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A CASE STUDY OF THE IMPACTS OF CONSUMER SAFETY STANDARDS: THE 1973 MATTRESS FLAMMABILITY STANDARD

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Working Paper No. 008

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A CASE STUDY OF THE IMPACTS OF CONSUMER SAFETY STANDARDS: THE 1973 MATTRESS FLAMMABILITY STANDARD

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ABSTRACT

A CASE STUDY OF THE IMPACTS OF CONSUMER SAFETY STANDARDS:

THE 1973 MATTRESS FLAMMABILITY STANDARD

Peter Linneman

This paper examines one of the earlier regulations of the Consumer Product Safety Commission, the 1973 Mattress Flammability Standard. It is found that the standard increased consumer safety by $1 million to $106 million (depending on parametric assumptions) at a minimum cost of between $5 million to $66 million. The unique aspect of this study is that in addition to these traditional cost/benefit calculations, an attempt is made to estimate the size and direction of income transfers associated with the standard. The data strongly indicate that there was a wealth redistribution from small to large mattress producers. Weaker evidence of income transfers between consumer categories is also presented.

A CASE STUDY OF THE IMPACTS OF CONSUMER SAFETY STANDARDS: THE 1973 MATTRESS FLAMMABILITY STANDARD

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I. Introduction

In May 1973 the Consumer Product Safety Commission (CPSC) started operations under the authority of the Consumer Product Safety Act of 1972.[1] Its charge was "to protect the public against unreasonable risks associated with consumer products." The CPSC is empowered to establish and police mandatory product safety requirements. Its tools for enforcement include product seizures, injunctions, cease and desist orders, and civil and criminal penalties.

Several papers (see, for example, Broussalian [1975], Grabowski and Vernon [1978], and Oi [1973]) have discussed the conceptual problems posed by the phrase "unreasonable risks." However, in spite of the fact that the CPSC enacted regulations for over 80 products in its first three years, little effort has been directed to the measurement of the empirical impacts of CPSC standards. Therefore, there is currently an absence of evidence concerning the performance of the CPSC in accomplishing its congressional mandate.

This paper presents evidence which indicates that the CPSC flammability standard for mattresses has led to an increase in the safety of mattress consumers. However, this improved safety is obtained at the cost of higher mattress prices as well as several notable income redistribution effects. Grabowski

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[1] This act also gave the CPSC the responsibility of administering the Flammable Fabrics Act, the Federal Hazardous Substance Act, the Poison Prevention Packaging Act, and the Refrigerator Safety Act.

and Vernon (1978) refer to these income redistribution effects of safety standards as "unintended side effects," however, in this case, these impacts are large and anticipatable. This finding is discussed more fully in the context of the modern theories of economic regulation developed by Stigler (1971) and Peltzman (1976).

In Section II brief descriptions of the mattress industry and the 1973 flammability standard are presented. In the third section an evaluation of the impact of the standard on consumer safety is provided. It is found that the resource savings associated with the mattress standard have a present value of between $1 million and $106 million. Section IV develops an estimate of the impact of the standard on mattress prices while the fifth section provides descriptive evidence on the impact of the standard on the economic welfare of several specific population groups. The findings reported in this paper do not allow one to test alternative models of regulatory behavior as they represent only a single data point. Section VI does, however, examine whether the findings for this particular regulation are consistent with existing models of the regulatory process. In this context it is noted that these results are probably descriptive of the impacts of the many privately established product standards. It is also argued in that section that in order to develop a data base with which one can test alternative regulatory models, a methodology similar to that employed in this paper is required. This is because such tests will require not only traditional cost and benefit estimates of regulations but also estimates of their income redistribution effects.

II. Industry and Standard Background

The mattress industry employs approximately 32,000 employees in approximately 1,000 firms. Approximately 12 million new mattresses are sold annually with 80 percent of these being traditional innerspring mattresses. In 1972

annual (wholesale) sales were $420 million (in 1972 dollars). Approximately 25 percent of industry sales are accounted for by the four largest producers and half are accounted for by the largest 50 firms. The industry is geographically dispersed roughly in proportion to population largely due to the high cost of shipping mattresses.

In the summer of 1973 the CPSC, after a year of hearings and debate, enacted one of its first safety standards, the 1973 Mattress Flammability Standard. Simply stated, the standard requires that mattresses not burn (either with or without bedding) when exposed to cigarettes in control conditions and established record-keeping and testing procedures for producers. The standard is not a new technology standard and it has been estimated that approximately 80 percent of the mattresses being produced already satisfied the standard. Judging from material flammability studies the main sources of mattress failure appear to be untreated cotton and untreated latex foam.

III. The Impacts on Consumer Safety

Consistent with the stated objective of the CPSC, the proclaimed purpose of the 1973 Mattress Flammability Standard is "to protect the public against unreasonable risk of the occurrence of fire."[2] This section concentrates solely on whether the post-standard risk of injury is significantly less than the pre-standard level and does not attempt to answer whether this risk is "unreasonable."

Fires associated with mattress ignition impose resource costs in terms of property and personal damages. The annual resource cost associated with mattress fires is the sum of the monetary valuations of: pain and suffering, loss

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[2] Federal Register, Vol. 38, No. 10, Friday, June 8, 1973, p. 15095.

of life, hospital costs, recovery costs, and property damages. Formally this cost is defined as

$$(1) \qquad T = N(c \cdot H + W \cdot H + Q \cdot R + v \cdot P + S) + K \cdot D$$

where T = the total annual resource cost of mattress fires

N = the number of mattress burn victims (annually)

c = the average daily hospital cost per day

H = the average hospital stay (in days)

W = the average difference between the value of a day when healthy and a day spent in the hospital

Q = the average difference between the value of a day when healthy and a day spent recovering after leaving the hospital

R = the average post-hospital recovery period (in full day equivalents)

v = the average monetary value of a life

P = the average probability of death from a mattress burn

S = the average monetary value of pain and suffering

K = the annual number of mattress fires which damage property, and

D = the average property damage per mattress fire.

The term $c \cdot H$ in parentheses represents the average monetary outlay for one's hospital stay while the term $W \cdot H$ measures the foregone value of time (and possible earnings) associated with the time spent in the hospital. Similarly the term $Q \cdot R$ captures the foregone value of time (and possible earnings) associated with time spent recovering after leaving the hospital. The expression $v \cdot P$ measures the monetary value of lives lost through mattress fires while S measures the monetary costs associated with the pain and suffering associated with the burn. The last term, $K \cdot D$, captures the resource cost associated with property damage from mattress fires.

In order to keep the number of parameters in the system within the feasibility limits of available data, several simplifying assumptions are employed. First, it is assumed that the post-hospital recovery period is proportional with the length of hospital stay

$$R = \gamma H, \ \gamma > 0 \quad . \tag{2}$$

The second assumption is that the level of pain and suffering is approximated by a linear combination of the probability of death from a burn and the length of hospital stay

$$S = \alpha H + BP \quad , \tag{3}$$

where α is the proportional increase in the value of pain and suffering as the hospital stay increases and B is the analogous term for the probability of death from a burn. Intuition suggests that both α and B are greater than zero.

Since data on mattress fire-related property damages are highly questionable due to the purportedly high correlation between mattress fires and arson, it is assumed that the number of property damaging mattress fires is proportional to the number of mattress fire burn victims

$$K = \lambda N, \ \lambda > 0 \quad . \tag{4}$$

Finally, it is assumed that the average property damage (in dollars) from a mattress fire can be expressed as a linear function of the length of hospital stay and the probability of death associated with mattress fires

$$D = \Theta H + \phi P, \ \Theta > 0, \ \phi > 0 \quad . \tag{5}$$

By substituting (2), (3), (4) and (5) into (1) and collecting terms these assumptions yield

$$T = N(C \cdot H + V \cdot P) \tag{6}$$

where $C \equiv c + W + Q\gamma + \alpha + \lambda\Theta$ = the full resource cost of a day spent in the hospital inclusive of recovery costs, pain and suffering, and property damages associated with increased hospital stay, and $V \equiv v + B + \lambda\phi$ = the full resource cost associated with the loss of a life inclusive of the pain and suffering and property damages associated with dying from burns.

Using this simplified expression of the total annual resource costs associated with mattress fires and treating the full resource costs of the loss of life and hospital stay as parametric implies that the change in total resource cost brought about by the 1973 flammability standard, L, is

$$\frac{dT}{dL} = (C \cdot H + V \cdot P)\frac{dN}{dL} + N \cdot C \frac{dH}{dL} + N \cdot V \frac{dP}{dL} \quad . \tag{7}$$

If $\frac{dT}{dL} < 0$ then the standard has improved consumer safety where safety is measured in monetary units.

It is easily seen from (7) that to measure the change in resource cost estimates of C, H, V, P, N, $\frac{dN}{dL}$, $\frac{dH}{dL}$, and $\frac{dP}{dL}$ are required. The data used to obtain estimates of these parameters are individual burn records from the National Institute for Burn Medicine's (NIBM) public use file. NIBM acts as a clearing house for information on burn victims who were taken to hospitals (alive or dead) as the result of burns. In the period 1965 to 1977 approximately 35,000 burn cases were reported to NIBM. Of these fewer than 1 percent (269) were identified as caused by beds or bedding. Although the incidence of mattress-related fires is quite low, their severity is very high. For example, the death rate is 3 times higher than the average (.31 versus .10) and the

average hospital stay is about 12 percent longer. This increased severity is largely due to the fact that 60 percent of mattress burn victims were either sleeping or resting when burned. The fact that approximately 17 percent of all mattress burn victims were neither smoking or drinking when they were burned suggests the presence of negative externalities associated with careless consumption of mattresses. These statistics indicate that cigarette-induced mattress combustion represents a major source of mattress-related fires, however, it remains an open question whether mattress flammability standard addresses the relevant dimensions of this source of fires.

The imposition of the flammability standard may reduce the number of mattress burn victims for two reasons. The first is that the standard addresses a primary source of mattress-related fires and by prohibiting the sale of substandard mattresses the regulation brings about a reduction in the stock of "burnable" mattresses held by the population. As the "burnable" stock declines in the post-standard period, so too will the number of burn victims (for a constant burn rate for burnable mattresses). A crude estimate of this stock effect on the number of burn victims is obtained by noting that the stock of substandard mattresses in 1973 was somewhat over 20 percent of the total stock of mattresses, or about 28 million mattresses. If it is assumed that in the pre-standard period only substandard mattresses caused burns and the annual average number of burn victims is 25 then the burn rate of substandard mattresses is approximately 1 in a million. If 10 percent of the stock of burnable mattresses are retired annually, this implies that in the first year after the standard there would be 2 fewer burn victims, in the second year there would be 4 fewer, in the third year there would be 6 fewer, etc., until by the tenth year (when the entire burnable stock is replaced by above-standard mattresses) there would be 25 fewer burn cases than the pre-standard average. Thus, if one asked what

was the average reduction in burn cases over the period 1974-1977, the estimated stock replacement effect would be about -5 cases per year. A higher turnover rate would increase the absolute value of this estimate while a lower burn rate would reduce the estimate. Of course, if the production rate of burnable mattresses was declining even in the absence of a standard, then the estimated stock impact of the standard would be reduced.

The flammability standard may also reduce the number of burn victims via an informational effect. The standard may signal consumers that some of them own potentially flammable mattresses. If this represents information that consumers previously did not possess, either because the benefits of obtaining this information were less than its cost or (as many have suggested) because consumers are inherently unable to correctly assess the probability of low probability events, then this information will lead to greater care in the use of cigarettes. This informational impact should be equal to zero if all consumers are fully informed of the flammability risks of their mattresses unless the standard itself conveys erroneous information.

The NIBM data are used to estimate a time series model with the annual number of burn cases, N, as a function of a linear trend, YR, the total number of burn cases (of all types) in the NIBM file, TOTAL, and a post-standard dummy variable which is equal to one for the years 1974-1977. The total number of burn cases in the NIBM sample, TOTAL, is included to control for increases in the number of hospitals and burn centers which report to the NIBM while the trend term is included to capture all omitted technological and population characteristics that move smoothly over time. Among these omitted traits are age composition, percentage of the population which smokes, flammability of linen, etc.

This model applied to the 13 annual observations yields

$$(8) \qquad \underset{}{N} = \underset{(0.75)}{100.62} + \underset{(0.70)}{1.45}YR + \underset{(1.07)}{0.0078}TOTAL - \underset{(0.66)}{9.19}L \quad , \qquad R^2 = .48$$

where absolute t values are given in parentheses. The F statistic for the model (2.80) indicates that the vector of coefficients is significantly different from a zero vector at the 90 percent level. The sample reveals a slightly positive trend and that the number of mattress victims rose roughly in proportion with the total sample holding constant the trend and flammability standard impacts. The impact of the standard is a reduction of 9 cases a year, however, this estimate is significantly different from zero at only the 53 percent level. While the point estimate of the standard impact is about 50 percent greater than the crude estimate of the stock effect on burn cases, this differential is not significant at any standard confidence level. In general, the data weakly suggest a reduction in the number of burn cases which is greater than the estimated stock effect with neither the difference between these estimates or the overall reduction estimate being significant at standard confidence levels.

The earlier discussion of the potential impact of the standard on burn cases suggested that the annual impact would increase over time as the stock of "burnable" mattresses was replaced. To test for the presence of this impact an alternative specification of the number of burn cases is estimated which allows the impact of the standard to increase over time,

$$(9) \qquad \underset{\quad (0.72)\ (0.68)\quad (0.80)\qquad\qquad (0.19)\ (0.21)}{N = 117.31 + 1.72YR + 0.0070TOTAL + 102.04L - 1.47L \cdot YR} \qquad R^2 = .48$$

where once again t values are reported beneath the coefficients. The results of this specification are broadly consistent with those reported in (8) both in terms, signs and significance. The estimated reductions in cases are: -6.7 in 1974, -8.2 in 1975, -9.7 in 1976, and -11.2 in 1977. The finding of a 1.5 case reduction annually is consistent with the estimated stock effect with an

initial reduction of 5.2 cases (6.7 - 1.5 = 5.2) due to the informational impact of the standard.[3]

The average hospital stay and probability of death for this censored sample of mattress burn victims is modeled as a recursive system.[4] The data set contains information on two objective measures of the seriousness of the burn: the percent of the body which is burned (% BODY) and the percent of the body which has all three skin layers burned (% THICK). These measures of the seriousness of the burn are modeled as functions of the age and sex of the burn victim; their smoking and drinking status at the time of the burn; a linear trend effect, and L. In turn, the average hospital stay and the probability of death are modeled as functions of the seriousness of the burn, the age and sex of the victim, a trend effect, and L. This specification yields a direct impact of the standard on hospital stay and probability of death and an indirect effect via the impacts of the standard on the seriousness of burns.

Table 1 displays the estimates obtained by applying this model to the sample of 269 individual burn cases. The % THICK equation (column 1) indicates that males suffer significantly less serious burns, however, no significant age pattern is discernible. There also is a positive trend in % THICK. The results suggest that prior to the standard smoking and smoking/drinking victims suffered

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[3]Similar specifications of the total number of burn cases in the NIBM sample, TOTAL, indicate that in the post-standard period there has been a marginally significant increase in TOTAL. Thus not only has there been an absolute decline in mattress burn cases but also their share has fallen.

[4]See Heckman (1976) for a discussion of the estimation biases potentially induced by censored samples. The data used here is not amenable to the selection bias correction procedure suggested in that paper as no exogenous information exists with which the probability of reporting a burn incident to a hospital can be identified.

Table 1

NIBM Burn Victim Results

	% THICK	% BODY	H	H	P	P
Constant	-31.84 (0.69)	-28.64 (0.59)	-10.23 (0.07)	33.42 (0.21)	-0.620 (2.08)	1.606 (1.94)
YR	0.73 (1.13)	0.79 (1.14)	-0.07 (0.04)	-0.28 (0.15)	0.008 (1.87)	-0.019 (1.51)
1 if Male Victim	-5.84 (1.96)	-5.94 (1.88)		-1.00 (0.21)	0.008 (0.37)	-0.021 (0.29)
Age of Victim	-0.08 (0.19)	0.61 (1.40)		-0.84 (1.31)	0.007 (2.42)	0.003 (0.31)
(Age of Victim)^2	0.003 (0.24)	-0.012 (0.95)		0.031 (0.71)	-2.5×10^{-4} (2.35)	-1.0×10^{-4} (0.37)
(Age of Victim)^3	-1.2×10^{-5} (0.13)	7.6×10^{-5} (0.75)		-8.2×10^{-5} (0.54)	2.9×10^{-6} (2.76)	1.7×10^{-6} (0.75)
L	-4.90 (1.00)	-5.87 (1.13)	12.61 (1.90)	14.54 (1.84)	-0.043 (1.48)	-0.081 (0.71)
1 if Smoking Only	1.94 (0.44)	-0.38 (0.08)		2.04 (0.29)		0.052 (0.47)
1 if Drinking Only	0.09 (0.01)	-11.25 (1.11)		20.47 (1.36)		-0.043 (0.25)
1 if Both S and D	4.20 (0.64)	-3.47 (0.49)		4.87 (0.46)		-0.126 (0.78)
Smoking • L	-2.77 (0.47)	-2.63 (0.42)		-1.88 (0.21)		0.035 (0.25)
Drinking • L	-10.11 (0.42)	-1.62 (0.06)		-1.45 (0.04)		-0.071 (0.41)
Both • L	-17.98 (0.77)	-23.08 (0.93)		-34.84 (0.95)		0.017 (0.10)
% Thick			0.65 (1.81)		0.007 (5.43)	
(% Thick)^2			-0.009 (1.56)			
% Body			0.58 (1.59)		0.004 (2.97)	
(% Body)^2			-0.009 (1.73)			
Total Sample Average H			1.16 (1.41)	0.99 (1.14)		
R^2	.038	.051	.103	.072		

Absolute t values in parentheses.
The P equations are GLS estimates of the linear probability model.

suffered more severe burns, however, none of the smoking or drinking status variables are significant at standard confidence levels. An interesting finding is that after the standard was implemented the extent of the body burned fell for all victims by 5 percent of the body and fell by more for relatively careless consumers, although this latter set of results is not significantly different from zero.

The specification of % BODY (column 2) reveals an age pattern in which the young and old are burned relatively more extensively. No significant trend effect is apparent and males once again are burned about 6 percent less severely than females. The standard has led to a 6 percent reduction for the base group of victims and larger negative impacts for the relatively careless victim categories. Although these results are not significantly different from zero at the 90 percent level, these estimates suggest that the standard has disproportionately improved the burn severity of relatively careless consumers.

Turning to the recursive specification of the hospitalization regression (column 3, Table 1), no significant trend effect is discernible. The seriousness of the burn suffered has a non-monotonic impact on hospital stay, turning negative at % THICK levels greater than 36 and % BODY levels exceeding 32 percent. These non-monotonic effects reflect the increased probability of death and the truncation of one's hospital stay at greater burn severities. The direct impact of the standard is an increase of almost 13 days. This direct standard impact presumably reflects the improvements in omitted measures of injury severity which result from the standard. The direct impacts on hospitalization are partially offset by the post-standard reductions in measured burn severities described earlier, except for the smoking/drinking category where the indirect impact is sufficiently large to reverse the sign of the effect. The mean total impacts of the standard are: +8 days for the base group, +6 days for smokers, +2.5 days for drinkers, and -8 days for smoker/drinkers.

An alternative formulation of the hospital stay is obtained by estimating the reduced form equivalent of the recursive model. These estimates are displayed in the fourth column of Table 1. In this model the estimated coefficients capture both the direct and indirect impacts of the standard. Once again no discernible sex or trend effects are found. Prior to the standard the careless consumer categories were spending more time in hospitals than the base group, however, this was reversed for the smoker/drinker category in the post-standard period. The standard significantly increased the hospital stay by 14.5 days for the base group, 12.6 days for smokers, 13 days for drinkers, and reduced the stay for smoker/drinkers by 20 days. The category specific results, however, are not significantly different from the impact on the base group. These reduced forms are largely consistent with the findings of the recursive model, particularly with respect to signs. Both specifications of the hospital stay equation indicate that the flammability standard has led to an increase in the per victim hospital-related resource costs for all victim categories except the most careless group of consumers, smoker/drinkers.

The estimates of the recursive and reduced form specifications of the linear probability model for the probability of dying (given one is burned) are presented in columns 5 and 6, respectively, of Table 1. Neither specification exhibits a significant sex impact while both reveal a non-monotonic age effect with young and old victims possessing the highest death probabilities. In the recursive model the probability of death is an increasing function of both % THICK and % BODY with the former being roughly twice as deadly. The recursive form indicates that the direct impact of the standard, via omitted severity indicators, is -4 percent. The indirect effects through the measured severity indicators yield total reductions in the probability of death of: 10.4 percent for the base group, 13.6 percent for smokers, 18.8 percent

for drinkers, and 33.5 percent for smoker/drinkers. The reduced form specification yields similar estimates of: -8.1 percent for the base group, -4.6 percent for smokers, -15.2 percent for drinkers, and -6.4 for smoker/drinkers. Both specifications suggest that the per victim resource costs associated with dying in mattress fires have been reduced by the standard as the probabilities of dying given one is burned are significantly reduced. The recursive model further suggests that these resource savings are relatively large for the careless consumer categories. This is consistent, following Peltzman's (1975) notion of self-protection, with the increase in the share of careless victims since the standard from 73 to 81 percent of all survivors and from 86 to 98 percent of all dying victims.

These estimates of $\frac{dN}{dL}$, $\frac{dH}{dL}$, and $\frac{dP}{dL}$, in conjunction with values of C and V, are used to calculate the change in total resource costs resulting from the flammability standard. C and V are key parameters in this evaluation process. Because of their complex forms, results are reported for a wide array of joint values of C and V. Table 2A displays the estimates of $\frac{dT}{dL}$ obtained from the recursive system estimates (Table 1). The estimator of $\frac{dT}{dL}$ represents an expanded version of equation (6) where the expansion incorporates the differential impacts of the standard on the various consumer categories.[5]

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[5]This expansion results from the system:

a) $T = N(CH + V P)$

b) $H \equiv \sum_{i=1}^{4} H_i s_i$, s_i = the share of consumer category i; H_i = the average hospital stay of consumer category i; $i = 1$ if smoking, 2 if drinking, 3 if smoking/drinking, and 4 if other victim category;

c) $P \equiv \sum_{i=1}^{4} s_i P_i$, where P_i is the average probability of death in consumer category i. Therefore,

d) $\frac{dT}{dL} = (C \cdot H + P \cdot V)\frac{dN}{dL} + N \cdot C\left(\sum_{i=1}^{4} s_i \frac{dH_i}{dL}\right) + N \cdot V \left(\sum_{i=1}^{4} s_i \frac{dP_i}{dL}\right)$.

Table 2A

Changes in Annual Resource Costs Associated with the 1973 Flammability Standard, Recursive System Estimates, Contingent on Values of V and C (in Millions)

C Value \ V Value	$100,000	$200,000	$400,000	$800,000	$1,200,000	$2,000,000	$5,000,000
$ 100	-.8	-1.6	-3.1	-6.1	-9.1	-15.2	-38.0
200	-.8	-1.6	-3.1	-6.1	-9.2	-15.3	-38.2
400	-.9	-1.7	-3.2	-6.2	-9.3	-15.4	-38.3
600	-1.0	-1.8	-3.3	-6.3	-9.4	-15.5	-38.4
800	-1.1	-1.9	-3.4	-6.4	-9.5	-15.6	-38.5
1,200	-1.2	-2.0	-3.5	-6.5	-9.6	-15.7	-38.6
1,800	-1.4	-2.2	-3.7	-6.7	-9.8	-15.9	-38.8
2,500	-1.7	-2.5	-4.0	-7.0	-10.1	-16.2	-39.1

Table 2B

Present Value Changes in Resource Costs Associated with the 1973 Flammability Standard, Recursive System Estimates, Contingent on Values of V and C (in Millions) with a 10-Year Horizon, 10 Percent Discount Factor, and Constant Shares

C Value \ V Value	$100,000	$200,000	$400,000	$800,000	$1,200,000	$2,000,000	$5,000,000
$ 100	-2.2	-4.2	-8.4	-16.6	-24.9	-41.4	-103.3
200	-2.3	-4.3	-8.5	-16.7	-25.0	-41.5	-103.7
400	-2.5	-4.5	-8.7	-16.9	-25.2	-41.7	-103.9
600	-2.7	-4.7	-8.9	-17.1	-25.4	-41.9	-104.1
800	-2.9	-4.9	-9.1	-17.3	-25.6	-42.1	-104.3
1,200	-3.3	-5.3	-9.5	-17.7	-26.0	-42.5	-104.7
1,800	-3.9	-5.9	-10.1	-18.3	-26.6	-43.1	-105.3
2,500	-4.6	-6.6	-10.8	-19.0	-27.3	-43.8	-106.0

Table 3A

Changes in Annual Resource Costs Associated with the 1973 Flammability Standard, Reduced Form System Estimates, Contingent on Values of V and C (in Millions)

C Value \ V Value	$100,000	$200,000	$400,000	$800,000	$1,200,000	$2,000,000	$5,000,000
$ 100	-.5	-.9	-1.8	-3.6	-5.3	-8.8	-22.0
200	-.5	-.9	-1.8	-3.6	-5.3	-8.8	-22.0
400	-.6	-1.0	-1.9	-3.7	-5.4	-8.9	-22.1
600	-.7	-1.1	-2.0	-3.8	-5.5	-9.0	-22.2
800	-.8	-1.2	-2.1	-3.9	-5.6	-9.1	-22.3
1,200	-1.0	-1.4	-2.3	-4.1	-5.8	-9.3	-22.5
1,800	-1.2	-1.6	-2.5	-4.3	-6.0	-9.5	-22.7
2,500	-1.5	-1.9	-2.8	-4.6	-6.3	-9.8	-23.0

Table 3B

Present Value Changes in Resource Costs Associated with the 1973 Flammability Standard, Reduced Form System Estimates, Contingent on Values of V and C (in Millions) with a 10-Year Horizon, 10 Percent Discount Factor, and Constant Shares

C Value \ V Value	$100,000	$200,000	$400,000	$800,000	$1,200,000	$2,000,000	$5,000,000
$ 100	-1.3	-2.5	-4.9	-9.7	-14.5	-24.0	-59.9
200	-1.4	-2.6	-5.0	-9.8	-14.6	-24.1	-60.0
400	-1.7	-2.9	-5.3	-10.1	-14.9	-24.4	-60.3
600	-1.9	-3.1	-5.5	-10.3	-15.1	-24.6	-60.5
800	-2.1	-3.3	-5.7	-10.5	-15.3	-24.8	-60.7
1,200	-2.6	-3.8	-6.2	-11.0	-15.8	-25.3	-61.2
1,800	-3.3	-4.5	-6.9	-11.7	-16.5	-26.0	-61.9
2,500	-4.1	-5.3	-7.7	-12.5	-17.3	-26.8	-62.7

Table 2B reports the present value of the recursive system's estimate of resource saving for alternative values of C and V with a 10 percent discount rate, 10-year time horizon, and constant victim shares over the 10-year interval. Tables 3A and 3B report the analogous results obtained from the reduced form system.

The present value estimates of the standard's resource savings are similar for the recursive and reduced form estimators. Both specifications indicate that the resource saving is an increasing function of C and V. The positive impact of V on resource savings reflects both the lower death probabilities and smaller number of victims associated with the standard while the positive impact of C indicates that the reduced number of victim impact outweighs the adverse per victim impact on hospital stay. The impact on resource savings of a proportionate change in V is greater than that of C for both estimators. For example, in Table 2B a 12-fold increase in C raises the present value savings by only $1 million while a 12-fold increase in V increases the present value savings by $23 million.

The present value resource savings associated with the mattress flammability standard for a set of "reasonable" values of V and C range from $1 million to $106 million. These estimates indicate the present value safety improvement per new mattress sold is between 1 cent and 90 cents. At intermediate values of $V = \$400{,}000$ and $C = \$600$, the present value savings estimates are $9 million and $5.5 million (or 7 and 4 cents per new mattress) for the recursive and reduced form specifications.[6] In general,

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[6]The value of $C = \$600$ seems a reasonable guess as it assumes $c = \$300$, $\gamma = .5$, $W = \$30$, $Q = \$14$, $\alpha = \$63$, $\lambda = 2$, and $\theta = \$100$. Similarly, $V = \$400{,}000$ seems reasonable as it assumes $B = \$100{,}000$, $\lambda = 2$, $\phi = \$50{,}000$ and $v = \$200{,}000$. The choice of $v = \$200{,}000$ is consistent (in 1967 dollars) with the value of life estimates obtained by Rosen and Thaler (1975) and Blomquist (1977) using the "willingness to pay" methodology.

the estimated resource savings are slightly more than one standard deviation greater than zero.

Summarizing the findings of this section, the data indicate present value safety improvements between $1 million and $106 depending upon the values of V and C. These estimates are, however, only significantly different from zero at about the 85 percent level. These safety improvement estimates are found to be relatively robust and suggest that the flammability standard has improved consumer safety.[7] This finding of improved safety, though weakened by relatively low significance level, is important in the context of the shift to the use of polyurethane in order to satisfy the standard. Since polyurethane is very resistant to low-grade combustion sources, such as smoldering cigarettes, many producers have found that the least costly method of satisfying the standard is to pad the mattress with a layer of lightweight polyurethane foam. This adjustment has come under increasing criticism because of the extreme flammability characteristics of polyurethane in the presence of high-grade combustion sources such as open flames.[8] The findings of post-standard reductions in number of burn victims, the seriousness of burns suffered, and reduced probability of dying given one is burned all suggest that the safety improvements associated with eliminating cigarettes more than offset any decreases in safety associated with the substitution to polyurethane. On net the standard has led to increased consumer

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[7]The models were also estimated with a quadratic trend term and with no trend term. Since the results are basically identical, they are not reported but are available upon request.

[8]On January 21 and 22, 1979 the Los Angeles Times ran a series describing the flammability hazards of urethane. These articles addressed themselves to this substitution but noted that empirical evidence does not exist with which one can ascertain its importance.

safety, however, it is not clear whether this improvement is associated with the elimination of "unreasonably" risky mattresses.

IV. Costs of the Mattress Flammability Standard

The direct costs of the mattress flammability standard are composed of CPSC administrative costs and the impacts of the standard on raising mattress prices to consumers. In the absence of accurate intra-agency administrative cost information this section concentrates solely on the latter effect.

The price of mattresses may rise as the result of the imposition of the flammability standard for three reasons. First, in the short run the standard will reduce the supply of salable mattresses as suppliers of sub-standard mattresses are prohibited from selling their mattresses. This will lead to a bidding up of the prices of above-standard mattresses as some consumers will shift their demands to the available higher quality mattresses. As low quality producers make the necessary technological adjustments to satisfy the standard, basically eliminating untreated cotton and including a layer of polyurethane, these short-term quasi-rents are eliminated but competitive equilibrium mattress prices are higher due to the higher production costs associated with satisfying the standard. A third effect on the average mattress price occurs as the distribution of sales shifts toward relatively higher quality mattresses due to the truncation of the lowest quality sales (they are prohibited) and because the standard leads to a relatively larger increase in the production costs (hence equilibrium prices) of low quality producers.

A sample of 1110 observations of suggested retail mattress prices (in 1967 dollars) and their associated quality vector was obtained from the 1959

through 1977 editions of the Sears, Pennys, Wards, and Aldens customer catalogues. The mean non-quality adjusted pre-standard price is $50.75 while the mean post-standard counterpart is $64.49. The average increase in mattress prices after the standard is $13.74 which represents approximately a 25 percent increase. This increase can be decomposed into: 1) the change in mattress prices for a constant quality vector; 2) the change in the quality vector which results from the altered payoffs to the various quality dimensions associated with the standard; and 3) quality vector changes which are independent of the influences of the standard. In this section we will estimate only the first component which is then used as a conservative estimate of the total standard-related increase.

In order to quantify the increase in mattress prices associated with the standard for a constant quality set of mattresses a hedonic price for mattresses is estimated as a function of the set of measurable quality dimensions obtained from catalogue descriptions and a dummy variable which is equal to unity in the post-standard period. These results are reported in column 1 of Table 4 where standard errors are reported in parentheses next to each coefficient.[9] In general, this hedonic function is in accord with intuition with the desirable quality components commanding positive price premiums. The dummy variable for the post-standard period is positive, $2.04, and significantly different from zero at the 99 percent level. This constant implicit quality premiums estimate of the impact of the standard represents a 4 percent increase in the price of a constant quality mattress.

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[9]Natural logarithmic specifications of the mattress price hedonic functions were also estimated. Since the results are generally equivalent they are not reported here but are available upon request.

Table 4
Mattress Hedonic Price Functions

	Sample Period					
	1959-1977		1959-1972		1973-1977	
Number of Observations	1110		830		280	
Constant	22.22	(2.67)	11.85	(2.65)	40.41	(7.96)
Coil Count if Spring	0.04	(0.002)	0.04	(0.002)	0.04	(0.005)
Thickness if Polyurethane	8.18	(0.66)	7.95	(0.71)	9.29	(1.45)
Thickness if Latex	11.40	(1.43)	12.51	(1.37)	13.69	(4.65)
Thickness if Poly/Latex Hybrid	6.94	(2.16)	7.05	(2.10)	11.48	(5.63)
Thickness if Other Foam	10.48	(2.09)	0.73	(2.12)	24.57	(10.12)
1 if Handles	2.79	(0.82)	2.83	(0.83)	1.82	(1.98)
1 if Contains Cotton	-7.74	(1.02)	-2.25	(1.12)	-16.54	(2.31)
1 if Contains Rayon	0.72	(0.88)	1.87	(0.86)	-3.19	(2.44)
Weight (in pounds)	0.17	(0.03)	0.24	(0.03)	0.13	(0.09)
1 if Twin Size	2.41	(0.86)	5.01	(1.73)	-3.25	(2.12)
1 if 3/4 Size	0.26	(1.61)	2.98	(1.73)	-5.81	(3.22)
1 if Queen Size	19.92	(2.62)	15.80	(3.19)	23.24	(4.66)
1 if King Size	44.91	(3.01)	34.07	(3.76)	52.08	(5.86)
1 if Latex Foam	-24.67	(8.03)	-26.33	(7.56)	-51.37	(28.24)
1 if Polyurethane Foam	-22.18	(3.86)	-17.59	(3.91)	-32.99	(9.73)
1 if Poly/Latex Hybrid Foam	-4.08	(12.74)	-1.16	(12.40)	-38.27	(32.60)
1 if Other Foam	-31.70	(12.21)	15.92	(11.77)	-108.78	(66.95)
1 if All Cotton Materials	5.47	(1.71)	5.75	(1.52)		
1 if Spring Lined with Latex	-3.67	(8.03)	0.60	(6.88)		
1 if Spring Lined with Polyurethane	7.63	(1.24)	8.68	(1.36)	6.13	(2.66)
1 if Spring Lined with Poly/Latex Hybrid	3.63	(5.18)	6.76	(5.63)	1.78	(11.05)
1 if Sears	1.07	(0.93)	-0.27	(0.89)	-0.04	(3.23)
1 if Aldens	-5.88	(1.42)	-5.76	(1.30)	-7.26	(5.62)
1 if Penny's	-0.30	(1.44)	-3.13	(1.39)	-1.04	(4.64)
1 if Sealy	17.66	(4.87)	14.23	(7.15)	11.08	(8.00)
1 if After Flammability Standard	2.04	(.95)				
R^2	.781		.798		.800	

For a base annual retail sales of approximately $610 million (in 1967 dollars) this amounts to an increase in mattress expenditures of $24 million annually for constant quality distribution of mattresses and unchanged quantity of mattresses sold.

A more general approach to the determination of the impact of the standard on constant quality mattress prices is to estimate separate hedonic functions for the pre-standard and post-standard samples and then analyze the difference between the predicted prices for an identical set of mattresses. Columns 2 and 3 of Table 4 display the respective hedonic price function estimates for the pre-standard and post-standard sample periods. These coefficients are used to predict the pre-standard and post-standard prices for the 1110 mattresses. The mean predicted pre-standard price for this sample is $53.06 while the mean predicted post-standard price for the sample is $55.23. Thus when the hedonic price function is specified with full interaction effects of the standard the estimated mean increase in mattress prices after the standard (for a constant quality set of mattresses) is +$0.17 or .3 percent. This interprets into increased annual retail expenditures of approximately $1.9 million dollars for a constant quality composition and constant annual volume sales.

A scan of the predicted price changes suggests that the percentage increase is dependent on the quality of the mattress. This impression is substantiated by estimating the change in predicted prices as a function of the original ranking of mattress quality. The ordinal quality of each mattress is established by defining 41 quality cells, each containing 27 mattresses, in terms of the predicted pre-standard price. For example, quality cell one contains the 27 mattresses with the highest predicted pre-standard prices. Applying ordinary least squares to the changes in predicted prices yields

the results shown in Table 5 where absolute t-values are shown in parentheses. The percentage difference in post-and pre-standard prices is significantly and non-monotonically related to the ordinal quality index. For the lowest 25 quality cells the impact of the standard is to increase the predicted price difference. This is consistent with the fact that the mattresses which failed the standard were of low quality and would, therefore, be expected to experience greater increases as these producers had to shift to higher cost (at least for them) production methods which are reflected in higher equilibrium mattress prices. This result is also consistent with intermediate quality producers (e.g., quality cells 10-25) earning quasi-rents, reflected in abnormally high prices, in the post-standard period.

The results presented here indicate that depending on the functional specification of the impacts of the flammability standard the increase in constant quality mattress prices are between .3 percent and 4 percent. For a constant quality set of mattresses and constant volume sales these increases represent present value (for a 10-year horizon and a 10 percent discount factor) increases on retail mattress expenditures of $5.3 million and $66 million respectively for the fully interactive and dummy variable specifications of the flammability standard effects on mattress prices. These point estimates represent lower bound estimates of the full costs of the standard as they ignore CPSC administrative costs as well as indirect effects of the standard on changing the quality composition of mattresses (via changes in the implicit quality component prices). Recall that the estimates of the present value of resource savings induced by the standard ranged from $1 million to $106 million. If $V = \$400,000$ and $C = \$600$ the present value resource savings are $8.9 million (for the recursive form) which

Table 5

The Predicted Price Change Regressions for a Constant Quality Set of Mattresses

	Predicted Post-Price Minus Predicted Pre-Price	(Predicted Post-Price Minus Predicted Pre-Price) Divided by Predicted Pre-Price
Ordinal Quality Index (Lowest = 1, Highest = 41)	0.22 (1.12)	0.0071 (2.22)
$(\text{Ordinal Quality Index})^2$	-0.004 (0.90)	-0.00014 (1.93)
Constant	-2.08 (1.15)	-0.068 (2.34)
Ordinal Quality Value Where Impact of Quality Becomes Negative	27	26
R^2	.04	.13

Absolute t values in parentheses.

suggests that the resource savings from the standard are of the same order of magnitude as the safety benefits.[10]

V. Redistributive Impacts of the Standard

Peltzman (1976) and Stigler (1971) suggest that regulations are established in order to maximize the political support of the regulator. This process of support maximization will, therefore, make the nature of the income distributional impacts key determinants of regulatory action. In this section an attempt is made to determine if any significant income redistributions are associated with the 1973 mattress standard and if these redistributions were anticipatable by their beneficiaries. Largely for reasons of data availability, attention is focused on the intra-industry redistributive effects and the differential value of safety benefits realized by mattress consumers.

As noted earlier, the flammability standard does not require the development of new production technology. Most substandard producers achieved the required quality by eliminating untreated cotton and substituting a polyurethane lining. Since most large producers had adopted the requisite production technology as the result of an unconstrained profit maximization prior to the standard, it is hypothesized that the standard gives a comparative advantage to relatively large producers. This hypothesis is strengthened by the observation that a large portion of the compliance costs are relatively fixed costs (such as learning and implementing the testing and record-keeping requirements of the standard). Finally, the profits of all surviving firms, which by the above reasoning will tend to be disproportionately large, will

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[10] An alternative methodology is to treat the estimates of resource savings and increased mattress expenditure costs as unbiased estimators and then solve for the implicit value of life necessary to equate costs and benefits. For C = $600, the value of life implicit via the fully interactive price effect specification is approximately $300,000 (in 1967 dollars) and roughly $3 million for the dummy variable price specification when the recursive estimates are utilized.

be increased to the extent that the flammability standard establishes an effective barrier to entry.

The hypothesis that the standard imposes a differentially large burden on small producers is substantiated by the results of 1973 and 1974 compliance surveys conducted by CPSC. These surveys reveal that approximately 20 percent of surveyed manufacturers were not yet in compliance with the standard and its associated testing and record keeping requirements (most violations were for the latter reason). Forty-three percent of these violations were by firms with annual sales less than $100,000 (1973 dollars) and 81 percent of all violations were by firms with sales under $500,000. At the same time only 5 percent of the sample violations were by firms with annual sales over $3.5 million. Further, the smaller firms were much more likely to have committed multiple violations of the standard. The ratio of violation share to wholesale sales share is roughly 6 to 1 for firms with sales under $500,000 annually and 1 to 3 for firms with sales over $3.5 million.

The hypothesis that large producers were affected differentially by the standard is further substantiated by an examination of the distribution of industry sales and pre-tax net income.[11] This study is facilitated by an annual survey of mattress producers which is conducted by the National Association of Bedding Manufacturers (NABM) from 1959 to 1976.[12] The survey is sent annually to all NABM member producers and is returned answered by approximately 10 percent. No evidence of serious sampling bias is discernible, however, representatives of NABM suggest that the survey tends to over-represent large producers.

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[11] It is not possible to examine the impacts on stock prices as too few of the producers are listed on the major exchanges.

[12] I would like to thank NABM and, in particular, Mr. Russell Abolt, for their assistance in developing this data set.

Table 6 displays estimates of the impact of the standard on the industry distribution of sales and net income (all monetary units are in 1967 dollars), where the industry is divided into 4 size classifications on the basis of annual sales. The system of estimating equations yielding these results holds constant the level and distribution of industry (wholesale) advertising, the real value of the size bracket boundaries (in terms of sales), the annual national industrial production index, and a linear trend effect.[13] The impact of the law is captured by a dummy variable which equals unity for 1973 through 1976. The share equations are estimated subject to the restriction that the sum of the change in shares due to any independent variable is equal to zero over the 4 size categories of producers. Similarly the total and average effects are identified by the exclusion of redundant equations.

The sign pattern of the shares of sales and net income both support the hypothesis that the standard worked to the relative disadvantage of small firms. The greatest decrease for both measures is experienced (significantly) by the second smallest size producers (column 2) while the largest increases are realized by the relatively largest producers. The percentage increases for this largest group of producers are 12.2 and 19.0 respectively for shares of sales and pre-tax net income.

The differential distributive hypothesis is further validated by the findings that the average sales of the smallest firms fall by 11 percent while the sales of the largest two groups of producers rise by 8 and 44 percent respectively. Similarly the average pre-tax net incomes of firms in the smallest group fall by 66 percent and those in the second category fall by 93 percent at the same time that, cet. par., the same variables of the larger

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[13] The results are not seriously changed when the trend term is omitted or when a quadratic trend is included. These results are available upon request.

Table 6

Intraindustry Impacts of the 1973 Standard

	Size Categories in Terms of Annual Sales							
	Firms with Sales $0-$548,000		Firms with Sales $548,000-$1,000,000		Firms with Sales $1,000,000-$2,300,000		Firms with Sales Over $2,300,000	
Share of Sample Sales	-.001	(0.15)	-.048	(1.92)	-.015		.064	(1.30)
Average Category Sales	-42,000	(0.89)	40,000	(1.20)	120,000	(2.41)	1,900,000	(2.63)
Share of Pre-Tax Net Income	-.013	(0.51)	-.138	(2.79)	.032		.119	(0.86)
Average Category Pre-Tax Net Income	-5,000	(0.82)	-18,000	(2.80)	3,000	(0.15)	18,000	(1.82)

Absolute t-values in parentheses.

Table 7

Present Values of Average Impacts of Standard

	Firms with Sales $0-$548,000	Firms with Sales $548,000-$1,000,000	Firms with Sales $1,000,000-$2,300,000	Firms with Sales Over $2,300,000
Average Sales Impact	-114,000	109,000	326,000	5,165,000
Average Net Income Impact	-14,000	-49,000	8,000	49,000

firms rise by 6 and 9 percent respectively for categories 3 and 4. The present values of the average sale and pre-tax net income effects for firms in each category are described in Table 7 for a 10 percent discount factor and 10-year horizon. The per firm present value changes as the result of the standard suggest that the wealth redistributive impacts of the flammability standard are non-trivial and, given the structure of the standard, were *a priori* sign predictable.

The increases in the average net incomes of relatively large firms and decreases for relatively small producers is consistent with the hypothesis that during the post-standard period of adjustment those producers who initially offered above-standard mattresses realize short-term quasi-rents. This occurs because the short-term shortage of above-standard mattresses led to price increases which exceed the extra costs associated with the standard. Unless the standard represents an effective long-run barrier to entry, these short-term rents should dissipate. Unfortunately the available time series does not provide a sufficient number of post-standard observations to test whether these rents are, in fact, eliminated over time.

It is worth noting that the total average sales for the industry sample as a whole rose by $1,000,000 annually (or about 35 percent). In view of the earlier finding of standard-related price increases this indicates that the demand for mattresses is own price inelastic as expenditures rose with price. It is also consistent with the view that the standard transferred new information to consumers which led to an increase in the demand for new and relatively high quality mattresses. Current data, however, do not allow one to identify the magnitude of these separate effects.

Total industry average net income also rose by $10,400 (or 7 percent) in the post-standard period. Again this result may reflect the existence of

short-term quasi-rents accruing over the period of adjustment as well as long-run rents associated with the standard imposing a successful barrier to entry.

These overall improvements in the industry's welfare are consistent with the view of standards developed elsewhere by this author (1978). It is argued, in that paper, that when consumers find it difficult to assess the quality of a specific product, they will tend to use a broader set of consumption experiences to form their quality expectation. These consumption experiences, if general enough, will include experiences with other products as well as with the product in question. The use of experiences with other products creates an informational externality which if not internalized brings about lower industry (and consumer) welfare. It is suggested that minimum product standards represent one method producers may utilize to partially internalize the informational externality and hence improve industry welfare. In the case of mattress industry it is conceivable that consumers are ill-informed about the flammability (and perhaps other quality dimensions correlated with mattress flammability) of a particular mattress and, therefore, they are forced to use a broad set of consumption experiences (for example, the burn rate for mattresses as a whole) in estimating the probability of the mattress burning. This suggests the presence of an information externality which producers will attempt to internalize via product standards, advertising, and warranties. Since overall industry profits are increased by the imposition of the flammability standard this case is consistent with the information externality model of the demand for standards.

The second income redistribution examined in this section considers the differential safety benefits received by various consumers. If all consumers bear a roughly equal share of the standard's cost then since the standard

explicitly addresses the protection of relatively careless consumers (from themselves), i.e., the population of smokers, it seems reasonable to anticipate that careless consumers will realize relatively large safety gains from the imposition of the standard. In this respect the standard is similar to awarding a relatively attractive insurance policy to high-risk consumers at the same premium it is sold to lower risk consumers.

The expected value of the per consumer present value resource cost associated with mattress fires, $\tau(i)$, is simply the conditional probability of being burned given one is in the i^{th} consumer category, $Pr(BURN = 1|i)$, times the resource cost associated with being a burn victim in the i^{th} consumer category, $\tau(i|BURN = 1)$,

$$\tau(i) = Pr(BURN = 1|i) \cdot \tau(i|BURN = 1) \quad , \tag{10}$$

where i indexes the 4 consumer categories described in section III. Using (10), the change in the expected value of the per consumer present value resource cost brought about by the mattress flammability standard, L, is

$$\frac{d\tau(i)}{dL} = Pr(BURN = 1|i) \cdot \frac{d\tau(i|BURN = 1)}{dL} + \tau(i|BURN = 1) \cdot \frac{dPr(BURN = 1|i)}{dL} \quad . \tag{11}$$

If, for simplicity it is assumed that $\frac{dPr(BURN = 1|i)}{dL} = 0$ for all consumer categories then one can use the results presented in section III to estimate $\frac{d\tau(i)}{dL}$. For example, the recursive model estimates indicate that the values of $\frac{d\tau(i|BURN = 1)}{dL}$ when $C = \$600$ and $V = \$400,000$ are: -\$100,000 for a base group victim; -\$140,000 for smoking victims; -\$200,000 for drinking victims; and -\$380,000 for smoking/drinking victims.[14] These numbers indicate that as

[14] It should be noted, however, that these estimates are not significantly different at the 90 percent level.

the result of the standard a certainty burn victim who smoked and drank was helped about 4 times more than a relatively careful consumer. If it is assumed that $Pr(BURN = 1|Neither) = .5Pr(BURN = 1|Smoker) = Pr(BURN = 1|Drinker) = .25Pr(BURN = 1|Both) = \frac{1}{750,000}$, then the expected value of the per consumer resource savings associated with the standard are: 3¢ for base group consumers, 8¢ for smokers, 12¢ for drinkers, and 49¢ for consumers who both smoke and drink. These results are supportive of the hypothesis that the standard differentially benefited relatively careless consumers as the expected value of the present value savings for the most careless group of consumers is nearly 17 times larger than that for the most careful group of consumers. In the context of the theory of externalities this is a perverse result in terms of improving social welfare as careless consumers tend to impose negative externalities (for example, neighbors may suffer damages from the fire started when a careless neighbor starts a fire while smoking in bed). Although the point estimates of the effective subsidies are not significantly different from zero, the pattern of subsidization suggests that an area of concern to regulators should be whether standards provide a perverse incentive scheme with respect to raising social welfare.

Finally, recall that the prices of relatively low quality mattresses rose relatively more as the result of the standard. Since the lowest quality mattresses are, in general, purchased by relatively low income families one impact of the standard has been to raise product prices the most for those consumers who can least afford such increases. Further, the price of the highest quality mattresses fell after the establishment of the standard. One explanation of this finding is that the pass/fail nature of the standard inappropriately has led many consumers to believe that all passing mattresses are of the same quality (at least with respect to flammability). Armed with this new (mis)information, the demand for relatively high quality mattresses falls which brings about price

reductions for these mattresses. Since these higher quality mattresses tend to be purchased by relatively high income consumers the standard indirectly subsidizes well-informed high income consumers.

In sum, the evidence presented in this section indicates that large, significant and predictable income redistributions from small to large producers resulted from the 1973 flammability standard. It was also found that the standard tends to tax relatively low income families and subsidizes higher income families. Some evidence of income redistributions from careful to careless consumers was presented, however, this redistribution effect is not statistically significant.

VI. Summary and Conclusions

This paper has presented evidence on the impacts of a relatively early CPSC action with respect to consumer product safety, namely the 1973 Mattress Flammability Standard. The primary focus has been the empirical measurement of 3 types of economic impacts. First, it was discovered that consumer safety has been significantly improved by the standard with estimated safety improvements ranging from $1 million to $106 million. These safety improvements were obtained at a conservative cost estimate of between $5.5 million to $66 million, or .3 to 4.0 percent increases in mattress prices. In addition to these traditional benefit/cost calculations an estimate of the effects of the standard on income redistribution was also presented. It was shown that the flammability standard induced large and anticipatable income redistributions from small to large producers. It was suggested that these wealth transfers are largely the result of quasi-rents being earned in the post-standard market adjustment period, however, there is also some evidence which suggests the standard improved consumer information. Further, weak evidence of income transfers from careful to careless consumers was also presented.

One of the primary contributions of this paper is that it presents not only cost/benefit estimates but also examines the income redistribution impacts of a product standard. This is important as it provides descriptive evidence on perhaps one of the least understood economic phenomena, namely product quality standards. Of course a single data point does not allow one to generalize about the impacts of quality standards on the determinants of government regulatory action. However, the results of this study of the 1973 Mattress Flammability Standard are generally consistent with both the consumer welfare improvement and income redistribution models of regulatory behavior. In order to actually test these alternative models of regulatory behavior more case studies of specific regulations and quality standards are required. This larger data base will allow the identification of systematic and random regulatory impacts on both consumer welfare and wealth redistributions. It is important to stress that to be of use in understanding the behavior of CPSC and other regulatory agencies, these case studies must measure the costs, benefits, and wealth redistribution impacts of the standard in question. Hopefully this study represents the first step in developing the type of data which is needed for the empirical testing of theories of regulation.

This study has shown that one of the primary characteristics of product standards is that they are not neutral with respect to their impacts on the economic welfare of market participants. This is true whether the standard is established by a governmental agency such as CPSC or a private agency such as UL. It is plausible to suspect that the impacts of privately established standards will tend to be greater than those for governmentally established standards. This is because the procedures utilized by governmental agencies tend to provide a relatively greater degree of due process. Further, given the extent of direct industry support of private standards agencies, it is reasonable to

believe that dominant industry interests have more successfully "captured" private than public standard agencies. In any case the methodology employed here is also applicable to privately established standards and should prove useful in understanding the relationship between governmentally and privately established product standards.

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