©*The Journal of Risk and Insurance*, 2000, Vol. 67, No. 1, 73-90

International Property-Liability Insurance Consumption

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Abstract

During the 1980s and early 1990s, the world insurance market grew substantially. World insurance premiums in 1993 accounted for about 8 percent of world gross domestic product (GDP), compared to 4 percent in 1984.

This article explains a substantial proportion of the variation in property-liability insurance consumption across countries belonging to the Organization for Economic Cooperation and Development (OECD). The study focuses on two lines of insurance: motor vehicle and general liability. The authors' analysis indicates that economic conditions affect the demand for insurance differently across lines of coverage. In particular, the authors' results suggest that income has a far greater effect on motor vehicle insurance consumption than on general liability insurance consumption. The authors find evidence that several factors are important in explaining the purchase of both kinds of insurance. These factors include income, wealth, the percent of a country's insurance market controlled by foreign firms, and the form of the legal system in the country.

Introduction

Advances in technology have spurred significant growth in international trade during the past 30 years. National economies have become increasingly intertwined as evidenced by world trade dependency[1] that reached 32 percent in 1991 (Human Development Report, 1994). In 1969, total world exports and imports were approximately $256 billion and $268 billion, respectively. By 1998, total world exports and imports had grown to $5,445 billion and $5,534 billion, respectively (International Monetary Fund, 1999).

The world gross national product (GNP) has also grown significantly during this time period. In 1991, world GNP per capita was $4,010, compared to $810 in 1970

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[1] Trade dependency is defined as "exports plus imports as a percentage of Gross Domestic Product (GDP)."

(International Bank for Reconstruction and Development/The World Bank, 1993). The service sector has continued to expand and accounted for 63.4 percent of world gross domestic product (GDP) in 1991, compared to 50.4 percent in 1960 (United Nations Conference on Trade and Development, 1993). The world insurance business, which constitutes a significant portion of the service sector, has grown at a rate of 10 percent annually since 1950. This growth rate has far exceeded that of overall world economic development.

Table 1 reports that in recent years, the world insurance business has grown even more rapidly; it grew at an average annual growth rate of 26 percent from 1984 to 1993 (Swiss Reinsurance Company, 1986 and 1995). Data also show that during the same period, the non-life insurance business grew at a rate of 18 percent annually while the life insurance business grew at a rate of 36 percent annually. In 1993, world insurance premium volume was approximately $1.8 trillion and accounted for about 8 percent of world GDP, compared to 4 percent in 1984 (International Bank for Reconstruction and Development/The World Bank, 1995). These statistics indicate that the insurance business has become increasingly important in the world economy.

TABLE 1

World Premium Volume ($ millions) in 1984 and 1993

Year	Non-Life (share)	Life (share)	Total (100%)
1984	281,500 (57%)	216,500 (43%)	498,000
1993	792,087 (44%)	1,010,490 (56%)	1,802,731

Source: Swiss Reinsurance Company, *Sigma,* April 1986 and May 1995

The market share of countries belonging to the Organization for Economic Cooperation and Development (OECD) has been fairly consistent over the period 1988 through 1993. Table 2 provides a summary of non-life insurance business of OECD member countries in terms of premium volume, world market share, insurance density, and insurance penetration for the year 1993. Premium volume represents total non-life insurance premiums written in the reporting country and is a major indicator of the importance of the insurance industry in the economy of that country. The world market share of a country is the ratio of that country's premiums to total world premiums. Insurance density is calculated by dividing direct gross premiums by the population and represents average insurance spending per capita in a given country. Insurance penetration is the ratio of direct gross premiums to GDP and indicates the relative importance of the insurance business in the domestic economy.

The United States ranked first in 1993 in premium volume with 41.52 percent of the world share, followed by Japan (14.74 percent) and Germany (8.86 percent), respectively. The top ten countries in premium volume all belong to the OECD. Together they accounted for approximately 85 percent of the world non-life insurance premium volume.

TABLE 2

Non-Life Insurance Business of the OECD Member Countries in 1993

Member Country	Premiums† (in U.S. $)	World Share (%)	World Rank	Insurance Density†††	Insurance Penetration
Australia	9,786	1.24	10	554.1	3.47
Austria	6,552	0.83	14	820.0	3.60
Belgium	7,037	0.89	13	700.2	3.34
Canada	19,096	2.41	7	664.2	3.46
Denmark	3,458	0.44	20	666.3	2.57
Finland	1,914	0.24	26	376.7	2.28
France	37,306	4.76	5	653.9	3.01
Germany	70,177	8.86	3	864.4	4.07
Greece	741	0.09	40	71.6	1.01
Iceland	187	0.02	61	719.5	3.08
Ireland	1,784	0.23	27	501.1	3.74
Italy	22,311	2.82	6	390.9	2.25
Japan	116,807	14.74	2	937.9	2.70
Luxembourg	423	0.05	49	1,113.2	4.21
Mexico	3,830	0.48	17	42.0	1.06
Netherlands	12,902	1.63	9	843.3	4.18
New Zealand	1,703	0.21	28	492.1	3.90
Norway	3,367	0.43	21	781.3	3.26
Portugal	2,246	0.28	25	227.8	3.00
Spain	14,072	1.78	8	359.5	2.94
Sweden	4,593	0.58	16	524.9	2.48
Switzerland	8,673	1.09	11	1,249.7	3.74
Turkey	1,307	0.17	33	21.7	1.11
U.K.	39,570	4.99	4	683.2	4.19
U.S.A.	328,892	41.52	1	1,276.8	5.18
Total	**715,302**	**90.29%**		**989.5††**	**4.09††**

Source: Swiss Reinsurance Company, *Sigma,* no. 5/95, 1995

† This column lists premiums in millions of U.S. dollars.

†† These figures represent weighted averages.

††† This column lists insurance density in U.S. dollars.

Among OECD member countries, in 1993 the United States ranked first in insurance density ($1,276.8), followed by Switzerland ($1,249.7) and Luxembourg ($1,113.2), respectively. In insurance penetration, in 1993 the United States ranked first (5.18), followed by Luxembourg (4.21) and the United Kingdom (4.18), respectively.

Not surprisingly, the growth in the international insurance business has led to an increasingly competitive market. Skipper (1994) indicates that currently, one-tenth

of U.S. premium dollars are paid to non-U.S. insurance companies. This proportion is expected to double by the year 2000.

The purpose of this article is to explain the difference in property-liability insurance consumption across countries. The current analysis differs from previous studies of the purchase of property-liability insurance in several important ways. First, the article employs disaggregated insurance data. Unlike prior studies that grouped together insurance purchases across all lines of property-casualty insurance, the authors' analysis is coverage-specific. In particular, the authors focus on motor vehicle insurance, a coverage purchased primarily by households, and general liability insurance, a coverage purchased predominantly by businesses. The disaggregated data allow us to test whether country-specific factors, such as income and the average educational attainment of the population, affect household and business purchases of insurance differently. Prior research at this level of analysis is not known to have been done.

Second, the data are more recent and more representative than data used in prior research. The data in this article span the period 1987 through 1993. The cross-sectional, time series nature of the data permits panel data analysis. Panel data methods provide efficient economic estimates by using information on both the intertemporal dynamics and the individuality of the entities, in this case countries, being investigated. The data provide information on the OECD member countries. Collectively, OECD member countries accounted for approximately 90 percent of the world nonlife insurance business during the data period.

FACTORS AFFECTING PROPERTY-LIABILITY INSURANCE CONSUMPTION

Insurance demand theory based on the expected utility paradigm [see for instance, Mossin (1968) and Szpiro (1985)] suggests that an individual's purchase of insurance depends on a number of different factors. These factors include the individual's income and wealth, the price of insurance, the individual's degree of risk aversion, and the probability of loss. The corporate demand for insurance is driven by the maximization of current shareholder value [see, for instance, MacMinn (1987)]. Nonetheless, in a corporate insurance market with transaction costs, the same set of factors—income, the price of insurance, risk aversion, and the probability of loss—are hypothesized to be important determinants of insurance consumption by businesses.[2]

Income

Income level is hypothesized to positively affect insurance consumption in a nation. Beenstock, Dickinson, and Khajuria (1988) find a positive relationship between income and spending on property-liability insurance. Outreville (1990, 1992) finds a positive relationship between property-liability insurance consumption and a nation's economic development. In this article, the income level is measured by GNP per capita.

Wealth

Arrow (1965) shows that the demand for insurance increases with wealth when individuals are characterized by increasing relative risk aversion. In contrast, Mossin

[2] In an insurance market without transaction costs—that is, the expected loss equals the price of insurance—individuals will fully insure, and corporations will be indifferent about purchasing insurance.

(1968) postulates conditions under which the optimal level of insurance coverage decreases with increases in wealth. Which theory is more consistent with actual insurance-purchasing behavior is an empirical question.

The data that the authors employ on national wealth come from the World Bank (*Monitoring Environmental Progress*, 1995). The World Bank's measure of wealth takes into account both natural (i.e., land and crops) and mineral resources of a country as well as human and social resources. Because information on wealth is available for only one year, it is a time-invariant variable in this article's analysis.

Price of Insurance

The market share held by foreign insurers in a country during a year is used as a proxy for the price of insurance.[3] Skipper (1987) states that many countries impose trade barriers that are designed to protect their local insurance industry, and consumers, from foreign competition. Economic theory holds that trade restrictions result in higher market prices. Kim (1992) contends that the exclusion of competitive foreign firms from a market typically results in lower-quality goods and higher prices in the domestic market.

Because protective measures may reduce competition and thus raise prices, a negative relationship is expected between the price of insurance and the market share of foreign insurers. Consequently, a positive relationship is anticipated between the market share of foreign insurers and property-liability insurance consumption. This study defines the market share of foreign insurers to include the branches and agencies of foreign undertakings in the total domestic non-life insurance market. This proxy for price is based on the assumption that the market share of foreign insurers correlates with price in the market. To the degree that the market share held by foreign insurers does not correlate with the stringency of trade barriers and therefore does not influence price, the proxy will suffer. For instance, if a country has a highly competitive market internally, foreign companies may not be attracted to it. Thus, a lower market share of foreign companies may represent a highly competitive market in a host country, which in turn results in a higher consumption of insurance. If this effect dominates, it is expected that the proxy will have a negative relationship with property-liability insurance consumption.

Risk Aversion

The level of risk aversion is hypothesized to be positively correlated with insurance consumption in a nation. Pratt (1964), Arrow (1965), and Szpiro (1985) show that in theory the more risk averse an individual is, the higher the amount insured. Schlesinger (1981) demonstrates that an optimal insurance decision is directly related to the insured's degree of risk aversion. He shows, under various assumptions, that an individual with a higher loss probability, a higher degree of risk aversion, or a lower level of initial wealth will purchase more insurance.

[3] This is an indirect measure of price. Although it is reasonable to assume that the price of insurance is higher in countries with trade barriers, other factors are also likely to affect the price of insurance. Prior studies of insurance demand have used the inverse of the loss ratio as a proxy for price. This measure is not available to us.

For closely held firms and partnerships, risk aversion by owners may play an important role in their insurance purchasing decisions. Mayers and Smith (1990) argue that closely held firms are more likely to purchase insurance than firms with less-concentrated ownership for the same reason that an individual purchases insurance—risk aversion. This is true because, according to Arrow (1974), insurance contracts allow owners of closely held firms to specialize in risk bearing only in dimensions in which they have expertise and thus a comparative advantage.

Mayers and Smith (1990) contend that it is inappropriate to assume that corporations are risk averse. Nonetheless, they argue that corporate purchases of insurance will be made if the purchase is consistent with profit maximization. In their analysis, utility maximization by corporate stakeholders—lenders, customers, employees, and suppliers—coupled with the profit maximization goal of business might result in a business purchasing insurance. For instance, a lender might be willing to lend to a corporation at an interest rate lower than usual if the business has acquired insurance coverage against risks that may imperil its ability to repay the loan. The profit-maximizing business would purchase insurance if the cost of insurance were less than the increased cost of borrowing if it did not buy the insurance. Risk aversion on the part of lenders and other stakeholders of the corporation can thus be an important determinant of corporate insurance purchases. Corporate insurance purchases are also explained by the fact that corporations seeking to maximize shareholder value can mitigate risk-shifting, underinvestment, and other agency problems through the purchase of insurance.

In this article, the level of education in a country is used as a proxy for risk aversion. This education level is measured by the enrollment ratio of third-level education, defined by the United Nations Educational Scientific and Cultural Organization (UNESCO) as the ratio of total enrollment in third-level educational institutions to the total population age 20 to 24. Education at the third level is provided by different types of institutions, including universities, teacher-training institutions, and technical institutes.

Browne and Kim (1993) argue that, in general, a higher level of education may lead to a greater degree of risk aversion and greater awareness of the necessity of insurance. Outreville and Szpiro, however, provide evidence that aversion toward risk is negatively correlated with higher education. They argue that higher education leads to lower risk aversion that in turn leads to more risk-taking by skilled and well-educated people.

Loss Probability

The probability of loss is hypothesized to positively affect insurance consumption in a nation. Mossin (1968) shows that the maximum premium that an individual is willing to pay for full property insurance coverage increases with the probability of loss and amount of loss. Smith (1968) demonstrates that the optimal amount of property-liability insurance depends on the probability of loss. Schlesinger (1981) shows that an individual with a high loss probability will purchase more insurance. According to Barro (1993), this relationship is expected to hold for any organization because an organization bases its utility (or profit) maximization decisions partly on the same economic factors—for instance, probability of loss, price, chance of loss, and attitude toward risk—as do individual consumers.

In this article, loss probability is proxied by urbanization and the form of legal system in the country. Urbanization is the proportion of a country's population living in urban areas. Prior studies have suggested that the frequency of losses is greater in areas with higher rates of urbanization, as a higher rate of interaction exists among individuals. Danzon (1986a, b) uses urbanization in her analysis of medical malpractice litigation and finds that it is significantly, positively related to the frequency of claims.

The legal system in place in a country ascribes responsibility to those deemed at fault. In this article, two broad categories of legal systems are considered: common-law systems and statutory-law systems. Syverud, Bovbjerg, Pottier, and Witt (1994) contend that the common-law system of the United States is a factor in its leading the world in per capita consumption of liability insurance. They argue that insurers and attorneys, with the cooperation and encouragement of legal and political institutions, have successfully driven Americans to overconsume liability insurance. The authors hypothesize that insurance consumption is greater, other things being equal, in common-law countries than in statutory-law countries. Because there were no changes in the legal system in the authors' sample, it is a time-invariant variable in the analysis.

EMPIRICAL ANALYSIS

Data Sources and Characteristics

Insurance consumption in a society consists of the sum of demands from both individual households and firms. Assuming that the inhabitants of a nation are homogeneous relative to those of other countries, per capita values of non-life insurance premiums represent a country's insurance consumption. In this article, therefore, property-liability insurance consumption is measured by premium density of each of two lines of non-life insurance: motor vehicle and general liability. Because of the growing awareness of the importance of world insurance markets and the internationalization of the insurance business, the Organization for Economic Cooperation and Development (OECD) recently began publishing the *Insurance Statistics Yearbook.* This compilation has been prepared by the Directorate for Financial, Fiscal, and Enterprise of Affairs and is issued under the responsibility of the Secretary General of the OECD. A recent publication contains time series data of international property-liability insurance, which are compiled over the period 1987 through 1993. Available data include the number of insurance companies and employees, premium density, market penetration, productivity, and insurance premiums by line of property-liability insurance.

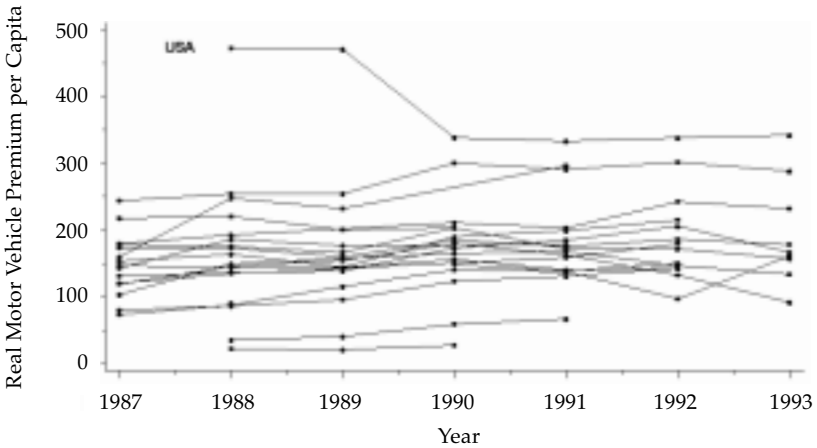
For the empirical analysis in this article, observations consist of both time series and cross-sectional data. This unique data set makes possible, for the first time, the analysis of factors believed to lead to variations in insurance consumption by line of property-liability insurance across OECD member countries. In 1993, OECD member countries accounted for approximately 92 percent of the world insurance premium volume: 90 percent of world non-life and 93 percent of world life insurance premium volume, respectively. A list of the data sources used in this article appears in Appendix Table B.1.

As shown in Table 4, the average premium density of motor vehicle insurance was $172.70 per capita during the period 1987 through 1993. This number represents approximately 21 percent of the average non-life premium density ($819 per capita) of the OECD member countries. Table 3 shows the growth in premium density over the period studied. For comparison, average premium density of general liability insurance was $34.23 per capita during the period 1987 through 1993. This number accounts for approximately 4 percent of the average non-life premium density of the OECD member countries.

TABLE 3

Multiple Time Series Plot of Motor Vehicle Premiums

Each line corresponds to a country; it represents a time series of motor vehicle premiums, on a per capita basis, in constant U.S. dollars. The figure illustrates that, for most countries, premiums are stable over time. The figure also shows that premium data are missing for many countries.



A list of the independent variables motivated by the section entitled "Factors Affecting Property-Liability Insurance Consumption" appears in Table 4. The average income (GNP per capita) among the OECD member countries was $15,342 per capita. The average protective measures (percentage of market share of foreign insurers) was 8.01 percent with Ireland ranked first with 37.88 percent in 1988, New Zealand ranked second with 30.09 percent in 1990, and Canada ranked third with 27.54 percent in 1988. The average risk aversion (enrollment ratio of third-level education) was 40.33 percent, with Canada ranked first in 1992 in this category at 98.8 percent, the United States ranked second with 80.6 percent in 1993, and New Zealand ranked third with 57.5 percent in 1993. Lastly, the average urbanization (percentage of population living in metropolitan areas) was 72.28 percent. Countries that ranked highly include Belgium, Iceland, and the Netherlands.

Model Estimation

To test the preceding hypotheses, we use both a fixed-effects panel data model and a pooled cross-sectional model. By including country-specific intercept terms, the fixed-effects model controls for differences between countries that are otherwise not ac-

counted for by other independent variables in the model. See, for example, Greene (1993), Hsiao (1986), and Baltagi (1995) for a description of fixed-effects models. The fixed-effects model does not include the time-invariant variables, wealth and legal system (see Appendix A). Coefficients cannot be estimated for time-invariant variables in a fixed-effects model (Hausman and Taylor, 1981). In contrast, the pooled cross-sectional model does not include the country-specific intercept terms of the fixed-effects model.

TABLE 4
Descriptive Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
Dependent Variables				
Motor Vehicle Premium Density (U.S. $/capita)	172.70	77.65	20.44	473.22
General Liability Premium Density (U.S. $/capita)	34.23	28.08	0.39	100.85
Independent Variables				
Income (U.S. $)	15,342.00	5,142.00	4,395.00	27,880.00
Protective Measures (Foreign Firm Market %)	8.02	9.89	0.00	37.88
Risk Aversion (Third-Level Education Ratio)	40.33	18.89	17.50	102.90
Loss Probability (Urbanization %)	72.28	13.81	32.70	96.50
Wealth (per capita, $1,000)	433.07	176.48	141.00	835.00
Legal System (1 if common law, 0 if statutory law)	0.31	0.46	0.00	1.00

Notes: 1. Out of 25 OECD member countries, Germany and Turkey are excluded because of lack of data reliability. Mexico is also excluded because of absence of data.
2. Also excluded are observations for which the premium density is missing.
3. Premium densities and income are in constant (1985) U.S. dollars.

The specification of the fixed-effects model is as follows:

$$y_{it} = \alpha_i + \beta_1 \text{INCOME}_{i,t} + \beta_2 \text{LOG(MARKET SHARE OF FOREIGN INSURERS)}_{i,t} + \beta_3 \text{LOG(ENROLLMENT RATIO OF THIRD-LEVEL EDUCATION)}_{i,t} + \beta_4 \text{LOG(URBANIZATION)}_{i,t} + \varepsilon_{it}$$

Here, the subscript i represents the country, with $i = 1, \ldots, 22$; the subscript t represents time, with $t = 1, \ldots, 7$; y_{it} represents premium density for country i at time t; α_i are country-specific intercept terms; $\beta_1, \ldots, \beta_4$ are the slope parameters; and ε_{it} are the random error terms. The model was estimated separately for motor vehicle and

general liability premium densities as dependent variables.[4] These estimated models are reported in Figure 5.

The country-specific intercept terms in the fixed-effects model control for differences that are not otherwise controlled for by other variables in the model. Although the model does not explicitly control for factors influencing insurance cost, such as accident rates, motorization rates, alcohol consumption, capital stock, and attitudes toward litigation, the country-specific intercept terms in the fixed-effects model implicitly control for these effects.

TABLE 5
Empirical Model Estimation

	Dependent Variables			
	Motor Vehicle		General Liability	
Independent Variables	Fixed Effects	Pooled Cross-Sectional	Fixed Effects	Pooled Cross-Sectional
INTERCEPT	—	77.572 (0.462)	—	160.63 (0.001)
INCOME (U.S. $)	0.010 (0.001)	0.012 (0.001)	0.001 (0.018)	0.007 (0.001)
LOG (Foreign Firm Market %)	–33.403 (0.056)	–17.901 (0.013)	10.927 (0.004)	8.003 (0.001)
LOG (Third-Level Education Ratio)	–10.688 (0.728)	11.672 (0.423)	8.968 (0.159)	–36.349 (0.001)
LOG (URBANIZATION %)	–147.844 (0.813)	–14.292 (0.552)	–77.008 (0.554)	–19.567 (0.012)
WEALTH ($1,000 U.S.)	—	–0.165 (0.001)	—	–0.069 (0.001)
LEGAL SYSTEM (1 if common law)	—	82.050 (0.001)	—	56.917 (0.001)
R^2 (%)	91.8	64.7	97.5	74.6

Note: p-values are in parentheses.

Several diagnostic tests were performed to validate these models. Scatter plots of standardized residuals versus fitted values from both models showed no serious heteroscedasticity problems. Further, recalculating standard errors using empirical estimates for heteroscedasticity correction due to Huber (1967) and White (1980) did not change the results substantially. Normal probability plots and related normality tests support the assumption that the residuals in each model are approximately normally distributed. Tests for autocorrelation suggested that both models were free of

[4] The model implicitly assumes that the relative price of insurance among countries remains constant over the period 1987 through 1993.

autocorrelation. As shown in Table 1, not all combinations of countries and time periods above are available, causing the panel to be unbalanced. This imbalance does not pose a problem with least squares estimation, although it can lead to missing data biases. See, for example, Frees (1996) for a discussion of this source of bias. Because of the nature of the sample selection, the authors do not anticipate this source of bias to be a problem. As another sensitivity test, the authors also fit a random effects model, whereby one treats the country-specific intercepts, α_i, as random variables. However, there was little difference in the estimation of the slope coefficients, β_j, between the two types of estimation methods. Further, the Hausman test statistic (see, for example, Hsiao, 1986, for a description) indicated that the difference between fixed and random effects estimates was not statistically significant.

Discussion of the relationships found between the insurance measures and each of the independent variables follows. As suggested by the coefficient of determination R^2 in Table 4, partial F (Chow) tests indicate that the fixed-effects models dominate the pooled cross-sectional models. Thus, the discussion focuses on results obtained from the fixed-effects models. The pooled cross-sectional models, plus technical details described in Appendix A, provide the basis for discussion of our time-invariant variables, wealth and legal systems.

Income

As reported in Table 5, the relationship between premium density and the independent variable INCOME (GNP per capita in U.S. dollars) is positive and statistically significant in all models. This is consistent with the findings from previous studies that income is positively correlated with insurance consumption. Although income is significant in both models, the coefficient estimates suggest that changes in income have a more pronounced effect on motor vehicle insurance consumption than on general liability insurance consumption.

Market Share of Foreign Insurers

The relationship between the market share of foreign insurers variable and motor vehicle premium density is negative and statistically significant. This result is interesting in that it seems to contradict competitive economic theory and Kim's (1992) open market argument. A possible explanation of this finding is that if a country has a highly competitive market internally, then the market is not attractive to foreign insurance companies. Thus, a low market share of foreign companies may represent a highly competitive domestic market, which in turn induces higher insurance consumption.

The relationship between the market share of foreign insurers and general liability premium density is positive and statistically significant. This finding is consistent with the hypothesis that the consumption of insurance is greater in markets in which foreign insurers have a greater market share, presumably because of greater price and quality competition.

The contrast in findings between the motor vehicle insurance line and the general liability insurance line may result from differences in skill needed to write the two types of insurance. Competition between domestic insurers to write motor vehicle

insurance may be much greater in many countries than competition between domestic insurers to write general liability insurance. As a result, insurers may be more likely to enter foreign markets to pursue profits writing general liability coverage rather than motor vehicle insurance.

Risk Aversion

The risk-aversion measure used in this article, the third-level education enrollment percentage, is statistically insignificant in the motor vehicle insurance model. The result is surprising in that it contradicts Browne and Kim's (1993) findings regarding life insurance consumption and contradicts the economic theory that risk aversion is one of the main reasons that individuals purchase insurance. Possibly education is not an adequate proxy for risk aversion. Contrary to Browne and Kim's (1993) hypothesis that education is positively related to risk aversion, Outreville and Szpiro (working paper) argue that higher education leads to lower risk aversion, which in turn leads to more risk-taking by skilled and well-educated people. The literature on the effects of education on risk aversion is inconclusive.

In the general liability insurance pooled cross-sectional analysis, the proxy for risk aversion is negatively related to premium density. The relationship is statistically significant. This finding provides support for Outreville and Szpiro's contention that higher education is associated with lower risk aversion.

Urbanization

The relationship between urbanization and premium density is statistically insignificant in all but the general liability pooled cross-sectional model. Contrary to the authors' hypothesis, this result suggests that general liability insurance consumption is greater in countries with lower urbanization rates. This finding needs to be treated with caution, as the variable is not also significant in the general liability fixed-effects model.

Wealth

The wealth variable is negative and statistically significant in both the motor vehicle and general liability ordinary least squares regression models. The results are consistent with Mossin (1968) and the contention that wealth is a substitute for insurance.

Legal System

The legal system variable is strongly statistically significant in both the motor vehicle and general liability least squares regression models. These findings suggest that, other things being equal, insurance consumption is greater in common-law countries than in statutory-law countries.

CONCLUSION

Significant growth has occurred in the world insurance market since 1950. This article provides information on the amount of property-liability insurance purchased in each of the OECD countries. As of 1993, the leading purchasers of insurance are the United States, Japan, and Germany.

Prior research on insurance consumption has been based on data that are aggregated across all lines of non-life insurance. This prevented detection of differential effects across individual lines of coverage. In the current article, disaggregated data are used to analyze the consumption of motor vehicle insurance and general liability insurance. Households purchase the majority of motor vehicle insurance. In contrast, businesses purchase the majority of general liability insurance.

The current article indicates that the use of disaggregated data is preferred when one attempts to explain variations in the international consumption of insurance. The analysis reveals that the purchase of different lines of insurance is influenced differently by various economic and demographic conditions. The authors find that income is positively correlated with the purchase of both lines of insurance. However, income has a much greater effect on the purchase of motor vehicle insurance than on the purchase of general liability insurance. The market share of foreign insurers is negatively related to motor vehicle insurance consumption. The relationship is statistically significant. In contrast, the relationship between this variable and general liability insurance consumption is positive and statistically significant. The difference in technical ability required to write these two lines of insurance may explain these contrasting results.

The authors include two time-invariant variables, national wealth and the form of the legal system in a country, in the analysis. Although the findings in regard to these variables must be interpreted with caution (see Appendix A), both variables are significantly related to insurance purchases in directions consistent with theory.

APPENDIX A

Significance of Time-Invariant Variables

Testing the significance of time-invariant independent variables in fixed effects panel data models has not been directly addressed in the panel data literature. See, for example, standard references such as Greene (1993), Hsiao (1986), and Baltagi (1995). Thus, to explain the importance of the time-invariant variables WEALTH and LEGAL, the authors first provide some background in terms of a general fixed effects panel data model.

To this end, consider the model

$$y_{it} = \alpha_i + \boldsymbol{\beta}' \mathbf{x}_{it} + \boldsymbol{\gamma}' \mathbf{z}_i + \varepsilon_{it}, \tag{A.1}$$

where $\mathbf{x}_{it}$ is a $k \times 1$ column vector of time-varying independent variables, $\boldsymbol{\beta}$ is the corresponding $k \times 1$ slope vector, $\mathbf{z}_i$ is a $q \times 1$ column vector of time-invariant independent variables, and $\boldsymbol{\gamma}$ is the corresponding $q \times 1$ slope vector. The authors allow for unbalanced data and explicitly denote it by using $t = 1, \ldots, T_i \leq T$, the maximal number of time periods. The subjects range from $i = 1, \ldots, n$, so that there are a total of $N = T_1 + T_2 + \cdots + T_n$ observations.

The variable intercepts $\{\alpha_i\}$ capture the many omitted variables that are specific to a subject and that do not depend on time (Hsiao, 1986, Chapter 3). However, it is well-

known that $\boldsymbol{\gamma}$ cannot be estimated when α_i are treated as fixed effects (Hausman and Taylor, 1981). This is often cited as an important drawback when modeling α_i as a fixed effect (see, for example, Baltagi, 1995, page 11). For comparison, when α_i is chosen to be a random effect, the time-invariant coefficients can be estimated. From a general linear model standpoint, the hypothesis H_0: $\boldsymbol{\gamma} = 0$ is not testable because $\boldsymbol{\gamma}$ is not an estimable function (Searle, 1987, Chapter 8, or Frees, 1996, page 625). The slopes $\boldsymbol{\gamma}$ are not estimable because the time-invariant variables $\mathbf{z}_i$ are collinear with the intercept terms α_i.

Although the parameters $\boldsymbol{\gamma}$ are not estimable, it is possible to fit the model in equation (A.1) using generalized inverses to solve the corresponding normal equations. Even without unique estimates of the parameters α_i and $\boldsymbol{\gamma}$, the residuals and corresponding sums of squares are unique, that is, invariant to the solution of the normal equations.

To this end, let SS($\boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\gamma}$) be the error sum of squares corresponding to the model in equation (A.1). Further, let SS($\boldsymbol{\beta}$), SS($\boldsymbol{\beta}$, $\boldsymbol{\gamma}$) and SS($\boldsymbol{\alpha}$, $\boldsymbol{\beta}$) be the sum of squares corresponding to the models

$$y_{it} = \beta_0 + \boldsymbol{\beta}'\mathbf{x}_{it} + \varepsilon_{it} \tag{A.2}$$

$$y_{it} = \beta_0 + \boldsymbol{\beta}'\mathbf{x}_{it} + \boldsymbol{\gamma}'z_i + \varepsilon_{it}, \tag{A.3}$$

and

$$y_{it} = \alpha_i + \boldsymbol{\beta}'\mathbf{x}_{it} + \varepsilon_{it}, \tag{A.4}$$

respectively. Define the sequential sum of squares $SS(\gamma|\beta) = SS(\beta) - SS(\beta, \gamma)$, $SS(\alpha|\beta) = SS(\beta) - SS(\alpha, \beta)$ and $SS(\alpha|\gamma, \beta) = SS(\beta, \gamma) = -SS(\alpha, \beta, \gamma) = SS(\beta, \gamma) - SS(\alpha, \beta)$.

With these sums of squares, standard linear model arguments can be used to develop testable questions. The authors' questions are presented so that they are parallel to a standard discussion of the importance of variables in fixed effects models, Chapter 2 of Hsiao (1986). The authors are now in a position to respond to the following questions:

1. Are the specific time-invariant effects identified through $\mathbf{z}_i$ ($\boldsymbol{\gamma}$) important? Here, H_0: $\boldsymbol{\gamma} = \mathbf{0}$ can be tested using the model in equation (A.3).
2. Are all time-invariant effects important? This is the traditional question of whether to pool. The null hypothesis H_0: $\alpha_1 = \cdots = \alpha_n$ can be tested using the model in equation (A.4).
3. Are the time-invariant effects over and above those identified through $\mathbf{z}_i$ ($\boldsymbol{\gamma}$) important? This is again a testable hypothesis using the model in equation (A.1).
4. Are the time-invariant effects identified through $\mathbf{z}_i$ ($\boldsymbol{\gamma}$) important given all other time-invariant effects? As discussed above, this is *not* a testable hypothesis. However, the importance of all time-invariant effects (Question number 2) can be tested for. If the results of this test are negative (supporting the null hypothesis), then this suggests that specific time-invariant effects $\boldsymbol{\gamma}$ are also unimportant.

In each case, decisions about the null hypothesis can be made by comparing a test statistic to an *F*-distribution. Table A.1 provides the test statistics and degrees of freedom for each testable hypothesis.

TABLE A.1
Test Statistics for Three Hypotheses for Judging the Importance of Time-Invariant Variables

Question	Test Statistic	Numerator Degrees of Freedom (d.f.$_1$)	Denominator Degrees of Freedom (d.f.$_2$)
1	$\dfrac{SS(\boldsymbol{\gamma}\mid\boldsymbol{\beta})\ /\ d.f._1}{SS(\boldsymbol{\gamma},\boldsymbol{\beta})\ /\ d.f._2}$	q	$N-(1+q+p)$
2	$\dfrac{SS(\boldsymbol{\alpha}\mid\boldsymbol{\beta})\ /\ d.f._1}{SS(\boldsymbol{\alpha},\boldsymbol{\beta})\ /\ d.f._2}$	$n-1$	$N-(n+p)$
3	$\dfrac{SS(\boldsymbol{\alpha}\mid\boldsymbol{\beta},\boldsymbol{\gamma})\ /\ d.f._1}{SS(\boldsymbol{\alpha},\boldsymbol{\beta},\boldsymbol{\gamma})\ /\ d.f._2}$	$n-q-1$	$N-(n+p)$

To illustrate these decision-making procedures, the authors return to the application that motivated the development. For simplicity, only motor vehicle insurance is considered.

Illustration A.1 Motor Vehicle Model

For the motor vehicle model described in the Model Estimation section, the authors are interested in the importance of $q = 2$ time-invariant variables, WEALTH and LEGAL. For the fitted model, we have $p = 4$ time-varying variables and, when including these variables, $n = 20$ countries and $N = 108$ observations. Each of the four questions concerning the time-invariant variables is considered in this context.

1. Are wealth and legal systems important determinants of a country's motor vehicle premiums (per capita)? The authors test the null hypothesis H_0: $\boldsymbol{\gamma}_{WEALTH} = \boldsymbol{\gamma}_{LEGAL} = 0$, using model (A.3). For our data set, it turns out that the test statistic in Figure A.1 is 19.25. With degrees of freedom $q = 2$ and $N - (1 + q + p) = 101$, the *p*-value is less than .0001, indicating strong statistical significance. This is true even after controlling for the other explanatory variables, income, price of insurance, risk aversion, and loss probability.

2. Clearly, many time-invariant variables may affect a country's motor vehicle premiums. Are the combined effects of these variables important? To respond to this question, the authors use a test of the null hypothesis H_0: $\alpha_1 = \cdots = \alpha_{20}$ with the model in equation (A.4). For our data set, it turns out that the test statistic in Figure A.1 is 22.09. With degrees of freedom $n - 1 = 19$ and $N - (n + p) = 84$, the p-value is less than .0001, indicating strong statistical significance.

3. Having accounted for the time-invariant variables wealth and legal systems, are there other important omitted, time-invariant variables that the model does not specifically include? The response to this question is that the test statistic in Figure A.1, for our data set, is 16.51. With degrees of freedom $n - q - 1 = 17$ and $N - (n + p) = 84$, the p-value is less than .0001, indicating strong statistical significance. This indicates that several important variables are omitted from the specification in model (A.3).
4. Are the time-invariant variables wealth and legal systems the best variables to use, or are there other, more appropriate, variables? As shown under question 3, the additional (unidentified) time-invariant effects are also important. Because hypothesis number 4 cannot be tested, it is possible that these additional effects are collinear with WEALTH and LEGAL. Thus, the study is susceptible to this source of bias.

APPENDIX B
Data Sources

Table B.1. The Data Sources

Data	Sources	Publishers
Premium Density	*Insurance Statistics Yearbook* (1986-1993)	OECD
Income (GNP/Capita)	*World Tables* 1995	IBRD/The World Bank
Consumer Price Index	*International Financial Statistics*	IMF
Protective Measures	*Insurance Statistics Yearbook* (1986-1993)	OECD
Third-Level Education	*UNESCO Statistical Yearbook*	UNESCO
Population Density	IMD&S 1996	BPC Wheatons Ltd.
Urbanization	*World Tables* 1995	IBRD/The World Bank
Wealth	*Monitoring Environmental Progress*	World Bank
Legal System	*Statistical Abstract of the World*	Gale Research Inc.

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