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Analysis of Insurance Premiums and Payouts for 1987-1988 Designated High Theft Rate Passenger Cars

Volume I

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16. Abstract

Insurance claim patterns over the 1983-1988 period were analyzed to consider whether the Motor Vehicle Theft Law Enforcement Act of 1984 has influenced a reduction in passenger car thefts.

This evaluation examined vehicle theft rates, recovery rates, the condition of recovered stolen vehicles, insurer losses due to motor vehicle theft and the premiums charged by insurers for automobile comprehensive coverage.

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PREFACE

The cooperation of the insurance industry was essential to the success of this project. KLD especially wishes to thank the National Automobile Theft Bureau, the Highway Loss Data Institute and the following companies: Aetna, Allstate, Amica, GEICO, State Farm, Travelers and USAA for their cooperation and assistance.

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

A growing market for stolen automotive parts has led to a substantial increase in the number of vehicles which are stolen and dismantled for their parts. In 1988, it was estimated that motor vehicle theft cost Americans approximately seven billion dollars.

To address the problem of automobile theft, Congress enacted the Motor Vehicle Theft Law Enforcement Act of 1984 (Public Law 98-547). This legislation added a new Title VI to the Motor Vehicle Information and Cost Savings Act which required the Department of Transportation to promulgate a Theft Prevention Standard for selected passenger cars exhibiting high theft rates.

This Standard became effective for selected 1987 and later models and requires automobile manufacturers and manufacturers of replacement parts to affix a unique identification number on 14 major vehicle components. The labelling is intended to facilitate law enforcement efforts to trace and recover stolen vehicles and parts as well as arrest and prosecute the criminals responsible. The increased likelihood of arrest and punishment is also meant to serve as a deterrent to auto thieves.

The legislation also requires the Department of Transportation to evaluate the effectiveness of the Theft Prevention Standard and assess whether the standard should be continued, and if so, extended to other classes of vehicles. The results of this evaluation must be reported to Congress by October 1990.

To comply with this reporting requirement, the National Highway Traffic Safety Administration (NHTSA) contracted for the development of a database of insurance claim information for motor vehicles stolen during the six year period from 1983 through 1988. This database includes information on motor vehicle thefts, recoveries, insurance losses due to vehicle theft and premiums charged to consumers for theft coverage.

This information was analyzed to determine whether the Theft Prevention Standard led to a reduction in the theft of marked vehicles and whether this led to an accompanying reduction in theft related insurance losses and lower automobile comprehensive premiums for consumers.

If the Theft Prevention Standard was effective in deterring or reducing the number of vehicles which are stolen for their parts, it would be expected that after the marking program began:

- Marked vehicles would exhibit a larger decrease in theft rates than unmarked vehicles or

- Marked vehicles would exhibit a smaller increase in theft rates than unmarked vehicles.

An analysis of theft rates indicates that the latter situation is occurring. Averaging over the two year period since the introduction of the marking program, theft rate increases were significantly lower for marked vehicles than for unmarked vehicles. These increases measured 2.1 and 1.6 thefts per 1000 insured vehicle years for unmarked and marked vehicles respectively.

This result primarily reflected a decrease in theft rates for marked vehicles during the second year of the marking program. Between 1987 and 1988, theft rates decreased from 6.06 to 5.21 thefts per 1000 insured vehicle years for marked vehicles and increased slightly from 3.7 to 3.84 thefts per 1000 insured vehicle years for unmarked vehicles.

Although the reduction in theft rates for marked vehicles is limited to a single year, it suggests that the marking program is beginning to influence the theft rate of marked vehicles. Additional experience with the marking program will be necessary to confirm this.

Additional investigations of insurance data did not produce any other evidence that the marking program specifically benefitted marked insured vehicles. Insurer losses for marked vehicles continued to increase after the marking program began and expected theft losses actually increased faster for marked vehicles than for unmarked vehicles. This reflected the fact that average claim payments for marked vehicles increased by $128 while average claim costs for unmarked vehicles decreased over $700.

There was also no evidence the insurers had yet considered measuring the effects of the Theft Prevention Standard in their determination of automobile comprehensive premiums.

Experience with the marking program is very limited. As more vehicles are marked, any benefits of the program should become more apparent. Since the early evidence suggests that the marking program is beginning to discourage thefts of marked vehicles, further investigation of the program over time is warranted.

1. INTRODUCTION

This document constitutes the final report for research performed by KLD Associates, Inc. for the National Highway Traffic Safety Administration (NHTSA) under Contract DTNH22-88-C-06000.

The purpose of this project was to examine insurance claim data over the 1983-1988 period to identify whether the Motor Vehicle Theft Law Enforcement Act of 1984 has encouraged a reduction in automobile theft.

This legislation was enacted by Congress to combat the steady increase in the number of vehicles which are stolen and dismantled for their parts.

The legislation required the Department of Transportation to promulgate a Theft Prevention Standard for selected 1987 and later models with high theft rates. This standard requires automobile manufacturers and manufacturers of replacement parts to affix a unique identification number on major vehicle components. The labelling is intended to facilitate law enforcement efforts to trace and recover stolen vehicles and parts as well as arrest and prosecute the criminals responsible. The increased likelihood of arrest and punishment is also meant to serve as a deterrent to auto thieves.

The legislation also requires the NHTSA to report to Congress on the effectiveness of the Theft Prevention Standard and provide specific recommendations for the future continuation of this standard.

As part of the NHTSA's efforts to comply with this reporting requirement, the Agency contracted for the development of a database of insurance claim information describing periods both before and after the introduction of the parts labelling program. This database includes information on: thefts and recoveries of insured motor vehicles; insurer's exposure to theft losses; dollar losses resulting from vehicle theft; and premiums charged to consumers for theft coverage.

This information was analyzed to determine whether the marking program has encouraged a reduction in the thefts of insured motor vehicles for their parts and whether this has led to an accompanying reduction in theft related insurance losses and lower automobile comprehensive premium rates for consumers.

1.1 Background

Over the last 20 years, the profile of automotive theft has changed dramatically. In 1960, theft was considered to be primarily a juvenile problem with approximately 94% (1) of thefts attributed to "joyriders". In the 1980's, motor vehicle theft has

become an adult crime which is increasingly professional in nature. Problems associated with this trend include (2):

- An estimated 1.4 million vehicles were stolen nationally during 1988.

- There were also 1.6 million thefts of contents from motor vehicles in 1988 and 1.3 million thefts of accessories. Thus, one out of every 42 registered motor vehicles was stolen itself, or had its contents or accessories stolen in 1988.

- Only 15 percent of vehicle thefts were cleared by arrests and many of these arrests failed to result in convictions or guilty pleas because of criminal justice system restrictions on budgets and manpower, heavy court loads and overcrowded jails.

- An estimated 48 percent of all property crime dollar losses are attributed to vehicle theft.

These statistics translate into one theft of a motor vehicle, its contents or parts every 22 seconds. The cost of these thefts to Americans during 1988 was estimated at $7 billion per year.

Motor vehicle theft is perceived by criminals as a low risk, high profit crime (1). Police and other agencies have been unable to track missing vehicles since many are "chopped" into component parts which become untraceable. Such dismantling of vehicles frustrates police efforts to make arrests and minimizes the risks to criminals of prosecution and punishment.

There is a growing market for stolen parts which has contributed to the stealing and "chopping" of vehicles. "Chop" shops can often deliver overnight by stealing the ordered parts, whereas legitimate replacement parts could take weeks to receive from manufacturers. Besides these time savings, chop shops can also deliver parts already assembled, thereby decreasing labor costs to repair facilities. Garage owners can profit from these savings since they can charge the same price for a part whether it is legitimate or stolen.

1.1.1 Legislative Action

In an effort to address these problems, Congress enacted the Motor Vehicle Theft Law Enforcement Act of 1984. To address the chop shop problem, the law requires manufacturers to label certain parts on vehicles with high theft rates. This facilitates law enforcement efforts to trace and recover stolen vehicles and parts as well as arrest and prosecute the criminals responsible. The increased likelihood of arrest and punishment is also meant to serve as a deterrent to auto thieves. The

legislation also enacted criminal penalties for altering Vehicle Identification Numbers (VIN's) and for possessing, trafficking, importing or exporting stolen vehicles.

The purposes stated by Congress for this legislation were:

1) To provide for the identification of certain motor vehicles and their major replacement parts to impede motor vehicle thefts.

2) To augment Federal criminal penalties imposed upon persons trafficking in stolen motor vehicles.

3) To encourage decreases in premiums charged consumers for motor vehicle theft insurance.

4) To reduce opportunities for exporting or importing motor vehicle and off-highway mobile equipment.

Section 101(a) added a new Title VI to the Motor Vehicle Information and Cost Savings Act (15 US 1901), requiring the Department of Transportation to promulgate a Theft Prevention Standard for passenger cars with high theft rates. This is a minimum performance standard relating to the identification of new motor vehicle parts and major replacement parts.

1.1.2 Actions Required by the Theft Act

The Theft Act calls for specific actions by several groups including:

- Automobile manufacturers (Original Equipment Manufacturers and Manufacturers of Replacement Parts)
- The Automobile Insurance Industry
- The National Highway Traffic Safety Administration (NHTSA) and Secretary of Transportation.

Under the Theft Act, manufacturers are held responsible for inscribing or affixing the appropriate identification numbers for the affected parts and car lines.

1.1.2.1 Insurance Industry Requirements

The insurance industry is required to provide information to the Secretary of Transportation under Section 612 of the Theft Act. The following information is required to be reported annually:

1) The thefts and recoveries of motor vehicles.

2) The number of vehicles which have been recovered intact, in whole or in part.

3) The rating rules and plans, such as loss data and rating characteristics, used by insurers to establish premiums for comprehensive insurance coverage for motor vehicles. Also to be included is the basis for such premiums and premium penalties for those motor vehicles considered as more likely to be stolen.

4) The actions taken by insurers to reduce premiums including changes in rate levels for automobile comprehensive coverages due to a reduction in thefts of motor vehicles.

5) The actions taken by insurers to assist in deterring or reducing thefts of motor vehicles.

6) Other information as required by the Secretary of Transportation to administer this title and produce the report and findings required by this title.

1.1.2.2 Department of Transportation Requirements

Under the Title VI Theft Prevention Standard, the National Highway Traffic Safety Administration has been given the responsibility to:

- Select the parts which are to be marked with the appropriate identification numbers.
- Select the high theft lines which are to be covered by the requirement.
- Establish the performance criteria for inscribing or affixing the appropriate identification numbers.
- Specify the manner and form for compliance certification and who will be authorized to certify compliance.
- Define specific annual insurer reporting requirements under Section 612.
- Identify insurers and leasing companies subject to the annual reporting requirements and grant exemptions from these requirements to insurers and small rental and leasing companies which qualify under Section 612.
- Grant an exemption from the standard if a line of vehicles is manufactured with an anti-theft device which is determined to most likely be as effective as the standard in deterring theft.

Under Section 614 of the legislation, the Secretary of Transportation is required to submit two reports to Congress on Motor Vehicle Theft. The first report was completed by NHTSA in October 1987 (3) and describes the impact of automotive theft on the insurance industry during calendar year 1985. This time frame preceded the implementation of the Theft Prevention Standard.

A second report is required to be submitted to Congress in October 1990. This report will provide an extensive evaluation of the effectiveness of the Motor Vehicle Theft Prevention Standard including recommendations to Congress to either:

- Continue the standard without change.
- Modify the standard to include fewer passenger car lines.
- Modify the standard to include other classes of motor vehicles, such as trucks, vans and motorcycles.
- Terminate the standard.

As required by subsection 614 b, the report shall also include:

A) The methods and procedures used by public and private entities for collecting, compiling and disseminating information concerning the theft and recovery of motor vehicles including:

   1) The accuracy, reliability and timeliness of the data.
   2) How such information can be improved.

B) Data on the number of motor vehicles stolen and recovered annually compiled by vehicle class, make and line.

C) The extent to which motor vehicles stolen annually are dismantled or exported.

D) A description of the market for such stolen parts.

E) Information concerning costs incurred by manufacturers and car purchasers in order to comply with the standard, as well as the dollar benefits of the standard and the extent to which these benefits exceed costs.

F) The experience of Federal, State and local officials in making arrests and successfully prosecuting violators.

G) Information concerning comprehensive premiums charged by insurers including any increase in these premiums charged because a vehicle is a likely candidate for theft. Also the extent to which the standard may have led to reduced

comprehensive premiums or alleviated premium increases.

H) The adequacy and effectiveness of Federal and State laws aimed at preventing the distribution and sale of used parts removed from stolen vehicles.

I) An assessment of whether the identification of parts for classes other than passenger cars would be beneficial.

J) Any other information available to the Secretary concerning the impact of the Act.

1.2 NHTSA Actions in Response to Legislation

As empowered under the Motor Vehicle Theft Law Enforcement Act of 1984, the NHTSA promulgated a series of rules to implement the Theft Prevention Standard. These rules

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Table 1. Major Parts Subject to Labelling Requirements

1) Engine
2) Transmission
3) Right front fender
4) Left front fender
5) Hood
6) Right front door
7) Left front door
8) Right rear door
9) Left rear door
10) Front bumper
11) Rear bumper
12) Right rear quarter panel
13) Left rear quarter panel
14) Decklid, tailgate or hatchback

be stolen and fenced with minimal risk.

Thus, the VIN marking requirements apply to twelve major components of two door vehicles and fourteen major components of four door vehicles.

1.2.2 Selection of High Theft Lines

The Theft Act defined three categories of car lines as high theft lines for purposes of the Theft Prevention Standard. These categories include:

1) Existing lines that had a theft rate exceeding the median theft rate in 1983 and 1984.

2) New lines likely to have a theft rate exceeding the median theft rate.

3) Existing or new lines that had a theft rate below the median rate, but had a majority of major parts which are interchangeable with lines whose theft rate exceeded or is likely to exceed the 1983 and 1984 median theft rate.

Existing lines were defined as lines first produced before January 1, 1983.

The Theft Act also directed the Department of Transportation to compile and publish theft rate listings for model year 1983 and later car lines offered for sale in the United States. The initial listing was published in November 1985 for model years 1983 and 1984 and covered 130 car lines. It also set the median theft rate for car lines subject to the Standard at 3.2712 thefts per 1,000 vehicles produced.

The requirements for labelling automotive parts became effective for 1987 model year vehicles. In April of 1986, NHTSA selected the 1987 car lines subject to these labelling requirements. Existing lines were selected on the basis of actual theft data. New lines were selected according to defined procedures (5). Several of the car lines initially selected were found to be equipped with anti-theft devices and were subsequently exempted from the standard in November 1986.

Lines subject to the parts labelling requirements during 1987 and 1988 are identified in Appendix B.

1.2.3 Selection of Insurer Reporting Requirements and Subject Insurers

In January 1987, the NHTSA promulgated a final rule (6) which defined the insurer reporting requirements under Section 612 of the Theft Act and identified 31 insurers who were

subject to these reporting requirements. The information submitted by insurers under this rule is intended to aid NHTSA in its efforts to publish the required insurance information in a form that would be helpful to the public, the law enforcement community and the Congress.

The insurer reports also provide the NHTSA with information needed to prepare the 1987 and 1990 evaluation reports for Congress as required in Section 614 of the legislation.

An initial list of the insurance reporting requirements was specified by Congress in the legislation as indicated in Section 1.1.2.1 of this report. Under the authority given to NHTSA in developing its final rule, one additional reporting requirement was added to assist the agency in determining whether anti-theft devices are as effective as parts marking in deterring and reducing vehicle thefts.

Considering the Congressional intent of the insurer reporting requirements, the agency formulated its reporting rule so that:

1) Insurers are required to report only information essential to the purposes of the Theft Act.

2) The costs of time and money imposed upon the insurers to supply information should be kept to the minimum necessary to satisfy the need for information.

3) To the maximum extent possible, insurers should report data previously gathered for their own purposes. The generation of new data could be justified only if this data was explicitly required by Section 612 of the legislation.

Given these considerations, the final rule requires that only theft and recovery data be stratified according to model, make and line. Loss and rating information are to be provided to the NHTSA in the same categories used by the insurers for their own purposes. This approach imposes the minimum burden on the insurers because they do not have to reformat their data.

The actual reporting requirements under the NHTSA's final rule are presented in Table 2.

The first insurer reports were filed with the NHTSA Office of Rulemaking in January 1987 covering calendar year 1985. The information in these reports was reviewed and analyzed by the Office of Rulemaking and was incorporated in NHTSA's October 1987 report. Insurer reports for each calendar year after 1985 are due approximately 10 months after the year has concluded.

Table 2. Insurer Reporting Requirements of Motor Vehicle Theft Law Enforcement Act of 1984

1. Total thefts and recoveries of insured vehicles during the reporting period, broken down into make, model, and line for each vehicle type, and the use made by the insurer of this information;

2. The rating rules and plans used by the insurer to establish comprehensive insurance premiums and premium penalties for motor vehicles considered by the insurer as more likely to be stolen, broken down into the risk groupings the insurer uses for its purposes;

3. The actions taken by the insurer to reduce comprehensive insurance premiums because of a reduction in vehicle thefts;

4. Information about any discounts the insurer offers for vehicles equipped with anti-theft devices, including the number of such discounts and thefts and recoveries of vehicles that received such discounts; and

5. The insurer's actions to assist in deterring and reducing vehicle thefts.

Insurer reports for calendar years 1986 and 1987 have already been submitted to the Department of Transportation. Reports for 1988 were submitted in November 1989.

1.3 Role of This Study

This study represents one of several efforts to provide information for NHTSA's evaluation of the effectiveness of the Theft Prevention Standard. This study examines the impact of the parts marking program on the thefts and recoveries of insured motor vehicles. The purpose of the Theft Act was not only to deter automobile theft but also to encourage decreases in the comprehensive premiums charged for motor vehicle theft insurance. Therefore, this study also examines whether the marking program has resulted in any reduction in insurer theft losses for vehicles with marked parts and whether any such savings have been translated into reduced comprehensive insurance premiums for consumers.

The information analyzed in this project was furnished by a limited number of major insurers who voluntarily cooperated with the NHTSA to provide important data for the evaluation of the Theft Prevention Standard. The claim information provided for this project was much more detailed than the information supplied under the mandatory insurer reporting requirements of Section 612 of the Theft Act.

Besides the additional detail, the information also includes annual theft data as far back as 1983 whereas Section 612 did not require annual insurer reporting information prior to 1985.

For purposes of evaluating the Theft Prevention Standard, it is important to consider theft data back to 1983 since the first lines subjected to the parts labelling requirements in model year 1987, were selected on the basis of their 1983-1984 theft rates.

1.4 Data Sources

The data base developed for the evaluation of the Theft Prevention Standard includes insurance claim information on motor vehicle thefts, recoveries, exposure to theft losses, payments due to vehicle theft and automobile comprehensive premiums charged to consumers during 1983-1988.

This information covers several years before and two years after the marking program began.

The information provided by the insurance industry included:

- A computer file produced by the National Automobile Theft Bureau (NATB) describing stolen insured vehicles and their condition upon recovery. This sample represents the 1983-1988 vehicle theft experience of seven companies including:

Aetna, Allstate, Amica, GEICO, State Farm, Travelers and USAA.

- A computer file produced by the Highway Loss Data Institute (HLDI) describing individual insurer payments issued to policyholders who sustained the theft of either a motor vehicle, its contents or components. This sample represents the 1983-1988 vehicle theft experience of five companies including: Aetna, Allstate, GEICO, State Farm and Travelers.

- A computer file produced by the HLDI describing insurers' exposure to theft losses (in insured vehicle years) by model and model year for 1983 through 1988. This file contains the aggregate exposure of six companies including: Aetna, Allstate, GEICO, State Farm, Travelers and USAA.

- Detailed theft claim records provided by one company indicating costs to repair recovered damaged vehicles to their pre-theft state.

- Data to identify the automobile comprehensive premiums charged to consumers during 1983-1988. Premium charges were obtained for six companies: Aetna, Amica, Geico, State Farm, Travelers and USAA for all vehicle rating classifications in up to 10 states.

1.5 Report Organization

Section 2 examines theft rates for insured vehicles before and after the marking program began to determine whether parts labelling has encouraged a reduction in the rate of thefts of marked vehicles.

Section 3 similarly examines recovery rates and the condition of recovered vehicles to determine whether the marking program has influenced a reduction in the proportion of vehicles which are stolen either for their parts or for export.

Section 4 considers whether insurance losses for stolen marked vehicles were reduced after the marking program began.

Section 5 examines the variability in automobile comprehensive premiums charged during 1983-1988 and examines the influence of changes in theft losses on comprehensive rates.

Section 6 examines specific characteristics of passenger car theft claims filed during 1987-1988. These characteristics include the distribution of theft claims by vehicle age, the proportion of insurance claims settled without payments issued to policyholders, the proportion of recovered vehicles found before the claim was settled and the cost to repair recovered vehicles to their pre-

theft state.

Section 7 presents the conclusions of this research project.

The report also includes four Appendix sections. Appendix A presents vehicle theft rates during 1983-1988. These rates are based on insurance data and are presented by calendar year, model year, vehicle type and vehicle line. These tabulations are discussed in Section 2.

Appendix B describes the number of vehicles stolen and recovered during 1983-1988 stratified by calendar year, vehicle age, vehicle type, make, line and model. These tabulations are discussed in Section 3.

Appendix C presents the average payments issued by insurers for stolen vehicles during 1983-1988. This information is stratified by calendar year, vehicle age, vehicle type, make and line. These tabulations are discussed in Section 4.

Appendix D presents a set of graphs depicting trends in automobile comprehensive insurance rates in various states over the 1983-1988 period. These graphs are discussed in Section 5.

2. THEFT RATES FOR INSURED VEHICLES DURING 1983-1988

An important goal of the Theft Act is to encourage a reduction in the number of vehicles stolen by professional thieves who export or dismantle vehicles for their parts. To examine whether this goal was met, theft rates were computed and compared before and after the parts marking program was initiated.

The sections which follow describe how theft rates were determined by model year and line and identify whether any reduction in theft rates was observed which might be attributable to the marking program.

2.1 Development of Theft Rates for 1983-1988

The National Automobile Theft Bureau (NATB) receives reports of motor vehicle thefts and recoveries from over 600 insurance companies throughout the United States. A nationwide sample of these reports was obtained for vehicles insured by seven major companies including: Aetna, Allstate, Amica, GEICO, State Farm, Travelers and USAA. These companies represented 33% of the premiums written for all types of motor vehicle insurance in the United States during 1984 (7).

NATB records were obtained for stolen vehicles insured by the selected companies during 1983-1988. Each calendar year sample included vehicles of specific ages as follows:

Calendar Year Samples	Vehicle Ages Included
1985-1988	Current Model Year (CMY), 1 and 2 year old vehicles
1984	CMY and 1 year old vehicles
1983	CMY vehicles

These samples included vehicles produced before and after the VIN labelling requirements of the Theft Act took effect. Within these samples, the marking program applied to selected:

- CMY 1987 vehicles stolen during 1987.
- CMY 1988 and 1 year old 1987 vehicles stolen during 1988.

This information was used to determine theft rates by model year and line during 1983-1988. Each theft rate, T_R was defined as:

$$T_R = \frac{\text{The Number of Insured Vehicles Stolen}}{\text{Insurers' Exposure to Potential Theft}}$$

The exposure to theft represents the time interval that each individual vehicle is insured. The exposure is expressed in units of insured vehicle years. Exposure by calendar year, model year, and line was provided on behalf of participating insurers by the Highway Loss Data Institute.

Annual thefts, exposure and theft rates are presented in Appendix A by calendar year, model year, and vehicle line. These theft rates represent the number of current model year vehicles stolen annually per 1000 insured vehicle years.

2.2 Variation in Theft Rates During 1983-1988

Theft rates were examined to consider:

- The variation in rates for CMY vehicles over the 1983-1988 period.
- The variation in rates by vehicle type.
- The variation in rates between marked vehicles, unmarked vehicles and vehicles equipped with an anti-theft device which were exempted from the marking program.

These analyses were designed to consider whether theft rates decreased for selected lines after they were labelled and whether other vehicles would benefit from the labelling program.

2.2.1 Variation in Theft Rates Over Time

Figure 1 illustrates the variation in annual theft rates for CMY insured vehicles during 1983-1988. After an 11 percent decrease in rates between 1983 and 1984, the theft rate for CMY vehicles increased between 1984 and 1988 from 2.56 to 4.38 thefts per 1000 insured vehicle years (Table 3). This represented an increase of 29 percent over the two year period prior to the introduction of parts labelling with a further increase of 32 percent over the two year period after the labelling began.

Of particular interest is the fact that theft rates for CMY vehicles climbed dramatically (31.1 percent) the first year after labelling was introduced and increased only 0.9 percent the second year after labelling began. At first glance, this might suggest that the overall problem of vehicle theft leveled in 1988 and suggests the possibility that the marking program might have begun to restrain the annual increases in theft rates for CMY vehicles.

Upon further investigation, neither of these possibilities seems likely. The problem of vehicle theft continued to increase between 1987 and 1988 with theft rates for one and two year old

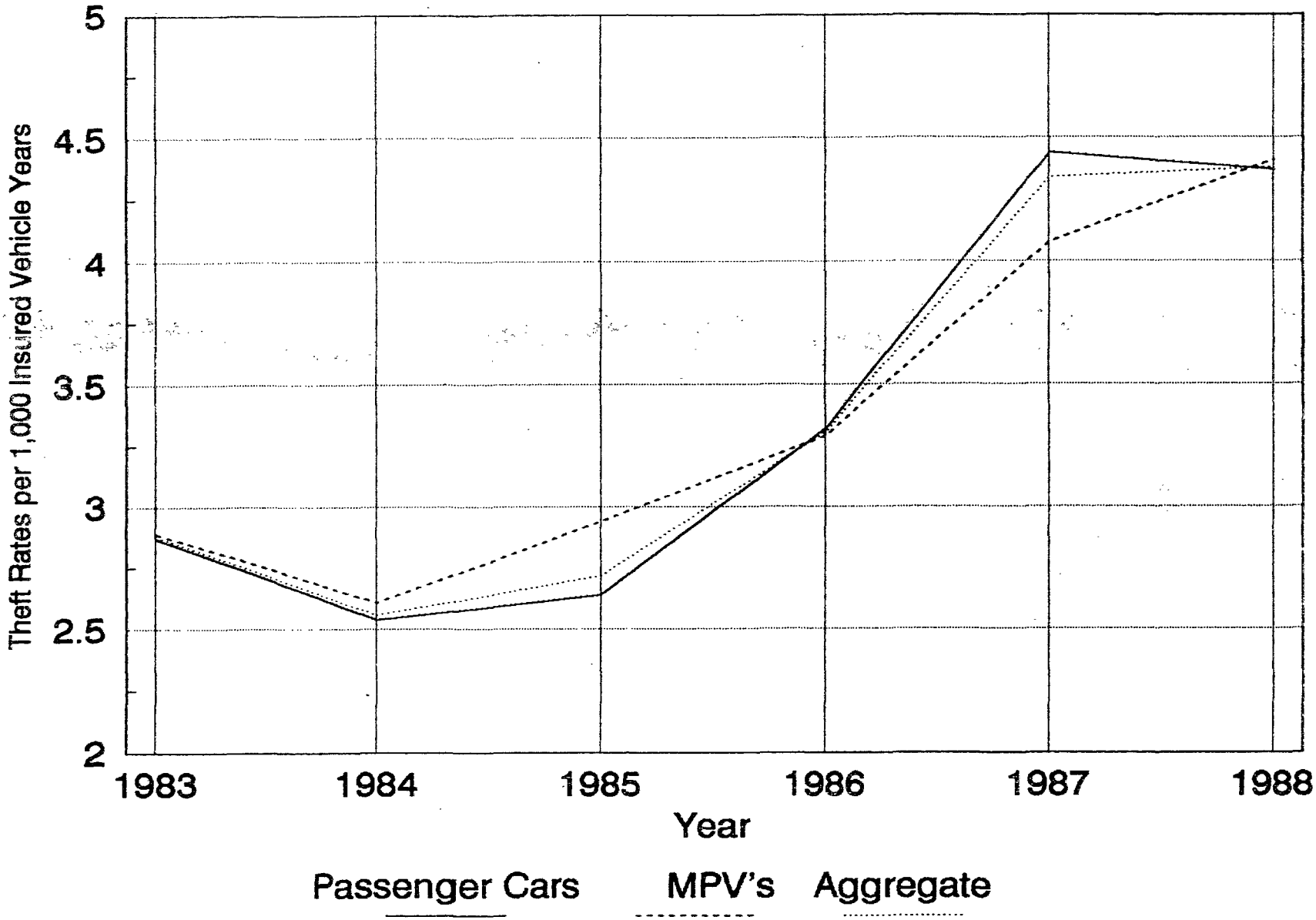


Figure 1 Annual Theft Rates for Current Model Year Insured Vehicles

Table 3. Theft Rates for Current Model Year Insured Vehicles by Vehicle Type

Annual CMY Theft Rate

(Annual Thefts Per 1000 Insured Vehicle Years)

Vehicle Type	1988	1987	1986	1985	1984	1983
Passenger Cars	4.37	4.44	3.32	2.64	2.54	2.87
MPVs/Light Trucks	4.41	4.08	3.29	2.94	2.61	2.89
All vehicle types**	4.38	4.34	3.31	2.72	2.56	2.88
Percent Change Between Years		0.9	31.1*	21.7*	6.3*	-11.1*

*Difference in theft rates between years is statistically significant at the 5% level.
**Includes passenger cars, multi-purpose vehicles and light trucks.

	Sample Sizes	
	Exposure	Thefts
1983 Aggregate	1708157	4913
1984 Aggregate	2659471	6799
1985 Aggregate	2786478	7580
1986 Aggregate	3004545	9953
1987 Aggregate	2664073	11575
1988 Aggregate	2691519	11788

vehicles increasing by 9.3 percent and 10.9 percent respectively (Appendix A). This is consistent with an 11.2 percent increase for all vehicle thefts between 1987 and 1988 reported by the NATB (2).

If the Theft Prevention Standard helped cause the rate of increase of thefts of CMY vehicles to slow between 1987-1988, it might be expected that similar results would be observed between 1987 and 1988 for one year old vehicles. Some of the one year old vehicles were marked in 1988 while none of the one year old vehicles were marked in 1987. However, theft rates for one year old vehicles continued to increase substantially between 1987-1988, even after some of these vehicles were marked. This would suggest that the marking program did not play a substantive role in the changes in overall theft rates for CMY vehicles observed between 1987 and 1988.

2.2.2 Variation in Theft Rates by Vehicle Type

Figure 1 also illustrates the variation in theft rates over 1983-1988 for CMY passenger cars and multipurpose vehicles (MPVs)/light trucks. Theft rates appeared very similar for both these groups. As shown in Table 3, theft rates were estimated as 4.37 and 4.41 thefts per 1000 insured vehicle years for 1988 passenger cars and MPVs respectively.

Substantial increases in overall CMY passenger car theft rates continued after some lines were marked. Over the two years prior to the introduction of parts labelling, the theft rate for passenger cars increased 30.7 percent. Two years after the introduction of labelling, the theft rate for passenger cars similarly increased another 31.6 percent. Thus, the introduction of marked vehicles did not appear to slow the dramatic increases in passenger car theft rates over time.

Two years after selected CMY passenger cars were marked, the theft rate for passenger cars remained essentially the same as the rate for unmarked MPVs/light trucks. At the start of the marking program, the theft rate for CMY passenger cars was 0.9 percent higher than the rate for CMY MPVs/light trucks. Two years after the marking program began, the situation reversed and the theft rate for passenger cars was 0.9 percent lower than the rate for MPVs/light trucks. Thus, the maximum possible contribution of marked vehicles to a reduction in overall passenger car theft rates relative to theft rates for unmarked MPVs/light trucks was 1.8 percent.

Therefore, the marking of selected passenger cars does not appear to have significantly changed the overall rate of theft for passenger cars as a group.

2.2.3 Variation in Theft Rates Between Marked and Unmarked Passenger Cars

The most direct technique to identify any changes in theft rates that might be attributable to the parts labelling program, is to compare rates for marked and unmarked passenger cars both before and after the labelling began.

Since vehicles were selected for marking on the basis of their high theft rates, it is possible for the marking to be effective in reducing theft while the actual theft rates for marked vehicles still remain somewhat higher than the rates for unmarked vehicles. Therefore, only relative changes in rates between marked and unmarked vehicles should be considered.

Thus, if the Theft Prevention Standard was effective in deterring or reducing the number of vehicles which are stolen for their parts, it would be expected that after the marking program began:

- Marked vehicles would exhibit a larger decrease in theft rates than unmarked vehicles or
- Marked vehicles would exhibit a smaller increase in theft rates than unmarked vehicles.

Figure 2 illustrates the variation in CMY vehicle theft rates from 1983-1988 for marked and unmarked vehicles. As shown in this figure, prior to the introduction of the marking program, the difference in theft rates between ancestors of marked cars and ancestors of unmarked cars appeared reasonably constant between 1983 and 1986.

One year after the marking program began, the difference in theft rates between these two vehicle groups continued to remain the same as before. However, during the second year of the marking program, the difference in theft rates between marked and unmarked cars narrowed considerably. This narrowing reflected a decrease in theft rates for marked cars between 1987 and 1988 from 6.06 to 5.21 thefts per 1000 insured vehicle years (Table 4). During the same period, the theft rate for unmarked cars increased slightly from 3.70 to 3.84 (Table 4). This suggests the possibility that the marking program may have begun to influence the rate of theft for marked vehicles in 1988.

Additional experience with the marking program will be necessary to determine whether the 1988 results are a statistical aberration or the beginning of a new trend towards lower theft rates for marked vehicles.

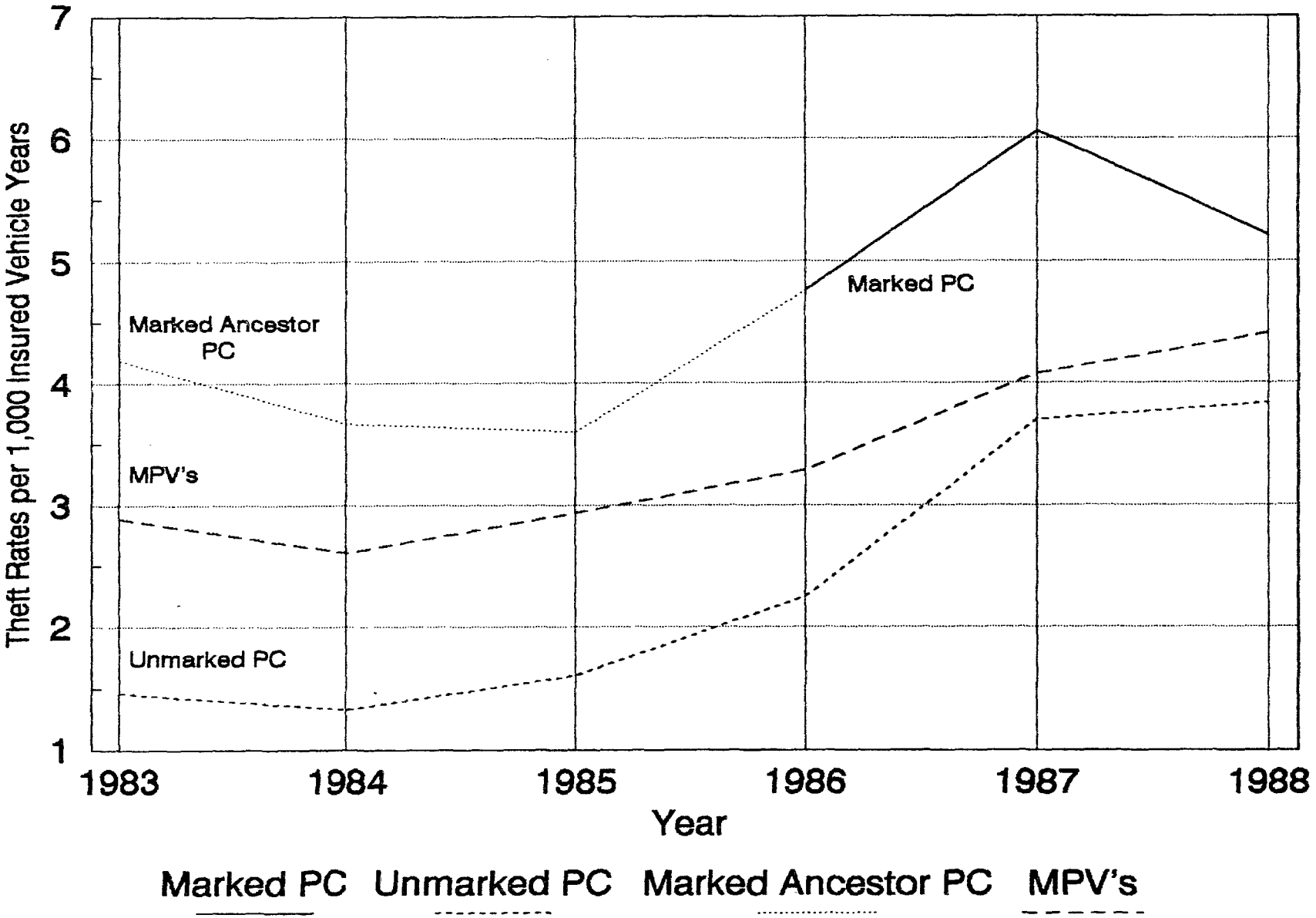


Figure 2 Theft Rates for CMY Marked and Unmarked Vehicles

Table 4. Theft Rates for Current Model Year Marked and Unmarked Passenger Cars (P.C.)

Annual CMY Theft Rate

(Annual Thefts Per 1000 Insured Vehicle Years)

Category	1988	1987	1986	1985	1984	1983
Marked* P.C.	5.21	6.06	4.76	3.60	3.67	4.19
Unmarked P.C.	3.84	3.70	2.25	1.61	1.33	1.46
Anti-Theft Exemptions	5.24	4.73	3.37	4.92	5.63	6.56
All P.C.	4.37	4.44	3.32	2.64	2.54	2.87

*Marking applied only to CMY 1987 and 1988 vehicles.

To further examine whether the marking program changed the rate of theft for marked vehicles, a series of statistical tests were performed. The proportions test was applied to compare theft rates for four groups of vehicles:

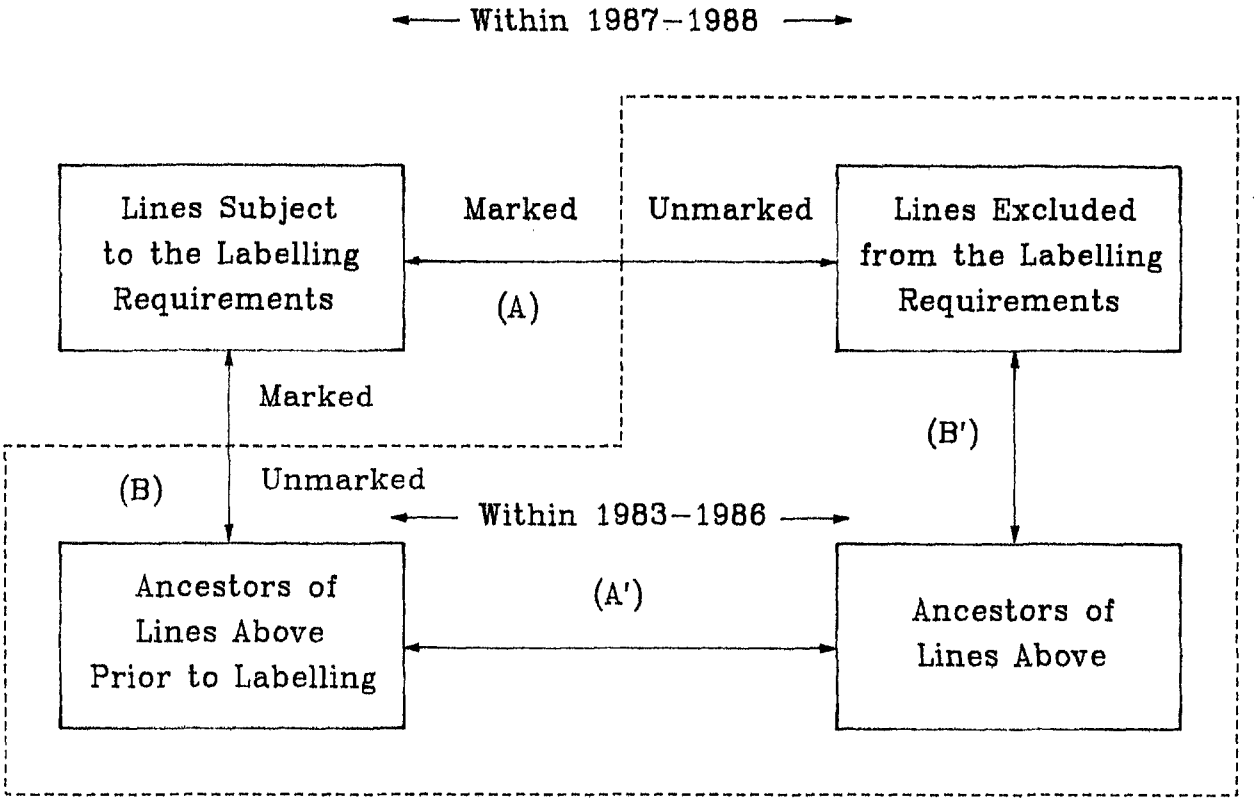
- CMY 1987-1988 passenger cars subject to the labelling requirements
- CMY 1987-1988 passenger cars excluded from the labelling requirements
- CMY 1983-1986 ancestor versions of the lines subject to the labelling requirements
- CMY 1983-1986 ancestor versions of the lines excluded from the labelling requirements.

Only vehicles in the first of these groupings had marked parts. Figure 3 illustrates how these samples were compared to investigate the effectiveness of the parts labelling program. The results of these comparisons are identified in Table 5.

The results indicate that theft rates for both marked and unmarked vehicles were significantly higher for the post-standard 1987-1988 period than rates for the prestandard 1983-1986 period (Comparison B and B'). These increases measured 2.1 and 1.6 thefts per 1000 insured vehicle years for unmarked and marked vehicles respectively. This represented an increase in theft rates of 124% for unmarked vehicles and 40% for marked vehicles after the marking program began.

Over the period since the introduction of the marking program, theft rates for marked vehicles continued to remain significantly higher than rates for unmarked vehicles as a group (Comparison A). However, the difference in rates between these groups appeared to be smaller after one group was marked (Comparisons A and A'). This might suggest that the standard was successful in lowering the rate of theft for marked vehicles relative to the rate for unmarked vehicles.

This hypothesis was tested to determine whether the introduction of marking significantly reduced the difference in theft rates between marked and unmarked vehicles given the significant increase in theft rates for both groups during the period the marking program has been in effect. Based on a test of the ratio of 2 random variables (8), this hypothesis was accepted with 95% confidence. Thus, it appears that the marking program had a beneficial effect on the theft rates of marked vehicles compared to unmarked vehicles.



Comparisons (A) and (B) directly compare lines with and without parts labelling

Comparisons (A') and (B') examine inherent differences exclusive of influence of parts labelling

Legend:

Samples

Comparisons ( )

Figure 3. Use of Samples to Investigate Effectiveness of Parts Labelling

Table 5. Results of Proportions Tests to Examine Changes in Theft Rates for Marked Passenger Cars After the Marking Program Began

Study	Description	Exposure (Insured Veh-Yrs)	Thefts Per 1000 Insured Veh-Yrs	Difference in Theft Rates
A	1987-1988 Marked Vehicles vs.	1267482	5.6	1.8*
	1987-1988 Unmarked Vehicles	2492475	3.8	
A'	1983-1986 Marked Ancestors vs.	3246672	4.0	2.3*
	1983-1986 Unmarked Ancestors	4028197	1.7	
B	1987-1988 Marked Vehicles vs.	1267482	5.6	1.8*
	1983-1986 Marked Ancestors	3246672	4.0	
B'	1987-1988 Unmarked Vehicles vs.	2492475	3.8	2.1*
	1983-1986 Unmarked Ancestors	4028197	1.7	

*Difference in theft rates is statistically significant at the 5% level.

2.2.4 Variation in Theft Rates Between Vehicles with Anti-Theft Devices and Marked and Unmarked Cars

The NHTSA grants exemptions from the VIN labelling requirements to passenger car lines equipped with passive anti-theft devices. These exemptions are granted on the expectation that the devices will perform at least as well as the labelling in deterring vehicle theft.

Several statistical comparisons were performed to examine how theft rates varied over time for lines exempted from the standard compared with theft rates for lines with and without VIN marking. These comparisons are illustrated in Figure 4. The results of these comparisons are presented in Table 6.

The results of these comparisons suggest that passive anti-theft devices have performed better than the marking program in reducing vehicle theft. Prior to the start of the marking program, ancestors of the lines receiving exemptions from the standard for anti-theft devices exhibited a significant 25% higher rate of theft than the ancestors of lines selected for subsequent VIN marking (Comparison C'). Over the two year period after marking began, lines equipped with passive anti-theft devices exhibited a significant 12.5% lower rate of theft than marked cars (Comparison C). Both differences were determined to be statistically significant.

This result reflects the fact that theft rates for lines equipped with anti-theft devices remained unchanged between the pre-standard 1983-1986 period and post-standard 1987-1988 period (Comparison E) while theft rates rose significantly for both marked and unmarked cars (Comparisons B and B').

Thus, after the marking program began, lines exempted from the standard because they were equipped with a passive anti-theft device exhibited a more favorable trend in theft rates than either marked or unmarked passenger cars.

2.3 Implications of Theft Rate Trends on the Evaluation of the Theft Act

Based on the analyses of 1983-1988 theft rates described in the previous section, several observations may be made relative to the effectiveness of the Theft Prevention Standard in deterring vehicle theft:

- The marking of selected passenger cars had no major impact on the theft rates of passenger cars as a group. Two years after the marking program began, theft rates for passenger cars continued to remain similar to rates for unmarked multipurpose vehicles and light trucks.

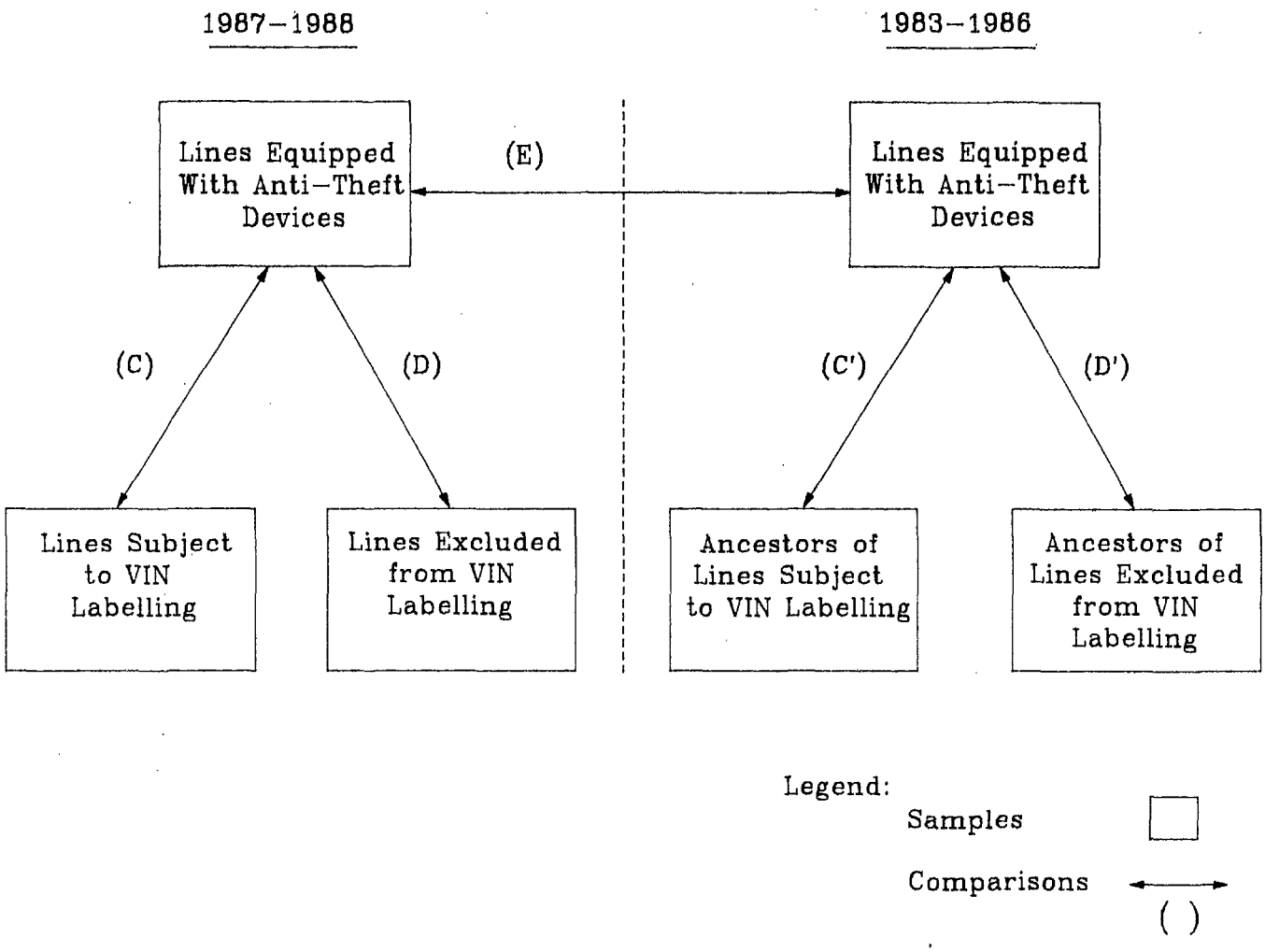


Figure 4. Use of Samples to Determine Effectiveness of Anti–Theft Devices

Table 6. Results of Proportion Tests to Compare Theft Rates for Cars with Anti-Theft Devices with Rates for Marked and Unmarked Cars

Study	Description	Exposure (Insured Veh-Yrs)	Thefts Per 1000 Insured Veh-Yrs	Difference in Theft Rates
C	1987-1988 Anti-Theft Vehicles vs.	145973	4.9	-0.7*
	1987-1988 Marked Vehicles	1267482	5.6	
C'	1983-1986 Anti-Theft Vehicles vs.	359697	5.0	1.0*
	1983-1986 Marked Ancestors	3246672	4.0	
D	1987-1988 Anti-Theft Vehicles vs.	145973	4.9	1.1*
	1987-1988 Unmarked Vehicles	2492475	3.8	
D'	1983-1986 Anti-Theft Vehicles vs.	359697	5.0	3.3*
	1983-1986 Unmarked Vehicles	4028197	1.7	
E	1983-1986 Anti-Theft Vehicles vs.	359697	5.0	0.1
	1987-1988 Anti-Theft Vehicles	145973	4.9	

*Difference in theft rates was statistically significant at the 5% level.

- Since the introduction of the parts marking program, theft rates for both marked and unmarked vehicles have increased significantly.

- During the first year of parts marking, theft rates continued to increase similarly for marked and unmarked vehicles. During the second year, the theft rate for marked cars decreased from 6.06 to 5.21 thefts per 1000 insured vehicle years while the theft rate for unmarked cars increased slightly from 3.7 to 3.84. Thus, additional experience with the marking program will be necessary to determine whether the program has begun to influence theft rates for marked vehicles.

- Over the two years since the introduction of the marking program, theft rate increases were significantly lower for marked vehicles than for unmarked vehicles. This was primarily due to the decrease in theft rates observed for marked vehicles between 1987 and 1988.

- Passenger cars equipped with passive anti-theft devices exhibited a more favorable trend in theft rates over the 1987-1988 period than either marked or unmarked cars. Lines exempted from parts marking due to the presence of a passive anti-theft device exhibited uniform theft rates between the pre-standard 1983-1986 period and post-standard 1987-1988 period while theft rates increased significantly for both marked and unmarked cars.

3. RECOVERY RATES FOR INSURED VEHICLES DURING 1983-1988

If the Theft Act was successful in reducing the number of vehicles which are stolen by professional thieves for export or dismantling, it might be expected that the recovery rate for stolen vehicles would increase after the marking program began independent of other factors. To examine whether this occurred, recovery rates were computed and compared before and after the parts marking program was initiated.

The sections which follow describe how recovery rates were determined by model year, line and model and consider whether there was any increase in recovery rates that may have resulted from the marking program.

3.1 Determination of Recovery Rates For 1983-1988

Records of motor vehicles thefts and recoveries furnished by the National Automobile Theft Bureau (NATB) were used to establish recovery rates for current model year (CMY), one and two year old vehicles stolen during 1983-1988. As described in Section 2.1 of this report, theft reports were provided by the NATB for seven major insurance companies including: Aetna, Allstate, Amica, GEICO, State Farm, Travelers and USAA.

Each theft record identified whether the stolen vehicle was recovered, the date of the recovery and the condition of the vehicle upon recovery. This information was used to determine recovery rates by model year, line and model during 1983-1988. Each recovery rate R was defined as:

$$R = \frac{\text{The number of Insured Vehicles Recovered}}{\text{The number of Insured Vehicles Stolen}}$$

To compute these rates, a vehicle was considered recovered if it had been recovered by December 31st of the year in which it was stolen.

Recovery information for calendar years 1983-1988 is presented by model year and by model in Appendix B of this report.

3.1.1 Characteristics of NATB Recovery Data

In 1986, to conform to the insurer reporting requirements of the Motor Vehicle Theft Law Enforcement Act of 1984, the NATB and the insurance industry modified their procedures to describe the condition of a recovered stolen vehicle. In its ruling on insurer reporting requirements (6), the NHTSA defined three categories of recoveries depending upon whether or not one or more of the major vehicle parts listed in Table 1 were missing from the vehicle at the time of recovery. These categories

include:

1) Recovery Intact - A vehicle reported as stolen is recovered with no major parts missing at the time of the recovery and with no apparent damage to the vehicle other than damage necessary to enter and operate the vehicle and ordinary wear and tear.

2) Recovery In-Whole - A vehicle reported as stolen is recovered with no major parts missing at the time of the recovery but with damage in addition to that sustained during unauthorized entry and operation. This would include vehicles stripped of other parts, wrecked vehicles, burned vehicles (with no major parts missing), etc.

3) Recovery In-Part - A vehicle reported as stolen is recovered with one or more major parts missing at the time of the recovery. This would include vehicles stripped of other parts, wrecked vehicles, burned vehicles (with major parts missing), etc.

A recovery in-part would indicate a possibility that the vehicle was stolen for use by a chop shop.

As of 1986, the NATB employed these terms (intact, in-whole, in-part) to describe the condition of recovered vehicles. Prior to 1986, the NATB could not specifically identify whether a major part (as defined by the standard) was removed prior to recovery. However, it was possible to determine whether a vehicle was recovered with all its parts present or with parts missing.

3.2 Variation in Motor Vehicle Recoveries During 1983-1988

Recovery rates were analyzed to identify:

- The variation in recovery rates for CMY vehicles over the 1983-1988 period.
- The variation in recovery rates by vehicle type.
- The variation in rates between marked vehicles, unmarked vehicles and vehicles equipped with an anti-theft theft device which warranted an exemption from the marking program.

These analyses were designed to identify any changes in recovery patterns that may have resulted from the Theft Act. These analyses are described in the sections which follow.

3.2.1 Variation in Recovery Rates Over Time by Vehicle Type

Table 7 identifies the recovery rates for CMY vehicles stolen during 1983-1988.

Over the five year period, 1984-1988, the rate of recovered CMY vehicles reported by the selected insurers to the NATB, increased 23 percent from 56 to 79 percent. Most of this increase (17 percent) occured between 1984-1986 before the parts marking requirements took full effect. As described previously (9), it is believed that much of this increase was due to an increased effort on the part of insurers to report thefts and recoveries to the NATB in response to the insurer reporting requirements of the Theft Act.

The trend of statistically significant annual increases in CMY recovery rates continued until 1987. Between 1987 and 1988, CMY recovery rates computed from NATB samples grew by only 1 percent.

Table 7 also presents annual recovery rates of CMY vehicles by type (i.e. passenger cars, multi-purpose vehicles/light trucks, and motorcycles).

It was found that the number of thefts and recoveries of heavy trucks reported to the NATB by the selected insurers was too small for analysis purposes.

Table 7 indicates that passenger cars were more likely to be recovered than any other vehicle type while motorcycles were generally least likely to be recovered.

The annual variation in recovery rates is illustrated in Figure 5. Recoveries of passenger cars and MPVs/light trucks increased annually each year between 1984 and 1987 consistent with the overall annual increase in recovery rates observed for the NATB samples in aggregate. Between 1987 and 1988, the rate of recovery for MPVs/light trucks continued to increase while the rate of recovery for passenger cars decreased by 1 percent.

The greatest increase in reported recoveries over the 1984-1988 period occured for multi-purpose vehicles and light trucks. This increase measured close to 40 percent over the period. By 1988, the rate of recovery for CMY multi-purpose vehicles and light trucks reached 74 percent, which was only 8 percent lower than the recovery rate for CMY passenger cars. In comparision, the difference between recovery rates of passenger cars and MPVs/light trucks was almost 30 percent in the NATB sample for 1984.

The increase in reported recoveries of MPVs/light trucks during 1984-1988 appears larger than the general increase due to improvements in insurer reporting to the NATB. Therefore, it appears that a genuine increase in the recovery rate of MPVs/light

Table 7. Recovery Rates for Current Model Year Vehicles by Vehicle Type (Based on NATB Sample for 7 Selected Companies)

	Annual CMY Recovery Rate					
Vehicle Type	1988	1987	1986	1985	1984	1983
Passenger Cars	82	83	80	71	65	67
MPVs/Light Trucks	74	70	63	43	36	39
Motorcycles	36	40	32	--	12	11
Unknown	74	86	59	59	53	50
Aggregate	79	78	73	64	56	59

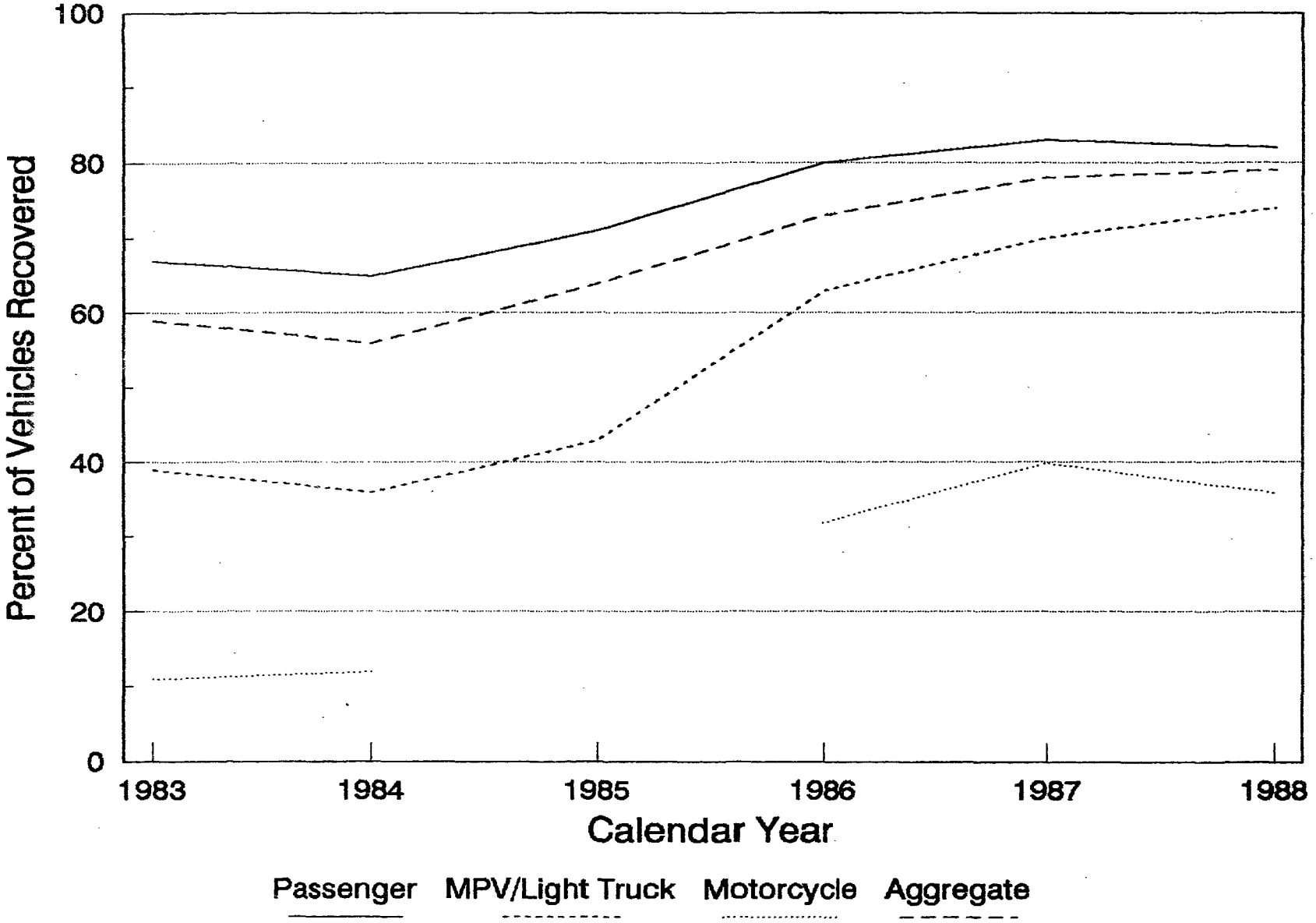


Figure 5 Recovery Rates for Current Model Year Vehicles Over Time

trucks is occurring. This is especially evident between 1986 and 1988 when the recovery rate for passenger cars varied no more than 3 percent while the recovery rate for MPVs/light trucks increased 11 percent.

If the Theft Prevention Standard strongly influenced a decrease in the number of marked passenger cars which were stolen to be exported or dismantled for their parts, it might be expected that the overall recovery rate for CMY passenger cars would be significantly higher after the standard took effect while the recovery rate for unmarked MPVs and motorcycles remained unchanged independent of other factors.

However, a statistical comparison of aggregate recovery rates before (1983-1986) and after (1987-1988) the standard took effect revealed that passenger cars, MPVs/light trucks and motorcycles all experienced a significant increase in recovery rates after the standard took effect. The results of these proportion analyses are shown in Table 8. No trend appeared which would suggest that the standard may have influenced an increase in recovery rates for passenger cars as a group beyond the general increases which are independent of the standard.

This is explored further in the next section to determine whether any unusual change in recovery rates occurred for marked vehicles after the marking program began.

3.2.2 Influence of Marking Program on Recovery Rates of Marked Vehicles

A series of statistical tests were performed to examine whether the parts labelling program encouraged an increase in the rate of recovery of marked vehicles. To perform these tests, four samples of vehicles were considered:

- CMY 1987-1988 passenger cars subject to the labelling requirements
- CMY 1987-1988 passenger cars excluded from the labelling requirements
- CMY 1983-1986 ancestor versions of the lines subject to the labelling requirements
- CMY 1983-1986 ancestor versions of the lines excluded from the labelling requirements.

Only vehicles in the first of these groupings had marked parts. Figure 3 in Section 2 illustrates how these samples were compared to investigate the effectiveness of the parts labelling program. The results of these comparisons are identified in Table 9.

Table 8. Results of Proportions Tests to Compare Recovery Rates Before and After Implementation of Theft Prevention Standard

Vehicle Type	Recovery Rate(%) Before Marking (1983 - 1986)	Recovery Rate(%) After Marking (1987 - 1988)	Difference in Recovery Rates
Passenger Cars	72	83	11*
MPVs/ Light Trucks	48	72	24*
Motorcycles	25	39	14*

Note: No MPVs or motorcycles are subject to marking program. These vehicle types serve as control groups.

*Difference in recovery rates is statistically significant at the 5% level.

	Sample Sizes			
	1983-1986 Thefts	1983-1986 Recoveries	1987-1988 Thefts	1987-1988 Recoveries
Passenger Cars	22767	16381	18092	14948
MPVs/ Light Trucks	7721	3714	7580	5474
Motorcycles	1164	288	625	241

Table 9. Results of Proportions Tests to Examine Changes in Recovery Rates for Marked Passenger Cars After the Marking Program Began

Study	Description	No. of Thefts	Rates (%)	Difference in Recovery Rates
A	1987-1988 Marked Vehicles	7465	83	
	vs.			-1
	1987-1988 Unmarked Vehicles	9909	84	
A'	1983-1986 Marked Ancestors	13695	72	
	vs.			-1
	1983-1986 Unmarked Ancestors	7258	73	
B	1987-1988 Marked Vehicles	7465	83	
	vs.			11*
	1983-1986 Marked Ancestors	13695	72	
B'	1987-1988 Unmarked Vehicles	9909	84	
	vs.			11*
	1983-1986 Unmarked Ancestors	7258	73	

*Difference in recovery rates is statistically significant at the 5% level.

These results indicate that the labelling program has not improved the rate of recovery of marked vehicles as might have been expected if the standard had served to reduce the number of marked vehicles stolen for export or dismantling. Although lines which were marked exhibited an 11 percent increase in recovery rates relative to their marked ancestors (Study B), exactly the same increase was observed over the same time frame for lines excluded from the marking program (Study B'). Prior to the marking program, ancestors of 1987-1988 marked vehicles experienced the same rate of recovery as did ancestors of 1987-1988 unmarked vehicles (Study A'). As shown in Table 9, this did not change after one group of vehicles was marked (Study A). Thus, there is no evidence that the marking program has influenced any change in the recovery rate of marked vehicles.

The discovery that recovery rates were the same for both marked and unmarked vehicles as shown in comparisons A and A' was unanticipated. Since the marked vehicles were selected on the basis of their high theft rate, it might be expected that the proportion of fraudulent claims and vehicles stolen for dismantling of export (and thus unrecoverable) would be larger for marked vehicles than unmarked vehicles. It would then follow that vehicles selected for marking would exhibit lower recovery rates than vehicles exempted from marking. Instead, it was found that vehicles with high theft rates (i.e. marked vehicles) exhibited the same rate of recovery as vehicles with relatively lower theft rates (i.e. unmarked vehicles).

These results indicate that the proportion of stolen vehicles which disappear (possibly fraudulent claims or vehicles exported or completely dismantled and therefore untraceable) is the same for both vehicles with high theft rates and those with low theft rates. Thus, stolen vehicles from lines with high theft rates are as likely to be either fraudulent claims, exported or thoroughly dismantled as stolen vehicles from lines with low theft rates.

However, other analyses described in Section 3.3 suggest that the proportion of vehicles stolen for specific major parts is larger for lines with high theft rates than for lines with low theft rates. For these thefts, certain desired parts are removed while the remainder of the vehicle is left for recovery.

3.2.3 Recovery Rates for Vehicles With Anti-Theft Devices

Several statistical comparisons were performed to examine how the recovery rates for lines with anti-theft devices compared with recovery rates for lines with and without VIN marking. These comparisons are illustrated in Figure 4 in Section 2. The results of these comparisons are presented in Table 10.

Table 10. Results of Proportions Tests to Examine Recovery Rates of Vehicles with Anti-Theft Devices

Study	Description	No. of Thefts	Recovery Rates (%)	Difference in Recovery Rates
C	1987-88 Anti-Theft Lines	718	67	
	vs.			-16*
	1987-88 Marked Lines	7465	83	
C'	1983-86 Anti-Theft Lines	1814	63	
	vs.			-9*
	1983-86 Ancestors of Marked Lines	13695	72	
D	1987-88 Anti-Theft Lines	718	67	
	vs.			-17*
	1987-88 Unmarked Lines	9909	84	
D'	1983-86 Anti-Theft Lines	1814	63	
	vs.			-10*
	1983-86 Ancestors of Unmarked Lines	7258	73	
E	1983-86 Anti-Theft Lines	1814	63	
	vs.			-4
	1987-88 Anti-Theft Lines	718	67	

*Difference in recovery rates is statistically significant at the 5% level.

These results indicate that 1987-1988 lines equipped with anti-theft devices experienced significantly lower rates of recovery than both lines with and without marked parts (Comparisons C and D). Stolen vehicles equipped with anti-theft devices consistently experienced a significantly lower rate of recovery than other vehicles (Comparisons C, C', D, D'). These differences were on the order of 9-17 percent.

Thus, thefts of lines with anti-theft devices more often lead to the complete disappearance of the vehicle (possibly through fraud, export or total dismantling) than thefts of other lines. This is consistent with the assumption that determined, professional thieves are involved in selecting and performing these thefts since it would be easier to steal a vehicle without an anti-theft device than one so equipped.

Over the 1983-1988 period, the recovery rate for vehicles with anti-theft devices did not show the statistical improvements exhibited by other lines (Comparisons E, B, B'). In fact, the difference in recovery rates between vehicles with anti-theft devices and marked and unmarked vehicles continued to widen from 9-10% to 16-17% after the marking program began (Comparisons C, C', D, D').

3.3 Condition of Vehicles Upon Recovery

If the marking program was successful in reducing the number of vehicles stolen for their parts, the proportion of marked vehicles which were recovered with major parts missing should have been reduced after the marking program began.

To verify whether this was the case, the proportion of vehicles recovered intact, in-whole and in-part were computed before and after the standard was implemented. The proportions test was used to compare results between marked and unmarked vehicles. The results of these comparisons are shown in Table 11.

These results indicate that the marking program has not significantly benefitted marked vehicles relative to unmarked vehicles. Both before and after the marking program began, vehicles selected for marking exhibited a 3-4 percent higher rate of recoveries with major parts missing than vehicles excluded from marking (Comparisons F and G). This difference was found to be statistically significant.

During the post-standard 1987-1988 period, both marked and unmarked vehicles exhibited a significantly lower proportion of recoveries in which major parts were missing than during pre-standard 1986 (Comparisons L and L'). The proportion of recoveries in-part decreased 5 percent from 21 to 16 percent for marked vehicles while decreasing 6 percent from 18 to 12 percent for unmarked vehicles. At the same time, in-whole recoveries increased

Table 11. Results of Proportions Tests to Compare Changes in the Proportion of Passenger Cars Recovered Intact In-Whole and In-Part After the Marking Program Began

Study	Description	No. of Recoveries Condition Known	Proportion of All Recoveries Condition Known	Difference in Proportions
F	1987-1988 Marked Vehicles recovered In-Part vs.	5153	16	4*
	1987-1988 Unmarked Vehicles recovered In-Part	6906	12	
G	1986 Ancestors of Marked Veh. recovered In-Part vs.	3194	21	3*
	1986 Ancestors of Unmarked Veh. recovered in-Part	2078	18	
H	1987-1988 Marked Vehicles recovered Intact vs.	5153	12	-5*
	1987-1988 Unmarked Vehicles recovered Intact	6906	17	
I	1986 Ancestors of Marked Veh. recovered Intact vs.	3194	16	-3*
	1986 Ancestors of Unmarked Veh. recovered Intact	2078	19	
J	1987-1988 Marked Vehicles recovered In-Whole vs.	5153	72	1
	1987-1988 Unmarked Vehicles recovered In-Whole	6906	71	

Table 11. Results of Proportions Tests to Compare Changes in the Proportion of Passenger Cars Recovered Intact In-Whole and In-Part After the Marking Program Began (conc.)

Study	Description	No. of Recoveries Condition Known	Proportion of All Recoveries Condition Known	Difference in Proportions
K	1986 Ancestors of Marked Veh. recovered In-Whole vs.	3194	63	0
	1986 Ancestors of Unmarked Veh. recovered In-Whole	2078	63	
L	1987-1988 Marked Vehicles recovered In-Part vs.	5153	16	-5*
	1986 Ancestors of Marked Veh. recovered In-Part	3194	21	
L'	1987-1988 Unmarked Vehicles recovered In-Part vs.	6906	12	-6*
	1986 Ancestors of Unmarked Veh. recovered In-Part	2078	18	

*Difference in Proportions is statistically significant at the 5% level.

approximately 9 percent for both marked and unmarked vehicles (Comparisons J and K). This represents an increase in the proportion of vehicles recovered with damage or recovered with non-major parts missing.

These trends suggest the possibility that thieves may be less willing to steal parts designated for marking (whether actually marked or not) and that thefts for other parts may be increasing.

To explore the motivation for passenger car theft, a measure may be defined which indicates the maximum proportion of car thefts for purposes of fraud, export or dismantling for major parts. This measure, T_P may be defined as:

$$T_P = \frac{\text{(No. of unrecovered vehicles + No. of recoveries in-part)}}{\text{No. of stolen vehicles}}$$

The numerator of this measure represents the maximum number of vehicles which either disappeared (and may have been exported or totally dismantled) or were partially dismantled to provide major parts (as the vehicle itself was recovered without these parts). These types of thefts are generally performed by professional thieves and are the focus of the deterrent provisions of the Theft Prevention Standard. If the proportion of these professional thefts has diminished, the marking program may be judged as successful even if thefts for joyriding and other purposes have increased (in which case other additional theft deterrent measures would be needed).

Values of the professional theft potential measure were computed and compared for marked and unmarked vehicles both before and after the marking program was implemented. The results of these comparisons are shown in Table 12.

These results indicate that the maximum proportion of thefts for export or parts has significantly diminished for both marked and unmarked cars during each of the two years since the marking program began (Comparisons M, M', N and N'). During the two years since the introduction of the marking program, the potential proportion of thefts for export or parts diminished by 8 percent for marked cars and 10 percent for unmarked cars.

Thus, unmarked vehicles appear to have experienced a larger reduction in thefts for export or parts than marked vehicles. Before the marking program, ancestors of marked cars experienced almost the same potential of theft for export or parts as did ancestors of unmarked vehicles (Comparison O).

By 1988, marked cars exhibited a statistically significant 3 percent higher proportion than unmarked cars of thefts potentially attibutable to fraud, export or dismantling (Comparison Q).

Table 12. Results of Proportions Tests to Compare Changes in the Maximum Proportion of Professional Thefts (T_p) After the Marking Program Began

Study	Description	No. of Thefts	Max. Proportion of Professional Thefts (T_p) %	Difference in Proportions
M	CMY 1986 Marked Ancestors	4227	34	
	vs.			4*
	CMY 1987 Marked Vehicles	3765	30	
M'	CMY 1986 Unmarked Ancestors	2863	33	
	vs.			6*
	CMY 1987 Unmarked Vehicles	5132	27	
N	CMY 1987 Marked Vehicles	3765	30	
	vs.			4*
	CMY 1988 Marked Vehicles	3700	26	
N'	CMY 1987 Unmarked Vehicles	5132	27	
	vs.			4*
	CMY 1988 Unmarked Vehicles	4777	23	
O	CMY 1986 Marked Ancestors	4227	34	
	vs.			1
	CMY 1986 Unmarked Ancestors	2863	33	
P	CMY 1987 Marked Vehicles	3765	30	
	vs.			3*
	CMY 1987 Unmarked Vehicles	5132	27	

Table 12. Results of Proportions Tests to Compare Changes in the Maximum Proportion of Professional Thefts (T_p) After the Marking Program Began (conc.)

Study	Description	No. of Thefts	Max. Proportion of Professional Thefts (T_p)%	Difference in Proportions
Q	CMY 1988 Marked Vehicles	3700	26	
	vs.			3*
	CMY 1988 Unmarked Vehicles	4777	23	
K	2 Yr Old 1986 Marked Ancestors	7038	38	
	vs.			14*
	2 Yr Old 1988 Marked Ancestors	10581	24	
S	2 Yr Old 1986 Unmarked Ancestors	3178	36	
	vs.			13*
	2 Yr Old 1988 Unmarked Ancestors	7672	23	

*Difference in Proportions is statistically significant at the 5% level.

Thus, while the goal of the Theft Prevention Standard to reduce thefts for parts appears to be occurring, it is not clear whether the marking program itself significantly contributed to this result.

If it was the marking program which reduced the motivation of thieves to steal current model year vehicles for their parts (since some of them have marked parts), it might be expected that there would be an increased motivation to steal older vehicles (none of which are marked).

This was explored and found not to be the case. Comparisons R and S in Table 12 indicate that unmarked two year old vehicles exhibited the same reduction in the potential of theft for fraud, export or parts as did current model year vehicles.

Thus, the results do not seem to suggest that the marking program was responsible for the desirable reduction in the maximum proportion of thefts for fraud, export or parts that occurred since the marking program began.

3.4 Implications of Recovery Trends on the Effectiveness of the Theft Prevention Standard

Based on the analyses described in the previous sections, several important results have emerged which indicate the effectiveness of the Theft Prevention Standard. These findings include:

- There was no indication that the marking program influenced the rate of recovery for CMY passenger cars as a group. Since the introduction of the marking program, passenger cars exhibited similarly increasing recovery rates as did unmarked MPV's/light trucks and motorcycles. In fact, the recovery rate for unmarked MPV's/light trucks appears to have grown faster than the recovery rate for passenger cars.

- Furthermore, there was no indication that the marking program influenced any change in the rate of recovery of marked vehicles. Although lines which were marked exhibited an 11 percent increase in recoveries relative to their unmarked ancestors, exactly the same increase was observed over the same time frame for lines excluded from the marking program.

- Thefts of cars exempted from the marking program because of an installed anti-theft device more often lead to the complete disappearance of the vehicle than thefts of either marked or unmarked cars. This is consistent with the assumption that determined, professional thieves select and perform these thefts since it is easier to steal a

vehicle without an anti-theft device than one so equipped. Thus, while cars receiving anti-theft exemptions were less likely to be stolen than marked cars, once they were stolen they are also less likely to be recovered.

- The maximum proportion of car thefts that might involve fraud, export or dismantling appears to have diminished significantly (8-10 percent) over the two year period since the introduction of the marking program. While this is an important goal of the Theft Prevention Standard, the evidence does not suggest that the marking program itself was responsible for this trend. Unmarked CMY cars appeared to have experienced a larger decrease in this measure than marked CMY cars. Also, the same decreases were observed for older vehicles as for CMY vehicles. None of these older vehicles had marked parts. Because information on the recovery of major parts was not maintained before 1986, this result is based only on available 1986-1988 information.

4. INSURER LOSS PAYMENTS DUE TO VEHICLE THEFT DURING 1983-1988

Another goal of the Theft Act is to encourage a decrease in premiums charged to consumers for motor vehicle theft insurance by inducing a reduction in insurer's losses for vehicle theft. Furthermore, if the marking program was successful in deterring thefts of vehicles for export or parts, it might be expected that the proportion of thefts attributable to joyriding and other causes would increase. If so, it might also be expected that average claim costs for recovered vehicles would decrease independent of other factors.

Insurance loss payments during 1983-1988 were examined to identify whether these anticipated benefits were achieved after the marking program was initiated. Specifically, loss payment records were analyzed to identify whether:

- Insurer's total losses due to vehicle theft were decreasing as a result of the marking program
- The average payment for a recovered stolen vehicle was decreasing as a result of the marking program.

The sections which follow describe how insurer's theft losses were determined and how these losses changed after the marking program began.

4.1 Determination of Insurance Losses During 1983-1988

The Highway Loss Data Institute (HLDI) maintains records of actual claim payments issued to policyholders resulting from the theft of a motor vehicle or its contents. A nationwide sample of these records was obtained for vehicle theft claims paid by five major insurance companies during 1983-1988. The participating companies included: Aetna, Allstate, GEICO, State Farm and USAA. The HLDI sample for each calendar year included the same groupings of CMY, one and two-year old vehicles as the NATB samples of theft and recovery data described in Section 2.1.

Because the HLDI records reflect actual insurance claim payments, they exclude theft claims valued below the policy deductible since no payments are issued for such claims. These claims might often represent instances in which a stolen vehicle was recovered intact or recovered with damage that could be repaired for less than the policy deductible.

Each loss payment record submitted by the HLDI included:

- Vehicle Identification Number (VIN)
- Date of theft
- Garaging location of the vehicle
- Total disbursement by insurer

- Policy deductible amount

Only claims involving the physical removal of a motor vehicle were considered for analysis. Claims for stolen contents or components were removed from the HLDI sample. This was accomplished by matching the VINs in HLDI loss payment records with those in NATB vehicle theft records to identify the payments for stolen vehicles.

The claim records for stolen vehicles were used to determine the average claim value and average claim payment for vehicle theft by model year and line during 1983-1988. The difference between average claim value and average claim payment reflects the average deductible amount not paid by the insurers. Average claim payments were also computed for recovered vehicles stratified by model year and line.

These values are presented in Appendix C for calendar years 1983 through 1988. All loss values for 1983-1988 are expressed in 1988 dollars.

4.2 Insurance Losses for Vehicle Theft During 1983-1988

Since the Theft Prevention Standard was intended to encourage reductions in automobile comprehensive premiums, it is important to ascertain whether the marking program contributed to a reduction in insurance losses for vehicle theft. Without such a reduction in losses, there could be no reasonable expectation that the Standard contributed to lower automobile comprehensive premiums.

To estimate how insurer's total vehicle theft losses changed after the introduction of the marking program, a cost-effectiveness measure E, was defined as:

E = Theft Rate x Average payment per theft claim

The measure E, represents the insurer's expected cost of vehicle theft per insured vehicle year. This measure represents an expected cost to the insurer for providing annual theft coverage per vehicle exclusive of profit, administrative and other expenses. Changes in the value of this measure indicate whether insurance costs for vehicle theft are increasing or decreasing.

The cost-effectiveness measure E, considers both changes in theft rates and average theft claim payments. Changes in theft rates were explicitly considered in Section 2. The sections which follow consider the variation in average theft claim payments and the resulting changes in insurance costs for vehicle theft.

4.2.1 Variation in Average Theft Payments During 1983-1988

Figure 6 illustrates the variation in average annual loss payments per claim for CMY vehicles stolen during 1983-1988. The actual dollar value of these losses is presented in Table 13. To account for the effects of inflation, all losses were expressed in 1988 dollars. These loss payments reflect several factors including:

- The replacement value of a stolen vehicle which is not recovered.
- The cost to repair recovered, damaged vehicles.
- Whether or not the vehicle was recovered prior to settlement.

As seen from Figure 6 and Table 13, average theft claim payments for CMY vehicles began to decrease in 1985 and decreased $1500 or 12 percent by 1987. This corresponded to a period in which overall recovery rates increased by 14 percent (Table 7). This increase in recovery rates undoubtedly contributed to lower average insurance payments during this period.

Between 1987 and 1988, average theft claim payments increased 6 percent from $10,750 to $11,435 (Table 13). During the same period, recovery rates increased by only 1 percent (Table 7). Since these values were adjusted to reflect the average annual increases in new car prices, the increase in payments between 1987 and 1988 reflects either or both an increase in damage sustained by recovered vehicles or a decrease in recoveries prior to settlement.

Upon investigation, both of these hypothesis were found to be true. An examination of Appendix Tables C1 and C4 indicate that the average payment for a recovered CMY vehicle increased between 1987 and 1988, from $7,693 to $8,159 adjusted for inflation. This was primarily caused by an $884 increase between 1987 and 1988 in costs for vehicles recovered in-whole. These recoveries represent instances in which the stolen vehicle was either damaged or non-major parts were removed.

It was also found that the proportion of vehicles recovered prior to settlement decreased between 1987 and 1988. This decrease is described further in Section 6.

As seen from Table 13, average claim payments were consistently higher for passenger cars with anti-theft devices than for other passenger cars or MPVs. This reflects the fact that once these vehicles are stolen, they are less likely to be recovered than other vehicles. It is also expected that these vehicles are

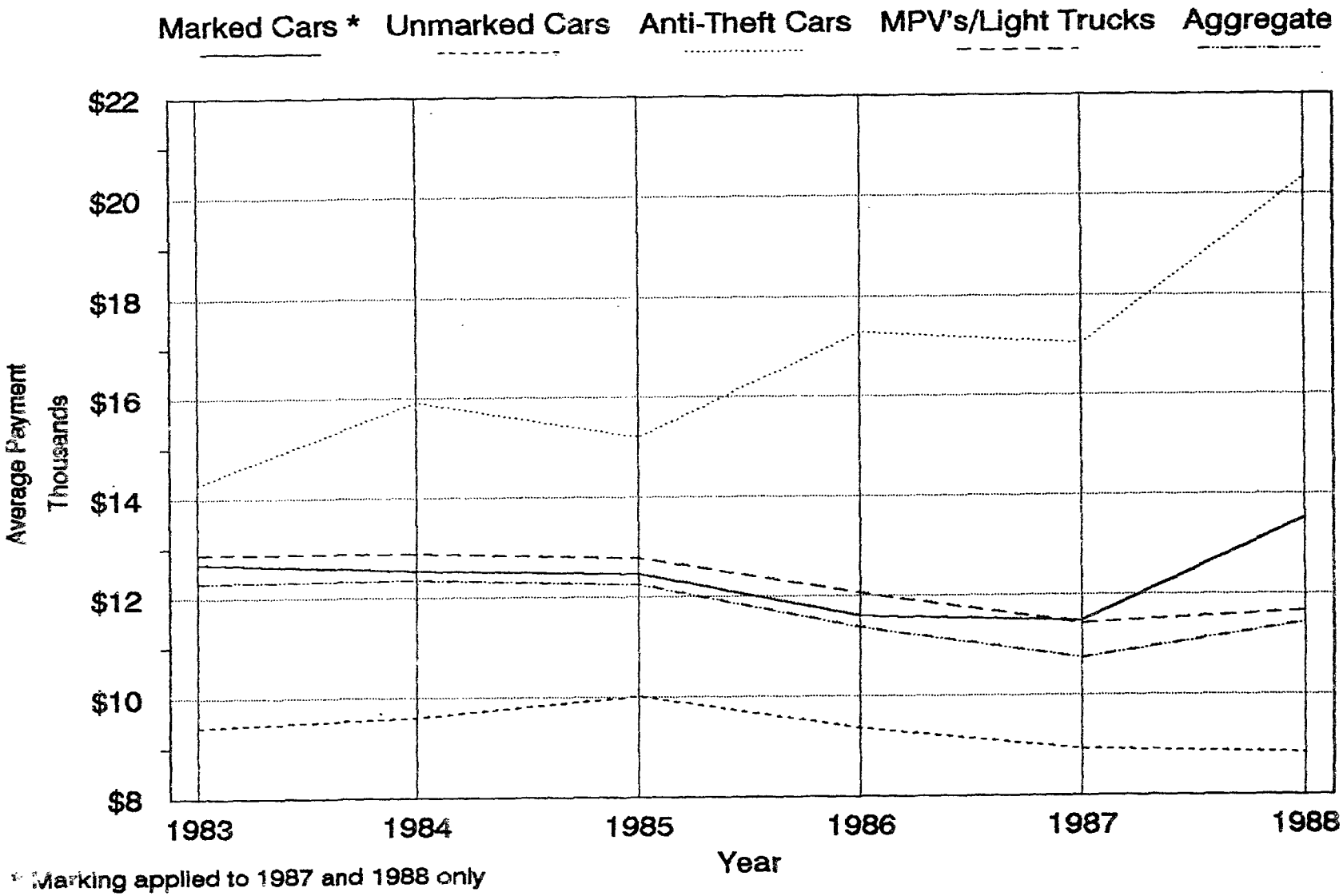


Figure 6. Average Loss Payment for CMY Stolen Vehicles
1988 Dollars

Table 13. Average Annual Insurer Loss Payments for CMY Vehicles Stolen During 1983-1988 (Based on HLDI Sample for 5 Selected Companies)

	1988	1987	1986	1985	1984	1983
Marked Cars*	13,524	11,491	11,602	12,472	12,547	12,705
Unmarked Cars	8,848	8,929	9,374	10,017	9,617	9,429
Anti-Theft Cars	20,338	17,047	17,298	15,210	15,923	14,310
MPV's/Light Trucks	11,667	11,434	12,066	12,793	12,891	12,884
Aggregate	11,435	10,750	11,369	12,252	12,359	12,316

*Marking applied to 1987 and 1988 only.

generally more expensive to replace than other vehicles.

Similarly, average payments were consistently higher for cars selected for the marking program than for other (unmarked) cars. This reflects the fact that cars selected for marking are typically more expensive than cars excluded from marking (10).

During the first year of the marking program, average payments for marked vehicles remained the same as they had been prior to marking. However, between 1987 and 1988, average payments for CMY marked vehicles increased by 17 percent (Table 13). Over the same two year period, average payments for unmarked vehicles decreased by 5.6 percent.

While average payments increased 17 percent for marked vehicles between 1987 and 1988, the recovery rate for these vehicles dropped by only 2.6 percent over the same period (Appendix B). Thus, other explanations are necessary to account for the increase in average payments. Possible causes for this increase include:

- Larger 1988 increases in new car prices for marked vehicles than other vehicles.

- An increase in damage, and/or parts removed from marked vehicles in 1988 causing a substantial increase in repair costs relative to 1987.

The latter hypothesis was verified based on an examination of Appendix Tables C1 and C4. Claim costs for recovered marked vehicles increased from $8,499 to $9,707 between 1987 and 1988 adjusted for inflation.

Nonetheless, there is no evidence that the marking program provided any reduction in average claim costs for marked vehicles as might occur independent of other factors if the marking had induced a smaller proportion of stolen vehicles to be exported or severely dismantled.

4.2.2 Insurer Theft Losses Before and After Marking Program

To estimate whether or not the marking program had encouraged a reduction in insurers' total vehicle theft losses, expected theft costs (E), per insured vehicle year were computed for marked cars, unmarked cars and cars equipped with anti-theft devices qualifying for exemptions from the marking program. Costs were computed for each group of passenger cars both for the pre-standard 1983-1986 period and post-standard 1987-1988 period.

These costs are presented in Table 14. As expected, losses per insured vehicle year are higher for marked cars than for unmarked cars. This reflects the higher theft rate of marked cars (the basis of their selection for marking) and higher replacement costs if unrecovered.

Positive indications that the marking program was successful, would include either a reduction in costs per vehicle year (adjusted for inflation) for marked vehicles after the marking program began or a narrowing of the difference in E between marked and unmarked vehicles.

Based on an examination of Table 14, neither of these results were evident. Adjusted for inflation, vehicle theft costs per insured vehicle year increased substantially for both marked and unmarked cars between the pre and post-standard periods. Between these periods, theft costs per insured vehicle year increased from $49.21 to $69.61 for marked vehicles and from $16.32 to $33.79 for unmarked vehicles. Thus, the difference in E between marked and unmarked cars actually widened after the marking program was initiated. This occurred even though theft rates did not appear to increase as much for marked vehicles as they did for unmarked vehicles after the start of the marking program.

This widening appears to reflect an increase in average theft claim payments for marked vehicles during the post-standard period at the same time that average claim payments decreased for unmarked vehicles.

These results suggest that the marking program has not had an effect on reducing insurer's theft losses for marked vehicles.

A review of Table 14 also indicates that lines equipped with an anti-theft device and exempted from the marking program experienced smaller increases in theft costs per insured vehicle year than either marked or unmarked vehicles. Between 1983-1986 and 1987-1988, theft costs per insured vehicle year increased $20.4 for marked cars, $17.47 for unmarked cars and only $11.44 for vehicles with anti-theft devices.

Nonetheless, lines equipped with anti-theft devices had higher theft costs per insured vehicle year than either marked or unmarked cars. This reflected the generally high cost to replace these vehicles once they are stolen.

In summary, the improvements in insurer losses for marked vehicles which were anticipated to result from the marking program were not evident. After the marking program began, expected theft claim costs per insured vehicle year, increased faster for marked vehicles than for unmarked vehicles. This appeared to result from the fact that average theft claim costs for marked vehicles increased by $128 while average theft claim costs for unmarked

Table 14. Insurance Theft Costs for CMY Passenger Cars Before and After Marking Program

Category	Thefts Per Insured Veh-Yr	X	Avg. Cost Per Theft Claim (1988 $)	=	(E) Expected Cost of Theft to Insurers Per Insured Veh-Yr
1987-1988 Marked Vehicles	0.0056		12,430		$69.61
1983-1986 Marked Ancestors	0.0040		12,302		49.21
1987-1988 Unmarked Vehicles	0.0038		8,893		33.79
1983-1986 Unmarked Ancestors	0.0017		9,602		16.32
1987-1988 Anti-Theft Lines	0.0049		18,246		89.41
1983-1986 Anti-Theft Ancestors	0.0050		15,594		77.97

vehicles decreased by $709 after the start of the marking program (Table 14).

Possible explanations for the increase in average theft claim costs for CMY marked vehicles once the marking program began include:

- An increase in the replacement cost of marked vehicles thereby increasing claim costs if stolen vehicles are not recovered prior to settlement of the claim, or are recovered with sufficient damage to be considered a total loss.
- A decrease in the proportion of marked vehicles recovered prior to settlement.
- An increase in damage, increase in the number of parts removed, or an increase in the value of parts removed from vehicles recovered prior to settlement.

The latter hypothesis is explored in Section 4.4.

4.3 Insurance Payments for Recovered Vehicles Before and After Start of Marking Program

If the Theft Prevention Standard was successful in reducing the proportion of thefts by professional thieves thereby increasing the proportion of thefts for joyriding or other causes, it might be expected that the average theft claim cost for recovered marked vehicles would decrease independent of other factors.

To determine if this occurred, differences in mean theft claim costs were statistically compared for marked and unmarked recovered cars both before and after the marking program was initiated. A set of comparisons was performed similar to those performed on theft and recovery rates as illustrated in Figure 3 of Section 2. The results of these comparisons are presented in Table 15.

While average theft claim costs for recovered CMY marked vehicles did decrease by $643 after the marking program began, claim costs for unmarked vehicles were reduced even further, decreasing by $977 (Comparisons B and B'). Both of these changes were found to be statistically significant (Table 15).

Thus, while claim costs for recovered vehicles decreased after the marking program began, these decreases were experienced both by marked and unmarked vehicles. If the marking program was responsible for the decrease, it might be expected that marked vehicles would exhibit a more pronounced change than unmarked vehicles assuming that thieves were aware of which lines were marked. By this assumption, it does not appear as though the

Table 15. Results of Statistical Tests to Examine Changes in Average Claim Payments for Recovered CMY Marked Passenger Cars After the Marking Program Began

Study	Description	No. of Paid Claims	Variance	Payments (1988 $)	Difference in Average Payments
A	1987-1988 Marked Vehicles	1194	76142782	9,053	$2,343*
	vs.				
	1987-1988 Unmarked Vehicles	1575	33568310	6,710	
A'	1983-1986 Marked Ancestors	1941	60000023	9,696	$2,009*
	vs.				
	1983-1986 Unmarked Ancestors	985	37800577	7,687	
B	1987-1988 Marked Vehicles	1194	74142782	9,053	-$ 643*
	vs.				
	1983-1986 Marked Ancestors	1941	60000023	9,696	
B'	1987-1988 Unmarked Vehicles	1575	33568310	6,710	-$ 977*
	vs.				
	1983-1986 Unmarked Ancestors	985	37800577	7,687	

*Difference in average payments is statistically significant at the 5% level.

marking program was responsible for the lower claim costs for recovered vehicles.

However, if thieves reacted to the standard but were not particularly aware of which specific lines were marked, it could be argued that the reduction in costs for both marked and unmarked CMY recovered vehicles might be attributable to the marking program. To examine this hypothesis, costs for two year old vehicles were examined. If thieves did not know which lines were marked and knew only that newer vehicles might be marked, they may have been inclined to steal older vehicles rather than newer vehicles.

Thus, if the marking program were responsible for the decrease in claim costs for recovered CMY vehicles, it might be expected that two year old vehicles would not exhibit the same reductions as CMY vehicles since none of the two year old vehicles were marked.

However, after the marking program began, two year old vehicles were found to exhibit decreases similar to those of CMY vehicles. These decreases were $793 for ancestors of unmarked cars and $686 for ancestors of marked cars (Appendix Tables C3, C6, C12 and C15).

Thus, it does not appear as though the marking program was responsible for the desirable reduction in average theft claim costs for recovered vehicles which occurred after the marking program began.

4.4 Claim Costs for Recovered Damaged Vehicles Before and After the Start of Parts Marking

It was noted in Section 4.2 that average theft claim costs for marked vehicles increased after the marking program began while average claim costs for unmarked vehicles decreased. This suggested the possibility that marked vehicles may have experienced an increase in damage, increase in the number of parts removed, or an increase in the value of parts removed after the start of the marking program.

Claim costs for vehicles recovered intact, in-whole and in-part were examined to consider whether this was the case. Mean theft claim costs for marked and unmarked vehicles were compared before and after the standard was implemented. The results of these comparisons are shown in Table 16.

If the standard was effective, it would be expected that fewer major parts would be stolen once these parts were marked. An indication that this was occurring might be a reduction in theft claim costs for marked vehicles recovered in-part after the marking began.

Table 16. Results of Statistical Tests to Compare Changes in the Claim Costs of CMY Passenger Cars Recovered Intact, In-Whole and In-Part Before and After the Marking Program Began

Study	Description	No. of Paid Claims	Variance	Payments (1988 $)	Difference in Average Payments
F	1987-88 Marked Vehicles recovered In-Part	179	86303610	13,217	$2,870*
	vs. 1987-88 Unmarked Vehicles recovered In-Part	155	40314518	10,347	
G	1986 Ancestors of Marked Veh. recovered In-Part	172	48870405	12,340	$2,401*
	vs. 1986 Ancestors of Unmarked Veh. recovered In-Part	92	33562540	9,939	
H	1987-88 Marked Vehicles recovered Intact	74	122392128	7,307	$1,457
	vs. 1987-88 Unmarked Vehicles recovered Intact	166	36672282	5,850	
I	1986 Ancestors of Marked Veh. recovered Intact	81	60459472	8,343	$1,573
	vs. 1986 Ancestors of Unmarked Veh. recovered Intact	65	50785250	6,770	
J	1987-88 Marked Vehicles recovered In-Whole	752	71072205	8,233	$2,001*
	vs. 1987-88 Unmarked Vehicles recovered In-Whole	1,010	29690122	6,232	

Table 16. Results of Statistical Tests to Compare Changes in the Claim Costs of CMY Passenger Cars Recovered Intact, In-Whole and In-Part Before and After the Marking Program Began (conc.)

Study	Description	No. of Paid Claims	Variance	Payments (1988 $)	Difference in Average Payments
K	1986 Ancestors of Marked Veh. recovered In-Whole vs.	366	44177545	7,831	$ 832
	1986 Ancestors of Unmarked Veh. recovered In-Whole	260	32305672	6,999	
L	1987-88 Marked Vehicles recovered In-Part vs.	179	86303610	13,217	$ 877
	1986 Ancestors of Marked Veh. recovered In-Part	172	48870405	12,340	
L'	1987-88 Unmarked Vehicles recovered In-Part vs.	155	40314518	10,347	$ 408
	1986 Ancestors of Unmarked Veh. recovered In-Part	92	33562540	9,939	

*Difference in average payments is statistically significant at the 5% level.

This was not found to be the case. No statistically significant changes in claim payments were observed for marked vehicles recovered in-part once the marking began (Comparison L). Similar results were observed for unmarked cars (Comparison L').

However, claim costs for vehicles recovered in-whole became significantly higher for marked vehicles relative to unmarked vehicles after the marking program began (Comparisons J and K). This result suggests that relative to unmarked vehicles, the marked vehicles experienced an increase in damage and/or thefts of non-marked parts. This result is consistent with the observation that average theft claim costs increased for marked vehicles between 1983-1986 and 1987-1988 while average theft claim costs for unmarked vehicles decreased.

It should also be noted that average payments for recovered vehicles in the HLDI sample appear somewhat higher than might normally be expected. This is especially evident for vehicles recovered intact (Comparisons H and I). Explanations for these higher than expected costs include:

- Claims valued below the policy deductible are excluded from the claim sample. Thus, the sample underrepresents instances in which a stolen vehicle is recovered intact within a few days of the theft.

- The average payments expressed for recovered vehicles includes both vehicles recovered before and after the date the claim was settled. Recoveries prior to the settlement date will reflect the damage sustained by the vehicle as a result of the theft. A claim in which the recovery occurred after the date of settlement, was paid as a total loss raising the overall average payment for recovered vehicles.

These issues are addressed in Section 6 to estimate the extent the HLDI sample underrepresents vehicles recovered intact and determine the proportion of recoveries which occur prior to settlement of the claim.

4.5 Implications of Theft Claim Payment Trends on Effectiveness of the Marking Program

Based on analyses of trends in insurer payments for vehicle theft claims, several observations may be stated regarding the effectiveness of the Theft Prevention Standard. These include:

- Insurer losses for marked vehicles continued to increase after the marking program began. In fact, expected theft claim costs (E) per insured vehicle year increased faster for marked vehicles than for unmarked vehicles. This occurred even though the rate of theft did not increase as

fast for marked vehicles as it did for unmarked vehicles. Between 1983-1986 and 1987-1988, theft costs per insured vehicle year increased $20.40 for marked cars, $17.47 for unmarked cars and only $11.44 for vehicles with anti-theft devices. This appeared to result from the fact that average claim costs for stolen marked vehicles increased by $128 while average theft claim costs for unmarked vehicles decreased by $709 after the start of the marking program (Table 14).

- Potential causes for the relative differences in theft loss payments between marked and unmarked vehicles after the marking program began include:

  1) A larger increase in the replacement cost of marked vehicles than unmarked vehicles during 1987-1988.

  2) A decrease in the proportion of marked vehicles recovered prior to settlement relative to the proportion for unmarked vehicles.

  3) A relative increase in damage, increase in the number of parts removed, or an increase in the value of parts removed from vehicles recovered prior to settlement for marked vehicles compared to unmarked vehicles.

- Results suggest that the latter scenario was occurring to some extent. Claim costs for vehicles recovered in-whole became significantly higher for marked vehicles relative to unmarked vehicles after the marking program began (Table 16). This result suggests that relative to unmarked vehicles, the marked vehicles experienced an increase in damage and/or thefts of non-marked parts. This result is consistent with the observation that average theft claim costs increased for marked vehicles between 1983-1986 and 1987-1988 while average theft claim costs for unmarked vehicles decreased.

- One measure that the standard was effective would be a reduction in the number of marked parts stolen once the marking program began. An indication that this was occurring might be a reduction in theft claim costs for marked vehicles recovered in-part. This was not found to be the case. No statistically significant changes in claim payments were observed for marked vehicles recovered in-part once the marking began (Table 16). Similar results were observed for unmarked cars.

- Average claim costs for recovered vehicles decreased significantly after the marking program began. This result might be expected if the standard reduced the extent of professional thefts thereby increasing the proportion of

thefts for joyriding and other purposes. However, the evidence does not appear to suggest that the marking program itself was responsible for this result. While average theft claim costs for recovered CMY marked vehicles did decrease by $643 after the marking program began, claim costs for unmarked vehicles were reduced even further, decreasing by $977. Both of these changes were found to be statistically significant (Table 15). Also, the same decreases were observed for older vehicles as for CMY vehicles. None of the older vehicles had marked parts.

5. AUTOMOBILE COMPREHENSIVE PREMIUMS CHARGED DURING 1983-1988

Since one of the purposes of the Theft Act was to encourage lower consumer costs for automobile comprehensive coverage, it is important to consider how insurers determine their premiums for this coverage and how vehicle theft influences these rates.

Based on the analysis of insurer losses performed in Section 4, there is no evidence that insurer costs for vehicle theft have diminished for marked vehicles. Thus, it does not as yet appear that the marking program could have led to lower consumer costs for comprehensive coverage. How this might occur in the future is explored in the sections which follow.

The following sections consider:

- The role of theft in determining automobile comprehensive premiums and how insurers can be expected to reflect the impacts of the Theft Act in their ratemaking.
- Whether and how insurers actually considered the Theft Act in the determination of 1983-1988 comprehensive rates.
- How premiums varied before and after the introduction of the marking program.

5.1 The Role of Theft in Determining Automobile Comprehensive Premiums

In general, policies insuring only against vehicle theft are not written in the non-commercial private passenger car market. Instead, coverage for the theft of an automobile is most frequently provided under a comprehensive policy. This type of policy also includes coverage for a number of other perils such as floods (e.g. as in the case of a hurricane), malicious mischief, vandalism, fire and glass damage. With the possible exception of glass damage, these are largely non-accident related events.

Most insurers establish rates for comprehensive coverage on a statewide basis by considering the total loss experience for comprehensive claims. Generally, the specific components of the loss experience such as theft losses, etc. are not considered. A stratification of losses by cause is often not warranted for ratemaking purposes because:

1) Infrequent perils, such as a serious hurricane, may occur only once in several years. Thus, losses for this type of peril in any single year are not representative of expected losses over time.

2) Even when losses occur more frequently, subdividing data extensively by cause of loss produces cells of experience that may be subject to severe statistical fluctuation.

Therefore, an individual insurer's own theft loss experience is often an insufficient basis to determine adjustments in the company's comprehensive rates. In fact, an insurer's total loss experience is often insufficient as a basis for rates for comprehensive coverage. These insurers might rely on the aggregate loss experience of many companies as compiled by a rating organization such as the Insurance Services Office (ISO).

Since losses entering the ratemaking formulas are not differentiated by cause of loss, there is no ready empirical basis on which to allocate costs by peril. Also, the differentials in rates between individual vehicles are normally based on countrywide experience, where the mix of losses may differ substantially from the state level. Thus, it is often difficult, if not impossible, to segregate the actual portion of the prospective premium due to vehicle theft.

For most companies, the best estimation of the proportion of comprehensive premium cost to provide theft coverage, is the proportion of total comprehensive losses which are due to vehicle theft. Based on information supplied by insurers under the Insurer Reporting Requirements of the Theft Act, it has been estimated that the proportion of comprehensive dollar losses due to the theft of motor vehicles was 38 percent in 1985 (3) and 40 percent in 1986 (11).

There are many caveats to using these loss estimates to estimate the theft component of comprehensive premiums. These caveats become apparent as the ratemaking process is further described below.

5.1.1 Ratemaking Process for Automobile Comprehensive Premiums

Ratemaking techniques vary across the country as the rate regulatory process differs substantially between states. Therefore, it is not surprising that rates have been found to vary significantly between states (9).

Some states use open competition, wherein rate justifications need not be filed, or are filed for informational purposes only. The rates and rating factors generally must be submitted, but companies need not await formal approvals. In these states, complete freedom of pricing techniques is allowed.

Other jurisdictions restrict the prerogatives of insurers to set rates and use a prior approval system for ratesetting. Rates must be filed with full supporting documentation and the rates can

only be used when formal approval is given. Insurance Departments in certain states may have "preferred" methods of ratemaking and approval of new premiums may be given only if such methods are followed. This can severely limit the ratemaking options of the company.

In the most restrictive states, such as Massachusetts, the Insurance Commisioner sets the rates. Insurers' rates are neither approved or disapproved but rather are determined by the state. This ratemaking process is highly formalized and few insurer options for deviations are permitted.

Besides the differences in regulations between states, there are also differences in the way insurers calculate their rate needs. Even when insurers use the same rating organization, such as ISO, to determine rates and rating factors, premiums may vary between companies because of differences in anticipated loss experience or expense needs.

Regardless of the specific methodology employed, the first stage of the ratemaking process is to determine the overall state average premium change that is required. This stage determines how much the rates will change on a statewide basis.

To establish these rates, a needed premium revenue based on the prior year's experience is compared with actual earned premiums brought up to the present rate level. Both losses and expenses which make up the needed premium revenue are adjusted to reflect the level of costs projected to be in effect when the new rates are to be enforced.

Within this process, there is normally no differentiation of the experience by cause of loss (e.g. theft, flood, vandalism, etc.). The only exception would be so-called catastrophe losses, where a great number of vehicles were damaged in a single incident, such as a hurricane. In such instances, losses in excess of a certain amount may be excluded.

Statewide rates are generally established for individual makes and models on the basis of their rating symbol (11). A rating symbol is an actuarial designation which principally reflects the original cost of the vehicle and may also reflect its damageability and repairability. The symbol assigned to a specific make and model is frequently adjusted up or down on a statewide basis based upon the vehicle's combined collision and loss experience. Since the majority of physical damages arise from collisions, the rating symbol may often correlate more closely to collision experience than theft experience (11).

Adjustments to these statewide rates are made on the basis of territory of operation. Rate relativities between territories generally reflect the relative total loss experience of each

territory. When it is determined that a change in premium income is required in a given state, the change is distributed to all territories and balanced so that the desired statewide change is achieved.

As in other stages of the ratemaking process, the determination of territorial adjustments is based upon aggregate experience normally without any differentiation of the experience by cause of loss. Theft experience is recognized only to the extent that it is implicit in the underlying data.

Theft experience can, of course, result in significant rate differentials by rating territory (geographic area). One would normally expect theft rates to be greater in urban environments than in rural areas. There is, however, no attempt to measure this effect directly, or to recognize different buying patterns by area. Only the results implicit in the overall experience are recognized within the ratemaking process.

Thus, throughout various stages of the ratemaking process; at the state level, territory level or vehicle (symbol) level, there is seldom an analysis of the cause of the specific loss elements of the experience. If such a study is done, it is normally for internal company use, as opposed to rate filing purposes.

5.1.2 Rating Characteristics to Establish Automobile Comprehensive Premiums

As described above, the premium charged for automobile comprehensive coverage is based upon the state and territory of operation, as well as the rating symbol assigned to the vehicle. Other factors which influence specific premiums include both driver and vehicle use characteristics (11).

Typical driver rating characteristics include:

- Age
- Sex
- Driver Training, Completion of Accident Prevention Course
- Driver Record
- Student Achievement (if applicable)
- Marital Status

Typical vehicle use rating characteristics include:

- Primary use of vehicle (i.e. commuting, business, etc.)

- Annual mileage travelled

Additional rating characteristics include:

- Number of other vehicles insured
- Model year (age) of the vehicle
- Policy deductible amount
- Whether vehicle is equipped with a Passive Occupant Restraint System
- Whether vehicle is equipped with a qualifying anti-theft device

Rating characteristics often used for light trucks include; commercial use of the vehicle, its age, cost and territory.

Rating characteristics often used for motorcycles include its age, engine size and territory of operation.

Very few of the companies furnishing Insurer Reports to NHTSA under Section 612 of the Theft Act assess any surcharge or premium penalty to insure vehicles which are stolen more frequently than others. Even when such surcharges are applied, they are generally not based specifically and solely upon theft loss experience. Several surrogate measures for vehicle theft are used rather than actual theft experience itself in determining theft related premium penalties. These include:

- The potential for higher than usual losses of all kinds under comprehensive coverage
- Performance characteristics of the vehicle such as acceleration capabilities
- Design characteristics such as luxury and sportiness
- Level of automotive production, availability of replacement parts and associated repair costs

The method most commonly cited by insurers to assess premium penalties for lines with poorer loss experience is the ISO Vehicle Series Rating (VSR) procedure. This procedure is used to raise or lower a vehicle's rating symbol based upon observed loss experience. However, this procedure is based upon a number of factors influencing loss potential and is not tied solely to the likelihood of theft. Thus, the procedure can not be used to develop discounts or penalties which specifically recognize a vehicle's theft loss potential.

5.1.3 Ratemaking Procedures to Reflect the Theft Act

It is expected that insurers' responses to any benefits of the Theft Act will be reflected through their normal ratemaking process. The procedures followed by most insurers are not currently aimed at changing comprehensive rates for a given motor vehicle line based on a determination that the theft rate for the line has changed (11). Lower rates for all passenger cars in a rating territory can be expected when total comprehensive losses or combined comprehensive and collision losses for the territory are reduced.

Thus, unless special consideration is taken by the insurers, it is expected that any benefits of parts labelling in reducing insurer theft losses for affected lines, would be dispersed to provide lower insurance premiums for other lines as well. These reductions in premiums could only be expected to occur to the extent that reductions in theft losses are not offset by changes in other losses insured under comprehensive coverage.

At this point it appears that the marking program has not reduced insurer losses. If this changes, the most appropriate insurer reaction would be to either adjust the symbol group applicable to affected vehicles or employ a special discount for marked vehicles similar to that employed by some of the insurers for lines equipped with certain anti-theft devices.

A few companies already provide a discount for a window marking system. Under such a system, the VIN number is etched on at least two windows of the vehicle, not including vent windows. These discounts are generally equivalent to the largest discounts offered for anti-theft devices. These discounts do not appear to apply to vehicles with any other marked parts.

Regardless of the propriety of a rate adjustment to reflect any changes caused by the Theft Act, it is unlikely that these changes would be reflected in 1987 and 1988 rates. Since the standards have only been in effect for 1987 and 1988 model year vehicles, their effects are not yet significantly represented in the insurers' data bases. For example, 1989 rates would generally be based on experience for 1988 and prior years. By the nature of the rating process, a degree of trend is built into the rates.

Given the currently available volume of claim data for any particular make and model, it is reasonable to expect that a broader span of experience is necessary before any effects of the marking program can be reflected in insurance rates. It is probably not reasonable to expect effects of the Theft Act to noticeably influence premiums before 1989 or 1990.

5.2 Insurer Considerations of Theft Act in Determining 1983-1988 Comprehensive Premiums

To examine whether and how insurers actually considered the Theft Act in determining premiums, rate filings were obtained and reviewed for 1983-1988 rates filed in several states by four companies. These companies included: State Farm, GEICO, USAA and Amica.

Three of these companies - GEICO, USAA and Amica essentially follow ISO rules and symbol relativities so that their overall actions are relatively similar. State Farm bases rates on its own loss experience and its ratemaking is independent of other companies to the extent that competition permits.

None of the rate filings examined included any reference or evidence that the Theft Act has as yet been taken into account in the rating of automobile comprehensive coverage.

The logical place to make such a recognition would be in the symbol group assignment of the affected vehicles. If insurers began to consider the Theft Act in their ratesetting, it would warrant specific mention in the affected rate filings, given the departure from past practice and the importance of such a change. Since no such mention was found, it is reasonably presumed that no reflection of the Theft Act was made by these companies.

The only symbol group modifications reflected within the rate filings involve changing the base model year. For example, in late 1986, a new rate category for 1987 model year vehicles would be necessary. There is a rule which permits the rating of such cars without a rate filing and allows CMY 1987 rates to be 5 percent higher than rates for CMY 1986 vehicles. This rate adjustment, however, would follow the model type and would not reflect any potential savings as a result of changes in anticipated costs due to the introduction of the Federal standards.

Thus, if insurers have begun to measure the effect of the Theft Act, these measurement efforts and effects are not yet reflected in the rate filings examined. This is not surprising given the usual time lag anticipated for any changes in losses to be reflected in rates.

5.3 Trends in Automobile Comprehensive Premiums During 1983-1988

As a result of the preceding discussion, it was found that there was no evidence that insurers were specifically considering the impacts of the Theft Act in determining comprehensive premiums during 1983-1988. Even if they had, theft losses have not yet appeared to diminish as a result of the marking program. Thus, it is improbable that the marking program has

influenced any reduction in 1987-1988 comprehensive rates.

To measure any future shift in comprehensive premiums that may result as more vehicles are marked, an analysis was performed to estimate the general trend in rates over the 1983-1988 period.

The analysis also served to demonstrate the variability of rates over time between companies, states, rural and urban areas, and high and low cost vehicles.

The analysis sought to examine the following questions:

1) How have automobile comprehensive premiums changed over the 1983-1988 period?

2) Are these changes consistent between states and companies?

3) Are premium trends for low cost vehicles different from those of expensive vehicles?

4) Are premium trends in dense metropolitan areas with generally high theft rates similar to trends in low density rural areas with lower theft rates?

5.3.1 Procedures to Analyze Premium Trends and Variability

To examine these issues, base levels of automobile comprehensive premiums charged during 1983-1988 were analyzed. These base premiums reflect the characteristics of the passenger car and its garaging location and exclude characteristics of the driver. Thus, the base premiums more directly represent the influence of vehicle theft than the final premiums which also reflect driver characteristics and include taxes, profits, etc.

Trend lines were fit to 1983-1988 base premiums to identify whether premiums were generally increasing or decreasing over the period. The slope of each line also identified the annual rate of change of premiums for the trend.

Trend lines were computed separately by state, company, territory and rating symbol. Five states were considered including: California, Florida, Michigan, Ohio and Washington. The first four states had generally high theft rates (12) while the state of Washington had the lowest theft rates in the group.

Within in each state, trends were considered separately in one territory with high population density and one territory with low population density. It is expected that theft rates in the areas with high population density are much higher than those in areas with low population density.

Rate trends in each territory were computed separately for two different insurance companies. One company used ISO rating factors and procedures while the other used its own loss experience and procedures to establish rates.

Rate trends for low cost and high cost CMY vehicles were considered separately. Low cost vehicles were defined as vehicles valued between $10,001 and $12,500 while high cost vehicles were valued between $28,001 and $33,000.

5.3.2 Results of Analysis of Premium Trends and Variability

Trend lines for 1983-1988 automobile comprehensive premiums are depicted in Appendix D. The annual change in premiums for each trend and the standard error of the linear fit are shown in Table 17. The standard error of the fit indicates the underlying variability of the rates. A small standard error implies that there is little difference between the actual premiums and the general trend line.

As seen from Table 17, the variability of the actual rates from the estimated linear trend line was reasonable in the large majority of instances. Of the 40 trend lines predicted for the 1983-1988 period:

- 26 cases had a standard error within $50
- 9 cases had a standard error between $50-$100 and
- Only 5 cases had a standard error over $100.

However, in three of the five cases with standard errors over $100 the 1983 premiums are responsible for generating the large standard error. Removal of these points would produce a much better linear fit.

Over the 1983-1988 period, rates were more often found to increase than decrease each year. Annual increases in premiums (i.e. trend lines with positive slope) occurred in 25 cases while annual decreases were found in 15 cases.

A majority of the trend lines exhibited small annual changes in premiums over the period. In 22 out of 40 cases, the estimated change in rates each year was within $10 (either increasing or decreasing). In another eight cases, annual rate changes varied between $11 and $30. Of these cases, four exhibited annual increases and four exhibited annual decreases.

Table 17 Results of Analysis of Trends
in Comprehensive Premiums During 1983–1988

		Low Density				High Density			
		Low Cost Vehicles		High Cost Vehicles		Low Cost Vehicles		High Cost Vehicles	
State/Company		Std. Error	Difference	Std. Error	Difference	Std. Error	Difference	Std. Error	Difference
CA	1	64.563	-28.74	139.675	-48.45	13.135	16.80	47.090	79.71
	2	36.557	1.25	66.473	9.37	51.472	1.82	67.428	17.74
FL	1	11.103	1.88	41.108	1.42	7.251	-3.32	33.314	-9.05
	2	4.648	-2.77	10.477	1.11	4.309	-4.57	10.425	-8.08
OH	1	58.214	-24.34	118.177	-58.02	26.541	-7.25	109.586	-20.85
	2	15.707	0.17	34.146	8.28	34.278	10.65	66.489	67.68
MI	1	15.255	5.82	33.685	15.08	21.511	53.02	52.172	124.42
	2	78.387	50.80	251.577	175.71	92.758	45.00	317.121	164.97
WA	1	9.863	2.68	39.964	4.22	3.835	1.82	24.750	1.57
	2	13.784	-5.05	42.399	-15.82	9.840	-1.00	41.118	-3.97
Average		30.808	0.17	77.768	9.29	26.493	11.30	76.949	41.41

Larger annual increases between $31 and $80 were found in five cases while annual decreases between $31 and $58 were found in two cases. Trend lines in three cases estimated exceptionally large annual increases in premiums between $125 and $175. Increases of this size were limited to expensive vehicles ($28,001-$33,000) insured in the state of Michigan.

Premium trends within a given state might vary significantly between companies especially for high cost vehicles. For example, premiums in a high density area of Ohio, were found to increase by $68 a year for one company while decreasing $21 a year for another company. Similarly, premiums for expensive vehicles in a high density area of California, increased by $80 a year for one company and only $18 a year for another company.

Relating premium trends to the expected likelihood of theft yields interesting results. For example, low cost vehicles in low population density areas would be expected to exhibit a relatively lower incidence of vehicle theft compared to high cost vehicles in dense metropolitan areas.

As the likelihood of vehicle theft increases, the rate of change of premiums over the 1983-1988 period also appears to increase as follows:

- The average annual increase in premiums for low cost vehicles in low density areas was estimated as only $0.17
- High cost vehicles in rural low density areas experienced average increases of $9.29 per year
- Lower cost vehicles in dense metropolitan areas experienced average annual increases of $11.30
- High cost vehicles in dense metropolitan areas exhibited the highest average annual increase in premiums of all categories considered. These increases averaged $41.41 per year.

This analysis suggests that there is a correlation between the likelihood of theft and the size of premium increases across the 1983-1988 period.

Similar results are obtained even when trend lines with high variability are excluded from consideration. By removing the five cases with standard errors above $100, results are unaffected for low cost vehicles while average annual premium increases for high cost vehicles are reduced from $9.29 to $3.38 in low density areas and reduced from $41.41 to $33.75 in high density areas. Nonetheless, the same general pattern emerges.

5.4 Implications of Analysis of Comprehensive Premiums on the Effectiveness of the Marking Program

Based on a review of the ratemaking process and an examination of rate filings and base automobile comprehensive premiums in effect during 1983-1988, the following observations are noted relative to the NHTSA evaluation of the effectiveness of the marking program:

- The procedures followed by most insurers are not currently aimed at changing comprehensive rates for a given vehicle line based upon a determination that the theft rate for the line has changed (11).

- Unless special consideration is taken by insurers, it is expected that any benefits of parts labelling in reducing insurer losses would not normally be targeted to reduce rates only for marked cars but would reduce rates for other cars as well.

- Based on prevalent ratemaking procedures, reductions in premiums could only be expected to occur to the extent that reductions in theft losses are not offset by changes in other losses insured under comprehensive coverage.

- An appropriate method to reflect any benefits of the marking program in insurance premiums would be to adjust the symbol group applicable to marked vehicles or employ a special discount for these vehicles similar to discounts offered by some insurers for lines with anti-theft devices.

- A review of insurer rate filings did not produce any evidence that the marking program has as yet been taken into account in the rating of automobile comprehensive coverage. Even if it had been considered, theft losses have not as yet appeared to diminish as a result of marking program. Thus, it is improbable that the program has had any significant influence on autombile premiums.

- An examination of premium trends during the 1983-1988 period suggests a correlation between the likelihood of theft and the rate of premium increase. On average, lower cost vehicles in rural areas exhibited virtually no change in premiums over the 1983-1988 period, while high cost vehicles in dense metropolitan areas exhibited annual increases averaging $41 a year. Thus, if the Theft Prevention Standard is effective, as more vehicles are marked, the rate of change of premium increases for expensive vehicles in high density areas should be found to diminish independent of other factors.

6. CHARACTERISTICS OF THEFT CLAIMS FILED DURING 1987-1988

A detailed record of all theft claims filed with one insurer was obtained for thefts occurring during calendar years 1987 and 1988. This sample provided the following detail that could not be obtained from the other insurers or from the NATB and HLDI claim samples:

1) The sample included all stolen passenger cars insured by this company regardless of the age of the vehicle. Samples requested from the NATB and the HLDI were specifically limited to thefts of current model year, one and two year old vehicles. The detailed sample could be used to identify the proportion of all vehicles stolen which were CMY, one or two years old. This would be indicative of the proportion of annual thefts represented in the NATB analysis sample.

2) The sample included all claims and their settlement amounts including claims without payment, whereas the HLDI samples included only paid claims (i.e. claims with values in excess of the policy deductible). Thus the detailed sample could be used to identify the proportion of claims without payment.

3) The sample identified the date of settlement of each claim making it possible to determine whether a stolen passenger car was recovered before or after an insurance settlement was reached. This also made it possible to identify costs to repair recovered stolen vehicles to their pre-theft state.

The sections which follow further describe the characteristics of this unique sample, as well as, the insights it reveals on the characteristics of theft claims.

6.1 Characteristics of Insurance Claim Records

Detailed theft claim records were maintained by the insurer in written form only. In support of NHTSA's evaluation effort, the insurer agreed to permit KLD Associates to review its hand-written claim records and construct a computerized sample of these records.

An analysis of this sample for thefts occurring during 1983 and 1984 was performed previously and is documented in a separate report submitted to the NHTSA (10). A similar analysis of 1985 and 1986 theft claims has also been performed (9).

For each selected motor vehicle theft claim, the following information was entered into the computerized data base:

- Claim number
- Date case was opened
- Date case was closed
- Date of Loss
- Vehicle make
- Model year
- Vehicle Identification Number (VIN)
- Date of recovery
- Date of settlement
- Net amount paid
- Repair cost
- Disposition

Thus, this sample contained detailed information that could not be obtained from the other samples.

The sample included claims for 7,219 vehicles stolen during 1987 and 5,887 vehicles stolen during 1988.

6.2 Distribution of Theft Claims by Vehicle Age

Figure 7 illustrates the distribution of thefts during 1987 based on vehicle age. Of all the vehicles insured during 1987, only selected 1987 and 1988 models were subject to the parts marking program. Together, marked and unmarked vehicles of these model years represented approximately 10 percent of all vehicle theft claims filed with this insurer during 1987. Most of these vehicles were built and insured during the course of 1987 and on average experienced less calendar time of exposure to theft during 1987 than older vehicles.

Thus, older 1986 vehicles represented 15.7 percent of annual thefts compared to 10 percent for CMY vehicles. The pattern was approximately the same for two year old 1985 vehicles, three year old 1984 vehicles and four year old 1983 vehicles. Vehicles of each of these ages represent approximately 10-14 percent of the total number of stolen vehicles in 1987. Approximately 5 percent of the stolen insured vehicles were more than 10 years old.

The distribution of thefts during 1988 by vehicle age is shown in Figure 8. This pattern is similar to that found for 1987. Of the vehicles insured during 1988, only selected 1987-1989 models had marked parts. Marked and unmarked vehicles of these model years represented no more than 25 percent of all the vehicle thefts reported to this insurer during 1988.

Based on these observations it is estimated that no more than 10 percent of all annual theft claims during 1987 and 25 percent of all annual theft claims during 1988 are suitable for a comparison of the relative performance of marked and unmarked vehicles.

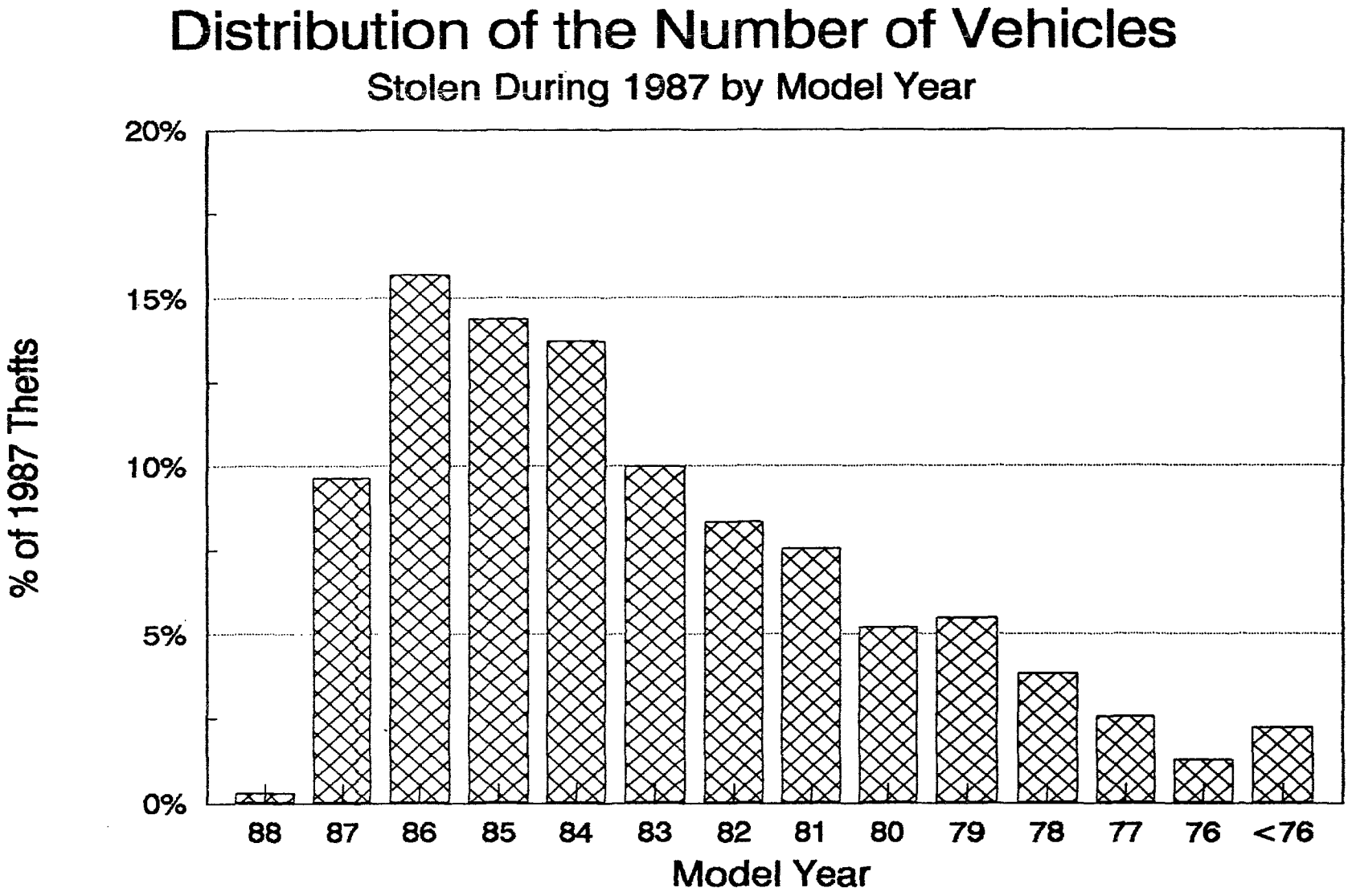


Figure 7 Distribution of Vehicles Stolen During 1987 by Model Year

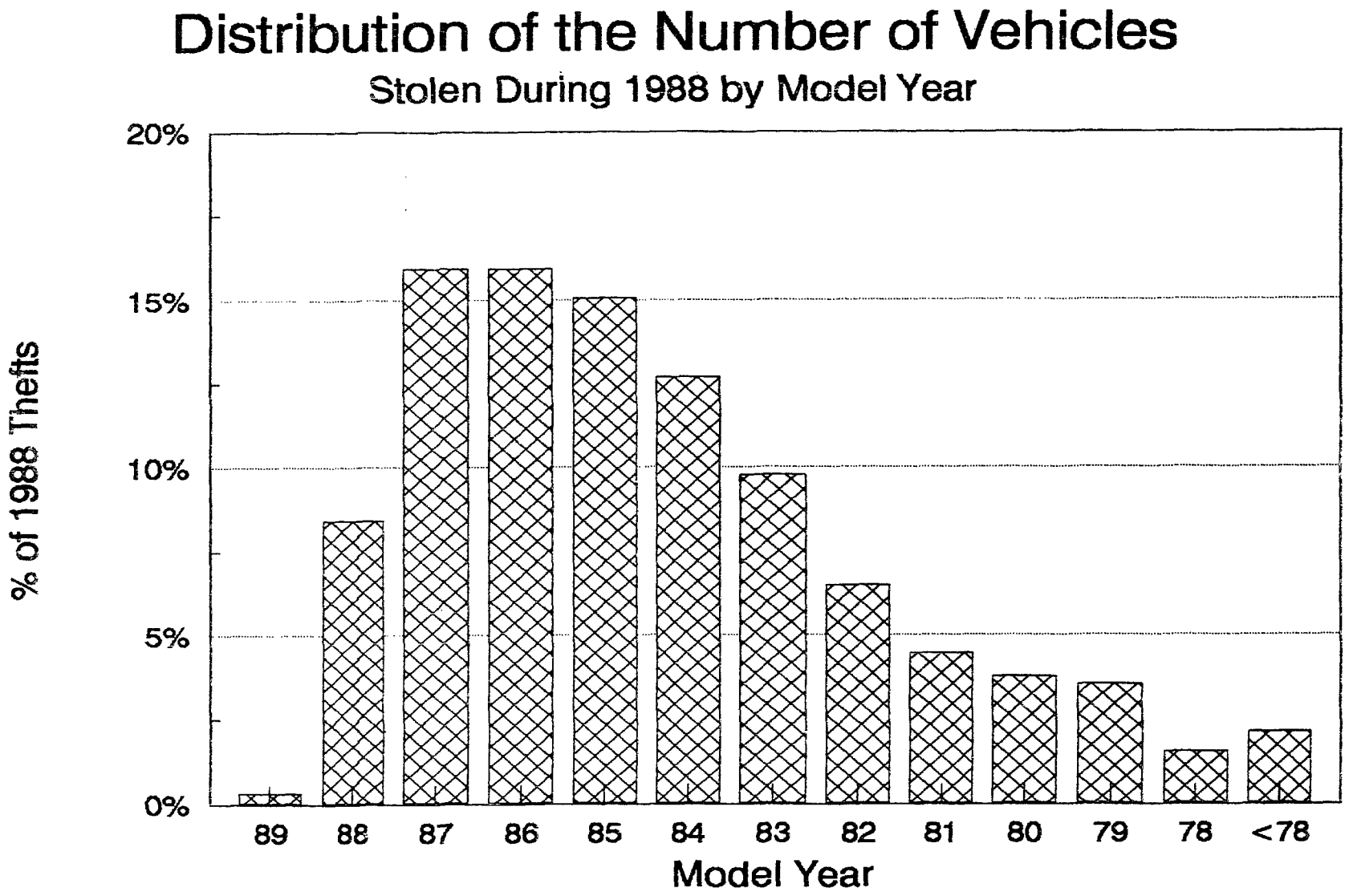


Figure 8 Distribution of Vehicles Stolen During 1988 by Model Year

It should be noted that the proportion of annual thefts of insured vehicles by age is strongly related to the distribution of theft policies written by vehicle age (exposure). For example, as a vehicle ages, it is less likely that policyholders retain automobile comprehensive coverage (including theft coverage). Also, the distribution of policies by vehicle age will vary somewhat between companies.

6.3 Proportion of Automotive Theft Claims Without Payment

The detailed sample included claims for vehicle thefts which were resolved without payments issued to the insured. These claims might include instances in which the stolen vehicle was recovered and the damage sustained as a result of the theft was less than the deductible value of the policy.

Thus, the distribution of theft claim values for this sample represents the entire spectrum of theft claim values. The distributions of claim values for thefts of current model year 1987 and 1988 vehicles are shown in Figure 9. These distributions reflect the value of the theft loss including deductible.

Figure 10 illustrates the distributions of theft claim values for the 1987 and 1988 HLDI samples. These values also reflect the dollar value of the theft loss including deductible but exclude claims in which the loss value was less than the deductible and no payment was issued.

As might be expected, the distributions in Figure 9 are skewed towards lower claim values relative to Figure 10. Figure 9 indicates more claims were valued between $0-$500, than were valued in any other cost range. Claims in this range comprised 21.6 percent of the claims for stolen current model year 1987 passenger cars and 20.4 percent of the claims for stolen current model year 1988 passenger cars.

Claims in the $0-$500 range comprised only about 5 percent of the claims in the HLDI samples for 1987 and 1988. More claims in these HLDI samples were valued in the $12,000-$16,000 cost range than in any other cost range.

A comparison of Figures 9 and 10 suggests the that for every 100 paid claims in the HLDI sample, roughly another 20 claims were filed with the participating insurers with actual claim values under $500.

6.4 Recoveries Prior to Settlement

The individual insurer claim sample identified the settlement date of each claim. This information made it possible to identify claim payments for vehicles recovered prior to settlement.

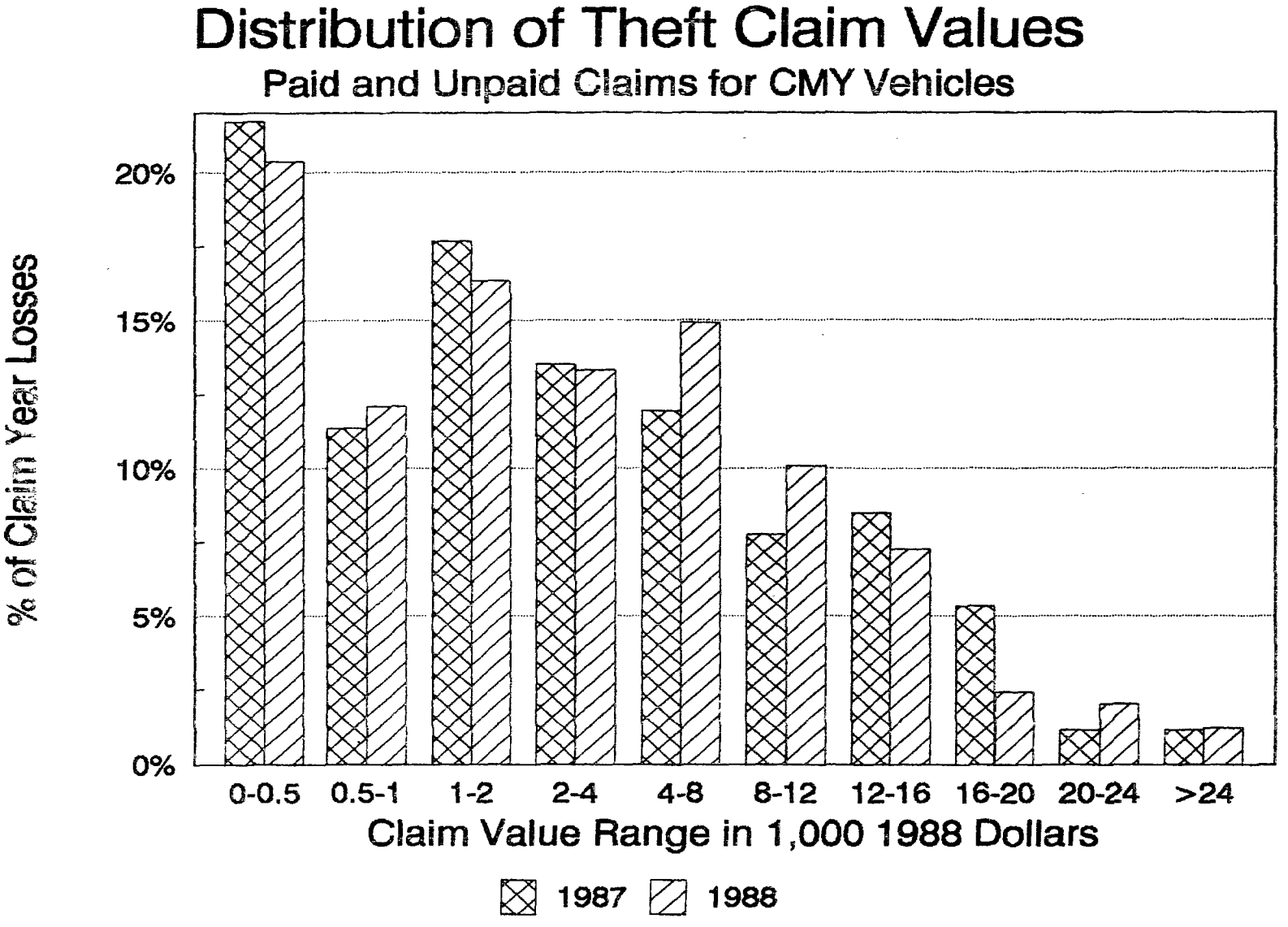


Figure 9 Distribution of Theft Claim Values for One Company Including Paid and Unpaid Claims

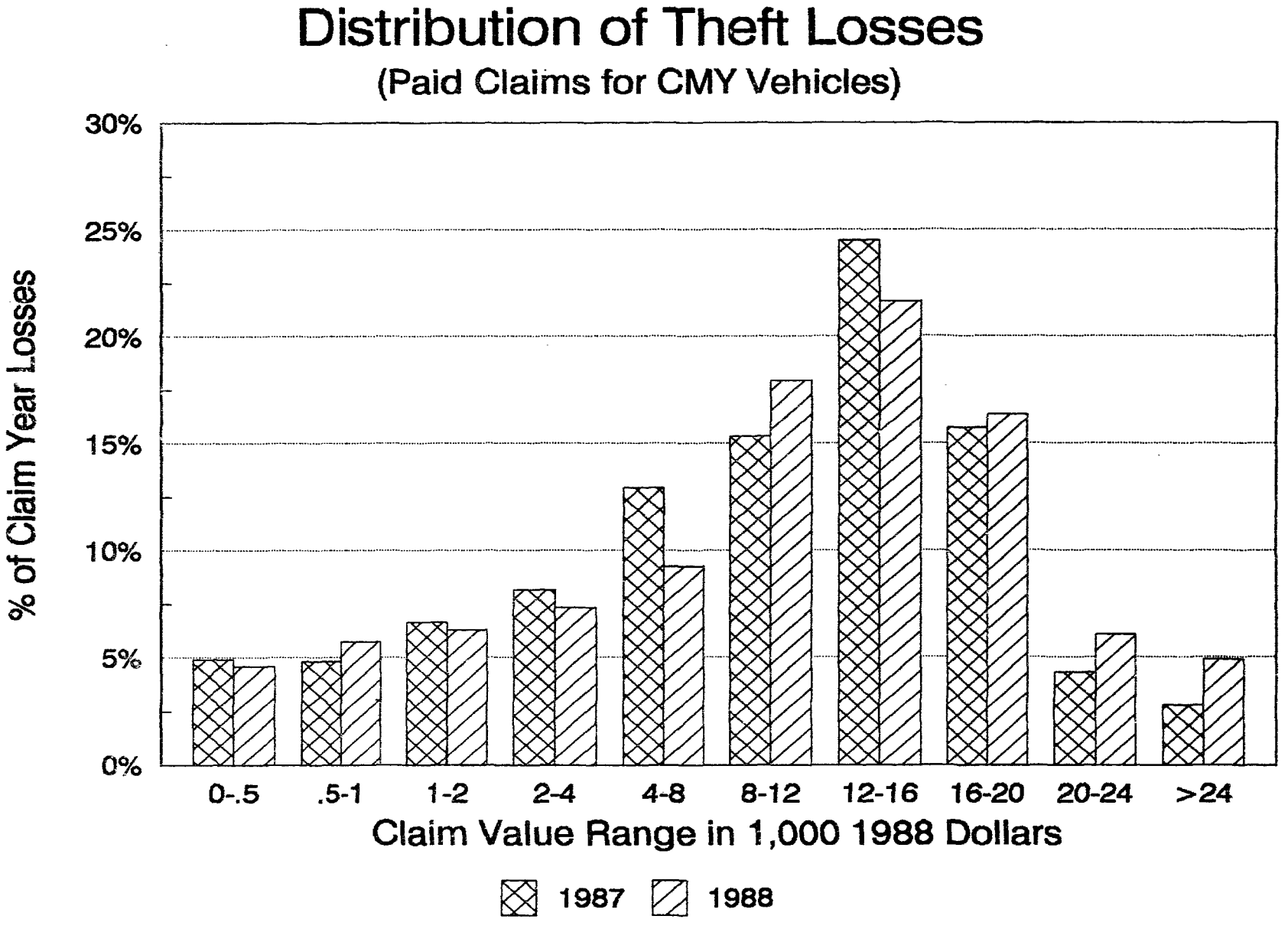


Figure 10 Distribution of Claim Payments Issued by Six Companies

Figure 11 presents the distribution of recoveries over time for current model year 1987 and 1988 vehicles recovered prior to settlement. Figure 11 indicates that approximately 95 percent of all recoveries prior to settlement occurred within 30 days of the theft. This was consistent with the practice of the insurer to settle theft claims within 30 days. A similar proportion was also observed for 1985 and 1986 (9).

The claim data also indicates that 50 percent of the recoveries in 1987 and 36 percent of the recoveries in 1988 of current model year vehicles occurred prior to settlement of the claim. If the Theft Prevention Standard met its goal of encouraging a reduction in the number of vehicles stolen for export or parts, it might be expected that the proportion of thefts attributable to joyriding would be increasing. Since joyriders tend to abandon vehicles after a relatively short period, it would be expected that an increase in the proportion of thefts for joyriding would be accompanied by an increase in the proportion of recovered vehicles found prior to claim settlement (assuming law enforcement efforts and other factors remained the same). Since the opposite of this trend appears to be occurring (i.e. the proportion of recoveries occurring prior to settlement appears to be decreasing), there is no evidence to suggest that the standard is effective by this criteria.

Figure 12 indicates the distribution of average payments over time for 1987 and 1988 current model year cars recovered prior to settlement. This figure indicates that settlements made after 30 days were substantially more expensive than settlements prior to 30 days for vehicles recovered prior to the settlement date.

Payments for these claims averaged:

- $2,964 in 1987 and $3,539 in 1988 for CMY vehicles recovered between 10 and 29 days after the theft
- $7,212 in 1987 and $5,538 in 1988 for CMY vehicles recovered between 30 and 89 days after the theft.

These costs are expressed in 1988 dollars.

An analysis of the claim sample indicated that the cost to repair a CMY vehicle recovered prior to settlement to its pre-theft state or consider the damage as a total loss averaged $4,400 in 1987 and $3,435 in 1988. These values are expressed in 1988 dollars. These figures suggest that stolen vehicles recovered prior to settlement sustained less damage as a result of theft in 1988 than in 1987. This trend is consistent with the goals of the Theft Prevention Standard.

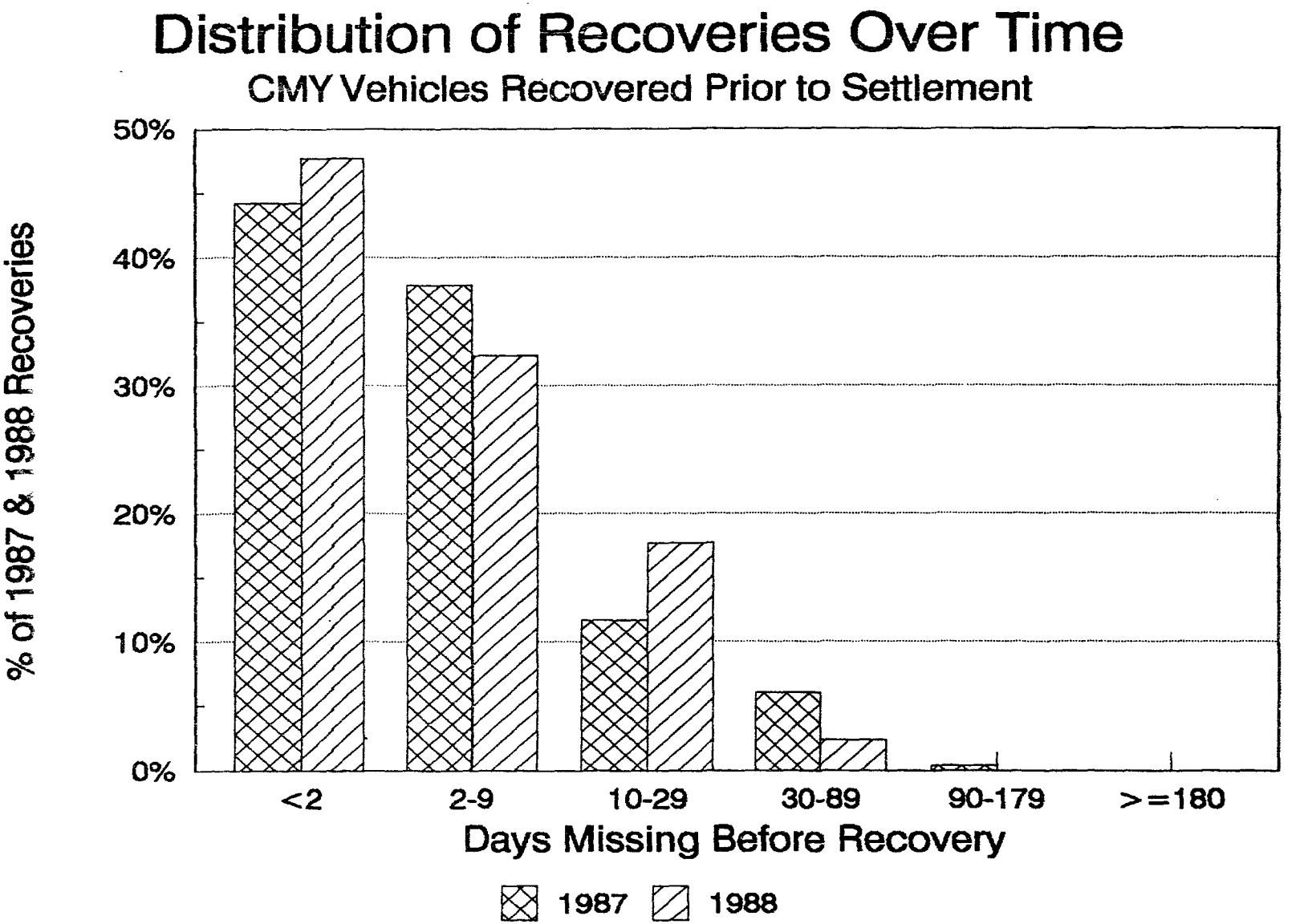


Figure 11 Distribution of Recoveries Over Time for Vehicles Recovered Prior to Settlement

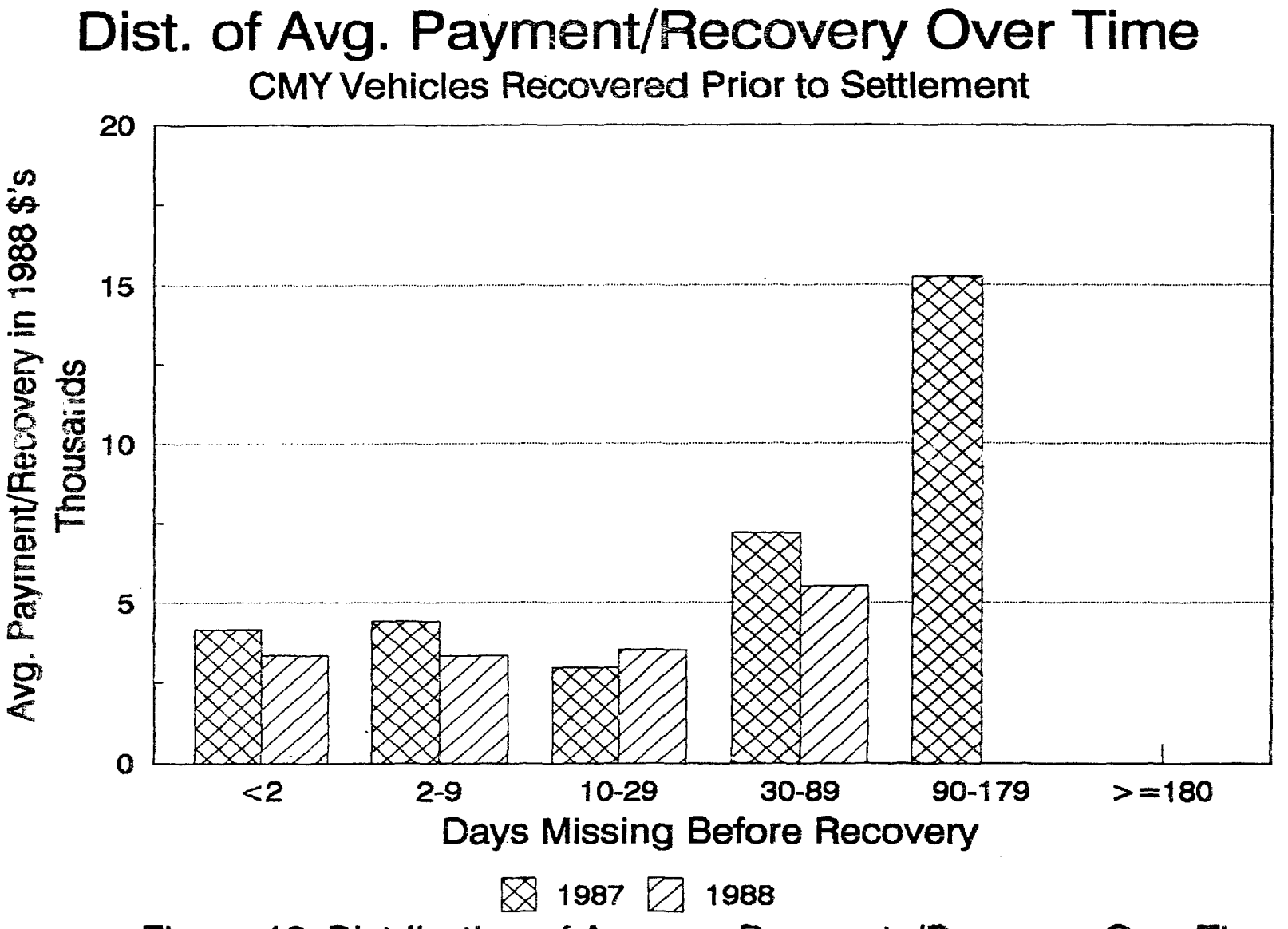


Figure 12 Distribution of Average Payments/Recovery Over Time for Vehicles Recovered Prior to Settlement

6.5 Implications of Theft Claim Characteristics on NHTSA Evaluation of Theft Act

The investigation of the insurer claim sample identified several results that are of specific interest to the NHTSA evaluation effort. These include:

1) The NHTSA analysis must focus heavily on current model year vehicles since it is primarily vehicles in this age group which may be equipped with VIN labelling in the 1987 analysis sample. It is estimated that current model year vehicles accounted for approximately 9 percent of the insured vehicles stolen during 1987 (Figure 7) and 8 percent of the vehicles stolen during 1988 (Figure 8). For 1988, the analysis may consider one year 1987 vehicles as well since some of these cars are marked. One year old 1987 vehicles comprised 16 percent of the insured vehicles stolen during 1988.

2) Unlike the HLDI sample, the insurer's claim records included claims which were settled without payments being issued to the policyholder. These claims included instances in which a stolen vehicle was recovered prior to settlement with damage valued below the policy deductible. Based on this information, it is estimated that for every 100 paid claims in the HLDI sample, there exist an additional 20 claims valued under $500 for which no payments were issued (Figures 9 and 10). The absence of these claims from the HLDI sample implies that the sample understates policyholder costs of automotive theft. Including the effects of these missing claims would substantially lower the average HLDI costs for cars which were recovered intact.

3) A smaller proportion of recovered vehicles were found prior to settlement in 1988 than in 1987. This helps to explain the increase in average theft claim payments between 1987 and 1988 observed in Section 4.2.1. The decrease in the proportion of vehicles recovered prior to settlement is not consistent with the expectation that the Theft Prevention Standard would reduce the proportion of thefts by professional thieves thereby increasing the proportion of thefts for joyriding independent of other factors. However, those vehicles which were recovered prior to settlement appeared to be sustaining less damage in 1988 than in 1987. Thus, the proportion of thefts for joyriding may be increasing for instances where the vehicle is recovered prior to settlement but does not appear to be increasing overall. As in all cases, these results must be qualified by the limited claim experience available since introduction of the marking program.

7. CONCLUSIONS

Motor vehicle theft is a worsening problem for the insurance industry and its policyholders. Between 1983 and 1988, theft rates for insured current model year (CMY) motor vehicles, grew from 2.88 to 4.38 thefts per 1000 insured vehicle years. This has increased insurance company losses due to motor vehicle theft. Between 1983 and 1988, insurers' expected cost of CMY vehicle theft grew 41 percent from $35.46 to $50.08 per insured vehicle year.

An analysis of theft rates suggests that the labelling of parts on selected high theft passenger cars may be beginning to discourage thefts of these vehicles. During the first year of the marking program, theft rates for marked and unmarked insured vehicles continued to increase almost equally. However, during the second year of the program, the theft rate for marked cars actually decreased from 6.06 to 5.21 thefts per 1000 insured vehicle years. At the same time, the theft rate for unmarked cars increased slightly from 3.7 to 3.84 thefts per 1000 insured vehicle years.

As a result, over the two years since the introduction of the marking program, theft rate increases were significantly lower for marked vehicles than for unmarked vehicles. This was primarily due to the decrease in theft rates observed for marked vehicles between 1987 and 1988.

Although the reduction in theft rates for marked vehicles is limited to a single year, it suggests that the marking program may be beginning to influence the rate of theft of marked vehicles. Additional experience with the marking program will be necessary to confirm this.

Additional investigations of insurance data did not produce any other evidence that the marking program specifically benefitted marked insured vehicles. For example:

- There was no indication that the marking program influenced any change in the rate of recovery of marked vehicles. Although lines which were marked exhibited an 11 percent increase in recoveries relative to their unmarked ancestors, exactly the same increase was observed over the same time frame for lines excluded from the marking program. In addition, the recovery rate for unmarked multi-purpose vehicles and light trucks appears to be growing faster than the recovery rate for either marked or unmarked passenger cars.

- Insurer losses for marked vehicles continued to increase after the marking program began. In fact, expected theft claim costs per insured vehicle year increased faster for marked vehicles than for unmarked vehicles. This occurred even though the rate of theft did not increase as fast for

marked vehicles as it did for unmarked vehicles. Between 1983-1986 and 1987-1988, theft costs per insured vehicle year increased $20.40 for marked cars, $17.47 for unmarked cars and only $11.44 for vehicles with anti-theft devices. This appeared to result from the fact that average claim costs for stolen marked vehicles increased by $128 while average claim costs for unmarked vehicles decreased by $709 after the start of the marking program.

- There was no statistically significant change in the value of payments for claims with stolen major parts after these parts were marked. Such a change might be expected to occur if thieves began to steal fewer marked parts after the marking program began.

- A review of insurer rate filings in several states did not produce any evidence that the marking program has as yet been taken into account in the rating of automobile comprehensive coverage.

Although some results were observed which were consistent with the goals of the Theft Prevention Standard, it did not appear as though the marking program itself was responsible for these results. For example:

- The maximum proportion of car thefts that might be fraudulent or lead to export or dismantling for parts appeared to diminish significantly (8-10 percent) over the two-year period since the introduction of the marking program. However, unmarked CMY cars appeared to have experienced a larger decrease in this measure than marked CMY cars. Also, the same decreases were observed for older vehicles as for CMY vehicles. None of the older vehicles had marked parts.

- Average claim costs for recovered vehicles decreased significantly after the marking program began. This result might be expected if the program reduced the extent of professional thefts thereby increasing the proportion of thefts for joyriding or other purposes. However, while average theft claim costs for recovered CMY marked vehicles decreased by $643 after the marking program began, claim costs for unmarked vehicles were reduced even further, decreasing by $977. Both of these changes were found to be statistically significant. Also, the same decreases observed for CMY marked vehicles were also observed for two year old unmarked vehicles.

Comparing results for marked and unmarked cars and cars equipped with anti-theft devices qualifying for exemptions from the marking program, it was found that:

- Vehicles equipped with passive anti-theft devices exhibited a more favorable trend in theft rates over the 1987-1988 period than either marked or unmarked cars. Cars with anti-theft devices, exhibited uniform theft rates between the pre-standard 1983-1986 period and post standard 1987-1988 period while theft rates increased significantly for both marked and unmarked cars.

- While cars with anti-theft devices were less likely to be stolen than marked cars, if stolen, they were also less likely to be recovered and more expensive to replace. This is consistent with the expectation that determined professional thieves steal these vehicles since other vehicles may be stolen with less effort.

To date, experience with the marking program is limited. Since the early evidence suggests that the program may be beginning to discourage thefts of marked vehicles, further investigation of the program over time is warranted.

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