Assurances et gestion des risques
Insurance and Risk Management

Evaluating Deterrence Incentives across Legal Systems: Effects of Changing the Basis for Measuring Exposure

Michael L. Smith

Volume 72, Number 1, 2004

Spécial assurance automobile

URI: https://id.erudit.org/iderudit/1092626ar
DOI: https://doi.org/10.7202/1092626ar

See table of contents

Publisher(s)

Faculté des sciences de l'administration, Université Laval

ISSN

1705-7299 (print)
2371-4913 (digital)

Explore this journal

Cite this article

Smith, M. (2004). Evaluating Deterrence Incentives across Legal Systems: Effects of Changing the Basis for Measuring Exposure. *Assurances et gestion des risques / Insurance and Risk Management*, *72*(1), 17–55. https://doi.org/10.7202/1092626ar

Article abstract

In the area of motor vehicle safety, legislators and public officials often rely on statistical measures to evaluate the effect of road design on safety or to evaluate legal and financial incentives for drivers to avoid accidents. The evidence used for evaluation typically takes the form of a rate such as a death rate per vehicle-mile, where the denominator of the rate reflects a measure of exposure. This paper shows how the basis for measuring exposure can affect such comparisons. Although this principle applies to any evaluation involving alternative measures of exposure, the empirical tests in this paper focus on the origin of countries' legal systems. The tests show that fatality rates from motor vehicle accidents vary significantly across countries classified by origin of legal System, although rankings of legal systems can depend on whether fatality rates are measured relative to population, vehicle count, or a basis combining population and vehicle count. Despite evidence of differences between legal Systems that persist over time, rankings also can depend on the time period from which data are drawn. The paper also illustrates how supplemental data can be used to reconcile discrepancies occurring when different measures of exposure are employed.

Evaluating Deterrence Incentives across Legal Systems: Effects of Changing the Basis for Measuring Exposure

by Michael L. Smith

ABSTRACT

In the area of motor vehicle safety, legislators and public officials often rely on statistical measures to evaluate the effect of road design on safety or to evaluate legal and financial incentives for drivers to avoid accidents. The evidence used for evaluation typically takes the form of a rate such as a death rate per vehicle-mile, where the denominator of the rate reflects a measure of exposure. This paper shows how the basis for measuring exposure can affect such comparisons. Although this principle applies to any evaluation involving alternative measures of exposure, the empirical tests in this paper focus on the origin of countries' legal systems. The tests show that fatality rates from motor vehicle accidents vary significantly across countries classified by origin of legal system, although rankings of legal systems can depend on whether fatality rates are measured relative to population, vehicle count, or a basis combining population and vehicle count. Despite evidence of differences between legal systems that persist over time, rankings also can depend on the time period from which data are drawn. The paper also illustrates how supplemental data can be used to reconcile discrepancies occurring when different measures of exposure are employed.

Keywords: Statistical Methodology; Legal Systems; Tort Law; Comparative Studies.

Author:

Michael L. Smith is professor at the Max M. Fisher College of Business, Ohio State University.

Note: Without necessarily implicating them in the conclusions, I thank Georges Dionne, Elliot Klayman, Darius Lakdawalla, participants in the 2003 meeting of the Risk Theory Seminar, and the referee for comments on earlier drafts of this paper. The project received financial support from the Community Mutual Blue Cross/Blue Shield Fund at Ohio State University, which I gratefully acknowledge. The conclusions in this paper do not reflect the position of Community Mutual Blue Cross/Blue Shield, its officers, or its employees.

RÉSUMÉ

Le législateur et les autorités gouvernementales se fondent souvent sur les statistiques en matière de sécurité des routes ou des véhicules, soit pour évaluer les effets de la conception des routes sur la prévention, soit pour évaluer les dispositions légales ou financières qui ont un effet dissuasif sur les conducteurs en vue de prévenir les accidents. Dans le cadre d'une évaluation typique, on établit un taux de mortalité par véhicule/nombre de milles, dans laquelle le dénominateur reflète une mesure d'exposition au risque. Cette étude montre comment les données de base pour mesurer l'exposition peuvent affecter les résultats d'une comparaison. Bien que les principes ci-dessus peuvent s'appliquer à toute évaluation où entrent en jeu les mesures alternatives d'exposition, les tests empiriques de cette étude se concentrent prioritairement sur l'origine et le type de système légal en cours dans chaque pays. Les tests montrent que les taux de décès découlant d'accidents d'automobile varient d'une façon significative selon le régime légal en cours dans les pays. Leur rang peut dépendre soit des taux de mortalité mesurés en fonction de la population, soit des taux basés à la fois sur la population et sur le nombre de véhicules. Bien qu'il existe des différences entre les régimes légaux qui se manifestent sur une longue période, leur rang peut aussi dépendre de la période au cours de laquelle les données ont été utilisées. Enfin, cette étude illustre comment des données additionnelles peuvent servir à concilier les divergences manifestées lorsqu'on utilise différentes mesures d'exposition au risque.

Mots clés : Méthodologie statistique, régimes légaux, responsabilité extra contractuelle, études comparatives.

INTRODUCTION: BACKGROUND AND SUMMARY OF FINDINGS

A country's road safety measures can affect the level of motor vehicle accident injuries and deaths. In addition, its systems for compensating motor vehicle accidents and allocating their costs can create legal and financial incentives to avoid accidents. Some effects are direct, as when safer road designs reduce the likelihood or severity of accidents. Other effects are indirect, as when traffic law enforcement or rules for allocating accident costs create incentives deterring possibly harmful actions. In evaluating these measures, legislators and public officials often rely on statistical measures of effectiveness. For example, highway safety engineers may evaluate guard rail designs by comparing frequencies of motor vehicle accidents where vehicles leave the highway, or legislators may set a national speed limit by considering estimated effects of speed on fatal accidents.

The evidence used in this type of evaluation typically takes the form of a rate, where the denominator of the rate reflects a measure of exposure. For example, published motor vehicle accident injury or death rates may use vehicle-miles, vehicles, licensed drivers or population as a measure of exposure.[1] This paper shows how the basis for measuring exposure to risk can affect the outcome of a comparison.[2] In concept, this principle applies to any evaluation involving alternative measures of exposure, although empirical tests in this paper focus on the origin of countries' legal systems. These tests rely on findings that build on and extend a large body of empirical evidence in the Law and Finance literature showing that a country's legal system affects the development of its financial markets by protecting investors against expropriation by controlling shareholders or managers. A series of papers by La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997, 1998, and 2000) is a prominent part of this literature.

If a country's legal system can create incentives that protect shareholders against expropriation, it also could create incentives against other types of possibly harmful acts (the area of law applying to acts that cause harm to others often is referred to as torts). Smith (2003) offers evidence that the type of incentives found in the Law and Finance literature extend into other areas, showing that death rates from motor vehicle accidents and from other types of accidents vary significantly across countries classified by origin of legal system. Smith's findings are evidence that incentives created by a country's legal system not only protect shareholders against expropriation but also discourage behavior that might lead to accidental death. Similar effects have been noted in studies of no-fault automobile compensation statutes.[3]

While confirming the presence of deterrence effects in legal systems, tests in this paper show that rankings can be affected by the measure of exposure: population, vehicles, or one based on both population and vehicles. Further, rankings depend on the time period from which the data are drawn, despite the data showing evidence of differences between legal systems that persist over time. For example, motor vehicle accident death rates under German Civil Code systems are significantly higher than under English Common-Law systems during 1970-1979 and 1990-1999 when death rates are measured relative to population, but not when measured relative to vehicles. Another example involves a comparison of motor vehicle accident death rates under Scandinavian Civil Code and English Common-Law systems between 1970 and 1989. When measured relative to vehicles, death rates under Scandinavian system are

significantly lower. When death rates are measured relative to population, differences between Scandinavian Civil Code and English Common-Law systems are insignificant.

The next section offers a context and rationale for empirical tests by providing an overview of philosophical differences between civil-law and common-law systems. The following section describes data sources and methodology, with results appearing in the section after. The last section concludes and summarizes the paper.

ORIGIN OF LEGAL SYSTEM AND INCENTIVES AGAINST BEHAVIOR POSSIBLY LEADING TO HARM

To reduce traffic accident injuries and deaths, countries typically rely on a combination of regulations, administrative penalties, other sanctions and enforcement in addition to incentives against harmful acts embedded in their legal systems. Also, each country's system for compensating accidents and allocating their cost creates further incentives to deter behavior that may lead to injury. Possibly, generous systems for compensating accident costs can undermine an individual's natural incentive to avoid injury. Tests in this paper summarize the effects of these measures by considering the origin of the country's legal system. The rationale for this step is based on three observations:

- with few exceptions, the origin of a country's legal system predates the introduction of motor vehicles (and the earliest date covered in the data),
- the legal system provides the foundation for other measures, and
- the relation between incentives created by the legal system and measures of other efforts to reduce accidents is ambiguous[4] and data on other efforts to reduce accidents are difficult to compare across countries. The brief summary of legal systems in the following paragraphs offers reasons why countries' legal systems may affect their accident rates.

Countries' legal systems can be grouped into five legal families based on their origins (see Glendon, Gordon, and Osakwe, 1994 and Zweigert and Kötz, 1998). Four of these families are civil code systems based on French, German, Scandinavian and Socialist traditions. The fifth family is based on English Common Law. Under

civil code systems, rules for resolving disputes between individuals are created by legislative authority and typically embodied in codes. The codes are designed to find a just solution to a dispute while maintaining or increasing the authority of the State, often emphasizing collective over individual rights. Under an English common-law system, in contrast, courts develop a body of law through their own decisions in addition to enforcing laws created by legislation. The pattern of development in English Common Law has been gradual, evolving from decision to decision, while civil law systems rely on legislation and codification of rules.

One difference between civil-law and common-law systems appears in the standard of proof. Under common-law systems, claims in disputes between private parties must be proved by a "preponderance of the evidence",[5] while in criminal cases the defendant must be proven guilty beyond a reasonable doubt. Under civil-law systems, the standard of proof in private disputes is virtually indistinguishable from criminal cases: the judge or judges must be convinced beyond a reasonable doubt that the alleged facts are true and covered by statute. Holding other factors constant, a higher standard of proof under civil code systems makes it more difficult for an injured person to prove that the other party caused the injury. Sherwin and Clermont (2001) examine historical reasons for the standard differing between civil- and common-law systems and offer explanations for its persistence.

To receive compensation from a party whose actions result in injury, an injured person must prove that the injurer's actions caused the injury. Common-law negligence rules further require that the injured person show that the injurer failed to exercise a level of care that would be expected from a reasonable, prudent person. In other words, a person whose act causes injury to another can escape liability under common-law negligence rules by showing that he or she exercised a prudent level of care. Common-law negligence rules do not require the injurer to adopt every possible precaution, however, but only reasonable precautions, where reasonableness is evaluated by the court weighing costs of adopting the precaution against the potential reduction in accident costs.[6] Civil code systems are more likely to apply a strict liability rule, which requires an injured person to show only that the injurer's act caused the injury. Thus common-law tort rules create an incentive for persons to exercise reasonably prudent care, an incentive that may be diminished under civil code systems.

Another important distinguishing feature of common-law systems is the jury trial. Even though jury trials occur in only a small

fraction of private disputes, traditions of the jury trial are embedded in litigation under common-law systems.[7] In a jury trial, considerable importance attaches to the preparation for trial by legal counsel, through means such as discovery. The trial is a continuous oral hearing that continues with minimal interruption, as the members of the jury cannot be subject to repeated recalls.

In contrast, proceedings under civil-law systems often take the form of a series of step-by-step sessions where the judge learns the facts and arguments of the parties to the dispute (See Zweigert and Kötz, 1998, p. 271-275). The judge takes an active role in questioning witnesses and in formulating issues in the case. Glendon, Gordon, and Osakwe (1994, p. 167) attribute these differences to the absence of a jury of private citizens in civil law countries. A common-law jury trial requires a group of ordinary citizens to convene, to consider all of the evidence, and to apply the law. As a consequence, the trial must be continuous and uninterrupted. The absence of a jury in a civil law trial allows the proceedings to be drawn out over a longer period.[8] In criminal trials under civil law systems, however, courts typically include lay judges who sit alongside professional judges. Even though civil law courts do not use a jury of ordinary citizens, the lay judges, who may be elected, are a functional analog of the jury (see Glendon, Gordon, and Osakwe, 1994, p. 179). Private disputes in countries using civil law systems typically are heard by only a professional judge, although parties to the dispute usually have a right to appeal the court decision.

Under any legal system that holds individuals responsible for harmful acts, incentives to avoid possibly harmful behavior are due to the specter of being required to defend one's actions against a legal attack as well as contemplating the actuality of being required to pay damages. While litigation is an expensive mechanism for redistribution that imposes deadweight costs on both parties to a dispute, the specter of litigation serves as an ex ante deterrent for individuals contemplating self-interested behavior that imposes cost on others. Parisi (2002) models the optimal level of fact-finding under adversarial (typically, common-law) and inquisitorial (typically, civil-law) systems, examining the results for social benefits of correct adjudication and costs of litigation.

In theory, a fault-based mechanism for allocating accident costs creates incentives for prudent behavior and against actions that might lead to harm. The design of other systems for compensating injury costs (e.g., no-fault) can include similar incentives through measures such as increasing insurance premiums of individuals who are involved in accidents or reducing compensation for individuals

whose behavior contributed to the accident. Dionne (2002) describes automobile compensation systems in Quebec, France, and Japan, with special emphasis on analysis the Quebec no-fault system and the bonus/malus system used for experience-rating vehicle insurance premiums under the French system. Whether one type of system offers stronger deterrence incentives than another is primarily an empirical question. Analysis of experience-rating methods, especially those based on traffic law violations, appears in Boyer and Dionne (1987, 1989) and Dionne, Maurice, Pinquet, and Vanasse (2001).

DATA AND OVERVIEW OF METHODOLOGY

The hypothesis underlying tests is whether the origin of countries' legal systems deters acts that could lead to motor vehicle accidents. This question is tested indirectly using cross-country data on fatality rates from motor vehicle accidents, as in Cummins, Phillips, and Weiss (2001), and Cohen and Dehejia's (2002) use of fatality rates to study effects of no-fault. Fatality rates are an objective gauge for assessing deterrence incentives. With other measures such as injury rates or economic cost, the system for compensating accidents and allocating their costs could have effects that are not necessarily related to the harm caused by the incident. Fatality rates capture a substantial element of the economic costs of accidents because death typically is associated with serious accidents, constituting a major if not the most significant aspect of the economic burden from the accident.

Table 1 summarizes sources of information and time period covered in the data. Data on the origin of countries' legal systems are based on La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998), Reynolds and Flores (1989), and the World Factbook.[9] Accident fatality rates for each of the 113 countries were calculated from World Health Organization (WHO) data for years 1950-2000 or, if fewer, for years in this interval where data were reported. These annual fatality rates were calculated by extracting data on population and number of deaths by cause from the World Health Organization (2000) statistical information system (WHOSIS). Data on motorized passenger vehicles in use for the years 1980-1999 were obtained from the CD-ROM version of the United Nations Statistical Yearbook (2001), while data for 1950-1979 were obtained from the print version of the same publication.[10]

TABLE 1
SOURCES OF INFORMATION, TIME PERIOD, AND NUMBER OF COUNTRIES COVERED BY DATA

Nature of Data	Sources of Information	Years Covered	Number of Countries
Classification of Countries' Legal Systems	LLSV (1998), Reynolds and Flores (1989), *World Factbook.*	C	113
Accident Fatality Rates	World Health Organization (2000) Statistical Information System (WHOSIS)	1950-2000	Varies by Year
Motor Vehicles in use	United Nations *Statistical Yearbook*	1950-1999	Varies by

Motor vehicle accident fatality rates were calculated per 100,000 persons and per thousand passenger vehicles. Estimated means by legal system and year are graphed in Figures 1 and 2. These figures provide background for formal tests that appear in the next section. The data graphed in Figure 2 suggests differences between legal systems that show strong persistence over time, although observed differences should be interpreted considering the small number of observations for some legal systems and some years, especially near the beginning and end of the sample period. This type of persistence is less evident in data graphed in Figure 1, despite both graphs being based on motor vehicle accident fatality rates. Since Figure 1 illustrates fatality rates relative to population while Figure 2 illustrates fatality rates relative to vehicle usage, patterns of vehicle usage can help to explain differences between the two graphs. Major shifts in vehicle ownership and usage occurred between 1950 and 1999, with patterns that differed between legal systems.

FIGURE 1
MOTOR VEHICLE ACCIDENT DEATHS PER 100,000 PERSONS (MEANS ACROSS COUNTRIES WITHIN LEGAL SYSTEMS)

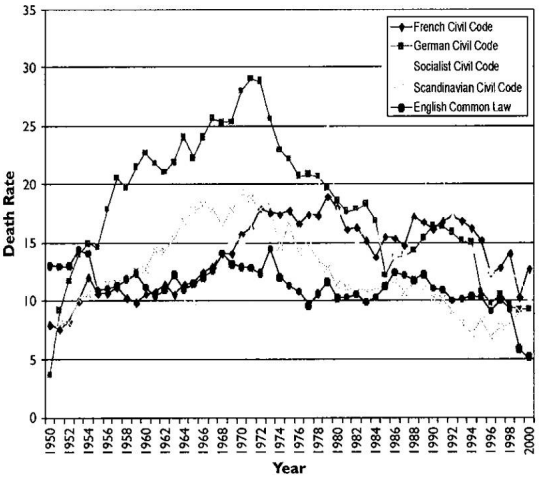


FIGURE 2
MOTOR VEHICLE ACCIDENT DEATHS PER THOUSAND PASSENGER VEHICLES (MEANS ACROSS COUNTRIES WITHIN LEGAL SYSTEMS)

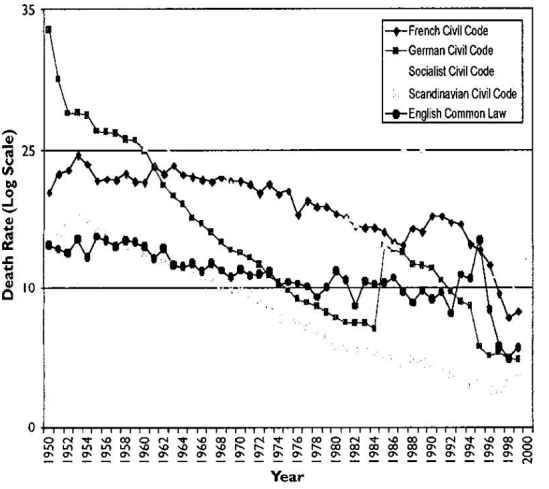
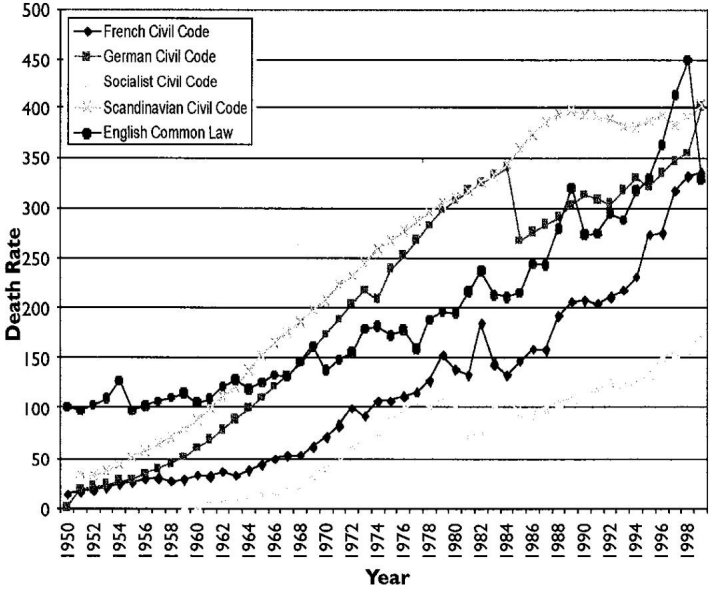


Figure 3 illustrates vehicle usage patterns by graphing passenger vehicles in use per thousand persons across countries classified by origin of legal system. Vehicle usage shows an upward trend in all legal systems. For example, vehicles per thousand persons in common-law countries rose to about 450 in 1998 from about 100 in 1950, approximately a 4.5-fold increase. By comparison, the increase in civil-law countries is more dramatic, as these countries began with a much smaller base. Vehicles per thousand persons in the French Civil Code countries, for example, rose to about 335 in year 1999 from about 13.7 in 1950, over a 24-fold increase.

FIGURE 3
PASSENGER VEHICLES PER THOUSAND PERSONS IN COUNTRIES AND YEARS WHERE DATA ALLOWS CALCULATION OF A DEATH RATE PER THOUSAND PASSENGER VEHICLES (MEANS ACROSS COUNTRIES WITHIN LEGAL SYSTEMS)



RESULTS

Origin of Legal System and Country-Level Motor Vehicle Accident Fatality Rates

Tables 2 and 3 present two-sample t-statistics for paired comparisons between legal systems of annual fatality rates. Table 2 compares fatality rates per 100,000 persons, while Table 3 compares fatality rates per thousand passenger vehicles. These comparisons are based directly on observed fatality rates, so they do not rely on a model for the process generating the fatalities. The five legal systems involved in the paired comparisons lead to a total of ten comparisons for each year where data are available. The first four columns report comparisons of common-law against the four civil code systems while the other six columns report comparisons between civil code systems.

T-tests in Tables 2 and 3 allow for unequal variances between samples, and in many comparisons the sample sizes are small (e.g., for Scandinavian and German Civil Code systems, respectively, the number of reporting countries never exceeds five or seven because relatively few countries have adopted these legal systems). Thus the power of the t-tests in rejecting the null hypothesis of no difference in fatality rates would be expected to be low. Despite the low power, the tests reported in Tables 2 and 3 show a large number of significant rejections.

Further, tests in Tables 2 and 3 confirm the persistence over time of differences between legal systems suggested by Figures 1 and 2. Table 2 shows only two instances where a comparison that is significant at a given point in time is later significant but of opposite sign. Both instances involve Scandinavian civil code systems, one in the comparison against French (higher in 1965, later falling below) and the other against Socialist civil code systems (higher in 1964 and 1965, later falling below). Table 3 shows no instances of such reversals. Earlier, the graphs in Figures 1 and 2 suggest a greater number of reversals, but the t-statistics in Tables 2 and 3 show that only two of these reversals involved significant differences.

Beyond the observed persistence, patterns of differences are complex because the pairwise comparison of five systems generates ten columns of yearly comparisons. Adding to the complexity are patterns of significance that change with the basis for measuring exposure: population (Table 2) or vehicles (Table 3). The comparisons of English Common-Law systems against French, German and Socialist Civil Code systems (the first three columns of Tables 2

and 3) offer an example. The comparisons of population death rates (Table 2) show fatality rates under English Common-Law systems falling significantly below those in French, German and Socialist Civil Code systems for at least 15 of the years where data allow a comparison. When exposure is measured relative to vehicles (Table 3), the contrast between English and French systems becomes stronger, the contrast between English and Socialist systems remains about the same but shifts across time periods, and the contrast between English and German systems becomes weaker. In fact, none of the comparisons between English and German systems in Table 3 crosses a threshold of significance. The comparisons of German against French systems (column five) and against Socialist systems (column eight) after 1979 offer another example. When the comparisons involve death rates relative to population (Table 2), none are significant. When the comparisons involve death rates relative to vehicles (Table 3), half or more show lower death rates under German systems at five percent or stronger level of significance.

Outcomes of other comparisons do not depend on the measure of exposure, instead being consistent between Tables 2 and 3. In Table 2, fatality rates relative to population under Scandinavian systems fall significantly below those in French and Socialist systems for at least 17 years late in the sample period, in both cases a reversal from prior experience noted above. This pattern of significance becomes stronger in Table 3, except that no reversal is present.

In a few cases, comparisons using different measures of exposure produce conflicting results. The fourth column of Table 2 offers weak evidence of population death rates under English systems being lower than under Scandinavian systems (for two years, at a five percent level of significance). Stronger evidence for the opposite conclusion appears when death rates are measured relative to vehicles; the fourth column of Table 3 shows death rates under English systems being higher than under Scandinavian systems (12 years at five percent and another 3 years at one percent level of significance). In one instance, the conflict appears on tests within the same year (1977), where Table 2 shows a significantly lower death rate under English systems and Table 3 shows a significantly higher death rate under English systems.

Changing patterns of vehicle usage across legal systems between 1950 and 1999 are helpful in interpreting these comparisons, especially those reported in Table 2. As shown earlier in Figure 3, English common-law countries began the period with, relative to population, a much larger number of passenger vehicles than civil code countries. Thus motor vehicle accident fatality rates in English

common-law countries during early periods (e.g., prior to 1970) reflect a larger number of vehicles relative to population when compared to civil code countries. Fatality rates in later periods reflect vehicle usage that is more nearly equal between common-law and civil code systems. Compared to English Common-Law countries, German Civil Code countries had low rates of vehicle usage prior to the late 1960s, so tests in Table 2 showing high fatality rates relative to population in German civil code countries at this time are noteworthy. For years prior to 1970, fatality rates per 100,000 persons under German systems are high relative to other civil code systems as well.

TABLE 2 : MOTOR VEHICLE ACCIDENT FATALITY RATES PER 100,000 PERSONS.
Two-Sample T-Statistics For Paired-Comparison Tests Between Legal Systems in Each Year. Column Headings Indicate the Two Legal Systems Being Compared, with Rate Under Latter System Subtracted from the First. Tests Allow for Unequal Variances Between Legal Systems

Year	English French	English/ German	English/ Socialist	English/ Scandinavian	French/ German	French/ Socialist	French/ Scandinavian	German/ Socialist	German/ Scandinavian	Socialist/ Scandinavian
1950	1.67	–	–	–	–	–	–	–	–	–
1951	1.48	0.60	–	1.37	- 0.30	–	- 0.25	–	0.22	–
1952	1.28	0.27	–	1.40	- 0.87	–	0.05	–	0.94	–
1953	1.26	0.08	–	1.41	- 0.84	–	- 0.07	–	0.87	–
1954	0.62	- 0.17	–	1.15	- 0.60	–	0.53	–	0.94	–
1955	0.09	- 0.82	1.38	- 0.07	- 0.96	1.68	- 0.22	1.85	0.86	- 1.93
1956	0.13	- 1.54	0.79	- 0.10	- 1.79	0.87	- 0.32	2.33	1.71	- 1.48
1957	0.05	- 1.87	0.85	- 0.09	- 2.07	1.09	- 0.20	2.60	2.04	- 1.46
1958	0.63	- 1.88	1.38	0.05	- 2.49	1.05	- 0.84	2.90*	2.13	- 1.67
1959	1.01	- 2.15	1.17	- 0.06	- 2.98*	0.50	- 1.20	2.87*	2.18	- 1.28
1960	0.23	- 3.23*	1.47	- 0.51	- 3.77*	1.46	- 0.81	4.12**	2.71*	- 1.85
1961	- 0.17	- 3.90**	0.45	- 1.44	- 4.35**	0.68	- 1.53	4.14*	2.62*	- 1.82
1962	- 0.20	- 3.30*	0.62	- 1.22	- 3.50*	0.92	- 1.21	3.92*	2.23	- 1.88
1963	0.70	- 3.26**	0.93	- 1.12	- 4.76**	0.44	- 2.17	4.30**	2.28	- 2.13
1964	- 0.16	- 4.02**	0.40	- 1.97	- 4.58**	0.64	- 2.23	4.43**	2.24	- 2.39*
1965	- 0.03	- 3.30**	0.53	- 1.91	- 4.21**	0.75	- 2.41*	4.35**	1.44	- 2.75*
1966	- 0.14	- 3.25**	0.10	- 1.69	- 4.16**	0.35	- 2.09	4.16**	1.71	- 2.22
1967	- 0.11	- 3.49*	0.08	- 1.71	- 3.72*	0.22	- 1.84	3.69*	2.04	- 1.88

TABLE 2 : MOTOR VEHICLE ACCIDENT FATALITY RATES PER 100,000 PERSONS.
Two-Sample T-Statistics For Paired-Comparison Tests Between Legal Systems in Each Year. Column Headings Indicate the Two Legal Systems Being Compared, with Rate Under Latter System Subtracted from the First. Tests Allow for Unequal Variances Between Legal Systems (continued)

Year	English French	English/ German	English/ Socialist	English/ Scandinavian	French/ German	French/ Socialist	French/ Scandinavian	German/ Socialist	German/ Scandinavian	Socialist/ Scandinavian
1968	0.01	- 2.96*	- 0.14	- 0.60	- 3.33*	- 0.19	- 0.67	3.04*	1.95	- 0.52
1969	- 0.34	- 3.59**	- 0.69	- 1.24	- 3.94**	- 0.47	- 1.13	3.30*	1.97	- 0.74
1970	- 0.93	- 3.94**	- 0.79	- 1.91	- 3.73*	0.18	- 1.31	3.85*	2.52*	- 1.46
1971	- 1.21	- 3.93**	- 1.12	- 1.64	- 3.41*	0.05	- 0.78	3.35*	2.35	- 0.78
1972	- 1.79	- 3.47*	- 1.55	- 1.45	- 2.45	0.36	0.02	2.70	2.22	- 0.25
1973	- 1.01	- 2.45*	- 0.62	- 1.02	- 1.90	0.55	- 0.14	2.28	1.68	- 0.60
1974	- 1.98	- 2.50	- 1.32	- 1.00	- 1.33	0.81	1.31	1.79	2.07	0.46
1975	- 2.35*	- 2.32	- 2.13*	- 2.35*	- 0.96	0.62	0.55	1.32	1.28	- 0.16
1976	- 2.26*	- 2.41	- 2.26*	- 1.35	- 1.00	0.22	1.06	1.17	1.66	0.95
1977	- 3.23**	- 2.67*	- 3.24**	- 2.40*	- 0.82	0.43	1.42	1.07	1.55	1.19
1978	- 2.63*	- 2.37	- 2.98*	- 1.39	- 0.79	- 0.64	1.94	0.34	1.83	2.38
1979	- 2.49*	- 1.79	- 1.69	- 0.44	- 0.18	- 0.78	3.92***	- 0.62	1.85	1.62
1980	- 3.29**	- 2.32	- 2.59*	- 0.58	- 0.16	0.10	3.73***	0.22	2.23	2.62*
1981	- 2.56*	- 2.19	- 2.41*	- 0.44	- 0.45	0.30	2.90**	0.66	2.18	2.81*
1982	- 2.45*	- 2.13	- 2.05*	- 0.29	- 0.46	0.60	3.15**	0.85	2.26	2.75*
1983	- 2.37*	- 2.45	- 2.58*	- 0.60	- 0.88	- 0.46	2.32*	0.52	2.32	2.51*
1984	- 1.78	- 2.07	- 2.40*	- 0.41	- 0.99	- 0.90	1.98	0.33	2.06	2.61*
1985	- 2.39*	- 0.32	- 1.63	- 0.08	1.19	1.03	2.87**	- 0.66	0.29	1.98

TABLE 2 : MOTOR VEHICLE ACCIDENT FATALITY RATES PER 100,000 PERSONS.

Two-Sample T-Statistics For Paired-Comparison Tests Between Legal Systems in Each Year. Column Headings Indicate the Two Legal Systems Being Compared, with Rate Under Latter System Subtracted from the First. Tests Allow for Unequal Variances Between Legal Systems (continued)

Year	English French	English/ German	English/ Socialist	English/ Scandinavian	French/ German	French/ Socialist	French/ Scandinavian	German/ Socialist	German/ Scandinavian	Socialist/ Scandinavian
1986	- 1.47	- 0.59	- 0.86	0.43	0.87	0.98	2.58*	- 0.15	1.22	2.12
1987	- 1.35	- 0.76	- 1.08	0.86	0.47	0.51	2.87**	- 0.10	1.78	2.99**
1988	- 2.91**	- 1.26	- 2.98**	0.15	1.46	0.24	3.48**	- 1.37	1.54	3.71**
1989	- 2.13*	- 1.18	- 3.35**	0.63	0.54	- 1.29	3.20**	- 1.55	1.81	4.64***
1990	- 2.53*	- 1.62	- 5.00***	0.47	- 0.07	- 2.66*	3.60**	- 1.57	1.99	6.46***
1991	- 3.50**	- 1.79	- 4.31***	0.53	0.13	- 1.54	4.08***	- 1.16	2.05	4.75***
1992	- 4.90***	- 2.28	- 4.33***	0.66	0.50	- 0.01	5.97***	- 0.48	2.69*	5.18***
1993	- 4.89***	- 1.88	- 3.29**	1.65	0.66	0.53	7.00***	- 0.28	2.72*	4.71***
1994	- 4.29***	- 1.39	- 1.90	2.01	0.38	0.89	5.97***	0.16	2.31	3.26**
1995	- 2.53*	- 0.23	- 1.49	1.17	1.92	0.84	3.90**	- 1.07	1.18	2.64*
1996	- 1.34	- 0.31	- 1.93	1.31	0.98	- 0.07	2.38*	- 1.34	1.45	3.51**
1997	- 1.22	- 0.20	- 1.24	1.61	0.81	0.29	2.34*	- 0.68	1.24	2.84*
1998	- 2.02	- 0.08	- 1.34	0.69	1.66	0.77	3.35**	- 1.06	0.67	2.53*
1999	- 1.60	- 1.58	- 3.10**	–	0.36	- 0.54	–	- 1.15	–	–
2000	–	–	–	–	0.54	0.38	–	- 0.31	–	–

Notes: T-Tests allow for unequal variances in samples. Critical values for significance tests vary with sample degrees of freedom.
Levels of Significance: * – $p < 0.05$; ** – $p < 0.01$; *** – $p < 0.001$

TABLE 3 : MOTOR VEHICLE ACCIDENT FATALITY RATES PER THOUSAND PASSENGER VEHICLES

Two-Sample T-Statistics For Paired-Comparison Tests Between Legal Systems in Each Year. Column Headings Indicate the Two Legal Systems Being Compared, with Rate Under Latter System Subtracted from the First. Tests Allow for Unequal Variances Between Legal Systems

Year	English French	English/ German	English/ Socialist	English/ Scandinavian	French/ German	French/ Socialist	French/ Scandinavian	German/ Socialist	German/ Scandinavian	Socialist/ Scandinavian
1950	- 2.76	–	–	–	–	–	–	–	–	–
1951	- 2.71	- 1.08	–	- 0.78	- 0.90	–	2.49	–	1.06	–
1952	- 3.55*	- 1.27	–	- 1.34	- 0.84	–	2.51*	–	1.17	–
1953	- 2.57*	- 1.30	–	- 1.09	- 0.72	–	2.16	–	1.22	–
1954	- 3.16*	- 1.28	–	- 1.42	- 0.76	–	2.48*	–	1.18	–
1955	- 2.90*	- 1.30	–	- 0.34	- 0.85	–	2.58*	–	1.26	–
1956	- 2.97**	- 1.41	–	- 0.26	- 0.89	–	2.76*	–	1.39	–
1957	- 3.55**	- 1.44	–	- 0.26	- 0.89	–	3.23**	–	1.41	–
1958	- 4.46***	- 1.28	–	0.30	- 0.65	–	4.55***	–	1.30	–
1959	- 4.28***	- 1.24	- 2.36	0.30	- 0.73	- 1.84	4.21***	- 0.79	1.26	2.38
1960	- 4.10***	- 1.22	- 1.45	0.24	- 0.61	- 0.78	3.85**	- 0.08	1.24	1.47
1961	- 4.09***	- 1.22	- 3.50	- 0.18	0.02	- 1.43	3.92***	- 0.86	1.20	3.45
1962	- 4.63***	- 1.11	- 3.32	0.73	0.35	- 1.44	5.06***	- 1.25	1.24	3.48
1963	- 3.86***	- 1.27	- 3.53	0.00	1.05	- 0.55	3.82***	- 1.39	1.26	3.51
1964	- 3.85***	- 1.34	- 4.55*	0.11	1.10	- 1.10	3.87***	- 1.94	1.37	4.57*
1965	- 4.31***	- 1.17	- 4.39*	0.50	1.82	- 0.86	4.51***	- 2.38	1.32	4.54*
1966	- 4.19***	- 1.32	- 4.24*	0.31	2.03	- 0.75	4.29***	- 2.52	1.42	4.33*
1967	- 3.89***	- 1.27	- 4.29*	1.27	2.63*	- 0.50	4.25***	- 3.08*	1.82	4.63*

TABLE 3 : MOTOR VEHICLE ACCIDENT FATALITY RATES PER THOUSAND PASSENGER VEHICLES
Two-Sample T-Statistics For Paired-Comparison Tests Between Legal Systems in Each Year. Column Headings Indicate the Two Legal Systems Being Compared, with Rate Under Latter System Subtracted from the First. Tests Allow for Unequal Variances Between Legal Systems (continued)

Year	English French	English/ German	English/ Socialist	English/ Scandinavian	French/ German	French/ Socialist	French/ Scandinavian	German/ Socialist	German/ Scandinavian	Socialist/ Scandinavian
1968	- 4.26***	- 1.28	- 5.85**	1.08	3.41**	- 0.41	4.59***	- 4.63**	1.98	6.28**
1969	- 3.86***	- 1.46	- 4.29*	0.86	3.20**	0.23	4.04***	- 3.45*	1.93	4.49**
1970	- 3.64**	- 1.04	- 2.80	1.23	3.31**	0.50	4.00***	- 2.49	2.40	3.13
1971	- 3.94***	- 1.27	- 2.78	1.15	3.59**	0.58	4.26***	- 2.46	2.51*	3.06
1972	- 3.00**	- 0.60	- 1.81	1.34	2.86**	0.92	3.42**	- 1.66	2.44*	2.23
1973	- 3.07**	0.33	- 1.74	1.78	3.18**	1.82	3.51**	- 1.93	1.87	2.50
1974	- 2.67*	- 0.17	- 1.86	1.61	2.66*	1.58	3.03**	- 1.88	2.99*	2.64
1975	- 3.38**	0.55	- 1.74	1.94	3.53**	2.28*	3.81***	- 2.05	1.60	2.64
1976	- 3.90***	0.96	- 1.89	2.25*	4.54***	2.30*	5.11***	- 2.75	1.97	3.60
1977	- 3.39**	1.03	- 1.68	2.22*	3.72***	2.47*	4.00***	- 2.44	2.04	3.12
1978	- 2.64*	0.61	- 3.07	2.16*	2.77*	1.44	3.01**	- 3.53	2.11	4.31*
1979	- 2.46*	1.22	- 1.73	2.19*	2.80*	1.75	3.01**	- 2.87	1.97	3.56
1980	- 1.69	1.88	- 1.34	2.51*	2.36*	0.78	2.55*	- 2.55*	2.50	2.89*
1981	- 2.50*	1.62	- 3.02**	2.19*	3.50**	0.05	3.77***	- 4.50***	2.18	4.86***
1982	- 2.70*	0.94	- 4.35***	2.11	3.01**	- 0.17	3.30**	- 4.97***	2.24	5.45***
1983	- 2.08*	1.44	- 1.44	2.03	3.19**	0.61	3.53**	- 2.56*	2.18	2.92*
1984	- 2.28*	1.69	- 1.44	2.28*	3.36**	0.93	3.65**	- 2.72*	1.99	3.08*
1985	- 2.36*	- 0.55	- 2.77**	3.26**	0.28	0.75	3.90***	- 0.02	1.01	6.50***

TABLE 3 : MOTOR VEHICLE ACCIDENT FATALITY RATES PER THOUSAND PASSENGER VEHICLES

Two-Sample T-Statistics For Paired-Comparison Tests Between Legal Systems in Each Year. Column Headings Indicate the Two Legal Systems Being Compared, with Rate Under Latter System Subtracted from the First. Tests Allow for Unequal Variances Between Legal Systems (continued)

Year	English/ French	English/ German	English/ Socialist	English/ Scandinavian	French/ German	French/ Socialist	French/ Scandinavian	German/ Socialist	German/ Scandinavian	Socialist/ Scandinavian
1986	- 1.62	- 0.47	- 2.13*	2.80*	0.16	0.15	3.62**	- 0.11	1.07	6.40***
1987	- 2.21*	- 0.60	- 1.11	3.18**	0.16	- 0.99	3.87***	- 1.00	1.08	1.19
1988	- 2.72*	- 0.65	- 1.23	2.41*	0.96	- 0.93	3.53**	- 1.11	1.10	1.31
1989	- 2.49*	- 0.46	- 1.22	2.61*	0.91	- 1.01	3.85***	- 1.15	1.11	1.31
1990	- 2.51*	- 0.55	- 4.83***	2.85**	1.40	0.55	3.12**	- 1.31	1.13	7.06***
1991	- 2.16*	- 0.26	- 3.11**	2.08	1.69	0.83	2.86**	- 1.54	1.18	6.02***
1992	- 3.08**	- 0.57	- 4.23***	2.71*	2.32*	1.22	3.68**	- 1.94	1.46	6.14***
1993	- 1.72	0.70	- 1.23	1.92	2.41*	0.97	3.41**	- 2.40*	1.49	5.05***
1994	- 1.26	0.73	- 0.83	1.99	2.11*	0.79	3.57**	- 2.06	1.46	6.01***
1995	0.23	1.34	0.57	1.46	2.49*	0.75	2.78*	- 4.90***	1.47	6.29***
1996	- 1.35	1.07	- 1.43	1.52	2.41*	0.48	2.75*	- 4.71***	1.44	5.97***
1997	- 2.01	0.31	- 4.28***	2.47*	2.07	- 0.82	2.86*	- 4.11***	1.38	5.77***
1998	- 1.44	- 0.05	- 5.08***	1.34	1.30	- 2.04	1.98	- 4.39***	0.90	6.10***
1999	- 0.54	0.34	- 2.33	–	0.69	- 0.40	–	- 3.43**	–	–
2000	–	–	–	–	–	–	–	–	–	–

Notes: T-Tests allow for unequal variances in samples. Critical values for significance tests vary with sample degrees of freedom.
Levels of Significance: * – $p < 0.05$; ** – $p < 0.01$; *** – $p < 0.001$

☐ Regression Tests on Pooled Country-Level Motor Vehicle Accident Fatality Rates

Effects related to the basis for measuring exposure also appear in regression tests using pooled cross-section time-series data. Tables 4 and 5 illustrate these effects using a between-cluster estimator of variance based on very general assumptions. The estimator allows for arbitrary dependence among observations within a given country and is based on a Huber (1967) and White (1980) variance estimator that allows for heteroscedasticity between countries.[11] The dependent variable is log motor vehicle accident fatality rate, per 100,000 persons in Table 4 and per thousand vehicles in Table 5. The tests compare English Common Law against the four civil code systems. Many of the comparisons between civil code systems would be significant if reported (e.g., see Tables 2 and 3), but these comparisons are not required for the issue being examined in this paper. Tests in Tables 4 and 5 use dummy variables for fixed year effects and ICD coding system effects, which serve as control variables.[12] Dummy variables also are used for the origin of countries' legal systems, the predictor variable. The fixed effects for each year and ICD coding system make the tests equivalent to pooled cross-sectional tests based on each legal system's deviation from the average for the year and ICD system. Because the tests focus on legal system effects, test statistics on year and ICD system variables are not reported. Tables 4 and 5 are based on observations allowing, for a given country and year, calculation of both a death rate per 100,000 persons and a death rate per thousand vehicles. Thus the number of observations underlying each entry in Table 4 is identical to the number of observations for the corresponding entry in Table 5.

The left-hand column of each table reports tests on data from the entire 1950-1999 period while the next five columns report tests on ten-year subintervals. Dummy variables were omitted for English Common Law countries, the earliest year in the period, and the ICD coding system most frequently used by Common Law countries during the period (or ICD 6 for the entire 1950-1999 sample period). Thus the intercept, which serves as a benchmark, includes the estimated log death rate for English Common-Law countries that were using this ICD reporting system at the beginning of the period. Coefficients for legal system dummy variables other than common-law are estimates of the log difference between that system's fatality rate and the rate for English Common-Law countries. For example, the left-hand column of Table 4 shows estimated coefficients of 2.10 for English Common-Law and 0.23 for French Civil Code countries for the entire 1950-1999 period, which implies geometric mean point estimates of $e^{2.10} = 8.17$ for English Common-Law and $e^{2.10 + 0.23} = 10.28$ for French Civil Code countries.

Estimates in Tables 4 and 5 mirror many of the tendencies in the paired-comparisons reported in Tables 2 and 3. When motor vehicle accident death rates are measured relative to vehicles in use (Table 5) estimated death rates in French and Socialist Civil Code countries are significantly higher than in common-law countries for the entire 1950-1999 period and for all subperiods, generally at very strong ($p < 0.001$) or strong ($p < 0.01$) levels of significance. These comparisons, however, become less striking when death rates are measured relative to population. In Table 4, death rates in French Civil Code countries are significantly higher only for the 1980-1989 and 1990-1999 subperiods but not for the entire1950-1999 period. Death rates in Socialist Civil Code countries are significantly higher for the entire1950-1999 period but only for subperiods beginning in 1970 and afterward; two of these tests are at strong ($p < 0.01$) levels of significance while one is significant ($p < 0.05$). Notably, death rates relative to population in Socialist countries fall significantly below those in common-law countries during the 1950-1959 subperiod.

The relatively fewer vehicles relative to population in Socialist and French Civil Code countries prior to 1980 as compared to common law countries (see Figure 3) can help to explain the apparent discrepancies when different measures of exposure are employed. During later periods, when vehicle count relative to population in Socialist and French countries moved closer to the averages for common-law countries, their population death rates rise significantly above common-law averages. Similar observations can explain other apparent discrepancies between tests in Tables 4 and 5. Table 4 shows death rates relative to population under German Civil Code systems being significantly above common-law countries for 1960-1969, 1970-1979, and 1990-1999, while, for death rates relative to vehicles, Table 5 shows significant differences for 1950-1959 and 1960-1969 with insignificant differences during later periods. Thus the two tables are in agreement only for 1960-1969. This apparent discrepancy again can be explained by vehicle count relative to population, which for German Civil Code systems lies below common-law countries during 1950-1959 but generally rises above common-law countries after 1970 (see Figure 3).[13] Vehicle count relative to population also can explain similar apparent discrepancies involving Scandinavian Civil Code countries. Notably, Table 5 shows death rates relative to vehicles under Scandinavian Civil Code systems falling significantly below common-law countries during 1970-1979 and 1980-1989 while Table 4 shows insignificant differences for death rates relative to population during these periods. Again, Figure 3 can explain the apparent discrepancy because it shows a vehicle count relative to population in Scandinavian Civil Code countries being higher than in common-law countries after 1970.[14]

TABLE 4
REGRESSION TESTS ON LOG MOTOR VEHICLE ACCIDENT FATALITY RATE PER 100,000 PERSONS; ICD, LEGAL SYSTEM AND YEAR FIXED EFFECTS

Each column of this table shows estimated coefficients in a regression across countries classified by origin of legal system. The dependent variable is log motor vehicle accident fatality rate per 100,000 persons. The explanatory variable is the origin of legal system, with ICD coding system and fixed year effects as control variables. The left-hand column reports test results on data from the entire 1950-1999 period while the next five columns report tests on data from ten-year sub periods. Years and ICD systems were coded as zero-one dummy variables to take into account year-to-year variation and changes in medical reporting conventions as fixed effects. Tests on these year and ICD dummies are not reported. Countries' legal systems were coded as zero-one dummy variables with a variable for English Common-Law countries omitted. Thus the coefficients for legal system dummy variables other than common law are estimates of the log difference between that system's fatality rate and the rate for English Common-Law countries. T-statistics, which are reported in parentheses, are based on a robust between-cluster variance estimator that allows for arbitrary dependence among observations within a given country and heteroscedasticity between countries.

	Full period	**10 Year Subperiods**				
	1950-1999	1950-1959		1950-1999	1950-1959	
No. of Countries	102	43	59	72	86	71
No. of Observations	2393	270	489	514	603	517
Intercept – Common Law	2.10*** (6.87)	2.16*** (6.92)	2.16*** (10.22)	2.41*** (11.97)	2.37*** (16.38)	2.39*** (19.22)
French Civil Code Dummy	0.23 (1.40)	-0.11 (-0.41)	0.05 (0.21)	0.37 (1.75)	0.35* (2.07)	0.38* (2.34)
German Civil Code Dummy	0.56** (2.75)	0.34 (0.91)	0.86** (3.68)	0.74** (2.96)	0.42 (1.64)	0.39* (2.51)
Socialist Civil Code Dummy	0.41* (2.61)	-0.64* (-2.27)	0.07 (0.27)	0.46* (2.33)	0.47** (3.16)	0.50** (3.17)
Scand. Civil Code Dummy	0.28 (1.49)	0.03 (0.10)	0.47 (1.85)	0.40 (1.88)	0.29 (1.27)	-0.004 (-0.02)
Other Fixed Effects	ICD, Year	ICD, Year	ICD, Year	ICD, Year	ICD, Year	ICD, Year

Levels of Significance: * – $p < 0.05$; ** – $p < 0.01$; *** – $p < 0.001$

TABLE 5
REGRESSION TESTS ON LOG MOTOR VEHICLE ACCIDENT FATALITY RATE PER THOUSAND PASSENGER VEHICLES; ICD, LEGAL SYSTEM AND YEAR FIXED EFFECTS

Each column of this table shows estimated coefficients in a regression across countries classified by origin of legal system. The dependent variable is log motor vehicle accident fatality rate per thousand passenger vehicles. The explanatory variable is the origin of legal system, with ICD coding system and fixed year effects as control variables. The left-hand column reports test results on data from the entire 1950-1999 period while the next five columns report tests on data from ten-year sub periods. Years and ICD systems were coded as zero-one dummy variables to take into account year-to-year variation and changes in medical reporting conventions as fixed effects. Tests on these year and ICD dummies are not reported. Countries' legal systems were coded as zero-one dummy variables with a variable for English Common-Law countries omitted. Thus the coefficients for legal system dummy variables other than common law are estimates of the log difference between that system's fatality rate and the rate for English Common-Law countries. T-statistics, which are reported in parentheses, are based on a robust between-cluster variance estimator that allows for arbitrary dependence among observations within a given country and heteroscedasticity between countries.

	Full period	**10 Year Subperiods**				
	1950-1999	1950-1959	1969-1969	1970-1979	1980-1989	1990-1999
No. of Countries	102	43	59	72	86	71
No. of Observations	2393	270	489	514	603	517
Intercept – Common Law	0.91* (2.39)	0.74** (2.81)	0.44* (2.54)	0.32 (1.82)	-0.16 (-0.85)	-0.63** (-2.91)
French Civil Code Dummy	1.05*** (4.89)	1.33*** (5.84)	1.34*** (6.07)	1.10*** (4.31)	0.74*** (2.95)	0.73* (2.28)
German Civil Code Dummy	0.53* (2.17)	1.82** (2.95)	0.83* (.2.22)	0.04 (0.21)	-0.04 (-0.08)	0.28 (0.79)
Socialist Civil Code Dummy	1.46*** (7.54)	2.63*** (7.72)	1.86*** (8.06)	0.95** (3.54)	1.24*** (4.89)	1.31*** (5.55)
Scand. Civil Code Dummy	-0.28 (-1.24)	0.39 (1.52)	-0.08 (-0.31)	-0.48* (-2.17)	-0.80** (-3.17)	-0.41 (-1.36)
Other Fixed Effects	ICD, Year	ICD, Year	ICD, Year	ICD, Year	ICD, Year	ICD, Year
R^2	0.50	0.52	0.48	0.39	0.30	0.39

Levels of Significance: * – $p < 0.05$; ** – $p < 0.01$; *** – $p < 0.001$

☐ Tests Based on Combined Population and Vehicle Count Data

If other factors are held constant, deaths from motor vehicle accident deaths are likely to be a positive function of both population and number of vehicles; i.e., a country's population death rate from motor vehicles accidents is likely to increase with the number of vehicles. Table 6 reports regression tests from model where the measure of exposure is the product of population and vehicle usage. The dependent variable is log motor vehicle accident fatalities, with origin of legal system as the explanatory variable. The control variables are log passenger vehicles, log population, and dummy variables for fixed year and ICD coding system effects.[15] As in Tables 4 and 5, the ICD and year fixed effects make the tests equivalent to pooled cross-sectional tests based on each legal system's deviation from the average for the year and ICD coding system, and test statistics on year and ICD dummy variables are not reported.

Reporting of test results in Table 6 follows the same pattern of organization used in Tables 4 and 5. The left-hand column reports test results on data from the entire 1950-1999 period while the next five columns report tests on data from 10-year subperiods. Countries' legal systems were coded as zero-one dummy variables, omitting variables for English Common Law countries, the earliest year in the period, and the ICD coding system most frequently used by Common Law countries during the period (or ICD 6 for the entire 1950-1999 sample period). Thus the estimated intercept includes the log death rate for English Common-Law countries. Coefficients for civil code system dummy variables are estimates of the log difference between that system's fatality rate and the rate for an English Common-Law country with the same population and vehicle count. For example, the coefficient 0.50 for French Civil Code countries for the entire 1950-1999 period implies a geometric mean fatality rate that is $e^{0.50} = 1.65$ times the rate in a comparable English Common-Law country.

Compared with earlier estimates in Tables 4 and 5, patterns of significance in Table 6 resemble those for death rates relative to vehicles in Table 5, except for Scandinavian systems. Table 6 shows motor vehicle accident fatality rates in French, German and Socialist civil code countries exceeding those in common-law countries, in many cases at very strong ($p < 0.001$) levels of significance. These differences are evident for the entire 1950-1999 interval as well as every 10-year subperiod except 1980-1989 for German Civil Code systems. Point estimates for 10-year subperiods show fatality rates under all legal systems declining for periods after 1970-1979 after reaching a peak in either 1960-1969 or 1970-1979.[16] Point estimates

in Table 6 show fatality rates under German and Scandinavian systems declining relative to common-law systems beginning in 1960, with those under French and Socialist systems initially rising and later declining. Over the five subperiods, the decline under German systems is especially dramatic. Despite declining relative to common-law systems, estimated fatality rates under French, German and Socialist systems continue to remain significantly above common-law systems during 1990-1999, the last subperiod.[17] Table 6 shows no significant differences between fatality rates under Scandinavian and common law systems,[18] either for the entire 1950-1999 period or any subperiod.[19]

TABLE 6
MOTOR VEHICLE ACCIDENT FATALITIES, NUMBER OF PASSENGER VEHICLES, AND POPULATION; ICD, LEGAL SYSTEM AND YEAR FIXED EFFECTS

Each column of this table shows estimated coefficients in a regression across countries classified by origin of legal system. The dependent variable is log number of motor vehicle accident fatalities. The explanatory variable is origin of legal system, with log number of passenger vehicles (in thousands), log population (in hundreds), ICD coding system, and fixed year effects as control variables. The left-hand column reports test results on data from the entire 1950-1999 period while the next five columns report tests on data from the ten-year sub periods. Countries' legal systems were coded as zero-one dummy variables with a variable for English Common-Law countries omitted. Thus the coefficients for legal system dummy variables other than common law are estimates of the log difference between that system's fatality rate and the rate for English Common-Law countries. Years and ICD reporting systems are coded as zero-one dummy variables to take into account year-to-year variation and changes in medical reporting conventions as fixed effects. Tests on these year and ICD dummies are not reported. T-statistics, which are reported in parentheses, are based on a robust between-cluster variance estimator that allows for arbitrary dependence among observations within a given country and heteroscedasticity between countries.

TABLE 6
MOTOR VEHICLE ACCIDENT FATALITIES, NUMBER OF PASSENGER VEHICLES, AND POPULATION; ICD, LEGAL SYSTEM AND YEAR FIXED EFFECTS (continued)

	Full period	10 Year Subperiods				
	1950-1999	1950-1959	1969-1969	1970-1979	1980-1989	1990-1999
No. of Countries	102	43	59	72	86	71
No. of Observations	2393	270	489	514	603	571
Intercept – Common Law	-3.10*** (-8.16)	-3.08*** (-6.91)	-2.66*** (-4.48)	-2.61*** (-6.05)	-3.73*** (-9.79)	-4.40*** (-9.17)
French Civil Code Dummy	0.50*** (5.17)	0.54*** (4.07)	0.63*** (3.77)	0.67*** (4.92)	0.42** (3.35)	0.39* (2.29)
German Civil Code Dummy	0.50*** (4.46)	0.93*** (6.44)	0.79*** (4.87)	0.42* (2.52)	0.24 (0.98)	0.31* (2.01)
Socialist Civil Code Dummy	0.75*** (6.73)	0.78* (2.55)	0.86*** (4.02)	0.64*** (4.30)	0.64*** (5.07)	0.57*** (3.85)
Scand. Civil Code Dummy	0.09 (0.60)	0.27 (1.93)	0.22 (1.26)	0.03 (0.18)	0.01 (0.07)	-0.06 (-0.31)
Log Passenger Vehicles (000)	0.36*** (9.31)	0.47*** (11.51)	0.46*** (7.46)	0.42*** (7.45)	0.27*** (5.17	0.12 (1.88)
Log Population (00)	0.67*** (13.85)	0.61*** (11.32)	0.57*** (6.50)	0.59*** (9.27)	0.77*** (13.11)	0.91*** (11.58)
Other Fixed Effects	ICD, Year	ICD, Year	ICD, Year	ICD, Year	ICD, Year	ICD, Year
R^2	0.93	0.97	0.94	0.95	0.94	0.91

Levels of Significance: * – $p < 0.05$; ** – $p < 0.01$; *** – $p < 0.001$

☐ Origin of Legal System and Motor Vehicle Accident Fatality Rates Using Data Aggregated Across Countries Within Legal Systems

Tests reported in Tables 2 through 6 are based on country-level observations, where each observation is the reported fatality rate in a

country during a year. Observations are weighted equally, so outliers from small countries could unduly influence the fatality rate being attributed to a legal system. Weighted regression offers a method for reducing the effect of outliers, one that requires resolving additional issues such as the weighting method (e.g., weighting by population or vehicles). This section uses another approach: aggregating deaths, population counts and vehicles across countries within legal systems, then testing aggregated data for differences between legal systems.

Under this approach, the unit of observation is the legal system and the measure of exposure is population or number of vehicles falling under that legal system. For example, motor vehicle deaths and passenger vehicles can be totaled across countries within legal systems for each year, with the ratio of the two totals used to calculate the fatality rate per thousand passenger vehicles for each legal system. A maximum of five observations each year is possible under this approach, one for each type of legal system. These observations are graphed in Figures 4 and 5, respectively showing motor vehicle accident fatality rates per 100,000 persons and per thousand passenger vehicles.

Relative to earlier tests on country-level observations, tests on aggregated data are based on fewer observations. A maximum of five observations is possible each year, but missing data reduced the total to 240 observations for the 1950–1999 period covered in the data. The small number of observations for each year raises the possibility of overfitting the data in statistical testing.

Figure 4 does not suggest any functional form to describe population death rates or differences between legal systems, so separate tests were not performed on population death rates. Figure 5 suggests a log-linear time trend for death rates relative to vehicles under each type of legal system, which is the approach used to develop the estimates summarized in Table 7. In Panel A, the dependent variable is log motor vehicle accident fatality rate per thousand passenger vehicles, with a linear time trend (slope and intercept) for each legal system as explanatory variables. In Panel B, the dependent variable is log number of motor vehicle accident deaths, with explanatory variables being log number of passenger vehicles, log population, and a linear time trend for each legal system (similar to the model underlying tests in Table 6). A model allowing a separate time trend for each legal system was chosen because the data strongly reject ($p < 0.001$) the hypothesis of equal slopes across legal systems.

FIGURE 4
MOTOR VEHICLE ACCIDENT DEATHS PER 100,000 POPULATION, DATA AGGREGATED ACROSS COUNTRIES WITHIN LEGAL SYSTEMS

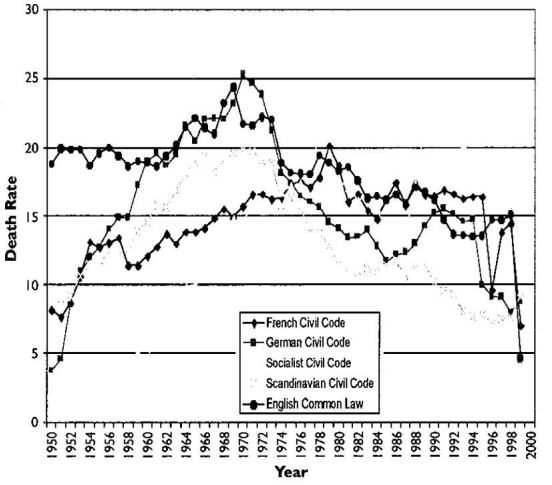
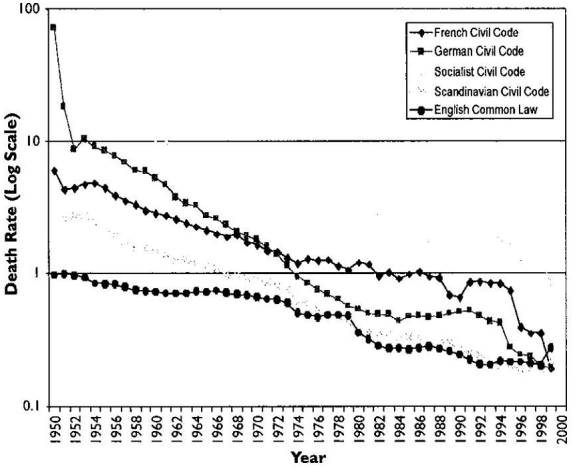


FIGURE 5
MOTOR VEHICLE ACCIDENT DEATHS PER THOUSAND PASSENGER VEHICLES, DATE AGGREGATED ACROSS COUNTRIES WITHIN LEGAL SYSTEMS



For the tests summarized in Table 7, countries' legal systems were coded as zero-one dummy variables with a variable for English Common-Law countries omitted. Thus estimates for civil code systems are an incremental effect relative to common-law systems, for both intercepts and slopes. The estimates include two intercepts for each legal system: one looking forward with a year 1950 origin and a second looking backward with a year 1999 origin. For civil code legal systems, these intercepts are estimates of log differences between the civil code and the common-law system, respectively at the beginning and end of the time period.

Estimates in Panel A and Panel B are consistent in several major respects. In both panels, estimated 1950 intercepts imply that motor vehicle accident fatality rates under every civil code system at the beginning of the period exceed those in common-law systems, at very strong ($p < 0.001$) levels of significance. Estimated 1999 intercepts imply that fatality rates under French and Socialist civil code systems still continue to exceed those under common-law systems, again at very strong ($p < 0.001$) levels of significance. Both panels also show end-of-period fatality rates under German civil code systems falling below those under common-law systems, although these test results are at a lower level of significance ($p < 0.05$). These tests also offer weak evidence of end-of-period fatality rates under Scandinavian Civil Code systems falling below those for common-law systems; this test is significant at $p < 0.05$ in Panel A but insignificant (and opposite in sign) in Panel B. The high vehicle count relative to population in Scandinavian Civil Code countries may help to explain this discrepancy (see Table 3).

Tests in Table 7 broadly support a conclusion that motor vehicle accident fatality rates under civil code systems declined at rates at least as high as those under common-law systems. Panel A tests on slope coefficients imply that fatality rates under every civil code system declined more steeply than under common-law systems. The tests on slope coefficients for French, German and Scandinavian systems are very strong ($p < 0.001$), while the test on Socialist systems is strong ($p < 0.01$). Panel B tests on slope coefficients still show fatality rates under German and Scandinavian systems declining at a greater rate than under common-law systems, at a very strong level of significance ($p < 0.001$). Panel B point estimates for slope coefficients also show death rates under French and Socialist systems declining more steeply than under common-law systems, but these tests are not significant.

TABLE 7 – PANEL A
MOTOR VEHICLE ACCIDENT FATALITIES – DATA AGGREGATED ACROSS COUNTRIES WITHIN LEGAL SYSTEMS TESTS ON FATALITY RATE PER THOUSAND PASSENGER VEHICLES

Both Panels of this table show estimated coefficients in regressions using data on population, fatalities and vehicles aggregated across countries within legal systems. In Panel A, the dependent variable is log motor vehicle accident fatality rate per thousand passenger vehicles. The explanatory variables are legal system and a linear time trend for each legal system. Countries' legal systems were coded as zero-one dummy variables with a variable for English Common-Law countries omitted. Thus estimates for legal systems other than common law are an incremental effect relative to common-law systems. Two sets of intercepts were estimated: one looking forward with a year 1950 origin and a second looking backward with a year 1999 origin. For other than common-law countries, 1950 and 1999 intercepts are estimates of log differences relative to common-law systems, respectively at the beginning and end of the time period. T-statistics are reported in parentheses.

Dependent Variable: Log Motor Vehicle Fatality Rate Per Thousand Passenger Vehicles

Explanatory Variables: Legal System, Time Trend

	Incremental Effect Relative to Common-Law Systems				
	English Common Law	French Civil Code	German Civil Code	Socialist Civil Code	Scandinavian Civil Code
Intercept (1950)	0.126 (1.68)	1.504*** (14.17)	2.448*** (23.07)	2.430*** (18.12)	0.916*** (8.46)
Forward Time- Slope Coefficient	-0.035*** (-13.85)	-0.014*** (-3.88)	-0.053*** (-14.70)	-0.013** (-3.12)	-0.023*** (-6.19)
Intercept (1999)	-1.68*** (-22.43)	0.788*** (7.43)	-0.266* (-2.51)	1.748*** (15.61)	-0.245* (-2.30)

Number of Observations: 240

$R^2 = 0.94$

Levels of Significance: * – $p < 0.05$; ** – $p < 0.01$; *** – $p < 0.001$

TABLE 7 – PANEL B
DATA AGGREGATED ACROSS COUNTRIES WITHIN LEGAL SYSTEMS MOTOR VEHICLE ACCIDENT FATALITIES, NUMBER OF PASSENGER VEHICLES, AND POPULATION

In Panel B, the dependent variable is log number of motor vehicle accident fatalities. The explanatory variables are legal system and a linear time trend for each legal system, with log number of passenger vehicles (in thousands) and log population (in hundreds) as control variables. Countries' legal systems were coded as zero-one dummy variables with a variable for English Common-Law countries omitted. Thus estimates for legal systems other than common law are an incremental effect relative to common-law systems. Two sets of intercepts were estimated: one looking forward with a year 1950 origin and a second looking backward with a year 1999 origin. For other than common-law countries, 1950 and 1999 intercepts are estimates of log differences relative to common-law systems, respectively at the beginning and end of the time period. T-statistics are reported in parentheses.

Dependent Variable: Log Number of Motor Vehicle Fatalities

Explanatory Variables: Legal System, Time Trend

Control Variables: Log Passenger Vehicles, Log Population

Log Passenger Vehicles (000)	0.510*** (24.10)
Log Population (00)	0.631*** (21.43)

	Incremental Effect Relative to Common-Law Systems				
	English Common Law	French Civil Code	German Civil Code	Socialist Civil Code	Scandinavian Civil Code
Intercept (1950)	-3.89*** (-13.08)	0.524*** (7.14)	1.168*** (13.90)	1.085*** (9.66)	0.692*** (8.69)
Forward Time- Slope Coefficient	-0.023*** (-15.58)	-0.002 (-0.75)	-0.026*** (10.84)	-0.0002 (-0.06)	-0.012*** (-6.07)
Intercept (1999)	-5.06*** (-17.67)	0.444*** (7.49)	-0.135* (-2.35)	1.076*** (16.#4)	0.062 (0.83)

Number of Observations: 240

$R^2 = 0.98$

Levels of Significance: * – $p < 0.05$; ** – $p < 0.01$; *** – $p < 0.001$

CONCLUSION

Using WHO data on mortality and United Nations data on vehicle usage, this paper shows how the measure of exposure can affect rankings of countries grouped by origin of legal system. The issue being studied is whether death rates from motor vehicle accidents vary across legal systems, although the underlying principle could be applied to other comparisons and other measures of exposure. Changing an aspect of the testing protocol such as the measure of exposure can affect and even may reverse specific conclusions about the effect of legal system on fatality rates. In some cases, a researcher may employ supplemental data to resolve discrepancies between testing methods.

Within the testing framework employed in this paper, the test results summarized in Tables 2 through 7 broadly support qualitative statements about differences between legal systems, some of which require qualification to reflect the measure of exposure or time interval. Motor vehicle accident fatality rates in common-law countries generally have fallen below those in other legal systems, especially French and Socialist Civil Code systems. These differences have been strong and persistent. A claim that common-law systems have the lowest motor vehicle accident fatality rates is supported by some of the tests. A claim that Scandinavian or German civil code systems have the lowest motor vehicle accident fatality rates is supported by other tests, although not until later in the period of study. None of the tests support a claim that common-law systems consistently have higher vehicle accident fatality rates than other legal systems.

The tests offer strong evidence of motor vehicle accident fatality rates under German and Scandinavian Civil Code systems during 1950-1999 declining at a steeper rate than under common-law systems. Additionally, the tests offer weak evidence of motor vehicle accident fatality rates under German and Scandinavian systems declining below those under common-law systems by 1999. The tests offer weaker evidence of fatality rates under French and Socialist systems declining at a greater rate than under common-law systems, but fatality rates under these systems still remain significantly above those under common-law systems at the end of the period of study.

TABLE A1
COUNTRIES LISTED BY ORIGIN OF LEGAL SYSTEM

English Common Law
Antigua and Barbuda
Australia
Bahamas
Bahrain
Barbados
Belize
Bermuda
British Virgin Islands
Canada
Cayman Islands
China, Hong Kong
Dominica
Egypt
Falkland Islands (Malvinas)
Fiji
Grenada
Guyana
Ireland
Israel
Jamaica
Malta
Montserrat
New Zealand
Papua New Guinea
Saint Kitts and Nevis
Saint Lucia
Saint Vincent & Grenadines
Singapore
Sri Lanka
Trinidad and Tobago
Turks & Caicos Islands
United Kingdom
United States

Scandinavian Civil Code
Denmark
Finland
Iceland
Norway
Sweden

French Civil Code
Argentina
Belgium
Brazil
Cape Verde
Chile
Colombia
Costa Rica
Cuba
Dominican Republic
Ecuador
El Salvador
France
French Guiana
Greece
Guadeloupe
Guatemala
Honduras
Italy
Jordan
Kuwait
Luxembourg
Martinique
Mauritius
Mexico
Netherlands
Netherlands Antilles
Nicaragua
Panama
Paraguay
Peru
Philippines
Portugal
Puerto Rico
Republic of Moldova
Saint Pierre and Miquelon
Sao Tome and Principe
Seychelles
Spain
Suriname
Turkey
Uruguay
Venezuela

Socialist Civil Code
Albania
Armenia
Azerbaijan
Belarus
Bulgaria
Croatia
Czechoslovakia (former)
Estonia
Georgia
German Democratic Republic
Hungary
Kazakhstan
Kyrgyzstan
Latvia
Lithuania
Macedonia (former)
Poland
Romania
Russian Federation
Slovakia
Slovenia
Tajikistan
Turkmenistan
Ukraine
Uzbekistan
Yugoslavia (former)

German Civil Code
Austria
Czech Republic
Germany
Germany – Federal Republic
Japan
Korea, Republic of
Switzerland

References

Boyer, Marcel and Georges Dionne,1987, "Description and Analysis of the Quebec Automobile Insurance Plan", *Canadian Public Policy – Analyse de Politiques,* 13, 2, p. 181-195.

Boyer, Marcel and Georges Dionne, 1989, "An Empirical Analysis of Moral Hazard and Experience Rating", *Review of Economics and Statistics,* 71, 1, p. 128-134.

Carrington, Paul D., 2003, "The Civil Jury and American Democracy", Duke Law School Public Law and Legal Theory Research Paper Series, Research Paper No. 44, Social Science Research Network Electronic Paper Collection, I.D. #460220.

Cohen, Alma and Rajeev Dehejia, 2002, "The Effect of Automobile Insurance and Accident Liability Laws on Traffic Fatalities", NBER Working Paper No. W9602, Social Science Research Network Electronic Library, Working Paper #363700.

Cummins, J. David, Richard D. Phillips, and Mary Weiss, 2001, "The Incentive Effects of No-Fault Automobile Insurance", Journal of Law and Economics, 44, p. 427-464.

Demougin, Dominique and Claude Fluet, 2002, "Preponderance of Evidence", Center for Economic Studies & ifo (CESifo) Institute for Economic Research Working Paper No. 725, 2, Social Science Research Network Electronic Paper Collection, I.D. #316767.

Dewees, Don, David Duff, and Michael Trebilcock, 1996, *Exploring the Domain of Accident Law*, New York, Oxford University Press.

Dionne, Georges, 2002, "Insurance Regulation in Other Countries", Chapter 9 in J. David Cummins (ed.), *Deregulating Property-Liability Insurance: Restoring Competition and Increasing Market Efficiency*, Washington, D.C., AEI-Brookings Joint Center for Regulatory Studies.

Dionne, Georges and Paul Lanoie, 2002, "How to Make a Public Choice about the Value of a Statistical Life: The Case of Road Safety", HEC Montreal, Risk Management Chair Working Paper Series No. 02-02, Social Science Research Network Electronic Paper Collection, I.D. #351700.

Dionne, Georges, Mathieu Maurice, Jean Pinquet , and Charles Vanasse, 2001, "The Role of Memory in Long-Term Contracting with Moral Hazard", Empirical Evidence in Automobile Insurance, Working Paper, Center for Research on Transportation, University of Montreal.

Djankov, Simeon, Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Shleifer, 2003, Courts, *The Quarterly Journal of Economics*, 118, 2, p. 453-517.

Glendon, Mary Ann, Michael Wallace Gordon, and Christopher Osakwe, 1994, *Comparative Legal Traditions*, St. Paul, Minnesota: West Publishing Company.

Huber, P. J., 1967, "The Behavior of Maximum Likelihood Estimates under Non-Standard Conditions", *In Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics*, vol. 1, p. 221-233. Berkeley, CA: University of California Press.

Keeton, W. Page, Dan B. Dobbs, Robert E. Keeton, and David G. Owen, 1984, *Prosser and Keeton on the Law of Torts,* St. Paul, MN, West Publishing Company.

Kochanowski, Paul S. and Madelyn V. Young, 1985, "Deterrent Aspects of No-Fault Automobile Insurance: Some Empirical Findings", *Journal of Risk and Insurance*, 52, 2, p. 269-288.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert W. Vishny, 2000, "Investor Protection and Corporate Governance" *Journal of Financial Economics,* 58, p. 3-27.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert W. Vishny, 1998, "Law and Finance", *Journal of Political Economy*, 106, 6, p. 1113-1155.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert W. Vishny, 1997, "Legal Determinants of External Finance", *Journal of Finance*, 52, p. 1131-1150.

Mattiacci, Giuseppe Dari, 2003, "Tort Law and Economics", Forthcoming in Hatzis Aritides (ed.), *Economic Analysis of Law: A European Perspective*, Edward Elgar, Social Science Research Network Electronic Library, Working Paper #347801.

Parisi, Francesco, 2002, "Rent-seeking Through Litigation: Adversarial and Inquisitorial Systems Compared", *International Review of Law and Economics*, 22, 2, p. 193-216.

Posner, Richard A., 1972, "A Theory of Negligence", *Journal of Legal Studies*, 1, 1, p. 29-96.

Reynolds, Thomas H. and Arturo A. Flores, 1989, "Foreign Law", *Current Sources of Codes and Basic Legislation in Jurisdictions of the World*, Littleton, Colorado, Rothman.

Sherwin, Emily L. and Kevin M. Clermont, 2001, "A Comparative View of Standards of Proof", University of San Diego School of Law, Public Law and Legal Theory, Working Paper 32, Winter 2000-2001, Forthcoming in the *American Journal of Comparative Law.*

Sloan, Frank A., Emily M. Stout, Kathryn Whetten-Goldstein, and Lan Liang, 2000, *Drinkers, Drivers, and Bartenders*, Chicago, University of Chicago Press.

Smith, Michael L., 2003, "Deterrence and Origin of Legal System: Evidence from 1950-2000", Ohio State University Dice Center working paper 2003-9, Social Science Research Network Electronic Library, Working Paper #414365.

Speiser, Stuart M., Charles F. Krause, and Alfred W. Gans, 1983, *The American Law of Torts*, Rochester, N.Y., The Lawyers Co-operative Publishing Co.; San Francisco, Calif., Bancroft-Whitney Co.

Statistical Abstract of the United States, U. S. Census Bureau, published annually.

United Nations, 2001, Department of Economics and Social Affairs, Statistics Division, *Statistical Yearbook*, 45th issue, CD-ROM version, New York.

United Nations, Department of Economic and Social Affairs, Statistics Division, *Statistical Yearbook*. New York, published annually.

U. S. Central Intelligence Agency, *The World Factbook*, Web version.

White, Halbert, 1980, "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity", *Econometrica*, 48, p. 817-838.

Williams, Rick L., 2000, "A Note on Robust Variance Estimation for Cluster-Correlated Data", *Biometrics,* 56, p. 645-646.

World Health Organization, 2000, "World Health Statistics Annual", World Health Organization mortality and population data available in the World Health Organization Statistical Information System (WHOSIS).

Zweigert, Konrad and Hein Kötz, 1998, *Introduction to Comparative Law*. New York, Oxford University Press.

☐ Notes

1. Table No. 1069 of the *2002 Statistical Abstract of the United States* reports U.S. motor vehicle accident death rates per 100 million vehicle-miles, per 100,000 licensed drivers, per 100,000 registered vehicles, and per 100,000 resident population. The following Table (No. 1070) uses the rate per 100 million vehicle-miles to compare death rates among states.

2. Where measures of cost-effectiveness are required for actions to reduce mortality rates, valuation of human life becomes another aspect of the problem. Dionne and Lanoie (2002) describe and evaluate methods for estimating the value of a statistical life for use in assessing projects affecting the risk of death or injury. Their study, which surveys over 85 papers on the subject, finds wide variation in estimated values, ranging from 0.16 million to 33 million Canadian dollars in year 2000.

3. The issue of possible deterrence effects of tort liability rules arose frequently in debates on no-fault automobile injury compensation systems in the United States and Canada (e.g., see Kochanowski and Young, 1985 or Boyer and Dionne, 1987). The enactment of no-fault systems in many states of the U.S. as well as in other countries led to empirical tests for deterrence effects. Early tests based on motor vehicle accident fatality rates produced mixed results, but later studies typically find that adoption of no-fault rules to replace common-law tort liability leads to an increase in automobile accident fatality rates (e.g., see Cummins, Phillips, and Weiss, 2001 and Cohen and Dehejia, 2002). Cohen and Dehejia also estimate the effect of compulsory insurance requirements which typically accompany no-fault. Less frequently, studies of deterrence effects have extended into other areas of liability. Dewees, Duff and Trebilcock (1996) analyze a large body of research in five areas of tort liability in the U.S. and Canada and conclude that deterrence effects seem strongest for automobile accidents and weakest for environmentally-related accidents, but generally not strong enough to overcome defects they identify in the tort system. Sloan, Stout, Whetten-Goldstein and Liang (2000) reach an opposite conclusion with respect to the liability of commercial servers of alcoholic beverages, citing studies including their own showing that imposition of liability on severs consistently reduces fatalities from alcohol-related motor vehicle accidents.

4. Enforcement of traffic rules provides an example. Evidence showing stringent enforcement could be interpreted as a sign of a legal system's focus on accident prevention. It also could be interpreted as an effort to strengthen incentives against dangerous behavior when incentives created by the legal system are weak. Mattiacci's (2003) survey of literature on economic incentives created by tort law and systems for allocating liability argues that civil law systems impose criminal sanctions or administrative penalties if their tort rules allow persons to less than fully internalize expected injury costs when

contemplating actions that might harm others. Less than full internalization of injury costs could occur where compensation does not consider aspects of injury whose costs are difficult to estimate or where the injuring party can escape being found liable. According to Mattiacci, punitive damages serve a similar purpose under the U.S. legal system.

5. To prove an assertion by the preponderance of evidence means to show that the assertion is more likely true than not. Demougin and Fluet (2002) use a mechanism design framework to show formally that a common-law type of negligence rule with preponderance of evidence standard is the only general rule for assessing liability that has minimal informational requirements to establish liability while also minimizing the sum of accident prevention costs and expected accident costs. Their finding holds even when parties to a dispute have unequal access to evidence and can distort information.

6. In the fifth edition of *Prosser and Keeton on Torts*, Keeton, Dobbs, Keeton and Owen (1984, p. 169-173) define negligence as behavior which should be recognized as involving unreasonable danger to others, where reasonableness is determined by the court balancing the risk of an act against its utility. In an early contribution to the Law and Economics literature, Posner (1972) argues that common-law rules of liability for negligence are designed to bring about efficient levels of safety and accident prevention (in the sense of weighing expected costs against benefits). Posner finds evidence supporting this theory in a sample of 1528 American appellate courts cases from the period 1875-1905.

7. In England, only criminal cases involving serious crimes where the defendant pleads "not guilty" are settled by jury trial. In the United States, not more than two or three percent of potential personal injury cases are litigated to a trial-court judgment, according to estimates cited by Speiser, Krause and Gans (1983, p. 10). That only a small fraction of injury cases are litigated presumably applies in most if not all countries, ones using civil as well as common law systems. The importance of jury trials lies not in the number of trials, however, but rather in the parties to a dispute having the right to a jury trial, a point recognized by Carrington (2003). In Carrington's view, the function of common-law juries includes modifying the enforcement of law that departs too far from common sense or commonly shared moral values.

8. Djankov, La Porta, Lopez-de-Silanes and Shleifer (2003) find that dispute resolution is more formalized in civil-law (especially French civil-law) countries as compared to common-law countries and in less-developed as compared to richer countries. Within civil-law countries, they find German and Scandinavian systems to be least formalized and French systems the most formalized. Their study examines the consequences of formalism for several measures of judicial quality, finding that more formalism is associated with longer duration of the dispute resolution process; lower judicial efficiency; greater corruption; lower levels of honesty, consistency and fairness of the court system; and inferior access to justice.

9. Countries grouped by origin of legal system appear in Table A1. Each country falls into one of five groups based on origin of legal system: four civil code systems based on French, German, Scandinavian and Socialist law; and a fifth based on English common law. In the few instances where a country changes legal system (e.g., the German Democratic Republic), the names appearing in Table A1 are those in the WHO data for the country during the time intervals when the legal system was present. Insufficient mortality data were available covering countries with legal systems based on Islamic law to include the group in the study. The mortality data in the World Health Organization (WHO) statistical information system covers only a single Islamic law country, for a total of nine years during the period 1973-1985. The Socialist Civil Code group consists of former members of the Soviet Union and Eastern Bloc countries because of their shared 20th century origin, although this grouping may mask heterogeneity among counties within the group.

10. Data on passenger vehicles rather than total vehicles were used because of better data availability.

11. Williams (2000) offers a proof that the robust between-cluster variance estimator is unbiased under very general assumptions for cluster-correlated data where observations are correlated within countries (clusters) but uncorrelated between countries. Williams also notes that this estimator is not well-documented in the literature despite being well-known and offering a wide range of applicability. Analyses that do not correct for dependence within clusters are likely to underestimate true variance.

12. The International Classification of Diseases (ICD) system is used to code causes of death for WHO reports. During the period 1950-1999, five ICD systems were in use: ICD 6, ICD 7, ICD 8, ICD 9, and ICD 10. In general, higher-numbered systems offering finer distinctions were adopted later in the period, although points of adoption differed across countries. The ICD variable is a proxy for changes in medical reporting conventions.

13. Figures 2 and 3 and, to a lesser extent, Figure 1 show abrupt changes in year 1985 for German Civil Code systems. These changes, which accompany the entry of data from a country previously not reporting, are noticeable because the number of countries adopting German Civil Code systems is small.

14. As a check on the sensitivity of the results to the inclusion of ICD coding and fixed time effects, results in Tables 4 and 5 were re-estimated omitting one or both control variables. Both sets of regressions employ legal system as a predictor variable. One set included ICD coding effects as the only control variable (i.e., without fixed time effects) while the other employed no control variables (i.e., no ICD coding or time effects). The resulting changes were minor. Tables 4 and 5 each report a total of 24 tests comparing civil code against common-law countries. Re-estimation developed 48 tests for each table, or a total of 96 tests. In two instances, an insignificant estimate changed sign but remained insignificant. A total of 18 changes in level of significance occurred in these re-estimations. None of these changes involved more than one level of significance relative to Table 4 or 5 (e.g., from ($p < 0.01$) to ($p < 0.001$) or from ($p < 0.05$) to insignificant). Of these total 18 changes, 8 were upward and 10 were downward. Two of these changes somewhat weaken conclusions in the narrative explaining Tables 4 and 5. In Table 4, estimates for Socialist Civil Code countries during 1950-1959 and for German Civil Code countries during 1990-1999 show death rates being significantly different from those in common law countries, at a five percent level of significance. These tests remain significant at the five percent level (and the same sign) if ICD coding effects are included as a control variable but drop below five percent when neither ICD coding or fixed time effects are included.

15. Data on passenger-miles could substitute for the combined population and vehicle count measure of exposure, but data on passenger-miles are available for few countries.

16. For civil code countries in Table 6, the point estimate of the intercept is the sum of the intercepts for the civil code group and the common-law countries.

17. The Law and Finance literature cited earlier in section 1 of this paper shows that a country's legal system affects the development of its financial markets, which ultimately could affect its economic development. Because economic development is not considered explicitly in the tests reported in Tables 4, 5, and 6, it is possible that the effects being attributed to origin of legal system instead are related to economic development. Unfortunately, problems related to induce correlation arise if economic development is considered explicitly in the type of tests reported in Tables 4 and 5. In either table, a per capita measure of economic development is by construction likely to be strongly correlated the dependent variable (motor vehicle accident fatality rate relative

to population or vehicles in use), either because the per capita measure is relative to population or because of the strong relation between economic development and vehicle usage. This problem is less likely to appear with the type of test reported in Table 6, where the dependent variable (motor vehicle fatalities) is not a ratio. The CD-ROM version of the United Nations Statistical Yearbook (2001) includes data on Per Capita Gross Domestic Product in U.S. Dollars for years 1980-1999, or Gross Domestic Product when multiplied by population. These data allowed a re-estimate of legal system effects in the presence of the measure of economic development for the last two ten-year subperiods in the tests reported in Table 6. Two changes in levels of significance occurred relative to Table 6: an increase for French Civil Code systems for 1980-1989 (from $p < 0.01$ to $p < 0.001$) and a decrease for Socialist Civil Code systems for 1990-1999 (from $p < 0.001$ to $p < 0.01$). Additionally, the level of significance declined for tests on passenger vehicles in use (another control variable), as would be expected because of its correlation with economic development. None of these changes affect the qualitative nature of the conclusions on legal system effects, which remain intact when economic development is taken into account.

18. The small sample size for the Scandinavian legal system (five countries) may be a contributing factor.

19. As in the earlier robustness check on the sensitivity of the results to the inclusion of ICD coding and fixed time effects, two other sets of regressions were run for the tests in Table 6. Both regressions use legal system as a predictor variable with population and vehicle count as control variables. One set of tests drops the ICD coding system control variable while the other drops both ICD coding and time effects. The resulting changes were minor. Table 6 reports a total of 24 tests comparing civil code against common-law countries. Re-estimation developed 48 tests, in which five changed level of significance relative to Table 6. When neither ICD coding nor time effects are used as control variables, tests on French and German Civil Code systems for 1990-1999 become insignificant while the level of significance for the test on German Civil Code systems for the entire 1950-1999 period drops to a five percent. Dropping either ICD coding system or both ICD coding and time effects as control variables causes the level of significance for tests on Socialist Civil Code systems for 1990-1999 to drop to one percent.