Memorandum

Date: OCT **1 5** 2008

TO   :   The Commission

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SUBJECT   :   2007 Annual Report of All-Terrain Vehicle (ATV)-Related Deaths and Injuries

Attached is the annual report* of ATV-related deaths and injuries for the year 2007. This report includes ATV-related fatality information available to CPSC staff as of December 31, 2007 and ATV-related injury data for emergency-room-treated injuries occurring through December 31, 2007.

Attachment (1)

*The analysis was prepared by CPSC staff. It has not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.

2007 Annual Report of ATV-Related Deaths and Injuries

October 2008

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This analysis was prepared by CPSC staff. It has not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.

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INTRODUCTION

This report presents the 2007 annual update of information collected by the U.S. Consumer Product Safety Commission (CPSC) staff on deaths and injuries related to the use of all-terrain vehicles (ATVs). The update includes information on ATV-related deaths based on data available to CPSC staff as of December 31, 2007, as well as information on ATV-related injuries treated in hospital emergency rooms from January 1, 2007 through December 31, 2007.

The report begins with a brief background section. This is followed by a summary of ATV-related fatality <u>counts</u> derived from CPSC staff data and a discussion of reported ATV-related deaths involving children younger than 16 years of age. Then, based on the counts of ATV-related fatalities reported to CPSC staff, annual <u>estimates</u> of ATV-related deaths are presented, together with estimates of the annual risk of death per 10,000 four-wheel ATVs in use. Next, the report provides estimates of ATV-related, hospital emergency room-treated injuries, together with estimates of the annual risk of injury per 10,000 four-wheel ATVs in use. The report concludes with a short discussion of the observed patterns of ATV-related deaths and injuries over time.

BACKGROUND

CPSC staff considers an ATV to be an off-road, motorized vehicle having three or four low pressure tires, a straddle seat for the operator, and handlebars for steering control. Off-road motor vehicles having steering wheels and either bench or bucket seats (e.g., golf carts, dune buggies, and certain types of utility vehicles) are not categorized as ATVs by CPSC staff. Consequently, fatalities and injuries associated with these types of vehicles are not addressed in this report.

CPSC staff first began analyzing ATV incident data in the early 1980s in order to provide information on the numbers of deaths and injuries associated with three-wheel ATVs. In the late 1980s, the major ATV distributors agreed to refrain from selling or distributing three-wheel ATVs (U.S. CPSC, 2006). Consequently, although some older three-wheel ATVs continue to be used by consumers, nearly all ATVs in use today are four-wheel ATVs, which are available in a range of engine sizes and designs.

ATV-RELATED FATALITIES
Reported Deaths

By December 31, 2007, CPSC staff had received reports of 8,995 ATV-related deaths that occurred between 1982 and 2007 (Table 1). The number of new fatality reports increased by 891 since the December 31, 2006 tabulation prepared by CPSC staff (U.S. CPSC, 2008). These 891 additional reports represent ATV-related fatalities that occurred during the years 2003 through 2007.

Table 1
Reported ATV-Related Fatalities (by Year)
ATVs with 3, 4 or Unknown Number of Wheels
Reported for the Period January 1, 1982 through December 31, 2007

Year[1]	Number of Deaths	Difference Since Last Update (12/31/2006)
Total	**8,995**	**+891**
2007	*542*	*+542*
2006	*750*	*+195*
2005	*804*	*+138*
2004	760	+15
2003	655	+1
2002	548	0
2001	517	0
2000	451	0
1999[2]	398	0
1998	251	0
1997	241	0
1996	248	0
1995	200	0
1994	198	0
1993	183	0
1992	221	0
1991	230	0
1990	234	0
1989	230	0
1988	250	0
1987	264	0
1986	299	0
1985	251	0
1984	156	0
1983	85	0
1982	29	0

Source: U.S. Consumer Product Safety Commission: Directorate for Epidemiology/Division of Hazard Analysis.
Italics denote the period for which reporting is ongoing.

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[1] Reporting is ongoing for the years 2005 - 2007.
[2] Beginning in 1999, death certificates were coded under the Tenth Revision of the International Classification of Diseases (ICD-10). See Appendix B for an explanation of the effect of this change.

Data collection for the years 2005 through 2007 is ongoing. As a result, the numbers of reported deaths for 2005 through 2007 are expected to increase before the next annual report is prepared.

In Table 1, the counts presented for 1999 and later (i.e., the values above the heavy line) reflect a revised mortality data classification system from the one used prior to 1999. Specifically, the heavy line marks the change from death certificate mortality coding under the Ninth Revision of the International Classification of Diseases (ICD-9) to coding under the Tenth Revision (ICD-10), a transition that allows CPSC staff to more accurately gather mortality data for a number of consumer products, including ATVs. This change was implemented by the National Center for Health Statistics (NCHS) in January 1999 (NCHS, 2007). Since the implementation of ICD-10 coding, all ATV-related fatalities, including incidents involving traffic accidents on public roads, are grouped under a single set of mortality codes. Because of the use of different coding systems between the two time periods (i.e., prior to 1999 versus 1999 and later), comparisons of numbers between these periods should be undertaken with caution. The ICD-10 transition and related methodological issues are discussed more fully in Appendix B.

Table 2 gives the numbers of reported ATV-related deaths for each state, the District of Columbia, and Puerto Rico. States are listed in descending order of the number of ATV-related fatalities reported for the years 1982 through 2004 (i.e., the years for which data collection is considered complete). Reported deaths that occurred during these years are tabulated in the second column. The following states had the highest numbers of ATV-related deaths occurring in this period: California (376 deaths), Pennsylvania (360), Texas (333), Kentucky (299), and West Virginia (299). Together, these five states accounted for 24 percent of all reported ATV-related deaths in the U.S. for the years 1982 through 2004 (n = 6,899), as shown in the third column of Table 2.

When reviewing state death counts for the period 1982 through 2004, two points deserve note:
- Consistent with CPSC staff's previous annual reports on ATV-related deaths and injuries, the counts shown in Table 2 have not been adjusted for demographic characteristics (e.g., total population, age structure of population, etc.).

- Also consistent with previous CPSC staff reports, these counts reflect the state in which the death occurred rather than the state where the ATV incident occurred. This approach allows the most accurate matching of death certificates to other types of incident reports received by CPSC staff. However, as medical transport capabilities (e.g., helicopter transport) and trauma care have advanced in recent years, some states with major trauma centers have ATV-related fatalities included in their reported counts for incidents that did not occur within their state boundaries. Similarly, some states have reported counts that do not fully account for all of the ATV-related fatality incidents that occurred within their state boundaries.

The fourth column of Table 2 presents, by state, the ATV-related death counts reported to CPSC staff as of December 31, 2007 for the period 2005 through 2007. These counts should not be used for between-state comparisons because data collection for this period is ongoing and because data collection from some states is more complete than from other states for these years.

Each state's total number of reported deaths is listed in the fifth column. These counts include information for the years that have ongoing reporting as well as information for the years where data collection is considered complete.

Table 2
Reported ATV-Related Fatalities (by State)
ATVs with 3, 4 or Unknown Number of Wheels
Reported for the Period January 1, 1982 through December 31, 2007

State	Reported Deaths 1982 - 2004	Cumulative Percent of U.S. 1982 - 2004	Reported Deaths 2005 - 2007*	Total Reported Deaths*
CALIFORNIA	376	5%	*100*	*476*
PENNSYLVANIA	360	11%	*87*	*447*
TEXAS	333	15%	*107*	*440*
KENTUCKY	299	20%	*114*	*413*
WEST VIRGINIA	299	24%	*143*	*442*
FLORIDA	268	28%	*123*	*391*
MICHIGAN	267	32%	*50*	*317*
NEW YORK	267	36%	*66*	*333*
TENNESSEE	257	40%	*83*	*340*
NORTH CAROLINA	256	43%	*68*	*324*
GEORGIA	225	46%	*44*	*269*
OHIO	207	49%	*65*	*272*
MISSISSIPPI	206	52%	*65*	*271*
ARKANSAS	202	55%	*35*	*237*
MISSOURI	192	58%	*71*	*263*
WISCONSIN	184	61%	*47*	*231*
MINNESOTA	182	63%	*52*	*234*
ALABAMA	162	66%	*40*	*202*
ILLINOIS	153	68%	*42*	*195*
ARIZONA	147	70%	*52*	*199*
LOUISIANA	147	72%	*49*	*196*
INDIANA	134	74%	*36*	*170*
VIRGINIA	124	76%	*47*	*171*
UTAH	119	78%	*32*	*151*
OREGON	110	79%	*31*	*141*
ALASKA	107	81%	*34*	*141*
OKLAHOMA	95	82%	*43*	*138*
MAINE	90	84%	*25*	*115*
IDAHO	89	85%	*25*	*114*
IOWA	87	86%	*25*	*112*
COLORADO	86	87%	*30*	*116*
KANSAS	85	89%	*23*	*108*
WASHINGTON	77	90%	*28*	*105*
SOUTH CAROLINA	76	91%	*26*	*102*
NEW MEXICO	71	92%	*15*	*86*
NEBRASKA	63	93%	*17*	*80*
NEVADA	58	94%	*12*	*70*
MASSACHUSETTS	56	94%	*10*	*66*
NEW HAMPSHIRE	50	95%	*5*	*55*
NEW JERSEY	50	96%	*17*	*67*
MARYLAND	46	97%	*16*	*62*
MONTANA	46	97%	*16*	*62*
VERMONT	41	98%	*14*	*55*
SOUTH DAKOTA	39	98%	*15*	*54*
NORTH DAKOTA	33	99%	*21*	*54*
CONNECTICUT	28	99%	*11*	*39*
WYOMING	26	100%	*8*	*34*
HAWAII	7	100%	*7*	*14*
DELAWARE	6	100%	*1*	*7*
RHODE ISLAND	5	100%	*2*	*7*
DISTRICT OF COLUMBIA	4	100%	*1*	*5*
PUERTO RICO	2	100%	*0*	*2*

Source: U.S. Consumer Product Safety Commission: Directorate for Epidemiology/Division of Hazard Analysis.
State rankings are based on ATV-related fatality counts for the period 1982 – 2004.
*Italicized data (columns 4 and 5) denote the years for which reporting is ongoing (2005 – 2007).

Reported Deaths of Children Under 16 Years of Age

A review of the reported ATV-related fatalities indicated that 2,497 decedents (28 percent of the 8,995 total) were under 16 years of age, and 1,062 (12 percent of the total) were under 12 years of age. Table 3 gives the numbers and percentages of reported fatalities by year for individuals younger than 16 years of age. Appendix A contains a more detailed breakdown of the reported deaths in this age group.

Table 3
Reported ATV-Related Fatalities: Children Younger Than 16 Years Old
ATVs with 3, 4 or Unknown Number of Wheels
Reported for the Period January 1, 1982 through December 31, 2007

Year[3]	Younger Than 16	Younger Than 16 Percent of Total
Total	**2,497**	**28%**
2007	*107*	*20*
2006	*139*	*19*
2005	*162*	*20*
2004	183	24
2003	155	24
2002	133	24
2001	132	26
2000	124	27
1999[4]	90	23
1998	82	33
1997	79	33
1996	87	35
1995	64	32
1994	54	27
1993	59	32
1992	71	32
1991	68	30
1990	81	35
1982-1989	627	40

Source: U.S. Consumer Product Safety Commission: Directorate for Epidemiology/Division of Hazard Analysis.
Italics denote the period for which reporting is ongoing.

While the percentage of victims under age 16 appears to have declined since 1998, it is also probable that adult deaths were under-reported during the period 1982 to 1998. Because of coding limitations for ATV-related fatalities under the old ICD-9 system (see Appendix B), CPSC staff was generally not able to gather reports of deaths on public roads during those years. If, during that time period, adults were more likely than children to have been involved in ATV-related fatality incidents on public roads, then the calculated percentages of deaths involving children shown in Table 3 may be higher than the true proportions of ATV-related fatalities involving children for the years prior to 1999.

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[3] Reporting is ongoing for 2005 – 2007. Percentages for these years should be interpreted with caution because the rate at which deaths are reported may not be consistent across all age groups.
[4] Beginning in 1999, death certificates were coded under the Tenth Revision of the International Classification of Diseases (ICD-10). See Appendix B for a discussion of the effect of this change.

Three-Wheel vs. Four-Wheel ATVs

As noted in the background section, CPSC staff began tabulating reports of ATV-related deaths and injuries in the early 1980s in order to assess incidents associated with three-wheel ATVs. However, in the late-1980s, the major distributors agreed to refrain from selling or distributing three-wheel ATVs, and, currently, the ATVs distributed in the U.S. are nearly all four-wheel models (U.S. CPSC, 2006). The percentage of reported fatalities involving four-wheel ATVs increased from 7 percent or less prior to 1985 to more than 95 percent in 2007, based on 2007 fatalities reported to CPSC staff as of December 31, 2007. Although data collection for 2007 is ongoing, it is not expected that this percentage will change greatly as additional reports of 2007 fatalities are received.

From the incident reports, it is not always possible to ascertain whether the ATV involved in the incident has three wheels or four wheels. In these cases, the vehicle is coded as an ATV having an unknown number of wheels. For the four-wheel ATV estimations described below, ATVs having an unknown number of wheels were apportioned between three-wheel and four-wheel ATVs, using the methods described in Appendix B.

Estimated ATV-Related Deaths and Risk of Death, 1985 to 2006

Death reports received by CPSC staff represent a minimum count of ATV-related deaths because not all ATV-related fatalities may be reported. To account for unreported deaths, CPSC staff estimated annual ATV-related fatalities for the period 1985 to 2006 using a statistical estimation method (Hook and Regal, 2004). Table 4 shows both the annual reported counts and the derived estimates of ATV-related deaths involving ATVs having three, four or an unknown number of wheels. Table 4 also presents the annual estimated risk of death per 10,000 four-wheel ATVs in use for this period.

The heavy line between 1998 and 1999 in Table 4 again demarcates the switch from mortality data collection under ICD-9 to collection under ICD-10. Because mortality coding under ICD-10 allows CPSC staff to gather more complete data on ATV-related deaths, some of the increase in estimated deaths observed between 1998 and 1999 is probably a result of the ICD-9/ICD-10 transition. Although the magnitude of the effect of the coding change is unknown, it follows that the death estimates and risks calculated for the years prior to 1999 may have been underestimates.

Column 5 of Table 4 gives annual estimates for the numbers of four-wheel ATVs in use. According to CPSC staff's *All Terrain Vehicle 2001 Injury and Exposure Studies*, in 2001, about 5.6 million three- and four-wheel ATVs were in use, and about 86 percent of these were four-wheel ATVs (Levenson, 2003a). Since that study, CPSC staff has relied on annual ATV sales information, together with survival analysis models, to derive estimates of the number of four-wheel ATVs in use during each year.

A discussion of the methodologies used to estimate ATV-related deaths and the risk of death per 10,000 four-wheel ATVs in use is given in Appendix B.

Table 4
Annual Estimates of ATV-Related Fatalities and Risk of Death per 10,000 4-Wheel ATVs in Use
1985 – 2006
Based on Fatality Data Available as of December 31, 2007

Year	Reported Deaths[5]	Estimated Deaths Associated with ATVs with 3, 4 or Unknown Wheels	Estimated Deaths Involving 4-Wheel ATVs	Estimated 4-Wheel ATVs in Use (millions)[6]	Estimated Risk of Death per 10,000 4-Wheel ATVs in Use[6]
2006	*750*	*882*	*855*	*8.6*	*1.0*
2005	*804*	*948*	*907*	*7.8*	*1.2*
2004	760	869	830	7.0	1.2
2003	655	767	730	6.3	1.2
2002	548	606	570	5.6	1.0
2001	517	593	549	4.9	1.1
2000	451	552	502	4.2	1.2
1999[7]	398	536	488	3.6	1.4
1998	251	287	245	3.1	0.8
1997	241	291	243	2.7	0.9
1996	248	267	208	2.4	0.9
1995	200	276	212	2.2	1.0
1994	198	244	168	2.0	0.8
1993	183	211	144	1.9	0.7
1992	221	241	158	1.9	0.8
1991	230	255	152	1.8	0.8
1990	234	250	151	1.8	0.9
1989	230	258	153	1.6	0.9
1988	250	286	152	1.4	1.1
1987	264	282	126	1.1	1.1
1986	299	347	95	0.7	1.3
1985	251	295	55	0.4	1.5

Source: U.S. Consumer Product Safety Commission: the Directorate for Economic Analysis; and the Directorate for Epidemiology/Division of Hazard Analysis.
Italics denote the period for which reporting is ongoing.

ATV-RELATED INJURIES

Table 5 shows estimates of ATV-related injuries treated in hospital emergency rooms nationwide between January 1, 1982 and December 31, 2007. These estimates were generated from CPSC's National Electronic Injury Surveillance System (NEISS), a probability sample of U.S. hospitals with 24-hour emergency rooms and more than six beds. In this analysis, the current estimates were compared to the estimates from the previous year (2006), as well as to a base year. The base year

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[5] Reporting is ongoing for 2005 – 2006.

[6] Estimates have been rounded.

[7] Beginning in 1999, deaths were coded under the Tenth Revision of the International Classification of Diseases (ICD-10). See Appendix B for an explanation of the effect of this change.

chosen for comparison was 2001.[8] The existence of a possible trend in injuries associated with ATVs with three, four or an unknown number of wheels is also considered, using trend analysis methods developed by CPSC staff (Schroeder, 2000).

Table 5
Annual Estimates[9] of ATV-Related, Emergency Room-Treated Injuries
ATVs with 3, 4 or Unknown Number of Wheels
January 1, 1982 through December 31, 2007

Year	Estimated Number of Injuries All Ages	Estimated Number of Injuries Ages Younger Than 16 Years	Percent of Total Ages Younger Than 16 Years
2007	150,900	40,000	27%
2006	146,600	39,300	27
2005	136,700	40,400	30
2004	136,100	44,700	33
2003	125,500	38,600	31
2002	113,900	37,100	33
2001	110,100	34,300	31
2000	92,200	32,000	35
1999	82,000	27,700	34
1998	67,800	25,100	37
1997	52,800	20,600	39
1996	53,600	20,200	38
1995	52,200	19,300	37
1994	50,800	21,400	42
1993	49,800	17,900	36
1992	58,200	22,000	38
1991	58,100	22,500	39
1990	59,500	22,400	38
1989	70,300	25,700	37
1988	74,600	28,500	38
1987	93,600	38,600	41
1986	106,000	47,600	45
1985	105,700	42,700	40
1984	77,900	[10]	---
1983	32,100	[10]	---
1982	10,100	[10]	---

Source: U.S. Consumer Product Safety Commission: National Electronic Injury Surveillance System.
Note: For the years 2001 through 2007, the coefficients of variation (CVs) for the all-ages injury estimates range from 9 percent to 11 percent. During this same time period, CVs for injury estimates among the under-16 age group range from 9 percent to 13 percent. See Appendix B for an explanation of the use and calculation of CVs.

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[8] See the methodology section in Appendix B for a discussion of the rationale for choosing 2001 as the base year.
[9] Estimates have been adjusted to reflect NEISS Coding Manual changes and sampling frame updates. Estimates have also been adjusted to account for cases that are out of scope for this report. See Appendix B for additional discussion.
[10] Adjusted estimates for children under 16 years old were not computed prior to 1985.

The 2007 injury estimate for all ages reflects an increase of 3 percent over the 2006 estimate. This increase was not statistically significant (p = 0.4559[11]). However, the increase of 37 percent over the estimated number of injuries for 2001 was statistically significant (p < 0.0001). In addition, trend analysis (Schroeder, 2000) indicates that, for ATVs having three or four or an unknown number of wheels, there was a statistically significant upward trend in emergency room-treated injuries for all ages collectively during the years 2001 through 2007 (p = 0.0015).

The 2007 estimate for children under 16 represents a 2 percent increase over the 2006 estimate. This increase was not statistically significant (p = 0.7495). The 2007 under-16 estimate also represents a 17 percent increase over the 2001 estimate for this same age group. The 17 percent increase was statistically significant (p = 0.0186).
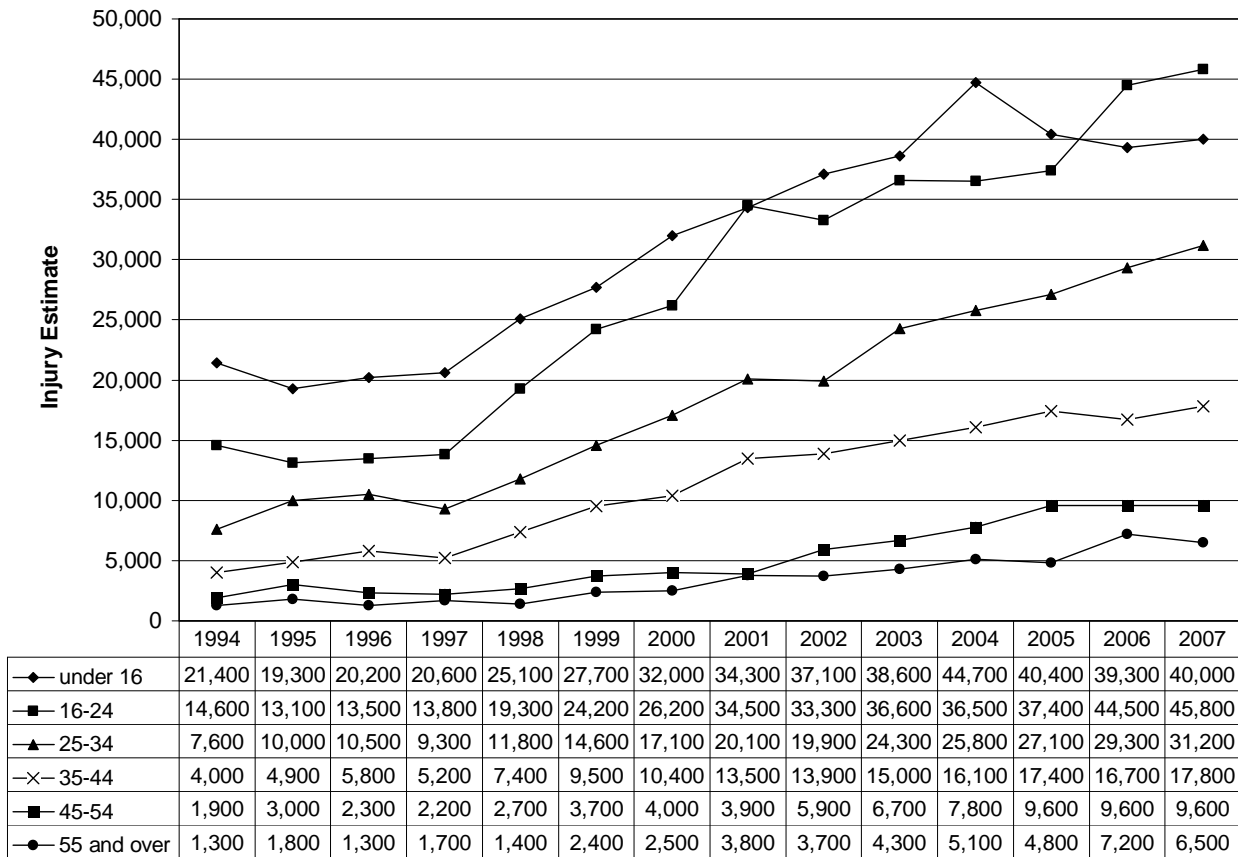
In 2007, 27 percent of the estimated number of ATV-related, emergency room-treated injuries involved children under 16 years of age. For the years 1985 through 2007, children under 16 represented approximately 35 percent of the total estimated number of injuries (i.e., 708,600/2,047,000).

Figure 1 presents annual estimates by age group for ATV-related injuries treated in hospital emergency rooms since 1994.

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[11] This p value represents the probability of observing results as extreme as or more extreme than the results obtained if there is no difference in the two reported estimates. A small p value (e.g., p < 0.05) suggests an observed difference is likely to reflect a difference between the two estimates that is associated with some factor or factors beyond the inherent variability in the estimates themselves.

Figure 1
Annual ATV-Related Hospital Emergency Room-Treated Injury Estimates[12]
ATVs with 3, 4 or Unknown Number of Wheels
1994 – 2007

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
◆ under 16	21,400	19,300	20,200	20,600	25,100	27,700	32,000	34,300	37,100	38,600	44,700	40,400	39,300	40,000
■ 16-24	14,600	13,100	13,500	13,800	19,300	24,200	26,200	34,500	33,300	36,600	36,500	37,400	44,500	45,800
▲ 25-34	7,600	10,000	10,500	9,300	11,800	14,600	17,100	20,100	19,900	24,300	25,800	27,100	29,300	31,200
✕ 35-44	4,000	4,900	5,800	5,200	7,400	9,500	10,400	13,500	13,900	15,000	16,100	17,400	16,700	17,800
■ 45-54	1,900	3,000	2,300	2,200	2,700	3,700	4,000	3,900	5,900	6,700	7,800	9,600	9,600	9,600
● 55 and over	1,300	1,800	1,300	1,700	1,400	2,400	2,500	3,800	3,700	4,300	5,100	4,800	7,200	6,500

Source: U.S. Consumer Product Safety Commission: National Electronic Injury Surveillance System.
Columns may not add to annual totals due to rounding.

Review of the information in Figure 1 suggests the following:

- Between 2006 and 2007, the estimated number of injuries increased in the under-16 age group, the 16 to 24 age group, the 25 to 34 age group, and the 35 to 44 age group. However, none of these increases was statistically significant (p = 0.7495, p = 0.6011, p = 0.3646, and p = 0.4511, respectively).

- In 2007, the estimated number of injuries was unchanged from the preceding year among individuals 45 to 54 years old.

- In 2007, the estimated number of injuries decreased from the preceding year among individuals 55 and older. This change was not statistically significant (p = 0.3838).

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[12] Estimates have been adjusted to reflect NEISS Coding Manual changes and sampling frame updates. Estimates have also been adjusted by factors to account for cases that are out of scope for this report. See Appendix B for further detail.

Table 6 shows estimates of four-wheel ATV-related injuries and risk of injury per 10,000 four-wheel ATVs in use for the years 1985 to 2007. In 2007, four-wheel ATV injuries constituted 97 percent of the total injury estimate for ATVs having three, four or an unknown number of wheels (i.e., 146,500/150,900). The four-wheel ATV injury estimate for 2007 represented a 4 percent increase over the 2006 estimate, an increase that was not statistically significant ($p = 0.3771$). It was, however, a statistically significant increase over the 2001 estimate ($p < 0.0001$). There was also a statistically significant upward trend in emergency room-treated injuries associated with four-wheel ATVs between 2001 and 2007 ($p = 0.0008$).

In Table 6, risk is defined as the estimated number of emergency room-treated injuries per 10,000 four-wheel ATVs in use. From 2001 to 2007, there was a statistically significant downward trend in injury risk per 10,000 four-wheel ATVs in use ($p = 0.0212$).

Table 6
Estimated Number of Emergency Room-Treated Injuries and
Risk of Emergency Room-Treated Injury per 10,000 4-Wheel ATVs in Use
January 1, 1985 through December 31, 2007

Year	Injury Estimate[13, 14]	Estimated 4-Wheel ATVs in Use (millions)[14]	Risk Estimate per 10,000 4-Wheel ATVs in Use[14]
2007	146,500	9.5	153.9
2006	140,900	8.6	163.0
2005	130,000	7.8	167.2
2004	129,500	7.0	185.4
2003	116,600	6.3	186.3
2002	104,800	5.6	188.5
2001	98,200	4.9	200.3
2000	82,300	4.2	197.2
1999	68,900	3.6	193.0
1998	57,100	3.1	184.7
1997	39,700	2.7	146.1
1996	40,700	2.4	168.1
1995	36,200	2.2	165.7
1994	33,300	2.0	165.4
1993	32,000	1.9	164.9
1992	33,000	1.9	175.1
1991	34,400	1.8	188.1
1990	30,800	1.8	175.1
1989	35,700	1.6	217.8
1988	39,400	1.4	276.1
1987	33,900	1.1	305.9
1986	23,400	0.7	319.2
1985	14,700	0.4	391.1

Sources: U.S. Consumer Product Safety Commission: National Electronic Injury Surveillance System; the Directorate for Economic Analysis; and the Directorate for Epidemiology/Division of Hazard Analysis.
Note: For the years 2001 through 2007, the coefficients of variation (CVs) for four-wheel ATV injury estimates (column 2) are all on the order of 9 percent. For these same years, the CVs for the estimates of the number of 4-wheel ATVs in use (column 3) range from 3 percent to 4 percent, and the CVs for the risk estimates (column 4) range from 9 percent to 10 percent (see Levenson, 2005a, 2005b, and 2005c for discussion of the methods used to estimate these CVs).

DISCUSSION

In analyzing deaths and injuries associated with ATVs, it is useful to consider three distinct time periods, the boundaries of which are determined primarily by fatality data availability and by the completeness of the available data. By considering these three periods separately, we can compare years within periods, and thereby control, at least in part, for changes in fatality data availability as

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[13] Estimates have been adjusted to reflect NEISS Coding Manual changes and sampling frame updates. Estimates have also been adjusted by factors to account for cases that are out of scope for this report. Appendix B provides further detail.
[14] Estimates have been rounded.

well as for possible changes in the ATV marketplace. While the boundaries of the periods considered here are defined by factors involving the collection of mortality data, it is also useful to consider the injury estimates within the same time periods.

The periods selected for discussion were defined as follows:
- The first period, from 1982 to 1998, begins with the first year of CPSC staff's reported ATV-related death counts (see Table 1) and ends with the ICD-9/ICD-10 transition for classification of mortality data.

- The second period, from 1999 to 2004, begins with the transition to ICD-10 coding and ends with the most recent complete year of death data collection.

- The third period, from 2005 to 2007, spans the period of ongoing mortality data collection by CPSC staff. During this period, CPSC issued both an Advance Notice of Proposed Rulemaking (2005) and a Notice of Proposed Rulemaking (2006) for ATVs. In addition, during this period, Congress debated various forms of ATV legislation. One likely result of the recent regulatory focus on ATVs may have been an increase in media attention to ATV-related fatalities, and this, in turn, may have allowed the collection of more complete and more timely death reports during the third period.

ATV-related deaths and injuries occurring in each of these three time periods are reviewed below.

1982 – 1998
In the first period (1982 – 1998), reported deaths reached a high of 299 in 1986 (Table 1). These reported deaths were largely associated with three-wheel ATVs, which were still being manufactured and sold. During the mid-1980s, three-wheel ATVs were still heavily in use, and four-wheel ATVs were only beginning to gain in popularity.

As previously noted, CPSC staff's ability to gather death reports during the first period (1982 – 1998) was limited by the ICD-9 reporting codes and by ICD-9 reporting requirements which made it difficult for CPSC staff to obtain death certificates for ATV-related fatality incidents occurring on public roads (see Appendix B). Consequently, the death estimates for this period are likely to be underestimates. However, because data collection methodologies were substantially consistent throughout the first period, general comparisons among the annual death estimates within the first period may still be made, provided that the degree of underestimation is similar from year to year. Other than the ICD-9 coding, CPSC staff is not aware of any factors that would have contributed to an underestimation of ATV-related fatalities in this period. CPSC staff is also not aware of any factors that would have caused differences in ICD-9-related underestimation in different years.

With these cautions in mind, a review of Table 4 suggests that, during the first period, the estimated number of deaths associated with all ATVs (i.e., ATVs having three, four or an unknown number of wheels) likely peaked around 1986. This peak was followed by a decline in estimated ATV-related fatalities until the early- to mid-1990s (Table 4). Then, a general increase in the estimated deaths appears to have occurred from the mid-1990s to the end of the period (Table 4). Note that these generalizations do not depend upon the magnitude of the estimates. The reader is cautioned against making similar generalizations over this same time period regarding the estimated number of four-wheel ATVs in use and the estimated risk of death per 10,000 four-wheel ATVs in use because these

latter measures may be subject to sources of variability other than those associated with the death estimates.

A similar pattern can be observed in the estimated number of emergency room-treated injuries associated with ATVs having three, four or an unknown number of wheels. That is, the estimated number of ATV-related, emergency room-treated injuries appeared to peak during the years 1985 and 1986 (Table 5), when injuries rose above 100,000. This was followed by a decline in injury estimates until the early- to mid-1990s, and then by an increase in injury estimates until the end of the period. The similarities between death and injury data suggest that the pattern seen in the estimated number of deaths is not simply an artifact of the fatality data.

1999 – 2004
As a result of the transition to ICD-10 mortality coding, the second period (1999 – 2004) reflects several years during which CPSC staff had a greater opportunity to collect comprehensive data on ATV-related fatalities than had been possible prior to 1999. This period also predated recent ATV-related regulatory activities. Consequently, any effect of heightened media exposure on data collection would be less of a factor in the second period (as compared to the third period). Estimated deaths associated with ATVs having three, four or an unknown number of wheels increased 62 percent during the second period. The estimated numbers of emergency room-treated injuries associated with ATVs having three, four or an unknown number of wheels increased 66 percent during this same period.

2005 – 2007
The third period (2005 – 2007) contains three years of incomplete death data collection. It is likely that the number of reported deaths for these years will increase as CPSC staff receives additional reports. For this reason, the estimated numbers of deaths and the estimated risk of death per 10,000 four-wheel ATVs in use will likely require revision for these years in future CPSC staff reports.

During the third period, the all-ages, emergency room-treated injury estimates increased each year, both for ATVs having three, four or an unknown number of wheels (Table 5) and for four-wheel ATVs (Table 6). For ATVs having three, four or an unknown number of wheels, the increase from 2005 to 2007 was marginally significant (p = 0.0500). For four-wheel ATVs, the corresponding two-year increase was statistically significant (p = 0.0293). It should be noted that the data collection process supporting the derivation of the injury estimates is complete for this period (2005 – 2007), and, thus, the injury estimates for 2005 through 2007 are not expected to require revision in future CPSC staff reports.

Appendix A

Table 7
Reported ATV-Related Deaths by Year and Age Group
ATVs with 3, 4 or Unknown Number of Wheels
January 1, 1982 through December 31, 2007

Year[15, 16]	Younger Than 12 Years Old	Younger Than 12 Years Old Percent of Total	Younger Than 16 Years Old	Younger Than 16 Years Old Percent of Total
Total	**1,062**	**12%**	**2,497**	**28%**
2007	*51*	*9*	*107*	*20*
2006	*62*	*8*	*139*	*19*
2005	*77*	*10*	*162*	*20*
2004	69	9	183	24
2003	69	11	155	24
2002	45	8	133	24
2001	58	11	132	26
2000	50	11	124	27
1999[17]	34	9	90	23
1998	30	12	82	33
1997	38	16	79	33
1996	40	16	87	35
1995	26	13	64	32
1994	20	10	54	27
1993	18	10	59	32
1992	32	14	71	32
1991	40	17	68	30
1990	27	12	81	35
1982-1989	276	18	627	40

Source: U.S. Consumer Product Safety Commission, Directorate for Epidemiology, Division of Hazard Analysis.
Italics denote the period for which reporting is incomplete.

[15] Reporting is ongoing for 2005 – 2007.

[16] Percentages for years with ongoing reporting should be interpreted with caution because the rate at which deaths are reported may not be consistent across all age groups.

[17] Beginning in 1999, deaths were coded under the Tenth Revision of the International Classification of Diseases (ICD-10). The effect of this change is discussed in Appendix B.

Appendix B

Estimation Methodologies

This appendix describes the methodologies used to estimate ATV-related deaths and injuries, together with other information used in developing the report analyses.

ATV-Related Deaths
In-Scope ATV-Related Fatalities
ATV-related fatalities considered in scope in this report include any unintentional incident involving an ATV, whether or not the ATV is in operation at the time of the incident. Because of the difficulties inherent in distinguishing between occupational and non-occupational use, occupational fatalities are included in both the death counts and the death estimates. For example, it may be difficult to classify a fatality that occurs when a victim is riding alongside a fence on a ranch for the purpose of checking the fence, and then is subsequently involved in an ATV-related fatality incident while deviating from his work routine to take a recreational ride up a nearby hill.

ICD-9 versus ICD-10 Coding
In 1999, CPSC staff began collecting death certificates for all fatalities where an external cause of death listed on the death certificate was reported to involve an ATV, as coded under the Tenth Revision of the International Classification of Diseases (ICD-10). ICD-10 marks the first revision where all ATV-related fatalities are grouped under a single code (V86.X), thus facilitating more complete collection of these incidents by CPSC staff than could be accomplished prior to 1999.

It should be noted that the ICD-10 codes (V86.X) characterizing the external cause of death as "ATV-related" include fatalities resulting from all specialty motor vehicles intended primarily for off-road use (World Health Organization, 2007). Thus, other types of off-road vehicles, including dune buggies and dirt bikes, are captured in this set of codes. Through the conduct of in-depth investigations (IDIs), CPSC staff attempts to verify that the vehicles involved in these incidents are ATVs, as defined by CPSC staff (i.e., an ATV is a motorized vehicle intended for off-road use and having three or four low pressure tires, a straddle seat for the operator, and handlebars for steering control). In cases where the specific type of off-road vehicle cannot be ascertained, CPSC staff counts the death report as an ATV-related fatality. This assumption may result in an overestimation of ATV-related deaths.

Estimation of ATV-Related Fatalities (1999 – present)
CPSC staff estimates the number of deaths associated with ATVs by use of a capture-recapture approach. This approach involves examining the numbers of reports of ATV-related fatalities gathered via two different avenues:
- The first avenue is the collection of death certificates obtained by CPSC staff,[18] where the death is deemed to be ATV-related by the medical examiner. These incidents are entered into CPSC staff's death certificate database (DTHS).

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[18] CPSC staff purchases death certificates from the 50 states, the District of Columbia, and New York City for fatalities involving selected consumer products, including ATVs. Determination of the association between a fatality and a consumer product is based on the external cause of death code(s) reported on the death certificate. Since 1999, the external causes of death reported on U.S. death certificates have been coded in accordance with ICD-10 (National Center for Health Statistics, 2007).

- The second avenue involves the collection of reports of fatal, ATV-related incidents by any other means available to CPSC staff. Sources for these types of reports include: news clips; reports from the Medical Examiners and Coroners Alert Project (MECAP); reports from consumers or their representatives via telephone or Internet; and hospital reports from the National Electronic Injury Surveillance System (NEISS). With regard to NEISS reports, it should be noted that the NEISS database primarily includes product-related injuries rather than fatalities. However, all ATV-related NEISS cases are reviewed to identify incidents where an emergency room-treated, ATV-related injury was reported to result in death, and these deaths are included in the ATV-related fatality reports available to CPSC staff.

In many cases, CPSC staff receives fatality reports that are duplicates either of deaths counted in a previous annual report or of deaths reported for the first time in this annual report. For example, CPSC staff may receive a MECAP report for a fatality that was previously reported to CPSC staff via a news clip. Reports from non-DTHS sources are carefully reviewed to match duplicate reports for both the current reporting year and for previous years. Counts of these duplicate reports are not included in Table 1.

The calculation of the capture-recapture estimate entails the matching of fatality reports from DTHS and non-DTHS sources. Then, for each year of interest, CPSC staff determines the total number of fatalities included in DTHS, the total number of fatalities included in non-DTHS sources, and the total number of deaths included in both sources (i.e., DTHS and non-DTHS). The estimate is then calculated using the following equation (Hook and Regal, 1992; Morrison and Stone, 2000; Hook and Regal, 2004):

$$estimate = \frac{(M+1)(N+1)}{n+1} - 1 \qquad\qquad Equation\ 1$$

where

M is the number of incidents captured by purchase of death certificates from the states (DTHS),
N is the number of incidents collected by other means (non-DTHS),
and
n is the number of incidents captured by both death certificate purchase and at least one
    other source.

Estimates of fatalities that occurred on or after January 1, 1999 and that are associated with ATVs having three, four or an unknown number of wheels are calculated using equation 1.

Estimation of ATV-Related Fatalities (1985 – 1998)
Prior to 1999, CPSC staff received death certificates only for two types of ATV-related fatality incidents: (1) ATV-related fatalities occurring in places other than public roads, and (2) ATV-related fatalities occurring in public road locations that were erroneously reported as non-public-road locations. Because of this, the capture-recapture procedure for estimating pre-1999 ATV-related deaths had two parts:
- For public road fatalities, the estimates were based solely on the number of fatalities reported to CPSC staff. Reports of these fatalities were largely contained in CPSC staff's Injury or

Potential Injury Incident file (IPII). As noted, death certificates were generally not received for these fatalities.

- For incidents occurring in other places, the capture-recapture approach was applied.

Using equation 2 (below), these two parts (i.e., incidents occurring on public roads and incidents occurring in other places) were then combined to derive the pre-1999 annual estimates of ATV-related deaths for ATVs having three, four or an unknown number of wheels.

$$estimate = \frac{(M_{NP}+1)(N_{NP}+1)}{n_{NP}+1} - 1 + C_{P} \qquad\qquad Equation\ 2$$

where
M_{NP} is the number of reports of non-public-road fatalities captured by purchase of death certificates from the states,
N_{NP} is the number of reports of non-public-road fatalities collected by other means,
n_{NP} is the number of reports of non-public-road fatalities captured by both death certificate purchase and at least one other source,
and
C_{P} is the count of reports of ATV-related fatalities occurring on public roads from any source.

CPSC staff believes the ATV-related fatality estimates for the years prior to 1999 were likely to be underestimates because the pre-1999 estimates used only the available counts of public road fatalities and did not account for missing reports in these types of incidents. As noted previously, CPSC staff now receives death certificates for ATV-related incidents occurring on public roads. Consequently, since 1999, the capture-recapture approach has been fully applied to both components (i.e., those incidents occurring on public roads and those incidents occurring in other locations) of the annual estimates of ATV-related deaths. For this reason, CPSC staff expects that the annual death estimates for 1999 and later represent better estimates of ATV-related fatalities than were possible in the years before 1999.

Estimation of Fatalities Associated with Four-Wheel ATVs
A number of incidents reported to CPSC staff involve ATVs for which the number of wheels is unknown. Because some of these likely involve four-wheel ATVs, the unknowns are apportioned in the calculation of the estimated number of deaths associated with four-wheel ATVs. This estimate is calculated by first dividing the reported number of deaths for four-wheel ATVs by the combined reported number of deaths for three- and four-wheel ATVs, and then multiplying this quotient by the estimated number of deaths for all ATVs (three, four or unknown number of wheels). Thus, the estimate of deaths associated with four-wheel ATVs is given by equation 3.

$$Estimate_{4W} = \frac{rep_{4W}}{rep_{3W+4W}} Est_{3W+4W+UW} \qquad\qquad Equation\ 3$$

where
> $Estimate_{4W}$ is the estimated number of fatalities associated with four-wheel ATVs,
> rep_{4W} is the reported number of fatalities associated with four-wheel ATVs,
> rep_{3W+4W} is the reported number of fatalities associated with three- and four-wheel ATVs, and
> $Est_{3W+4W+UW}$ is the estimated number of fatalities associated with ATVs having three, four or an unknown number of wheels. [Note: this is the "estimate" derived in equations 1 and 2].

Risk of Death per 10,000 Four-Wheel ATVs in Use

The risk of death associated with four-wheel ATVs in use is calculated by dividing the annual estimate of fatalities associated with four-wheel ATVs ($Estimate_{4W}$) by the estimated number of four-wheel ATVs in use in a given year. Annual estimates of the numbers of four-wheel ATVs in use are determined from four-wheel ATV sales and operability rates based on CPSC staff studies (Levenson, 2003a; Levenson, 2003b) and on information compiled by CPSC's Directorate for Economic Analysis. Annual four-wheel ATVs-in-use estimates for 1994 and prior years are computed from a survival model derived from 1994 data. Annual four-wheel ATVs-in-use estimates for years 2001 and after are computed from a survival model derived from 2001 data. Estimates of the annual numbers of in-use four-wheel ATVs for the intervening years come from a model that provides a smooth transition between the 1994 and the 2001 survival models. The estimated numbers of four-wheel ATVs in use in Tables 4 and 6 are rounded figures. As a result, risk estimates calculated using these rounded figures may not match the estimates presented in the tables.

Because reliable operability rate data are not available for three-wheel ATVs, this report presents only the risk of death per 10,000 <u>four-wheel</u> ATVs in use.

Estimation of ATV-Related Injuries

All injury estimates in this report have been derived from data collected through CPSC's National Electronic Injury Surveillance System, a probability sample of U.S. hospitals with 24-hour emergency rooms and more than six beds (Schroeder and Ault, 2001a and 2001b). Thus, ATV-related injury estimates in this report represent hospital emergency room-treated injuries only. ATV-related injuries that were not treated in hospital emergency rooms are not included in these estimates.

Injury estimates have been adjusted to reflect revisions in the NEISS Coding Manual in 1985, as well as to account for NEISS sampling frame updates (Marker, et al, 1988; Marker and Lo, 1996). Estimates for 1982 through 1985 were also adjusted based on a review of NEISS comments to exclude dune buggies and to include ATVs that had been misclassified as mini or trail bikes.

Injury estimates for 1985, 1989, 1997 and 2001 are based on injury surveys using NEISS cases. Injury estimates for other years have been adjusted by factors to account for out-of-scope (non-ATV) cases based on injury studies in those years (Levenson, 2003c; Rodgers and Zamula, 1986; Rodgers, 1990; U.S. CPSC, 1998). An in-scope injury case is defined to be any non-occupational, unintentional case involving an ATV, whether or not the victim was operating the ATV at the time of the incident. Note that NEISS does not collect occupational injuries, and, thus, the definition of in-scope, ATV-related injuries differs slightly from the definition of in-scope, ATV-related fatalities. The applied adjustment factors were as follows: 0.93 for 1986 through 1988; 0.95 for 1990 through 1996; 0.903 for 1998 through 2000 (amended from 0.935); and 0.922 for 2002 and after.

Coefficients of Variation

A coefficient of variation (or CV) is an expression of the standard deviation relative to the estimate itself. In this report, CVs for injury estimates are given as percents. The adjustment factors discussed above are also estimated and have associated variability. This variability (along with the variability of the injury estimates) affects significance tests and tests for trends. Calculation of NEISS estimates and their variances is discussed in Schroeder and Ault (2001a) and Schroeder and Ault (2001b). Adjustment factors and other concepts specific to variability associated with ATV estimates are more fully discussed in Levenson (2003c, 2005b, 2005c).

Estimation of Hospital Emergency Room-Treated Injuries Associated with Four-Wheel ATVs

NEISS includes injuries that are associated with ATVs for which the number of wheels is unknown. Because of this, the estimated injuries associated with ATVs having an unknown number of wheels are apportioned in the calculation of the estimated injuries associated with four-wheel ATVs, using equation 4.

$$Total\ Estimate_{4W} = \frac{Estimate_{4W}}{Estimate_{3W+4W}}\left(Estimate_{3W+4W+UW}\right) \qquad Equation\ 4$$

where

$Total\ Estimate_{4W}$ is the total estimated injuries associated with four-wheel ATVs with
    unknowns apportioned,

$Estimate_{4W}$ is the estimated injuries associated with four-wheel ATVs (excluding unknowns),

$Estimate_{3W+4W}$ is the combined estimated injuries associated with three- and four-wheel ATVs
    (excluding unknowns),

and

$Estimate_{3W+4W+UW}$ is the combined estimated injuries associated with ATVs having three, four or
    an unknown number of wheels.

Risk of Injury per 10,000 Four-Wheel ATVs in Use

The risk of injury per 10,000 four-wheel ATVs in use is calculated as the total estimated number of hospital emergency room-treated injuries associated with four-wheel ATVs (*Total Estimate$_{4w}$*) divided by the number of four-wheel ATVs in use and then multiplied by 10,000. Annual ATV population estimates were the same as those used in the calculation of risk of death and are discussed elsewhere in this appendix. Trend analysis of the risk of injury follows the methodology discussed in section 4 of Levenson 2005b.

Changes in Injury Estimates and Risk of Injury per 10,000 Four-Wheel ATVs in Use

Consistent with the 2005 ATV Annual Report (U.S. CPSC, 2007) and the 2006 ATV Annual Report (U.S. CPSC, 2008), relative changes in the annual injury estimates shown in Table 5 and Table 6 are assessed using 2001 as the base year (see pages 10 – 14). Certain features of the current market, including the increase in new-entrant import model ATVs, may make comparisons across recent time spans (e.g., 2001 – 2007) more meaningful than comparisons using older data.

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