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Total Cost of Fire in the United States

FINAL REPORT BY:

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Executive Summary and Illustrations

In response to an increased demand for data to aid decision making in fire protection at the strategic and operational levels, this report aims to provide data on the cost of fire[1] in the United States to anyone with an interest in understanding or using this data. This report is an update of a previous version (*The Total Cost of Fire in the United States*; NFPA, 2014b, which calculated the total cost of fire from 1980 to 2011) to provide more updated prevention, protection, and mitigation costs, with critical attention on estimating the economic impact of fire. In addition to providing updated methodologies for calculating the total cost of fire and its components, this report also identifies the areas where more future work is needed to improve the accuracy of estimating the total cost of fire.

The total cost of fire in the United States in 2014 was $328.5 billion, which was 1.9% of the U.S. Gross Domestic Product (GDP). The components of the total cost of fire are given in Table 1. The total cost of fire has been broken down into mutually exclusive categories of “expenditure" and “loss" and their sub-categories. The expenditures constitute $273.1 billion (83.1% of total) and the losses constitute $55.4 billion (16.9% of total).

Table 1: Components of the total cost of fire in the U.S. in 2014. All values are in billion U.S. dollars.

Breakdown of the total cost of fire in the U.S., 2014				Value (in billion $)
Expenditure (273.1)	Direct (90.1)	Active fire protection expenditure (90.1)	Local fire department expenditures	41.9
			Value of donated time of volunteer firefighters	46.9
			Donations to fire departments	1.3
	Indirect (183.0)	Passive fire protection expenditure (159.4)	Fire safety costs in building construction	57.4
			Fire grade products	54.0
			Fire maintenance	36.5
			Fire retardants	7.5
			Disaster planning	3.4
			Preparing/maintaining standards	0.6
		Net fire insurance		23.6
Loss (55.4)	Direct (53.5)	Human loss (40.4)	Cost of statistical deaths	31.4
			Cost of statistical injuries	9.0
		Property loss		13.2
	Indirect losses			1.9
Total				328.5

Some important highlights/findings from the analysis presented in this report are:

- For each cost component and for all the years from 1980 to 2014, the actual dollar values as well as the 2014 dollar equivalent have been calculated. The 2014 dollar values are estimated from the actual values, using inflation rates in Table 4. The costs discussed in this summary are inflation-adjusted values.
- Over the years 1980 to 2014, the total cost of fire has increased by 50.3%. However, over the same period of time, the total cost of fire as a percentage of U.S. GDP has decreased by 75.3% (from 7.6% in 1980 to 1.9% in 2014).

[1] This report only considers structural fires; wildfires and vehicle fires are excluded from analysis. Some other costs that are not considered are: the cost of industry-owned-fire-departments; the cost of water for firefighting; and the costs of enhancing the fire protection features of already constructed buildings.

- The fire safety costs in building construction ($57.4 billion) constitute the largest share (17.5%) of the total cost in 2014. Cost of fire grade products, the value of donated time of volunteer firefighters, and local fire department expenditure are the second, third, and fourth largest shares (16.4% at $54.0 billion, 14.3% at $46.9 billion, and 12.8% at $41.9 billion, respectively).

- Due to a significant decrease in the number of deaths and injuries (civilian and firefighter) over the years 1980 to 2014, the cost of statistical deaths and injuries has decreased by 49.7% (from $62.4 billion to $31.4 billion) and 50.3% (from $18.1 billion to $9.0 billion), respectively.

- This report documents multiple calculation methods for certain cost components. In such cases, we selected the most reasonable methods in which the data required was the most readily available. For example, five different methods are presented in Section 2.1 to calculate the value of donated time of firefighters. Since unavailability of accurate data hinders estimation of donated time, this report adopts the most reasonable method (in terms of data availability), which defines the value of donated time as the “cost to replace all volunteer fire departments with career," rather than calculating “the actual value of the donated time of volunteer firefighters." Adoption of this method should not be interpreted as an acknowledgment that eventually all volunteer firefighters would be replaced by career firefighters. The most important and the most difficult-to-estimate value of volunteer firefighters is their availability in the community and their readiness to respond at any hour of the day without being compensated.

- This report defines the ‘economic impact of fire’ as the net monetary downstream effects of fires on the economy. In other words,the economic impact of fire is the sum of all indirect losses due to fire incidents, which is a subset of the total cost of fire. Indirect losses, especially from large-loss fires, are expected to be significantly high and hence would impact the regional economy considerably. However, lack of adequate data on indirect losses makes it difficult to quantify the actual economic impact of fire.

Figure 1 shows the breakdown of the total cost of fire in the U.S. in 2014 into various components. The components are sorted from largest to smallest (top to bottom) in Figure 2. Although highly dependent on the parameters[2] used for calculation, the cost of statistical deaths and the cost of statistical injuries form almost 12.3% of the total cost, or $40.4 billion. Fire maintenance costs ($36.5 billion) and net fire insurance costs ($23.6 billion) also have significant shares of the total cost (11.1% and 7.2%, respectively). Interestingly, direct and indirect property losses ($13.2 billion and $1.9 billion respectively) together constitute only 4.6% of the total cost of fire. Moreover, all of the loss components ($55.4 billion) add up to only 16.9% of the total cost, while the expenditure components ($273.1 billion) add up to the remaining 83.1%. While at first, this may appear imbalanced, in a counterintuitive sense, this highlights the importance of savings provided by the active and passive fire protection efforts, including the fire service. Nevertheless, a conventional cost-benefit analysis may not be practical in the case of fire protection as the potential losses of the resources that are at stake are immense.

Figure 3 shows the trend of the total cost of fire in the U.S. for the years 1980 to 2014. Over the years 1980 to 2014, the total cost has increased by 50.3%. However, an increase in the total cost is expected due to economic factors such as increases in manufacturing, construction, population, and technological improvements. GDP is the best indicator of these changes in the economy. Hence, the total cost of fire is calculated and plotted as a percentage of U.S. GDP for the period of 1980 to 2014. It is seen that this percentage has decreased by 75.3% (from 7.6% in 1980 to 1.9% in 2014). Figure 4 uses the same data as in Figure 3, to show that the total cost as a percentage of GDP has an exponentially decreasing trend in the total cost. During the period 1980-2014, the total losses have

[2]For details on parameters such as the value of statistical life and the value of statistical injury, refer Section 3.1.

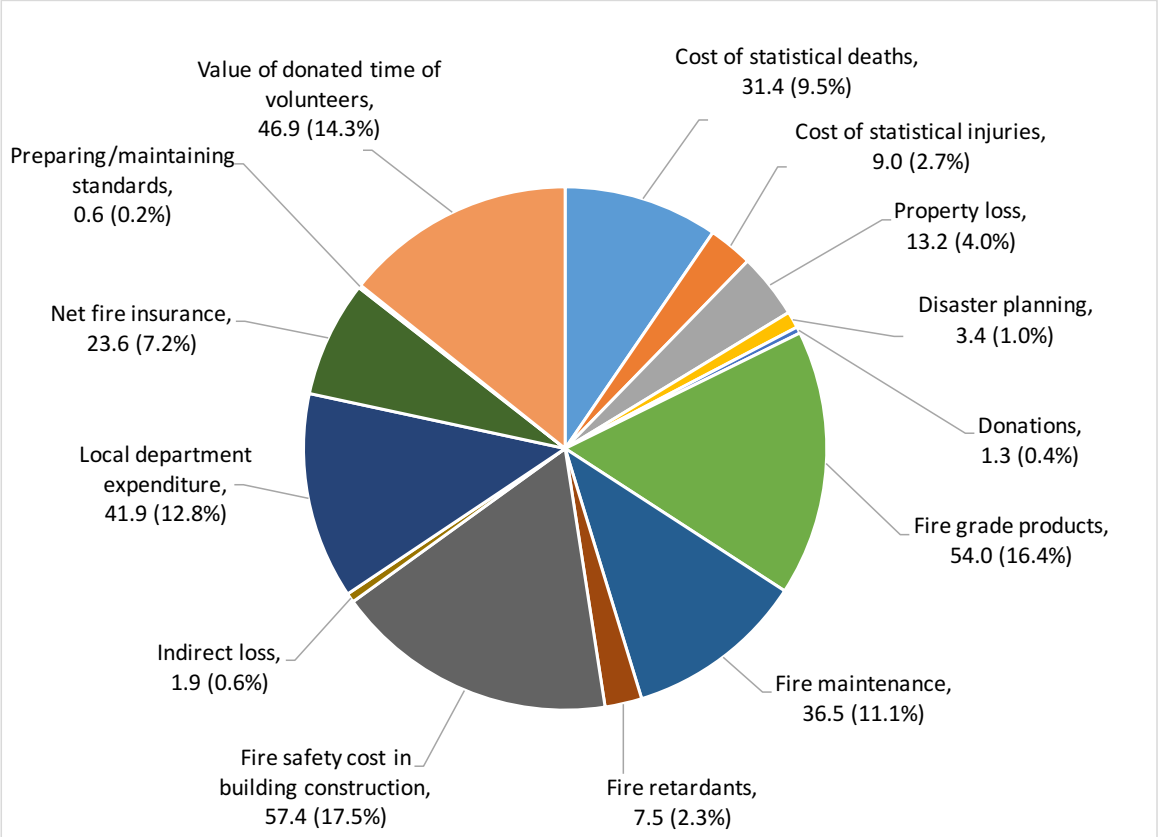

Figure 1: Values (in billion $) and percentage shares of the components of the total cost of fire ($328.5 billion) in the U.S. in 2014.

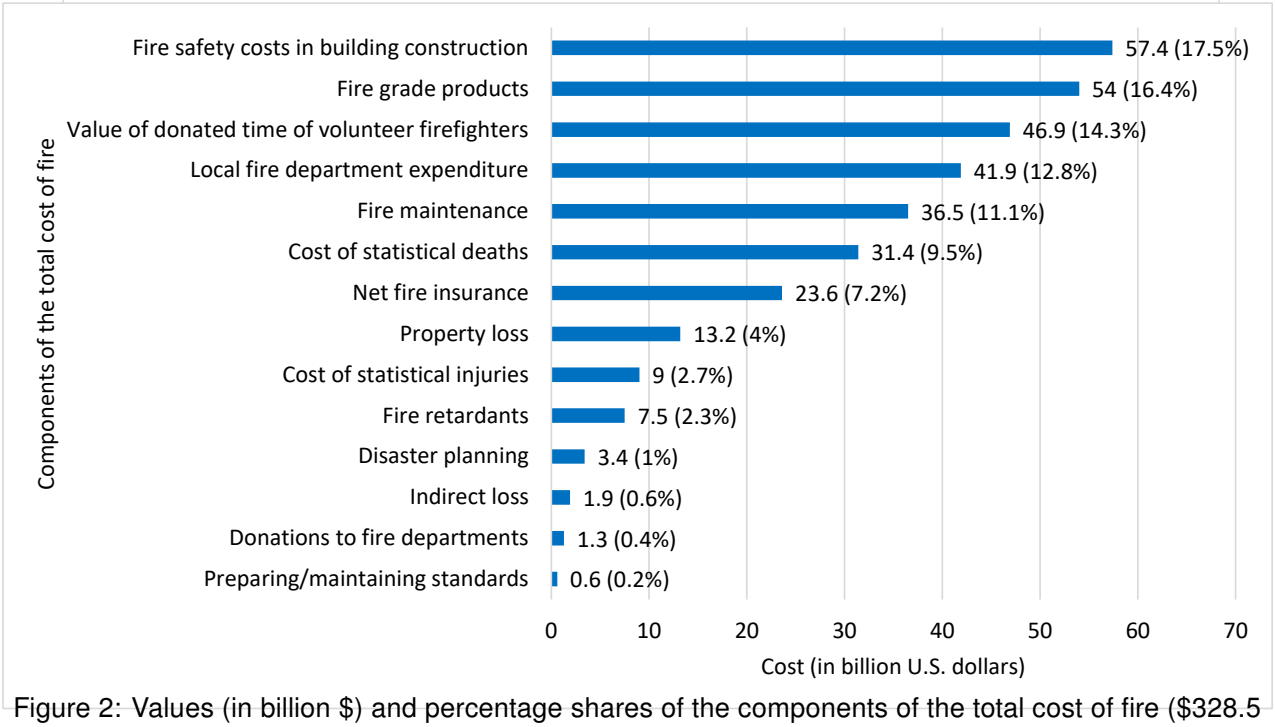

Figure 2: Values (in billion $) and percentage shares of the components of the total cost of fire ($328.5 billion) in the U.S. in 2014, arranged in decreasing order from top to bottom.

decreased by $49.6 billion (47.2%) from $105.0 billion to $55.4 billion, while the total expenditures have increased by $159.6 billion (140.6%) from $113.5 billion to $273.1 billion (Figure 5). Figure 6 shows that the ratio of the total losses to the total expenditures have decreased from 0.93 in 1980 to 0.20 in 2014 (see Table 2 for these ratios). This is attributed to the increased in expenditure over the years, and also to the savings from fire protection efforts, which are impossible to calculate but are very large. Figure 7 shows that losses have decreased in expenditure with decreasing marginal losses.

In summary, this report presents a comprehensive analysis of the total cost of fire in the United States for the years 1980 to 2014, and describes the impact of fire on various sectors of the U.S. economy.

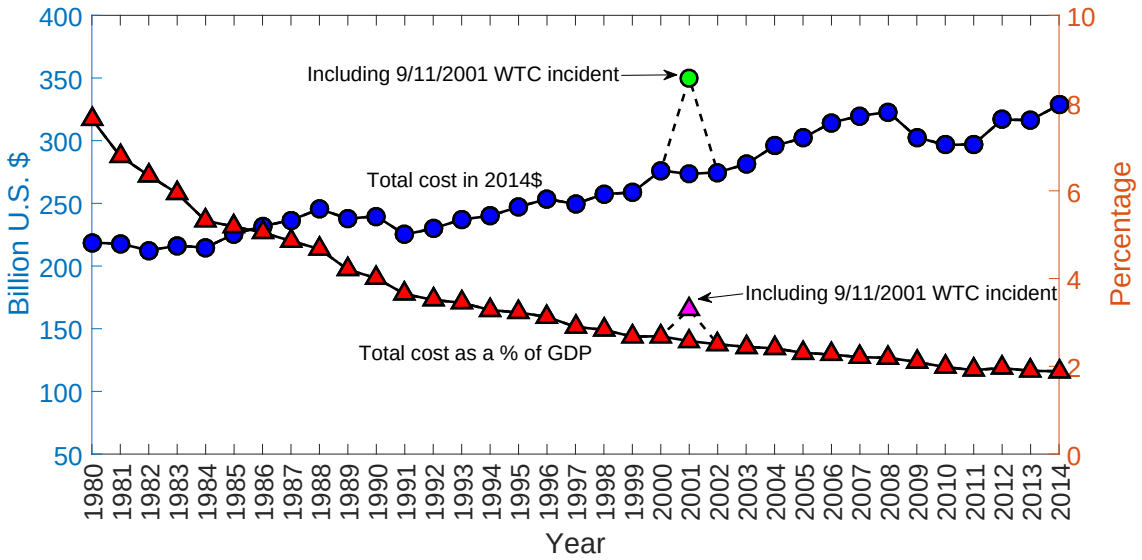

Figure 3: Changes in the total cost of fire in the U.S., for the years 1980 to 2014 (in 2014 dollars), compared with U.S. GDP. For each trend line, the spike point with dotted lines shows the corresponding value when the losses associated with the World Trade Center incident of September 11, 2001 are included.

Table 2: Ratio of losses to expenditures. “2001a" represents 2001 value including the 9/11 Word Trade Center incident, and “2001b" represents 2001 value excluding the 9/11 Word Trade Center incident.

Year	Ratio	Year	Ratio	Year	Ratio	Year	Ratio
1980	0.93	1989	0.61	1998	0.37	2006	0.26
1981	0.94	1990	0.55	1999	0.35	2007	0.25
1982	0.83	1991	0.56	2000	0.35	2008	0.26
1983	0.80	1992	0.53	2001a	0.66	2009	0.25
1984	0.70	1993	0.51	2001b	0.32	2010	0.23
1985	0.76	1994	0.45	2002	0.32	2011	0.23
1986	0.66	1995	0.45	2003	0.30	2012	0.21
1987	0.65	1996	0.46	2004	0.28	2013	0.20
1988	0.68	1997	0.38	2005	0.28	2014	0.20

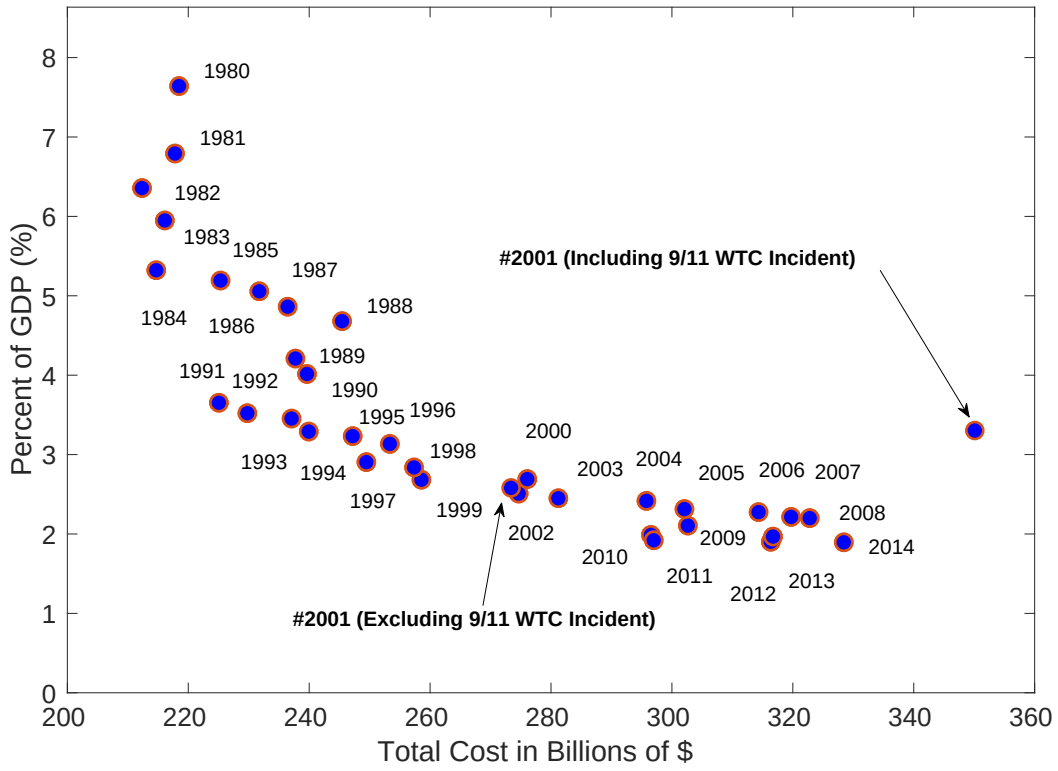

Figure 4: Scatter plot that compares the total cost of fire in the U.S. against the total cost as a function of GDP, for the years 1980 to 2014.

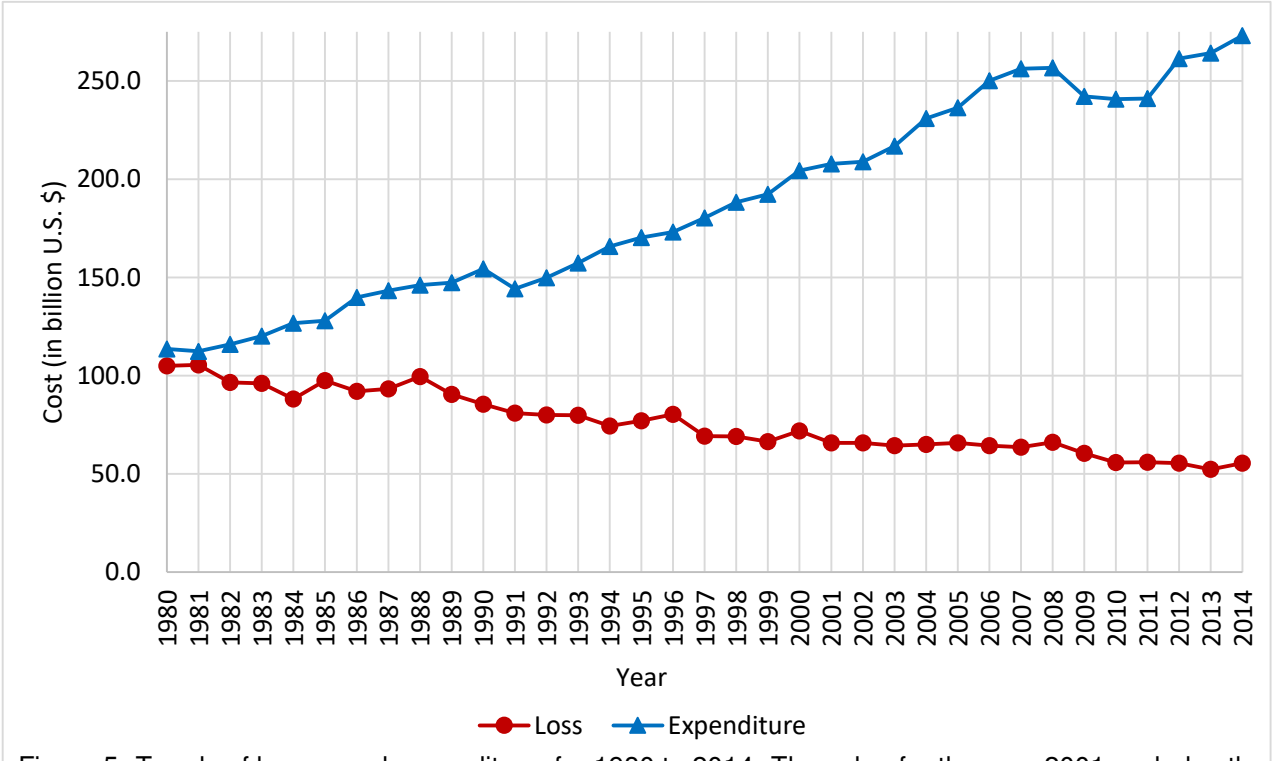

Figure 5: Trends of losses and expenditure, for 1980 to 2014. The value for the year 2001 excludes the 9/11 Word Trade Center incident.

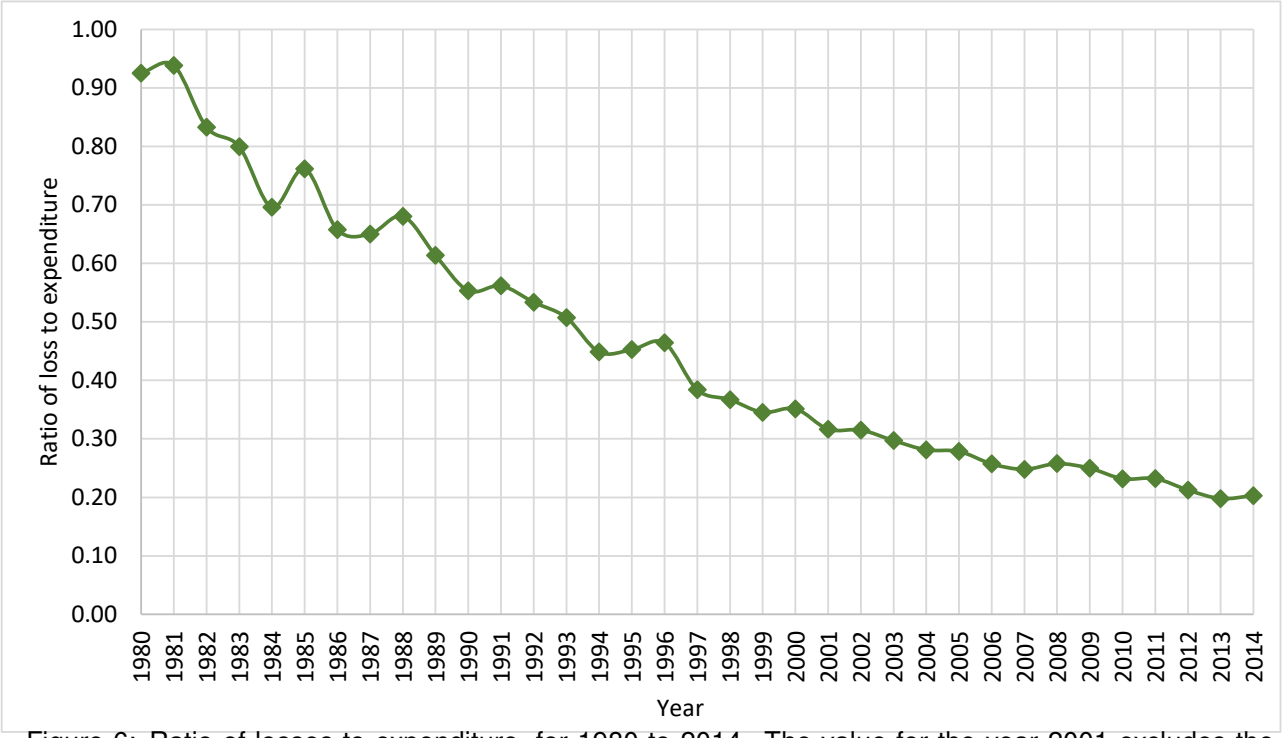

Figure 6: Ratio of losses to expenditure, for 1980 to 2014. The value for the year 2001 excludes the 9/11 Word Trade Center incident.

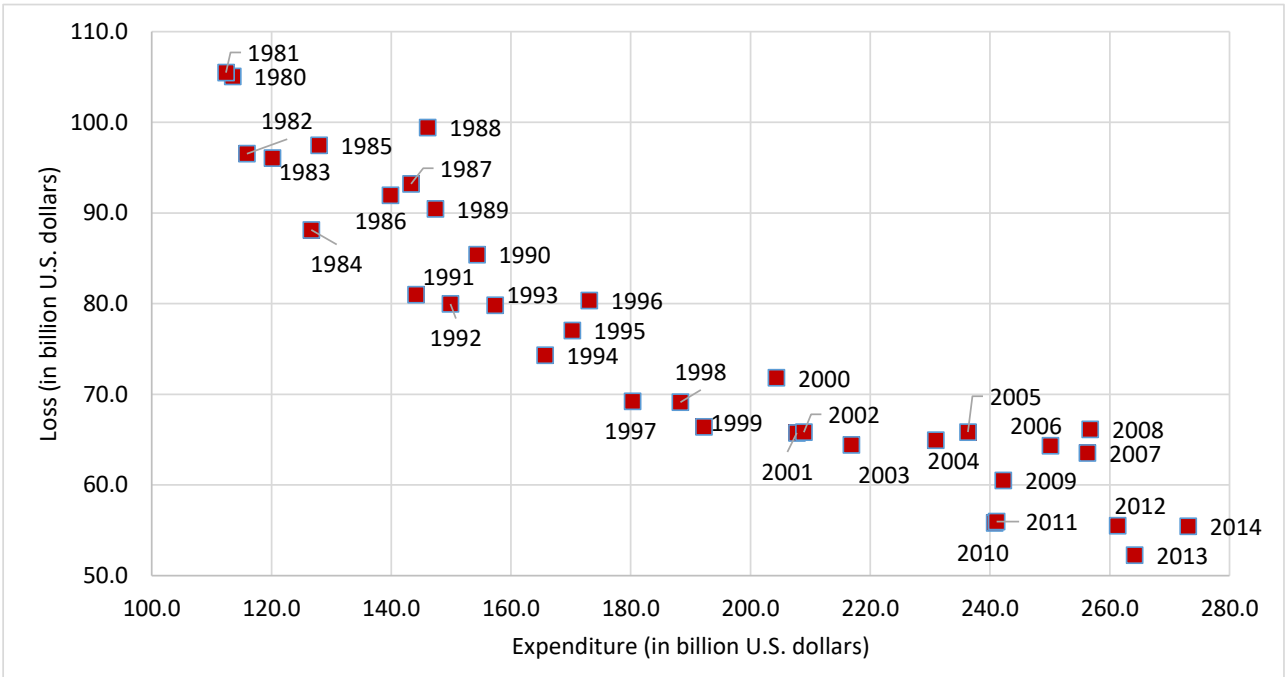

Figure 7: Losses versus expenditures diagram for 1980 to 2014, which shows that losses have decreased in expenditures, with decreasing marginal losses. The value for the year 2001 excludes the 9/11 Word Trade Center incident. Note that the X-axis (expenditure axis) and the Y-axis (loss axis) start from $100 billion and $50 billion respectively, and not from $0 billion.