NOTES

EVIDENCE THAT SEAT BELTS ARE AS EFFECTIVE AS CHILD SAFETY SEATS IN PREVENTING DEATH FOR CHILDREN AGED TWO AND UP

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Abstract—Over the past thirty years, the use of child safety seats in motor vehicles has increased dramatically. There is, however, relatively little empirical evidence regarding the efficacy of child safety seats relative to the much cheaper alternative of traditional seat belts. Using data on all fatal crashes in the United States from 1975 to 2003, I find that child safety seats, in actual practice, do not provide any discernible improvement over adult lap and shoulder belts in reducing fatalities among children aged two to six. Lap-only belts are somewhat less effective, but still far superior to riding unrestrained.

I. Introduction

CHILD safety seats have been heralded as one of the most successful safety innovations of recent decades (Kahane, 1986), with benefit-cost ratio estimates as high as 32 to 1 (Children's Safety Network, 1996). All fifty states currently require that children ride in approved safety seats, and the ages and weights up to which a child must use a safety seat have increased greatly over time (Insurance Institute for Highway Safety, 2004). It is against the law to restrain young children with adult seat belts.

In light of the widespread support for child safety seats, there is surprisingly little systematic empirical research evaluating their effectiveness relative to adult seat belts. A series of studies by the National Highway Traffic Safety Administration (NHTSA) researchers (Kahane, 1986; Partyka, 1988; Hertz, 1996) find that child safety seats greatly reduce fatalities and injuries relative to riding unrestrained, but do not make direct comparisons between child safety seats and seat belts. The presumption that child safety seats are superior to adult seat belts for children is so pervasive among researchers that no one has felt the need to test the hypothesis directly.[1]

In light of this widely held conventional wisdom, it is striking and surprising that I find no discernible benefit of child safety seats over lap and shoulder belts for children aged two and up using data from the Fatality Analysis Reporting System (FARS) database, which includes the universe of fatal motor vehicle crashes in the United States over the period 1975–2003.[2] This result holds true in the raw data, in regressions that control for an extensive set of covariates, and when employing the sample selection correction of Levitt and Porter (2001) to deal with likely biases in the way the data set is constructed.

II. Background on Child Safety Seats

The concept of the child safety seat was first introduced in the mid-1960s by car manufacturers.[3] In 1971, NHTSA issued the first federal safety standard addressing child safety seats. Entitled FMVSS 213, it required that safety seats be anchored by the vehicle's seat belts, but it did not initially have any requirements regarding performance in crash tests. In 1981, FMVSS 213 was revised to require that the safety seat meet certain requirements in 30 mph crash tests. In 1999, further stipulations related to the distance the head travels in crash tests and requiring safety seats to have upper and lower tethers were added. FMVSS 225, also published in 1999, requires motor vehicles to have anchors for attaching the tethers.

Tennessee was the first state to mandate safety seats for young children in 1978. By 1985, every state in the country had enacted such laws. Over time, the statutory age at which children have been allowed to "graduate" from child safety seats to seat belts has increased. As of 2003, 44 states required children to be in safety seats at least until their fourth birthday. Since that time, more than a dozen states have increased the age or weight requirement, extending the population mandated to ride in safety seats.

The fraction of children in car seats has paralleled the rise of laws requiring their use. Kahane (1986) reports that only 16% of children under the age of four were restrained in child safety seats in 1974, but Glassbrenner (2003) finds that by 2002, more than 82% of children aged one to three were in car seats.[4]

III. Data and Estimation Approach

The data used in this analysis are drawn from the FARS for the period 1975–2003.[5] FARS contains detailed information on all vehicles and passengers for the universe of motor vehicle crashes in which at least one person dies. Included in the FARS data is information on the type of restraint used by each vehicle occupant, which distin-

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[1] The NHTSA papers cited above do report results for both child safety seats and adult seat belts, but do not test the hypothesis of equality of the estimates for these two safety restraints. Furthermore, no standard errors are included in these studies. I have attempted to replicate these studies, obtaining generally similar patterns, but not exactly matching the reported results. Based on the bootstrapped standard errors that I obtain, I cannot reject the null hypothesis of equal coefficients on seat belts and child safety seats using their methodology because of substantial standard errors.

[2] I have also looked at the one-year-olds. Because few one-year-olds wear adult seat belts, the estimates are quite imprecise. It should be noted, however, that the point estimate on child safety seats is greater than the point estimate on either form of seat belts for one-year-olds, which is consistent with child safety seats providing better protection for children under the age of two.

[3] The background information on car seats draws heavily on Kahane (1986, 2004) and Insurance Institute for Highway Safety (2004). The interested reader is directed to these sources for greater detail on the subject.

[4] Glassbrenner (2003) does not distinguish between backless booster seats and seat belts, and thus this estimate understates the true use of car seats and booster seats

[5] FARS is the standard data source for analysis of motor vehicle fatalities. See, for instance, Evans (1986), Saffer and Grossman (1987), Ruhm (1996), Braver et al. (1997), Lave and Elias (1997), Cohen and Dehejia (2004), and Grabowski and Morrisey (2004).

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TABLE 1.—PROBABILITY OF A FATAL INJURY BY RESTRAINT STATUS AND CRASH CHARACTERISTICS

	No Restraint	Child Seat	Lap and Shoulder Belt	Lap-Only Belt
All crashes	29.34 [N=21,136]	18.16 [N=6,835]	19.39 [N=5,045]	16.71 [N=4,619]
In front seat	36.15 [N=7,812]	22.90 [N=1,087]	25.20 [N=2,325]	21.00 [N=862]
In back seat	25.34 [N=13,324]	17.26 [N=5,748]	14.41 [N=2,720]	15.73 [N=3,757]
Year of crash:				
Pre-1994	28.37 [N=15,145]	20.10 [N=1,980]	22.72 [N=1,184]	16.76 [N=2,190]
1994–1998	30.39 [N=3,383)	18.51 [N=1,918]	19.72 [N=1,739]	18.08 [N=1,333]
1999–2003	33.63 [N=2,608]	16.62 [N=2,937]	17.25 [N=2,122]	14.96 [N=1,096]
Ages 2–3	31.40 [N=8,830]	18.40 [N=5,450]	21.18 [N=1,138]	17.32 [N=1,420]
Ages 4–6	27.86 [N=12,306]	17.18 [N=1,385]	18.86 [N=3,907]	16.44 [N=3,199]

Entries in the table show percentages of children who were fatally injured by type of restraint system used and different crash characteristics. The sample includes children between the ages of two and six who were involved in a car where at least one person was fatally injured. The total number of observations is 37,365. The data are from the FARS data set for the years 1975–2003. The number of observations in the sample for each cell are reported in brackets beneath the percentage.

guishes between lap-only seat belts, lap and shoulder seat belts, and child safety seats.[6]

I restrict the data set in a number of dimensions. Crashes in which the only fatalities are to pedestrians, motorcyclists, or occupants of nonstandard vehicles (for example, four-wheeled all-terrain vehicles) are dropped from the sample. For the remaining crashes, the sample is limited to occupants of automobiles, minivans, and sports utility vehicles (SUVs) with model years later than 1969. I drop individual records in which injury severity, age, gender, the hour of the crash, the principle point of impact, the day of the week, or the restraint used (that is, child safety seat, lap belt, lap and shoulder belt, no restraint) is missing. I also drop cases in which the person was not seated in one of the first three rows of the vehicle.

The sample covers children aged two to six. Children under the age of two are almost exclusively in child safety seats or unrestrained, and children over the age of six are rarely observed in child safety seats in the data. Thus, only for the age range two to six are direct comparisons of child safety seats and seat belts available. After these exclusions, and limiting the ages in this manner, 37,635 observations remain.

Table 1 reports observed fatality rates by restraint type for the sample as a whole.[7] In the overall sample, nearly 30% of the children who are unrestrained die in these crashes. In comparison, 18.2% of children in child safety seats die. The death rate among children using lap and shoulder belts is slightly higher in the raw data, at 19.4%. Those using lap belts only, on the other hand, experience slightly lower death rates of 16.7%. Dividing the sample into front-seat and back-seat passengers, death rates are higher for those in the front seat, regardless of which restraint is used. Nearly half of all children using lap and shoulder belts are riding in the front seat, compared with less than 20% of children using the other restraints. This difference in composition makes lap and shoulder belts appear less effective in the overall sample than is likely the case. When one limits the sample to back-seat passengers only, raw fatality rates are lowest for passengers using lap and shoulder belts (14.41%), next lowest for lap-only belts (15.73%), and higher for child safety seats (17.26%). Dividing the sample by the year of the crash shows that fatality rates among unrestrained children have risen over time, whereas death rates are generally falling over time with all the types of restraints. In all three time periods, the raw death rates are lowest for those with lap-only belts. Younger children are more likely to be in car seats than either type of seat belt. For both age groups, lap-only belts yield the lowest fatality rates in the raw data.

There are two primary reasons why the raw crash data might provide misleading estimates of the causal impact of child safety seat and seat belt usage.[8] First, crash severity, vehicle type, and other circumstances systematically vary across children using different types of restraints and unrestrained children, as is apparent in the preceding paragraph. Second, the FARS database includes only crashes in which a fatality occurs. If the use of a child restraint affects the probability a child dies, and there are no other fatalities resulting from the crash, then there is sample selection with respect to which crashes are included in the data (Levitt & Porter, 2001).

To deal with omitted variable bias, I run linear probability models of the following form:[9]

$$Fatal_i = \sum_{r=1}^{R} \beta_r \times r_i + X_i\Gamma + \varepsilon_i, \qquad (1)$$

where i and r index individuals and restraint types, respectively. Restraint types r_i are mutually exclusive indicator variables corresponding to no restraint, child safety seat, lap belt only, and lap and shoulder belt.[10] *Fatal* is an indicator equal to 1 if the child dies in the crash. A wide variety of characteristics corresponding to the individual, the vehicle he or she is traveling in, and the particulars of the crash are included in the vector of covariates X.

To deal with the fact that restraint use potentially affects whether a crash is included in the data set, I adopt the approach of Levitt and

[6] There are currently a wide variety of types of child safety seats in use (such as rear facing, forward facing, and backless booster seats). In addition there are dozens of car seat manufacturers. Unfortunately, the FARS data that we use do not allow us to distinguish the style or brand of car seat in use in a particular vehicle, although the age of the occupant provides a strong signal as to whether the seat is forward or backward facing.

[7] Details of the rules and coding used to construct the precise sample used in table 1 and throughout the paper are available in an online data appendix: http://pricetheory.uchicago.edu/levitt/home.html.

[8] An additional concern about the raw data is that there have been substantial technological improvements in both child safety seats and seat belts over the last three decades. A comparison of average effectiveness over the entire sample may differ substantially from the benefits afforded by the currently available technology. The results I obtain, however, are robust to limiting the sample to recent crashes or recent vehicle model years.

[9] None of the results of the paper are sensitive to using logit or probit models and evaluating the marginal effects at the sample means.

[10] There are a small number of observations recorded as shoulder belt only. These are included in the lap belt only category. Following earlier work (Hertz, 1996), I code passengers as using a restraint even if they are recorded as using that restraint improperly (for example, a child is in a car seat but not properly buckled, or a single seat belt is used for multiple passengers). The findings are not sensitive to this choice.

TABLE 2—SAMPLE STATISTICS

	Full Sample		Mean			
	Mean	s.d.	No Restraint	Child Seat	Lap and Shoulder Belt	Lap-Only Belt
Child died	0.244	0.430	0.293	0.182	0.194	0.167
Restraint:						
None	0.562	0.496	1	0	0	0
Child seat	0.182	0.386	0	1	0	0
Lap and shoulder belt	0.134	0.341	0	0	1	0
Lap-only belt	0.123	0.328	0	0	0	1
Point of impact:						
Direct front	0.415	0.493	0.374	0.468	0.453	0.479
Partial front	0.169	0.375	0.178	0.150	0.165	0.162
Direct rear	0.041	0.199	0.037	0.051	0.047	0.039
Partial reat	0.053	0.225	0.051	0.059	0.064	0.047
Right side	0.103	0.305	0.111	0.090	0.094	0.100
Left side	0.083	0.276	0.083	0.085	0.078	0.087
Non-collision	0.086	0.280	0.108	0.057	0.059	0.056
Child seated in:						
Front	0.321	0.467	0.370	0.159	0.461	0.187
Back left (driver's side)	0.239	0.426	0.200	0.325	0.259	0.268
Back middle	0.176	0.381	0.199	0.171	0.009	0.258
Back right	0.238	0.426	0.193	0.335	0.266	0.268
Back other	0.027	0.161	0.039	0.010	0.005	0.018
Male	0.509	0.500	0.506	0.512	0.513	0.519
Driver belted	0.495	0.500	0.258	0.746	0.800	0.871
Car	0.774	0.418	0.852	0.660	0.737	0.637
One-car crash	0.260	0.438	0.316	0.192	0.184	0.185
Two-car crash	0.572	0.495	0.549	0.593	0.609	0.602
Model year $\leq$ 1990	0.705	0.456	0.846	0.476	0.704	0.422
Model year $>$ 1990	0.295	0.456	0.154	0.524	0.296	0.578
Speed limit less than 55	0.834	0.372	0.854	0.797	0.834	0.804
Rural road	0.538	0.499	0.469	0.636	0.621	0.614
Daytime	0.782	0.413	0.747	0.830	0.813	0.837
Evening	0.152	0.359	0.169	0.125	0.145	0.123
Early morning	0.066	0.248	0.084	0.045	0.042	0.039
Weekend	0.378	0.485	0.388	0.354	0.384	0.363
Vehicle weight (1,000s lbs.)	3.020	0.779	3.025	3.048	2.950	3.026
Difference in vehicles' weights in crash	0.578	1.004	0.521	0.639	0.608	0.719
Number in crash	5.462	2.069	5.520	5.203	5.877	5.193

Summary statistics are for children between the ages of two and six (inclusive) involved in crashes with at least one fatality as reported in the FARS data for the years 1975–2003. Observations with missing values for injury severity, restraint use, seat position, age, sex, or model year were dropped. Additional observations where the restraint was a helmet, the model year of the automobile was before 1970, or the type of automobile was classified as a large truck, nonmotorist, motocyclist, or other nonstandard vehicle were dropped.

Porter (2001). Namely, I restrict the sample to individuals involved in two-car crashes in which someone dies in the *other* vehicle. Under the assumption that, conditional on other factors, safety device usage in *one* vehicle is independent of the fatality outcome of individuals in the *other* vehicle involved in a crash, limiting the sample in this way eliminates the sample selection problem.[11] Restricting the sample in this way eliminates any link between one's own safety device usage and inclusion in the sample. One important caveat of this approach is that the subset of crashes in which someone in the other vehicle dies are on average less severe than the typical crash in the data set. It is uncertain whether estimates from the sample selection–corrected data generalize to the full distribution of crashes.

Summary statistics for the other variables included in the analysis are presented in table 2. Means and standard deviations for the full sample are shown in the first two columns. The remaining four columns divide the sample by restraint type. More than half of the children in the sample are unrestrained. The remainder of children are distributed relatively equally across child safety seats and the two types of seat belts. Over time, these proportions have shifted away from being unrestrained and toward child safety seats. Children who are unrestrained are over-represented in vehicles with drivers who are unbelted and have previous moving violations, in one-car crashes, and in early morning crashes (between midnight and 6 a.m.). There are few systematic differences in characteristics across the three types of restraints, except that front-seat passengers and earlier-model vehicles are more likely to use lap and shoulder belts to restrain children.

IV. Empirical Results

Table 3 presents regression estimates of equation (1). The first three columns correspond to the full sample; columns 4 through 6 are limited to the subset of the sample in which someone dies in the other vehicle, to address sample selection. The unit of observation is a child-crash. The dependent variable is an indicator equal to 1 if the child dies and 0 otherwise. The estimates reported are from linear probability models. Standard errors, clustered to reflect the fact that there are sometimes multiple occupants of a single vehicle, are in

[11] Note that in order for the estimate to reflect a true causal estimate of restraint use, one also requires the standard identifying assumption that, conditional on the set of observed individual and crash characteristics, restraint use is as good as randomly assigned. The presence of a Peltzman (1975) effect, in which the safety afforded by restraint usage leads to more aggressive driving, could lead to bias in specifications that do not control for restraint use by passengers in the other vehicle. When I condition on restraint use, the Peltzman effect is no longer a concern. Empirically, the results are not affected by the inclusion of this control.

TABLE 3.—IMPACT OF CHILD RESTRAINTS ON PROBABILITY OF FATALITY

	Dependent Variable = 1 if Fatal Injury, 0 Otherwise					
	Without Sample Selection Correction			With Sample Selection Correction		
	(1)	(2)	(3)	(4)	(5)	(6)
Child seat	−0.112 [0.006]**	−0.098 [0.007]**	−0.132 [0.007]**	−0.055 [0.006]**	−0.05 [0.007]**	−0.054 [0.007]**
Lap and shoulder belt	−0.1 [0.007]**	−0.111 [0.008]**	−0.132 [0.008]**	−0.057 [0.006]**	−0.05 [0.007]**	−0.052 [0.007]**
Lap-only belt	−0.126 [0.007]**	−0.098 [0.007]**	−0.108 [0.007]**	−0.067 [0.006]**	−0.044 [0.007]**	−0.046 [0.007]**
Child seated in:						
Front		0.148 [0.007]**	0.091 [0.007]**		0.035 [0.007]**	0.027 [0.007]**
Back left		0.054 [0.007]**	0.047 [0.007]**		0.018 [0.007]**	0.019 [0.007]**
Back middle		0 [0.000]	0 [0.000]		0 [0.000]	0 [0.000]
Back right		0.049 [0.007]**	0.039 [0.007]**		0.011 [0.007]	0.011 [0.007]
Back other		0.017 [0.014]	0.027 [0.014]		0.024 [0.017]	0.021 [0.017]
Male		0.001 [0.004]	−0.001 [0.004]		0.001 [0.004]	0.001 [0.004]
Driver belted		0.011 [0.006]*	0.021 [0.006]**		−0.011 [0.006]	−0.008 [0.006]
Car		0.048 [0.007]**	0.039 [0.007]**		0.014 [0.007]*	0.013 [0.007]
One-car crash		0.128 [0.008]**	0.002 [0.009]		0.019 [0.017]	−0.034 [0.018]
Two-car crash		0.083 [0.007]**	0.038 [0.007]**		0.018 [0.006]**	0.013 [0.006]*
Vehicle weight (1,000s lbs.)		−0.039 [0.003]**	−0.031 [0.003]**		−0.022 [0.004]**	−0.022 [0.004]**
Controls		year, model year, age of passenger, impact, other controls	year, model year, age of passenger, impact, number in crash, other controls		year, model year, age of passenger, impact, other controls	year, model year, age of passenger, impact, number in crash, other controls
Constant	0.293 [0.003]**			0.097 [0.003]**		
Observations	37,635	37,635	37,635	12,548	12,548	12,548
R-squared	0.02	0.08	0.11	0.01	0.11	0.12

Presented statistics are from regressions where the level of observation is a child in a crash; the independent variable indicates whether the child died. The data are from the Fatality Analysis Reporting System (FARS) for the years 1975–2003. Only crashes involving at least one fatality are recorded in FARS. Values in the table show the change in probability of dying in the car crash associated with each variable for two- to six-year-olds involved in crashes where at least one person was killed. Columns 1–3 do not include the sample selection correction while columns 4–6 do. "Other controls" for are the difference in the weight of the cars in a two-car crash, if the weight of the vehicle was missing, if the driver had had a major violation in the past, if the speed limit on the road was less than or equal to 55 mph, if it was a rural road, if it was a weekend, and three dummies dividing the day into daytime (6 a.m. to 7 p.m.), evening (8 p.m. to midnight), and early morning (1 a.m. to 5 a.m.). The restraint type variables—child seat, lap and shoulder belt, and lap or shoulder belt—are relative to no restraint use. The seating position variables, such as front or back left, are relative to the middle seat in the back. Age dummies are relative to six-year-olds. An example of a crash that is "noncollision" would be a rollover. All reported regressions are linear probability models as described in the text. Standard errors, clustered to reflect the fact that there are sometimes multiple occupants of a single vehicle, are in parentheses. * denotes statistical significance at the .05 level; ** denotes statistical significance at the .01 level.

parentheses. In all specifications, the estimates of restraint effectiveness are relative to a child who is unrestrained, that is, the omitted category for restraint type is "no restraint used." The baseline death rate for unrestrained children is 0.293.

In column 1 of table 3, the only right-side variables included are the type of restraint used. Each of the three restraint types (child safety seats, lap and shoulder belts, and lap belts only) provides similar fatality reductions, reducing the death rate between 0.10 and 0.126, or a little more than one-third of the rate for a child with no restraint.[12] In each case, the life-saving benefits of the restraints are highly statistically significant relative to the baseline of no restraint use. The null hypothesis of equality across the coefficients of the three restraint types, however, cannot be rejected.

Column 2 adds a wide range of controls to the basic specification: seating position and age dummies, indicator variables for the year of the crash, the model year of the vehicle the passenger is traveling in, the point of impact for the crash, the gender of the child, information about the driver and the vehicle, and the circumstances of the crash (only some of which are included in the table; full results are available from the author on request). Adding these controls yields a point estimate on lap and shoulder belts that is larger than for child safety seats or lap-only belts, but the coefficients are not statistically different from one another. The coefficients on the controls imply that the back seat is safer than the front seat, with the middle of the back seat better than the sides. In side-impact crashes, the child seated near the point of impact fares especially badly; by being in the middle a passenger avoids the direct impacts on either side and is likely to make contact with the front seat. Children fare worse in cars and better in heavier vehicles.

Column 3 includes indicator variables for the number of people involved in the crash. Although it is unlikely that the number of people in the crash has any actual causal link to the probability of death, because of sample selection in how the data set is created, the number of people in the crash serves as an indirect measure of crash severity. Controlling for other factors, the more people in the crash, the more likely that the crash is included in the sample, even if this particular child survives. Thus, on average, death rates in observed crashes are strongly negatively related to the number of individuals involved in the crash.[13] To the extent that restraint use is systematically correlated with the number of people in crashes (for example, if families with more children in the car are less likely to use car seats), failure to control for number of vehicle occupants would lead to biased estimates of the impact of restraint use. In this specification, child safety seats and lap and shoulder belts carry identical coefficients; lap-only

[12] The percentage reduction in fatalities reported here is smaller than that estimated in prior research using the paired comparison approach of Partyka (1988) and Hertz (1996). The lower safety restraint effectiveness, when expressed in percentage terms, is due to sample selection. When I control for sample selection in columns 4 to 6, the effectiveness of the restraints, measured by the percentage reduction in deaths relative to unrestrained passengers, rises to levels comparable to the prior research.

[13] Although not shown in tabular form, the coefficients from column 5 of table 3 imply, for instance, that all else equal the child is 20 percentage points more likely to die in a crash with three people involved than in a crash with ten people involved.

belts have a smaller point estimate. I am able to reject the null that the lap-only coefficient is equal to the values on the other restraints at the 5% level.[14]

Columns 4 to 6 of table 3 mirror the first three columns, but with the sample selection correction. All of the coefficients on the restraints are lower with the sample selection correction. This is because these crashes are, on average, less severe than the overall sample of crashes. In terms of the percentage of lives saved through the use of safety devices relative to a baseline of no restraint, however, the estimates correcting for selection are larger. The death rate among unrestrained children in this set of crashes is roughly 10%. Thus, restraint use cuts fatalities between 44% and 67%, depending on the restraint and the specification. As was the case earlier, there is no evidence that child safety seats systematically outperform lap and shoulder belts with respect to preventing fatalities, and only mixed evidence that these two types of devices outperform lap-only seat belts. In none of the six specifications shown can the null hypothesis of equal coefficients be rejected.[15]

Sensitivity Analysis

To test the robustness of the results, I have reestimated the specifications in columns 3 and 6 of table 3 on a wide range of data subsets, such as by seat position, principal point of impact, crash year, model year, speed limit, number of vehicles in the crash, time of the day, time of the week, type of vehicle, and child's age. Because of space constraints, these results are not reported in tabular form, but are available from the author on request. The point estimate on child safety seats and lap and shoulder belts are always very similar. The lap and shoulder belt coefficient is larger in magnitude than the child safety seat coefficient in slightly more than half the cases. Lap-only belts perform statistically significantly worse at the 5% level in about one-sixth of the specifications.

V. Discussion and Conclusion

The empirical evidence presented in this paper suggests that for children aged two and up, child safety seats provide no discernible advantage over traditional lap and shoulder belts in reducing fatalities, and only a marginal improvement relative to lap-only seat belts. These conclusions are robust to the inclusion of a wide array of covariates, analyzing a variety of subsamples of the data, including vehicle fixed effects, and correcting for sample selection in the way the FARS data set is constructed.

The estimates in this paper are just one input into a full accounting of the cost-benefit of child safety seats and the laws that mandate them. Another key consideration is the relative effectiveness of child safety seats versus seat belts in reducing injury. Because FARS includes only fatal crashes, it is not the ideal data set for evaluating nonfatal injuries.[16] Doyle and Levitt (2006), analyzing three different data sets (a nationally representative sample of crashes reported to police, as well as all crashes reported to the police in the states of New Jersey and Wisconsin) find no systematic difference in the two most serious injury categories (incapacitating and nonincapacitating injuries) for child safety seats and lap and shoulder belts. Child safety seats reduce the least serious injury category (possible injuries) by approximately 20% in their sample. These injury reductions are not sufficient by themselves to make child safety seats cost effective. It should be noted, however, that the findings of Doyle and Levitt (2006) stand in stark contrast to the results of Winston et al. (2000) and Durbin, Elliot, and Winston (2003), both of which draw subjects from insurance claims and conduct telephone interviews to assess restraint use and injury severity, finding that child safety seats reduce injuries by roughly 60% relative to seat belts.

An obvious question to ask, although one that is beyond the scope of the FARS data, is the extent to which the failure of child safety seats to outperform seat belts is a consequence of child safety seats frequently being improperly installed. Indeed, NHTSA (1996) estimates that more than 80% of all child safety seats are incorrectly installed.[17] Based on crash tests, Kahane (1986) argues that properly installed car seats reduce fatalities[18] by 71%, compared with 44% for improperly installed safety seats. Thus, there may be potential gains to achieving better installation. On the other hand, it is worth noting that when I conducted my own crash tests at an independent lab using lap and shoulder belts on dummies corresponding to children aged three and six, the seat belts performed well within the guidelines the federal government has established for child safety seats, and just about as well as the (properly installed) child safety seats that I tested. While far from definitive, the crash tests I conducted suggest that even with proper installation, there may not be clear advantages of car seats over seat belts.

The indirect consequences of child safety seats and mandatory use laws are also important to consider. To the extent that it is easier to enforce car seat laws than seat belt usage (for example, because visual identification is easier), the existence of these laws may raise overall restraint usage. Similarly, if parents perceive greater benefits from child safety seats than adult seat belts (even if this perception is inaccurate), the presence of car seats may increase overall restraint use. On the other hand, because the government mandates the use of child safety seats, there is little financial incentive on the part of automobile manufacturers to invest in developing seat belts that better

[14] It is also possible to include vehicle fixed effects, so that the coefficients are identified solely off of variation from multiple children riding in the same vehicle and involved in the same crash. Because there is relatively little within-vehicle variation in restraint use, however, the estimates become imprecise. The point estimate on child safety seats, lap and shoulder belts, and lap-only belts with vehicle fixed effects are respectively −0.215 (s.e. = −0.025), −0.192 (s.e. = 0.026), and −0.193 (s.e. = 0.025). One cannot reject the null hypothesis of equality across these three coefficients.

[15] Although the focus of this paper is on child outcomes, a comparison with adults yields two insights. First, the fatality reduction associated with restraint use by adults is roughly double the magnitude for children. Second, the reduction in fatalities from moving an adult from the front seat to the back seat is almost four times higher than that of moving a child to the back seat. From the perspective of minimizing total lives lost, it is optimal to have both adult and child passengers ride in the back seat. But conditional on having one passenger ride in the front seat, from a safety perspective alone, it is better to put the child in front and the adult in back. Although beyond the scope of this paper, it is interesting to note that there has been an extremely effective public health campaign to move children from the front seat to the back seat, but no parallel effort whatsoever with respect to adult passengers.

[16] In an earlier version of this paper, I reported injury estimates using FARS data. After correcting for sample selection, the point estimates suggested a slight shifting by child safety seats away from the more severe nonfatal injuries to less serious injuries, relative to lap and shoulder belts, although these differences are not statistically significant. Lap-only seat belts significantly underperformed the other safety restraints with respect to injuries.

[17] The complexity of correctly installing car seats is underscored by the fact that law enforcement officers undergo a four-day training program to become a certified Child Passenger Safety Technician.

[18] For a longer description of these crash tests, see Dubner and Levitt (2005).

serve the needs of child passengers, thus possibly reducing welfare in the long run.

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TRADE, FACTOR PROPORTIONS, AND POLITICAL RIGHTS

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Abstract—This paper uses aggregate data to test the implication that capital-poor individuals favor trade liberalization in poor (capital-scarce) countries and are against it in rich (labor-scarce) countries. Income per capita is used as a proxy for the country capital-labor ratio while political rights is used as a proxy for the capital-labor ratio of the median voter. We analyze the determinants of average tariff rates in a cross section of countries to find that they are negatively associated with both income per capita and political rights, while they are positively, significantly, and robustly associated with their interaction, corroborating our initial hypothesis.

I. Introduction

In the past few decades, the world has experienced a dramatic increase in the volume of international trade, similar to the experience of trade integration in the late nineteenth century. However, unlike the nineteenth century, today the exchange of goods across borders takes place between established democracies or countries that progressively award more political rights to their citizens. The Freedom House Index of Political Rights increased on average from 0.42 to 0.59 between 1972 and 1999, higher figures denoting more political rights.[1] The rise in trade is accompanied in rich countries by fears that inexpensive imports from low-wage developing countries will drive out jobs or drive down wages. In the United States there has been an absolute decline in the wage rate of the unskilled since the mid 1970s, partly attributable to increased international integration,[2] while Europe has experienced an increase in the unemployment rate.[3] There is

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[1] The Freedom House Index, structured for convenience on a scale from 0 to 10, is available from Freedom House (2005).
[2] The tendency for real wages to rise in the United States conspicuously halted in the early 1970s, while imports as a share of gross domestic product started a sharp increase.
[3] Other forces, such as technology, have been advanced as possible causes of the reversal in the wages of the unskilled. This paper exploits and emphasizes the trade link, but not necessarily because it is stronger. While policymakers can do little about technology, they can do something about trade openness.

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