low Effectiveness (CRA Rates = 22% for Cigarette, 48% for SMOF)
3%	\$87,842,415	(\$338,170)
7%	\$40,488,597	(\$27,638,538)

**Table 12b: CRA Net Benefits Estimates
of a Smolder-Only Standard
With Correction for Exposure**

	High Effectiveness (CPSC Rate = 40% for Cigarette, 66% for SMOF)	Low Effectiveness (CRA Rates = 22% for Cigarette, 48% for SMOF)
3%	\$77,299,633	(\$6,136,700)
7%	\$32,322,406	(\$32,129,944)

Notes:

We assume that cigarette-related deaths and injuries are 235 and 421, respectively, in the first year of the standard (2006), and that these figures will fall to 125 and 209, respectively, by 2021, the sixteenth year of the proposed standard. Cigarette losses will also experience a 3.5 percent decline in 2006, and a 2.6 percent decline in 2007, due to fire-safe cigarette regulations implemented in New York, California, and Vermont. We rely on the CPSC staff's figures for cigarette-related property damage, and all small open flame losses.

We assume a \$5 million statistical value of life, and that per unit costs will be \$36.72 for heavy cellulosic furniture.

We assume that only heavy cellulose would be affected by the smolder-only standard, and that there would be a reduction in small open flame and cigarette losses for heavy cellulosic furniture.

In the table that corrects for differences in exposure across furniture coverings, we assume that 50% of heavy cellulose are purchased/owned by high-income households, and that the smoking prevalence for these households is 16.8%. We assume that the remaining 50% of heavy cellulosic furniture is purchased/owned by households with an average smoking prevalence of 23% (the national average). Thus, the smoking prevalence rate among owners of heavy cellulose is 19.9% (23% x 50% + 16.8% x 50%). We use this smoking prevalence to re-calculate the percent of overall risk associated with heavy cellulose (for cigarette-related losses only), obtaining a value of 57.4% (versus 61% in the CPSC staff report).

The figure obtained based on our base case assumptions is bolded.

B. Other Non-Furniture Related Policies

The CPSC staff failed to adequately consider other non furniture-related regulations. Most importantly, the staff virtually dismissed the impact of fire-safe cigarette

regulations.¹³⁸ The staff concluded that the effects of such regulation would be largely offset by population growth. This is extremely unlikely. Despite population growth, the risk of fire fatalities and the number of upholstered furniture fires continue to fall. The popularity of these regulations is growing. Three states accounting for about 20 percent of the population have already passed such regulations. At least three more have legislation pending.

As noted in Section III.A, studies performed by the NBS and NFPA and empirical evidence from New York demonstrate the certainty and magnitude of fire-safe cigarette effectiveness relative to the draft standard. Based on this information, it seems likely that fire-safe cigarettes will lead to an *immediate* 52 to 78 percent reduction in deaths from cigarette-ignited bedding and furniture fires, whereas the effectiveness of the CPSC staff's draft standard is open to debate.

Not only is the effectiveness of such regulations more certain than the draft flammability standards, the efficiency of such a regulation will be much higher. The reason for this is straightforward. The fire-safe cigarette regulation targets the primary source for upholstered furniture fires – smokers. Smokers pay for any costs associated with reducing the fire risk. In contrast, all furniture buyers will pay the costs associated with the flammability standard even though non-smokers face very little risk of furniture fires. CPSC staff's cost benefit analysis masks this important difference. As shown in Table 13, under the CPSC staff's assumptions, non-smoking households with working smoke detectors face a **negative** net benefit of almost \$72 million annually, while households with smokers and no working smoke detectors enjoy a positive net benefit of \$558 million. Thus, 60 percent of U.S. households would receive a negative net benefit from the draft standard: they would pay to reduce a risk they did not face.

¹³⁸ *Staff Cost-Benefit Analysis*, pp. 60-61.

**Table 13: Results of the CPSC Staff's Assumptions Using CRA's Cost-Benefit Model
Net Benefits of the Draft Standard by Household Type**

Smokers with Smoke Detectors

Upholstery Covering Type	Per-Unit Societal Benefits (All)	Per-Unit Costs	Per-Unit Net Benefits (All)	Units	Total Net Benefits
Heavyweight Cellulosics	\$266.30	\$18.33	\$247.97	574,221	\$142,387,596
Medium Weight Cellulosics and Blends	\$139.28	\$6.65	\$132.63	274,870	\$36,455,871
Lightweight Cellulosics and Blends	\$47.35	\$6.65	\$40.70	642,104	\$26,135,999
Thermoplastics	\$9.02	\$6.65	\$2.37	2,390,363	\$5,657,541
<i>All Furniture</i>				<i>3,881,558</i>	<i>\$210,637,007</i>

Smokers without Smoke Detectors

Upholstery Covering Type	Per-Unit Societal Benefits (All)	Per-Unit Costs	Per-Unit Net Benefits	Units	Total Net Benefits
Heavyweight Cellulosics	\$2,057.29	\$18.33	\$2,038.96	173,463	\$353,683,363
Medium Weight Cellulosics and Blends	\$1,076.04	\$6.65	\$1,069.39	83,033	\$88,795,437
Lightweight Cellulosics and Blends	\$365.99	\$6.65	\$359.34	193,969	\$69,701,296
Thermoplastics	\$69.88	\$6.65	\$63.23	722,089	\$45,655,526
<i>All Furniture</i>				<i>1,172,554</i>	<i>\$557,835,622</i>

Non-Smokers with Smoke Detectors

Upholstery Covering Type	Per-Unit Societal Benefits (All)	Per-Unit Costs	Per-Unit Net Benefits	Units	Total Net Benefits
Heavyweight Cellulosics	\$4.34	\$18.33	(\$13.99)	1,922,393	(\$26,903,870)
Medium Weight Cellulosics and Blends	\$2.60	\$6.65	(\$4.05)	920,215	(\$3,730,573)
Lightweight Cellulosics and Blends	\$2.59	\$6.65	(\$4.06)	2,149,653	(\$8,734,934)
Thermoplastics	\$2.63	\$6.65	(\$4.02)	8,002,520	(\$32,178,654)
<i>All Furniture</i>				<i>12,994,781</i>	<i>(\$71,548,032)</i>

Non-Smokers without Smoke Detectors

Upholstery Covering Type	Per-Unit Societal Benefits (All)	Per-Unit Costs	Per-Unit Net Benefits	Units	Total Net Benefits
Heavyweight Cellulosics	\$33.86	\$18.33	\$15.53	580,723	\$9,020,570
Medium Weight Cellulosics and Blends	\$20.28	\$6.65	\$13.63	277,982	\$3,788,537
Lightweight Cellulosics and Blends	\$20.21	\$6.65	\$13.56	649,374	\$8,802,489
Thermoplastics	\$20.54	\$6.65	\$13.89	2,417,428	\$33,568,821
<i>All Furniture</i>				<i>3,925,507</i>	<i>\$55,180,418</i>

All Furniture

Upholstery Covering Type	Per-Unit Societal Benefits (All)	Per-Unit Costs	Per-Unit Net Benefits	Units	Total Net Benefits
Heavyweight Cellulosics	\$165.43	\$18.33	\$147.10	3,250,800	\$478,187,658.68
Medium Weight Cellulosics and Blends	\$87.18	\$6.65	\$80.53	1,556,100	\$125,309,272.40
Lightweight Cellulosics and Blends	\$33.03	\$6.65	\$26.38	3,635,100	\$95,904,849.35
Thermoplastics	\$10.54	\$6.65	\$3.89	13,532,400	\$52,703,234.58
<i>All Furniture</i>				<i>21,974,400</i>	<i>\$752,105,015</i>

Not only are fire-safe cigarette regulations more effective and better targeted – placing costs on those who benefit – they are also more immediate. In the first year of the draft furniture standard, less than 10 percent of furniture in use would reflect the regulation. As a result, the deaths avoided in the first year of the standard would be low: as shown in Table 14, we estimate that the furniture standard would prevent 4 upholstered furniture fire deaths in the first year. In contrast, if a national fire-safe cigarette regulation was implemented in 2006, we estimate that the regulation would prevent 118 furniture fire deaths as well as an additional 161 deaths from cigarette-ignited fires not involving furniture.¹³⁹

Table 14: Estimated Deaths Prevented in 2006 by CPSC and Fire-Safe Cigarette Standards if Enacted in 2006

	CPSC Standard	Fire-Safe Cigarette Standard
Upholstered Furniture Fire Deaths Prevented	4	118
Total Residential Fire Deaths Prevented	4	279

Notes:

Effectiveness rates from the CRA base model are utilized for the fire-safe cigarette standard (50%) and the CPSC standard (22%).

Deaths prevented is calculated assuming each standard is adopted across all states.

The numbers of deaths absent either standard are calculated from our regression results (235 for cigarette-ignited upholstered furniture fires, 60 for SMOF upholstered furniture fires, and 558 for total residential fires).

Sources:

1980-2002 NFIRS data, 1980-2002 NFPA national fire experience surveys.

The staff also ignores the potential impact of more aggressive smoke detector campaigns. Studies have consistently shown that working smoke detectors reduce fire fatalities. Promoting smoke detector maintenance would not only reduce furniture fires, but fires from all household ignition points.

VII. ECONOMIC IMPACTS OF THE DRAFT STANDARD

If enacted, the draft standard may have a negative impact on the upholstered furniture industry. The U.S. upholstered furniture industry is highly competitive, and the imposition of any additional costs may drive out small businesses. In 2002, there were 1,686 companies in the upholstered household furniture manufacturing business, with

¹³⁹ These figures assume independence of a furniture standard and a fire-safe cigarette regulation. In reality, the fire-safe cigarette regulation could eliminate the same fires addressed by the furniture standard.

1,946 establishments.¹⁴⁰ While the four largest companies account for 34 percent of sales, the 50 largest companies account for 69.4 percent of sales. The HHI for the 50 largest companies is 356.1, indicating that the industry is not concentrated.¹⁴¹

Given the degree of competition, it is not surprising that profit margins in the upholstered furniture industry are quite modest. Profit before taxes as a percentage of net sales has ranged from 1.5 to 4.3 percent over the years 1999-2003.¹⁴² Furthermore, smaller furniture manufacturers tend to operate with smaller profit margins. Approximately 1,392 of 1,946 establishments have fewer than 20 employees. These smaller furniture manufacturers, because of their thin profit margins and higher borrowing costs, will be hit hardest with the cost increases necessary to comply with the draft standard.

The U.S. upholstered furniture industry also faces substantial pressure from foreign firms. In the years 1996 to 2004, upholstered furniture exports have ranged from \$169 million to \$235 million, while imports have ranged from \$501 million to \$2,053 million.¹⁴³ The trade deficit (net imports) in upholstered furniture has steadily increased from \$332 million in 1996 to \$1,818 million in 2004. Imports from China in particular have risen dramatically over the last few years, sustaining an average yearly growth rate of over 58 percent since 1996. In 2004, imports from China exceeded imports from Italy, the leader of U.S. imports for many years. One industry specialist estimated that 17.2 percent of upholstered furniture consumed in 2004 was imported.¹⁴⁴

With the increased pressure from abroad in an already competitive industry, furniture manufacturers may not be able to fully pass through the costs of the draft standard to their customers. Although foreign manufacturers would also be required to abide by the draft standard, these firms may be able to comply at lower costs because of lower labor and materials costs, and may provide foreign manufacturers with a further competitive advantage. Most U.S. firms, already operating on very thin profit margins, may be in jeopardy of closing if required to bear the compliance costs of the standard.

¹⁴⁰ Data from this paragraph are from the U.S. Bureau of the Census, *Upholstered Household Furniture Manufacturing, Economic Census 2002*.

¹⁴¹ The HHI – Hershman-Herfindahl Index – is a measure of market concentration used as a measure of competitiveness. The U.S. Department of Justice employs this index in merger reviews. (U.S. Bureau of the Census, *Concentration Ratios in Manufacturing, Economic Census 1997*.)

¹⁴² Data from this paragraph are from RMA, *Annual Statement Studies 2004-2005*.

¹⁴³ Import and export data from this paragraph are from the Office of Consumer Goods website, Department of Commerce, available at <http://www.ita.doc.gov/td/ocg/index.htm>, site visited February 27, 2006.

¹⁴⁴ Jerry Epperson, “Like Numbers? Here’s Just What You’re Looking For,” *Furniture/Today*, April 25, 2005, p. 55.

Figure 5: Profit Margins of Furniture Manufacturers Traditionally Have Been Small

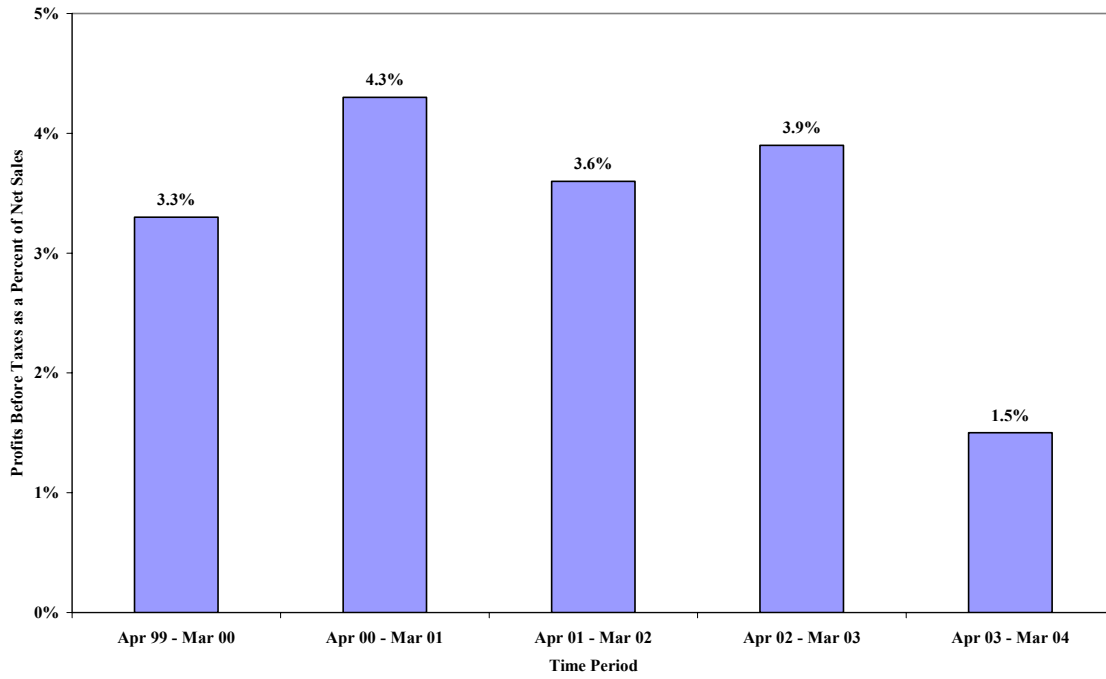
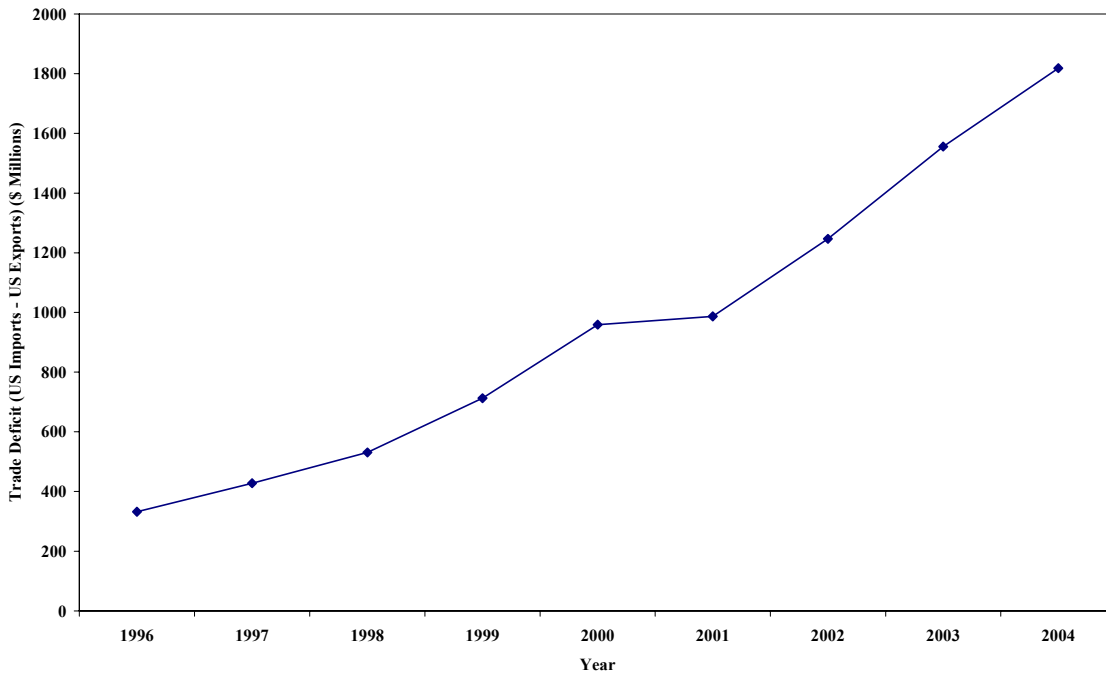


Figure 6: U.S. Trade Deficit in Upholstered Household Furniture Has Increased from 1996-2004



VIII. CONCLUSIONS

CRA has concluded that the draft standard is not supported by the underlying benefit-cost analyses. In particular, the staff finding that the benefits of the standard greatly exceed the costs is seriously flawed. Benefits are substantially overstated and costs are notably understated. The staff dismisses an alternative regulatory approach that will not only be more effective more quickly, but more accurately impose costs on those who benefit. In addition, potential negative consequences for the domestic furniture industry are ignored.

Current risks associated with upholstered furniture fires are already very low: from 1999-2002, the risk of death in a cigarette-ignited furniture fire was 0.72 per million population and the risk of death in a small open flame-ignited furniture fire was 0.16 per million population. These risks are well below what is considered reasonable in many instances of daily life as well as the CPSC in establishing other product standards and the EPA in establishing environmental regulations. In addition, the risk has been steadily falling in the absence of a standard and can be reasonably expected to fall further without intervention. The current risk level is already extremely low for non-smoking households with working smoke detectors, which represent at least 60 percent of U.S. households.

The CPSC staff overstates benefits for several reasons. First, the staff relies on effectiveness rates that are not based on thorough or recent testing and that are inconsistent with rates recently reported in the United Kingdom where similar standards have been in place for almost two decades. Moreover, the staff interpretations of some testing results directly contradict earlier interpretations. Second, the staff fails to fully account for the expected continued downward trend in fatal cigarette-ignited furniture fires resulting from further declines in smoking prevalence, fire-safe cigarette regulation, and further market penetration of furniture meeting UFAC voluntary fire safety standards. Third, the staff does not consider whether the distribution of smokers among furniture buyers could affect benefits. For example, cigarette ignition prone fabrics – which according to CPSC staff assumptions account for a large fraction of fatal fires – may be less likely to be purchased by smokers. These fabrics tend to be expensive and smoking prevalence falls with income. This would reduce benefits because the standard would affect consumers with already very low risk of fatal fires. Fourth, the staff relies on a very low discount rate and a relatively high statistical value of life to value future benefits.

The CPSC staff understates costs according to industry data provided to us and discussions with manufacturers. There are several causes of this understatement. First, the staff assumes that foam cost increases will be modest, but industry testing indicates that more costly reformulation is required to reliably pass the draft standard. Second, the staff cost estimates do not fully account for additional labor or efficiency losses associated with adding barriers. Third, the staff appears to underestimate the costs associated with FR treatment of cover fabrics.

The CPSC staff does conduct a sensitivity analysis as required by Office of Management and Budget (OMB), but it is incomplete. The staff reports results varying one important

factor at time including: the discount rate, compliance cost effectiveness and the statistical value of life. There is no reason to consider these factors separately unless they are mutually exclusive. They are not. Consequently, the sensitivity analysis should have reviewed all of the combinations of these factors. In addition, the sensitivity analysis should have addressed the potential for further declines in furniture fire fatalities in the absence of the standard. The need for this is underscored by the substantial reduction in estimated benefits when two more years of data than initially relied on by the CPSC staff revealed a continued decline in the number of fire fatalities.

Moreover, even if benefits were convincingly found to exceed costs, the standard should be considered relative to other standards or regulations that would reduce upholstered furniture fire risk. The draft standard is poorly targeted resulting in substantial expenditures from those who face *de minimis* risk – non-smokers – and thus little if any benefit from the standard. The draft standard will also take time to take affect. Only new furniture, representing about 10 percent of furniture in use in a given year will be affected. In contrast, fire-safe cigarette regulations now enacted in three states and under active consideration in at least three others are very targeted. They will impose costs and reduce risk immediately for those who face the most risk – smokers. Thus, the cost burden falls on those who benefit directly. Fire-safe cigarette regulations will also reduce fires associated with other products including bedding and mattresses providing further benefits at no additional cost.

Finally the CPSC staff also dismisses any substantial economic impacts from the draft standard by assuming that price increases associated with compliance will be modest and unlikely to deter purchases in the long term. There is no rigorous analysis behind this assumption. The upholstered furniture industry operates with very thin margins and faces increasing competition from foreign manufacturers, especially China. Consequently, to the extent that costs cannot be passed through to consumers, many domestic firms could be at risk. While foreign manufacturers must also legally meet the standards, they may be able to do so at lower costs because of lower labor and materials costs. This along with the prospect of lower compliance levels may provide foreign manufacturers with a further competitive advantage.

Figure 7a: CPSC Staff Estimates v. CRA Estimates of the Costs and Benefits of the Staff's Draft Standard and a Smolder-Only Standard

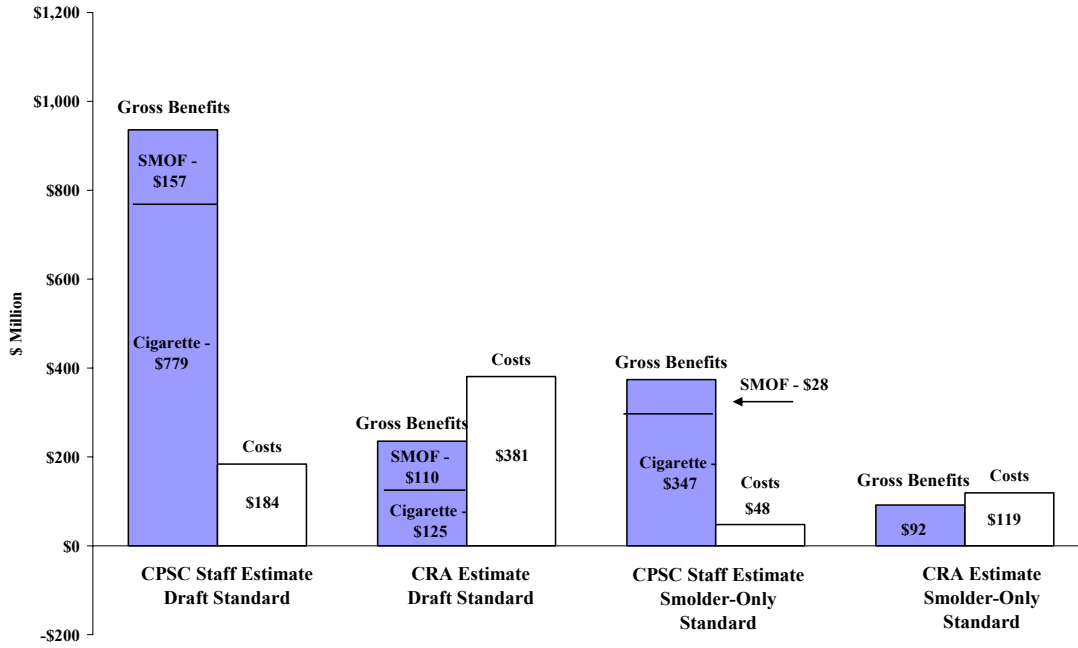
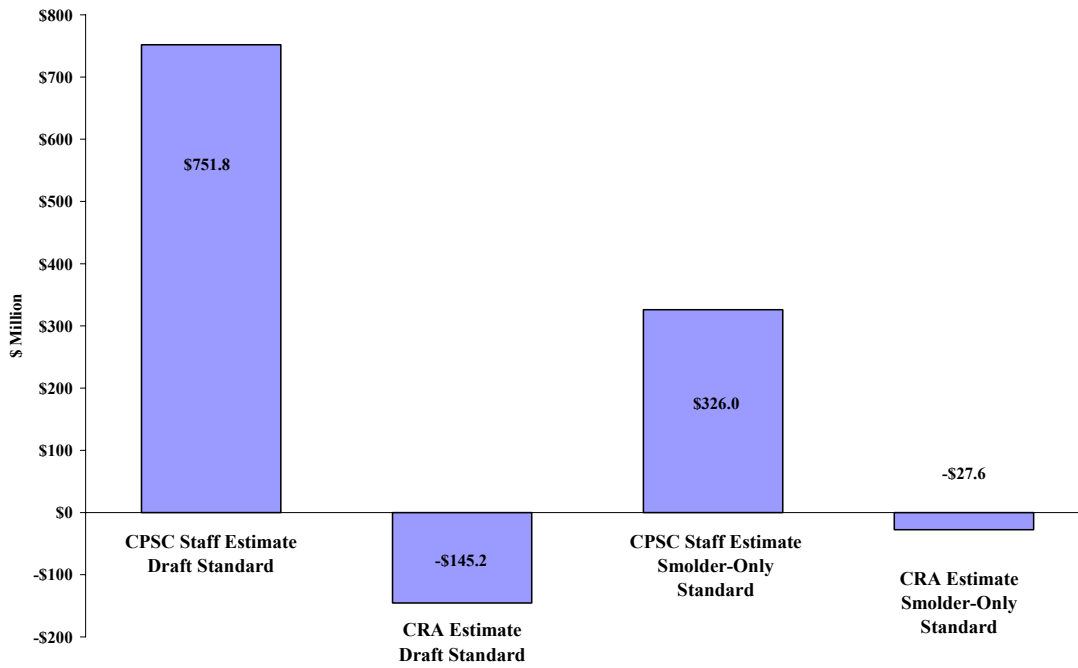


Figure 7b: CPSC Staff Estimates v. CRA Estimates of the Net Benefits of the Staff's Draft Standard and a Smolder-Only Standard



APPENDIX 1 : NFIRS DATA

In its cost-benefit analysis, the CPSC staff relies on the National Fire Incident Reporting System (NFIRS) database to estimate the annual societal costs of cigarette- and small open flame-ignited upholstered furniture fires. NFIRS is arguably the most detailed and comprehensive data source on fires in the United States, and can provide meaningful estimates of U.S. fire losses, especially on a macro level. However, there are a number of reasons to treat the CPSC staff's NFIRS-based national fire loss estimates – which represent a specific and small portion of all U.S. fire losses – with caution. This appendix provides an overview of the NFIRS database and the adjustments made by the CPSC staff to estimate national fire loss figures, and discusses the concerns associated with the data and the Commission's adjustments.

Overview of NFIRS

NFIRS was established by the United States Fire Administration (USFA) in the mid-1970s to help state and local governments develop fire reporting capabilities as well as to create a uniform reporting system to analyze data at the national level. The NFIRS system is voluntary – individual fire departments across the U.S. choose to participate – and is thus not a random sample, which can create difficulties in extrapolating figures to a national level. However, the strength of NFIRS is that it gathers detailed information on fire incidents, including information on the ignition factor, the form of material first ignited, the form of heat of ignition, the number of casualties, and the amount of property loss. Over the years, NFIRS has grown in both participation and use: all 50 states, more than 40 major metropolitan areas, and more than 15,000 fire departments have participated in NFIRS in at least one year since its inception. At present, NFIRS is the world's largest database of fire incident information.¹⁴⁵

Though participation has grown over time, NFIRS is currently estimated to record only 40 percent of the fires that occur in the United States in a given year. To project NFIRS results to a national level, the data are typically supplemented by the annual stratified random-sample survey of fire experience conducted by the National Fire Protection Association (NFPA). This survey produces nationally-representative figures for the total number of fire incidents and associated civilian deaths, civilian injuries, and property damage for different property-use classes (*e.g.*, residential structures), which can be used to project national totals from NFIRS counts. Specifically, to project NFIRS figures to the national level, researchers typically multiply the number of fires (deaths, injuries, property damage) of interest reported in NFIRS by the ratio of the number of residential structure fires (deaths, injuries, property damage) reported by the NFPA to the number of residential structure fires (deaths, injuries, property damage) reported in NFIRS.

However, before extrapolating figures to a national level, NFIRS data typically undergo another large adjustment to account for the large number of unknowns in the data. To

¹⁴⁵ NFIRS, "Complete Reference Guide," January 2004, viii.

calculate fire losses for specific types of fires (*e.g.*, cigarette- and small open flame-ignited furniture fires), one relies on NFIRS variables that code for the fire's heat source and item first ignited, but, for a large proportion of observations, heat source and/or item first ignited are missing or reported as unknown in NFIRS. In fact, the CPSC staff recently reported that, from 1999-2002, heat source was unknown for 22 percent to 32 percent of residential structure fires, and 46 percent to 48 percent of civilian residential structure fire deaths, while item first ignited was unknown for 16 percent to 29 percent of residential structure fires, and 35 percent to 43 percent of residential structure fire deaths.¹⁴⁶ To avoid estimates that are negatively biased, it is necessary to allocate unknowns to specific categories before scaling up to a national level. The CPSC staff's methodology allocates unknown fires and fatalities proportionally across all categories, under the assumption that fires with unreported characteristics, if known, would have the same proportions as the fires with known characteristics.

Previously, the CPSC staff allocated unknowns following a procedure referred to as the "national estimates method."¹⁴⁷ Using this method, variables are fit to the marginal one at a time without any iteration; for example, if 20 percent of fires with a reported heat source have cigarettes as the heat source, then 20 percent of fires with an unreported heat source are assigned cigarettes as the heat source. Other variables of interest are allocated in a similar fashion. As a result of this method, the first variable imputed fits the marginals exactly, but other variables do not. Consequently, allocated values are sensitive to the order of the variables used in the allocation.¹⁴⁸

In 2000, the CPSC staff revised its methodology for allocating unknowns, adopting a technique known as "raking." Like the national estimates method, raking relies on the assumption that fires with unknown characteristics have the same proportions as fires with known characteristics, but it employs an iterative technique to allocate unknowns. Consequently, results are not sensitive to the order in which variables are allocated.¹⁴⁹ As a side note, the NFPA does not appear to rely on raking; rather, it appears to continue to use the national estimates method previously used by the CPSC.¹⁵⁰

As a final caveat, a major revision to the NFIRS data coding system was implemented in 1999. Among other changes, "partial unknown" codes for fire characteristics were eliminated; in other words, prior to 1999, a fire department could identify the item first

¹⁴⁶ These percentages reflect the number of observations with unknown values after the CPSC performed "edits" to the data to "lessen the extent of missing data." (Risana Chowdhury, Michael Greene, David Miller, and Linda Smith, "1999 Revised - 2002 Residential Fire Loss Estimates," CPSC Division of Hazard Analysis, Directorate for Epidemiology, November 2005, p. 28.)

¹⁴⁷ John R. Hall, Jr., and B. Harwood, "The National Estimates Approach to U.S. Fire Statistics," *Fire Technology*, 1989, pp. 99-113.

¹⁴⁸ Michael A. Greene, Linda E. Smith, Mark S. Levenson, Signe Hiser, and Jean C. Mah, "Raking Fire Data," Consumer Product Safety Commission, p. 2.

¹⁴⁹ Raking is accomplished with a set of SAS macros written at Abt Associates.

¹⁵⁰ This is inferred from several NFPA reports from 2004 and 2005. See, for example, Kimberly D. Rohr, "Products First Ignited in U.S. Home Fires," National Fire Protection Association, April 2005, Appendix B.

ignited in a fire as “furniture, unable to classify further” if the specific type of furniture ignited was unknown. The inclusion of partial unknown codes required the CPSC staff to follow a two-stage methodology for allocating unknowns: the first stage dealt with true unknown observations, while the second stage attempted to allocate partial unknowns across specific codes within a category. The 1999 revision removed partial unknown codes, so that the CPSC staff no longer performs a two-stage allocation of unknowns. Other significant changes were also made to NFIRS, so much so that the CPSC staff “strongly discourages” comparisons of post-1998 estimates with estimates from earlier years.¹⁵¹ We disagree with this caution with respect to following the basic trends in fires and fire deaths because the definition changes have little, if any, effect on the basic measurements.

Concerns

Over time, the CPSC staff has gradually refined its methodology for estimating NFIRS-based national fire loss figures, and has corrected a number of obvious flaws in its estimation technique. In response to a 1999 General Accounting Office (GAO) report criticizing the CPSC staff’s methodology at the time, the most recent CPSC staff cigarette- and small open flame-ignited furniture fire loss figures represent the number of deaths and injuries that are actually “addressable” by the draft standard.¹⁵² For example, estimated losses are exclusive of losses from fires involving electrical equipment, fires started in rooms unlikely to contain upholstered furniture, arson fires, *etc.* However, there are still a number of reasons to treat the staff’s NFIRS-based national estimates of fire losses with concern.

A major concern with NFIRS, in general, relates to the fact that it is a voluntary program. Fire departments reporting to NFIRS may not be representative of U.S. fire departments as a whole, implying that NFIRS figures are susceptible to systematic bias. As NFPA researcher John Hall explains:

“...participation rates in NFIRS are not necessarily uniform across regions and sizes of community, both of which are factors correlated with frequency and severity of fires. This means NFIRS may be susceptible to systematic bias. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems.”¹⁵³

Because it is unknown whether and how much the sample of fire departments reporting to NFIRS strays from a representative sample of U.S. fire departments, it is difficult to

¹⁵¹ Risana Chowdhury, Michael Greene, David Miller, and Linda Smith, "1999 Revised - 2002 Residential Fire Loss Estimates," CPSC Division of Hazard Analysis, Directorate for Epidemiology, November 2005, p. 3.

¹⁵² See U.S. General Accounting Office, “Consumer Product Safety Commission – Additional Steps Needed to Assess Fire Hazards of Upholstered Furniture,” November 1999.

¹⁵³ John R. Hall, Jr., “The Smoking-Material Fire Problem,” Fire Analysis and Research Division, National Fire Protection Association, November 2004, p. 47.

ascertain the precision of NFIRS-based national fire loss estimates, a concern voiced by the General Accounting Office in 1999.¹⁵⁴

The CPSC staff's process of allocating unknowns creates additional concerns with NFIRS-based fire loss estimates, especially for fires that represent a small and specific portion of the total U.S. fire experience. As previously noted, the CPSC staff adopted raking to alleviate concerns associated with its method of allocating unknowns. Raking corrects for one of the problems associated with the national estimates method, but it continues to present a number of issues. First, raking is still based on the assumption that the proportion of different types of fires among fires with unknown characteristics is equal to the proportion among fires with known characteristics. In fact, there may be substantial differences in the proportions, perhaps because some types of fires are more easily identified than others. The lack of evidence to support this implicit assumption of raking adds additional uncertainty to national fire loss estimates obtained from raked NFIRS data.

Second, raking works optimally with large data sets, and can produce unreliable estimates when the number of reported fires, deaths, or injuries is small. As recently acknowledged by the CPSC staff, "the raking algorithm cannot appropriately produce raked results when cell values are zero or very low," which suggests that the CPSC staff's estimates of the number of deaths and injuries from cigarette- and small open flame-ignited fires may overstate or understate actual losses.¹⁵⁵ This is because, while there are hundreds of reported cigarette- and small open flame-ignited upholstered furniture fires in the NFIRS data, there are substantially fewer reported cigarette- and small open flame-ignited furniture fire injuries and deaths. For example, in 2002, there were only 31 reported deaths from cigarette-ignited furniture fires, and 9 reported deaths from small open flame-ignited furniture fires. In recent years, the death figures for cigarette-related fires and the death and injury figures for small open flame-related fires have arguably been sufficiently low to produce unreliable raked results.

Specifically, raking may substantially *overstate* deaths associated with cigarette- and small open flame-ignited fires. Relying on raked NFIRS data scaled to a national level (referred to as "raked and scaled data," hereafter), the average number of deaths per deadly cigarette-related fire ranges between 1.16 and 1.74 from 1999 to 2002.¹⁵⁶ In contrast, when relying on raw NFIRS data, the average number of deaths per deadly cigarette-ignited fire ranges between 1.03 and 1.22 during the same period. Raking cigarette-ignited furniture fire deaths therefore substantially increases the average number

¹⁵⁴ U.S. General Accounting Office, "Consumer Product Safety Commission – Additional Steps Needed to Assess Fire Hazards of Upholstered Furniture," November 1999.

¹⁵⁵ Risana Chowdhury, Michael Greene, David Miller, and Linda Smith, "1999 Revised - 2002 Residential Fire Loss Estimates," CPSC Division of Hazard Analysis, Directorate for Epidemiology, November 2005, p. 34.

¹⁵⁶ To estimate the number of deadly cigarette-ignited fires, we multiplied the number of cigarette-ignited fires obtained using raked and scaled data by the percent of NFIRS-reported cigarette-ignited furniture fires that were deadly.

of deaths per deadly fire. As shown in Table 15, the same holds true for small open flame-ignited fire deaths, though this trend is harder to establish for injuries (per fire) for cigarette- and small open flame-ignited fires. There is no reason why raking should increase the average number of deaths per deadly fire, unless there is evidence to show that deadly fires that take many lives are more likely to have unknown characteristics than deadly fires that take fewer lives.

Table 15: Comparison of Average Number of Deaths per Deadly Fire and Injuries per Fire Raked and Scaled NFIRS Data vs. Raw NFIRS Data

Year	Cigarettes				Total Small Open Flames			
	Injuries per Fire		Deaths per Deadly Fire		Injuries per Fire		Deaths per Deadly Fire	
	Raked and Scaled	Raw	Raked and Scaled	Raw	Raked and Scaled	Raw	Raked and Scaled	Raw
1980	0.07	0.18	1.31	1.22	0.08	0.23	1.22	1.25
1981	0.07	0.17	1.67	1.21	0.09	0.23	1.93	1.83
1982	0.07	0.17	1.47	1.25	0.10	0.24	1.66	1.23
1983	0.13	0.15	1.48	1.18	0.13	0.16	2.24	1.47
1984	0.10	0.09	1.72	1.24	0.13	0.13	1.72	1.59
1985	0.11	0.14	1.37	1.14	0.12	0.17	1.87	1.71
1986	0.11	0.14	1.52	1.27	0.15	0.21	2.03	1.53
1987	0.12	0.14	1.60	1.20	0.14	0.17	1.86	1.65
1988	0.13	0.14	1.63	1.23	0.13	0.15	2.06	1.56
1989	0.12	0.14	1.55	1.14	0.16	0.18	2.01	1.44
1990	0.14	0.16	1.54	1.13	0.19	0.22	2.09	1.47
1991	0.14	0.15	1.48	1.22	0.21	0.22	2.62	1.88
1992	0.12	0.14	1.42	1.18	0.16	0.20	1.64	1.43
1993	0.16	0.16	1.67	1.12	0.17	0.18	1.53	1.13
1994	0.15	0.17	1.31	1.13	0.17	0.20	1.94	1.90
1995	0.14	0.16	1.93	1.14	0.18	0.22	1.58	1.31
1996	0.16	0.18	1.96	1.14	0.17	0.21	1.39	1.00
1997	0.14	0.16	1.93	1.26	0.21	0.24	2.02	1.14
1998	0.15	0.15	1.79	1.27	0.18	0.20	1.77	2.00
1999	0.13	0.14	1.57	1.11	0.16	0.17	1.48	1.00
2000	0.13	0.13	1.74	1.11	0.18	0.17	2.92	1.80
2001	0.13	0.15	1.45	1.22	0.16	0.17	2.02	1.60
2002	0.10	0.14	1.16	1.03	0.15	0.20	1.72	1.50

Sources:

1980-2002 NFIRS data, 1980-2002 NFPA national fire experience surveys.

To estimate deaths and injuries more reliably, we rely on raked NFIRS data to estimate the number of cigarette- and small open flame-ignited furniture fires in the U.S. For these types of *fires* (as opposed to deaths and injuries from these types of fires), there are, most likely, sufficient cell counts to produce reliable raked results. To estimate deaths, we then multiply the estimated number of deadly cigarette- or small open flame-ignited furniture fires in the U.S. by the average number of deaths per cigarette- or small open flame-ignited furniture fire as calculated from raw NFIRS data. Using this methodology, we estimate that there were only 202 deaths from cigarette-ignited furniture fires annually from 1999-2002, and 45 deaths from small open flame-ignited furniture fires annually from the same period. These figures are substantially smaller than the figures obtained by raking deaths: 266 and 69 for cigarette- and small open flame-related deaths, respectively.

We estimated more reliable injury figures using a similar approach, multiplying the number of estimated U.S. fires (using raked and scaled NFIRS data) by the average number of injuries per fire as calculating using raw NFIRS data. We acknowledge that these figures may understate the true number of deaths and injuries from these types of fires, if heat source and item first ignited are harder to identify for deadly fires that take more lives than for deadly fires that take fewer lives, all else being equal. However, we have seen no evidence to support this conjecture. At the very least, these estimates demonstrate the unreliability of the CPSC staff's NFIRS-based fire loss estimates.

To further illustrate the imprecision of raking deaths, we draw attention to the CPSC staff's estimate of "addressable" small open flame-related deaths in 2000.¹⁵⁷ The CPSC staff estimates that there were 120 deaths from addressable small open flame-ignited furniture fires in 2000, twice as many as the next largest annual death figure for the 1999-2002 time period. Using the CPSC staff's raking methodology, we similarly found that there were 140 deaths from all small open flame-ignited furniture fires in 2000, a figure substantially larger than all other annual death figures for these types of fires from the late 1990s and early 2000s. In our calculations, the 2000 small open flame death figure is large due to the large number of lighter-related fire deaths calculated in that year. To be more precise, we calculated, without making any edits to the NFIRS data prior to raking, that there were 110 deaths from lighter-ignited furniture fires in 2000. This number is almost twice as large as all other annual lighter-related death figures *from the past decade*.

While it is possible there were an enormous number of deaths from lighter-ignited furniture fires in 2000, it is more likely that the CPSC staff's raking algorithm overstates the number of lighter deaths in that year. We performed Grubbs' outlier test on the series of lighter-ignited fire death figures from 1992 to 2002, and identified the 2000 figure as an outlier. More specifically, the 2000 figure was a mild outlier in the data (it was between 1.5 times and 3.0 times the interquartile range above the third quartile of the data). We also performed outlier tests on our raked and scaled estimates of cigarette-, match-, and candle-ignited furniture fire deaths from 1980 to 2002, and did not identify any other mild or severe outliers in the data.

We offer one more example demonstrating the sensitivity of raked results to extreme observations when cell values are low. As noted above, it is likely that the large number of lighter-related deaths in 2000 results from a particularly fatal lighter-fire reported in NFIRS, or some other extreme observation in the data. Upon closer inspection of the 2000 NFIRS casualty data, we identified one lighter-ignited upholstered furniture fire that took four lives, significantly more fatalities than most residential fires. To put this figure in perspective, of all the deadly residential structure fires reported in NFIRS in 2000, less than 3 percent took four or more lives. By dropping the deaths associated with this one fire prior to raking the data, the extrapolated number of lighter-ignited furniture fire

¹⁵⁷ CPSC Staff Memorandum from Mark S. Levenson (Division of Hazard Analysis) to Dale Ray (Directorate for Economic Analysis), "Upholstered Furniture Addressable Fire Loss Estimates for 1999-2002," November 21, 2005, p. 3.

deaths in 2000 falls to 83, a 33 percent decline. In other words, one fire in the NFIRS 2000 database added 27 deaths to our estimate of U.S. lighter-ignited furniture fires, a demonstration of the powerful effect of extreme values on raked estimates.

Overall, the points above raise some serious concerns regarding the uncertainties associated with national estimates based on NFIRS data, especially when investigating a specific and small portion of the overall U.S. fire experience. Although NFIRS may be the best data source available for estimating cigarette- and small open flame-ignited upholstered furniture fire losses, the CPSC staff's NFIRS-based national estimates should be interpreted with caution.

APPENDIX 2 : PANEL DATA REGRESSIONS

We have strong reason to believe that the number of cigarette-ignited upholstered furniture fires will continue to decline in the future due to a continuing decline in cigarette consumption and smoking prevalence.

Cigarette-ignited upholstered furniture fire fatalities, as well as smoking prevalence and cigarette consumption, have steadily declined over time. Thus, there is a very strong correlation between fire fatalities and smoking prevalence. However, correlation does not imply causation, and it is possible that outside factors are responsible for the decline in both. If these other factors are not expected to decline in the future along with smoking prevalence, then we might overstate future reductions in cigarette-related fatalities.

To test this hypothesis, we would ideally run regressions including other variables that we believe affect the rate of cigarette-related fatalities, such as alcohol consumption, household income, and education. The addition of variables to the national-level regression, however, causes the data to run out of degrees of freedom. Furthermore, at the national level, many of these variables are highly correlated, which causes multicollinearity problems in a regression.

To correct for these effects, we run a series of regressions using state-level data with the additional variables. The data span the same time period (1983 through 2002), but include cross-sectional data from all 50 states and the District of Columbia. This increases the number of observations, alleviating both the degrees of freedom and multicollinearity problems. However, because smoking prevalence data is not complete on the state level, we use cigarette consumption as a proxy for smoking prevalence in the regression.

We ran the following panel data regression:

$$fatality_rate = \alpha + \beta_1 \cdot cig_cons + \beta_2 \cdot alc_cons + \beta_3 \cdot povrate + \beta_{4-54} \cdot state + \varepsilon ,$$

where *fatality_rate* is equal to the number of deaths per million population due to cigarette-ignited upholstered furniture fires, *cig_cons* is the average number of packs of

cigarettes consumed by adults (persons age 18 or older) per year, *alc_cons* is the average amount of alcohol consumed by adults per year in gallons of ethanol equivalent, *povrate* is the state poverty rate, and *state* are state dummy variables. The regression was run for the years 1983-2002 using the *xtgee* generalized estimating equation for population-averaged panel data method in Stata.

Table 16 shows the results of the regression. We found that the coefficient for cigarette consumption per adult is positive and highly significant, indicating that lower cigarette consumption results in fewer fire fatalities. The coefficient for poverty rate is also positive and significant, indicating that the number of fire fatalities may decrease as income levels rise. The coefficient for alcohol consumption is positive but not statistically significant. Alcohol consumption does not appear to have a strong effect on furniture fire fatalities.

The regression results strengthen our belief that there is a strong causal relationship between the decline in smoking prevalence (and cigarette consumption) and the decline in cigarette-ignited upholstered furniture fire fatalities. As smoking prevalence continues to fall, both the number and rate of fire fatalities will continue to decline as well.

Table 16: Cigarette-Ignited Upholstered Furniture Fire Fatalities
Panel Data Analysis, 1983-2002

Number of Observations	824
Number of Groups (States)	51
Observations per State (min)	2
Observations per State (avg)	16.2
Observations per State (max)	20
Wald Chi Squared (3)	56.43
Pr > Chi Squared	0.00

	coeff.	semi-robust std. err.	z	Pr > z
Cigarette Consumption per Adult	0.009	0.002	3.93	0.000
Alcohol Consumption per Adult	0.121	0.173	0.70	0.484
Poverty Rate	6.325	2.221	2.85	0.004
Constant	-1.229	0.529	-2.32	0.020

Notes:

Fatalities data are extrapolated from NFIRS data using CDC death certificates for all fire death.

Cigarette consumption is measured in packs.

Alcohol consumption is measured in gallons of ethanol equivalent.

Sources:

Alcohol Epidemiologic Data System, National Institute on Alcohol Abuse and Alcoholism.

U.S. Census Bureau, Poverty and Health Statistics Branch, Current Population Reports.

U.S. Census Bureau, 1983-2002.

Tax Burden on Tobacco, Historical Compilation, Volume 38, 2003.

NFIRS, 1983-2002.

CDC WONDER database, fire death certificates.

APPENDIX 3: CRA COST-BENEFIT ESTIMATION MODEL

Assumptions

Our cost-benefit estimation model is similar in basic structure to CPSC staff methodology. We use the risk rates calculated by the CPSC for furniture covered in each fabric type to divide annual deaths and injuries among the categories. Following the CPSC methodology, leather, wool, and vinyl-coated furniture are assumed to be highly fire resistant. Furniture units covered in these materials are excluded from further analyses due to possessing a negligible risk rate. We take an additional step and divide losses (deaths, injuries, and property damage) assigned to each fabric type among households based on smoking/non-smoking status and presence or absence of working, effective smoke detectors. There are therefore four groups of households:

- smoking households with working smoke detectors,
- non-smoking households with working smoke detectors,
- smoking households without working smoke detectors, and
- non-smoking households without working smoke detectors.

This designation makes it possible to compare costs and benefits for each group.

To estimate the shares of each of these types of households, we rely on several facts provided by the NFPA. First, we estimate that 77% of homes (smoking and non-smoking) have at least one working, effective smoke detector, based on the findings that approximately 96% of homes have a smoke detector, and that 20% of these homes have non-functional smoke detectors ($.96 \times .80 = .768$).¹⁵⁸ From CDC data, we also know that approximately 23% of the adult U.S. population smokes, so we assume that about 23% of households contain at least one smoker.¹⁵⁹

In the case of cigarette losses, we assume that the chance of a cigarette-ignited furniture fire igniting in a non-smoking household is zero.¹⁶⁰ As a result, all of the losses stemming from cigarette-ignited furniture fires are assumed to occur in households with at least one smoker. Based on NFPA findings on the fire risk of not owning working smoke detectors, we then allocated 70% of total fires in each category to the group of smoking households without working smoke detectors (about 23% of smoking households were estimated to not have a working smoke detectors) and the remaining

¹⁵⁸ Marty Ahrens, "U.S. Experience with Smoke Alarms and Other Fire Detection/Alarm Equipment," Fire Analysis and Research Division, National Fire Protection Association, November 2004, p.16.

¹⁵⁹ CDC smoking prevalence rates, 1980-2003, available at http://www.cdc.gov/tobacco/research_data/adults_prev/prevali.htm, site visited February 27, 2006.

¹⁶⁰ This assumes that non-smokers would not allow smoking in their home. Even if this is not strictly true, it would not modify our results substantially.

30% of losses to smoking households with working smoke detectors.¹⁶¹ We did this for all furniture categories.

For SMOF-ignited fires, we assume that the risk of death or injury does not vary with smoking status (this may not be the case, but a lack of data prevents us from assuming otherwise). As with cigarette losses, we assign 70% of losses to households without a working smoke detector and 30% of losses to households with a working smoke detector.

We recognize that cigarette-related fatalities and injuries have steadily declined over time because of the decline in smoking prevalence. Thus, for the sixteen-year lifetime of a piece of upholstered furniture, we estimate the number of cigarette fire fatalities and injuries using our regression results, as seen in Table 6. We assume that the CPSC standard would go into effect immediately, and so the starting year would be 2006. Thus, we estimate upholstery furniture fire fatalities and injuries for the years 2006 through 2021. Our calculated values for fatalities and injuries in 2006 due to cigarette-ignited upholstered furniture fires are 235 and 421, dropping in year 2021 to 125 and 209, respectively. While we expect property damage to fall alongside fatalities and injuries, there are insufficient data to calculate a trend. We instead use the CPSC's values for property damage – \$102 million for cigarette fires and \$48 million for SMOF fires – for every year in the lifetime of the furniture.

Our regression results, however, do not account for the potential impact of the fire-safe cigarette standard. To incorporate the expected further decline in cigarette-ignited fires because of the passage of the fire-safe cigarette standard, we use our estimated effectiveness of the fire-safe cigarette standard (50%) to decrease the number of expected fatalities in the three states which have currently passed fire-safe cigarette standards (New York, California, and Vermont), starting from the year the standard goes in effect. To do this, we first estimate the percentage of upholstered furniture fire-related deaths that occur in each state. This is done using the NFIRS data, extrapolated using the CDC death certificate data. The value we use is the average percentage of all upholstered furniture fire deaths in each state for the latest ten years in which data are available (1993-2002). We assume that the reduction in fatalities due to the effectiveness of the fire-safe cigarette standard takes effect starting in 2006 in New York because the standard is already in effect. For Vermont and California, we assume that the fire-safe cigarette standard takes effect starting in 2007.¹⁶² We calculate that the three states account for 12.1% of national upholstered furniture fire deaths. Thus, in 2006 we decrease cigarette deaths by 3.5 percent (as New York represents 7 percent of fire deaths historically; 7 percent x 50 percent effectiveness = 3.5 percent), and in 2007 we reduce cigarette deaths by 2.6 percent (as California and Vermont represent 5.2 percent of fire deaths historically; 5.2 percent x 50 percent effectiveness = 2.6 percent).

¹⁶¹ Marty Ahrens, "U.S. Experience with Smoke Alarms and Other Fire Detection/Alarm Equipment," Fire Analysis and Research Division, National Fire Protection Association, November 2004, p. 25.

¹⁶² In actuality, Vermont's standard will go into effect in May 2006, and California's standard will go into effect January 2007. (See footnote 54.)

These assumptions are conservative, as we have not accounted for other states that may pass fire-safe cigarette bills; additional support for this measure will further decrease the number of expected deaths. Furthermore, we have not accounted for the effectiveness of the fire-safe cigarette standard in reducing injuries and property damage, both of which are very likely to decline along with fatalities.

For small open flame fires, Tables 2a and 2b indicate that there has been a small decline in injuries and deaths in recent years. The variation per year is large relative to the absolute numbers, so as a conservative measure, we hold SMOF deaths, casualties, and property damage constant across all 16 years, using the CPSC estimates of 60 deaths and 260 injuries.

Methodology

To calculate yearly societal costs for each furniture/household category, we first allocate cigarette and SMOF deaths, injuries, and property damage to each of the four furniture categories according to the overall risk percentages (taken from the CPSC staff report) of each furniture category in regard to cigarette and SMOF fires. Cigarette-related fatalities are adjusted downward to account for the reduction in deaths due to the state fire-safe cigarette regulations. Next, the losses in each furniture category are divided between households with working smoke detectors and households without smoke detectors: 30% in the former and 70% in the latter.

For each year, the annual societal cost is calculated for each category of furniture and category of household by converting losses to dollar values by multiplying deaths by the statistical value of life (\$5 million and \$2.9 million) and injuries by the average injury cost (\$187,449). A per-unit societal cost is then calculated by dividing the societal cost by the number of furniture units in that household/furniture category. We are assuming that furniture purchases in each furniture category are the same among the types of households; in reality, this is not the case, as discussed above in Section III.B.4. Note that, for small open flame fires, smoking and non-smoking households have the same societal costs. By assumption, all the societal costs associated with cigarette fires are allocated to smoking households.

The total per-unit societal costs for each type of furniture in each category of household is calculated by discounting all 16 years of annual societal costs back to the starting year (2006) using the discount rate. For each combination of furniture category and ignition source, the per-unit benefit of the CPSC standard is equal to the per-unit societal cost multiplied by the effectiveness rate of the standard. The total per-unit benefit of the standard for each household/furniture category is the sum of the cigarette and SMOF per-unit benefits.

We can now calculate the per-unit net benefits of the standard for each combination of furniture category and household type. This is equal to the difference between the per-unit benefits and the compliance costs for that furniture category. Note that the compliance cost only varies with furniture category, and does not vary with household

type. By multiplying the per-unit net benefits by the number of *new* furniture units expected to be produced in each household/furniture category, we arrive at a total net benefit of the standard for each household/furniture category. Summing across categories, we arrive at the total net benefit of the CPSC standard.

Results for Base Case

Table 17 shows the output of our cost-benefit estimation model under our base case assumptions. Smoking households without smoke detectors is the only group with a positive total net benefit. Smoking households with smoke detectors and non-smoking households all have negative total net benefits. Non-smoking households and smoking households with smoke detectors are, in effect, subsidizing smoking households without working smoke detectors. This effect is not surprising, given that the majority of societal benefits associated with the standard would come from a decline in cigarette-ignited fire deaths and injuries. The magnitude of the benefits disparity leads us to believe that a more efficient standard is possible (that is, one that imposes costs on the people who would receive the benefits). The fire-safe cigarette standard would be a much more efficient solution, while providing larger benefits in fires and deaths prevented.

**Table 17: Results of CRA Cost-Benefit Model Under
CRA's Base Case Assumptions**

Smoking HH's with Smoke Detectors

Upholstery Covering Type	Per-Unit Societal Benefits	Per-Unit Costs	Per-Unit Net Benefits (All)	Units	Total Net Benefits
Heavyweight Cellulosics	\$41.62	\$41.85	(\$0.23)	574,221	(\$130,104)
Medium Weight Cellulosics and Blends	\$26.51	\$13.08	\$13.43	274,870	\$3,692,847
Lightweight Cellulosics and Blends	\$9.99	\$13.08	(\$3.09)	642,104	(\$1,984,056)
Thermoplastics	\$3.13	\$13.08	(\$9.95)	2,390,363	(\$23,795,990)
<i>All Furniture</i>			(\$5.72)	3,881,558	(\$22,217,303)

Smoking HH's without Smoke Detectors

Upholstery Covering Type	Per-Unit Societal Benefits	Per-Unit Costs	Per-Unit Net Benefits	Units	Total Net Benefits
Heavyweight Cellulosics	\$321.67	\$41.85	\$279.82	173,463	\$48,537,984
Medium Weight Cellulosics and Blends	\$204.98	\$13.08	\$191.90	83,033	\$15,933,759
Lightweight Cellulosics and Blends	\$77.33	\$13.08	\$64.25	193,969	\$12,463,438
Thermoplastics	\$24.31	\$13.08	\$11.23	722,089	\$8,109,840
<i>All Furniture</i>			\$72.53	1,172,554	\$85,045,021

Non-Smoking HH's with Smoke Detectors

Upholstery Covering Type	Per-Unit Societal Benefits	Per-Unit Costs	Per-Unit Net Benefits	Units	Total Net Benefits
Heavyweight Cellulosics	\$1.86	\$41.85	(\$39.99)	1,922,393	(\$76,870,821)
Medium Weight Cellulosics and Blends	\$1.95	\$13.08	(\$11.13)	920,215	(\$10,239,861)
Lightweight Cellulosics and Blends	\$1.95	\$13.08	(\$11.13)	2,149,653	(\$23,935,835)
Thermoplastics	\$1.98	\$13.08	(\$11.10)	8,002,520	(\$88,851,136)
<i>All Furniture</i>			(\$15.38)	12,994,781	(\$199,897,653)

Non-Smoking HH's without Smoke Detectors

Upholstery Covering Type	Per-Unit Societal Benefits	Per-Unit Costs	Per-Unit Net Benefits	Units	Total Net Benefits
Heavyweight Cellulosics	\$14.55	\$41.85	(\$27.30)	580,723	(\$15,852,201)
Medium Weight Cellulosics and Blends	\$15.25	\$13.08	\$2.17	277,982	\$603,424
Lightweight Cellulosics and Blends	\$15.20	\$13.08	\$2.12	649,374	\$1,373,778
Thermoplastics	\$15.44	\$13.08	\$2.36	2,417,428	\$5,715,636
<i>All Furniture</i>			(\$2.08)	3,925,507	(\$8,159,363)

All Households

Upholstery Covering Type	Per-Unit Societal Benefits	Per-Unit Costs	Per-Unit Net Benefits	Units	Total Net Benefits
Heavyweight Cellulosics	\$28.22	\$41.85	(\$13.63)	3,250,800	(\$44,315,142.28)
Medium Weight Cellulosics and Blends	\$19.50	\$13.08	\$6.42	1,556,100	\$9,990,169.27
Lightweight Cellulosics and Blends	\$9.76	\$13.08	(\$3.32)	3,635,100	(\$12,082,674.43)
Thermoplastics	\$5.78	\$13.08	(\$7.30)	13,532,400	(\$98,821,650.37)
<i>All Furniture</i>			(\$6.61)	21,974,400	(\$145,229,298)

Sensitivity Analysis

For sensitivity analysis, we run our model adjusting the effectiveness of the CPSC standard, the discount rate used to discount future costs and benefits, the compliance costs for furniture, and the statistical value of life. For the CPSC standard effectiveness, we test three different values: the effectiveness rates specified in the CPSC Economic Report, the effectiveness rates implicated by the updated Surrey Report, and the CRA numbers. The values used in each are presented in Table 18.

Table 18: Effectiveness Rates Used in Sensitivity Analyses of CPSC Assumptions and CRA Assumptions

	Cigarette-Ignited Furniture Fires		SMOF-Ignited Furniture Fires	
	Severely Ignition Prone Cellulosics	All Other Furniture Categories	Severely Ignition Prone Cellulosics	All Other Furniture Categories
<i>Sensitivity Analysis of CPSC Assumptions</i>				
High Effectiveness	79.8%	67.4%	84.0%	50.0%
Medium Effectiveness (50% of CPSC Rates)	39.9%	33.7%	42.0%	25.0%
Low Effectiveness (CRA Rates)	22.0%	22.0%	48.0%	50.0%
<i>Sensitivity Analysis of CRA Assumptions</i>				
High Effectiveness	79.8%	67.4%	84.0%	50.0%
Medium Effectiveness (New Surrey Report Rates for Cigarettes)	40.0%	40.0%	48.0%	50.0%
Low Effectiveness (CRA Rates)	22.0%	22.0%	48.0%	50.0%

We also test three different values for the interest rate: 3%, 7%, and 10%. For the statistical value of life, we test the CPSC’s \$5 million and \$2.9 million based on the meta study.¹⁶³

Different values for compliance costs are also tested. Costs are different for heavyweight cellulosics than for the other categories (leather, wool, and vinyl-covered furniture do not require changes, and so do not incur any costs). We use the cost estimates discussed in Section IV in our model.

¹⁶³ See Section III.B.6.

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