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Corporate Risks and Property Insurance: Evidence From the People's Republic of China

Hong Zou
Mike B. Adams
Mike J. Buckle

Abstract

Using panel data (1997–1999) for 235 publicly listed companies in the People's Republic of China, this study empirically tests the linkage between corporate risks and the decision to purchase property insurance and its financial extent. To achieve these objectives, we first estimate a probit insurance participation decision model and then a fixed-effects insurance volume decision model with Heckman's sample selection correction. Our results indicate that the managerial decision to purchase property insurance is positively related to company size and insolvency risks. By contrast, the amount of property insurance purchased is positively related to systematic risks but negatively related to insolvency and unsystematic risks and company size. We find that the amount of property insurance used by Chinese companies can also be affected by other factors (e.g., the cash flow constraints). In addition, the decision to purchase property insurance and the financial extent to which it is used varies among Chinese companies according to their geographical location. However, state ownership does not appear to be an important determinant of the purchase of property insurance by Chinese publicly listed companies.

Hong Zou is a lecturer in Accounting and Finance at the Cardiff Business School, Cardiff University, U.K. Mike B. Adams and Mike J. Buckle are with the European Business Management School at the University of Wales, Swansea. Address correspondence to Hong Zou at e-mail: zouh2@cf.ac.uk. The comments of Simon Gao, Philip Hardwick, Robert Hoyt, Paul Klumpes, Clive Lennox, Steven Young, and two anonymous referees on earlier versions of this article are appreciated. The article benefited from the suggestions of delegates at the 2001 U.K. Chinese Economists' Conference, London; the 2001 University of Wales' Accounting and Finance Colloquia, Gregynog; and the 2001 American Risk and Insurance Association Conference, Indianapolis, Indiana. The comments of participants of seminars held at the Department of Management, University of Southampton, the Warwick Business School, University of Warwick, and the Accounting and Finance Department, University of Lancaster, United Kingdom, are also acknowledged. Hong Zou is further grateful for the generous financial support from the Association of British Insurers. Hong Zou dedicates this study to the School of Insurance, South Western University of Finance and Economics, China, and Mr. Wang Enshao for their role in stimulating his interest in the Chinese insurance industry. However, the usual disclaimer applies.

INTRODUCTION

Previous studies (e.g., MacMinn, 1987; MacMinn and Han, 1990, Grace and Rebello, 1993; Hoyt and Khang, 2000) suggest that insurance helps managers alleviate such business risks as bankruptcy following a major accidental loss. Therefore, other things being equal, one expects companies with higher expected claims costs (hereafter, high-risk companies) to have a greater propensity to purchase insurance than entities with lower expected claims costs (hereafter, low-risk companies). Researchers such as Harrington (1984) and Harrington and Danzon (2000) add that regulatory controls on premium rates could encourage high-risk companies to hedge their activities via insurance because such entities can secure economic advantages because insurers are unable to charge risk-commensurate premiums. Therefore, the degree to which insurance is used to manage corporate risks in a large and price-regulated insurance market, like the People's Republic of China (PRC), is an empirical issue of some importance to those parties (e.g., multinational corporations) with an investment interest in emerging markets. This study thus seeks to examine empirically the relation between discretionary (i.e., nonstatutory) property (asset-based) insurance and corporate risks using 1997–1999 panel data drawn from 235 Chinese publicly listed companies.

Our study adds to the literature in two key regards. First, the panel data design used in this study (fixed-effects) controls for unobservable intercompany differences resulting from the strategic choices of managers and variations in the quality of risk management expertise (see "Multivariate Models" section). Second, our research advances on recent studies, such as Yamori (1999) and Hoyt and Khang (2000), in that for the first time we test the linkage between the insurance participation/volume decisions and company systematic and unsystematic risks using the two-step procedure of Heckman (1979) to control for potential sample selectivity bias.[1] This enables us to perform a refined empirical test of the influence of corporate risks on managerial insurance purchasing decisions.

The remainder of this article is structured as follows: "Institutional Environment" provides information on the institutional background in China. We develop our test hypotheses in "Hypotheses Development." "Research Design" includes the sources of data, the measurement of variables, and models used. "Results" discusses the empirical results, followed by the "Conclusion."

INSTITUTIONAL ENVIRONMENT

Over the last 20 years or so, the corporate insurance market in the PRC has grown at more than 30 percent per annum (Ma et al., 1998). In absolute terms, PRC-based companies incurred annual property insurance premium expenditures of approximately RMB 30 billion (US$3.6 billion) in 1999, representing more than 70 percent of the nonmotor general insurance market in China (People's Bank of China [PBOC], 2000). This growth in the volume of annual premiums came primarily from discretionary

[1] For example, in his Japanese study, Yamori (1999) does not test whether the managerial demand for insurance varies according to corporate risks. In their U.S. study, Hoyt and Khang (2000) use an aggregate industry-based cost-of-risk variable, which they define as " . . . the sum of net insurance premiums, unreimbursed losses and the cost of risk control, loss prevention and administration" (1999, p. 100) rather than company-specific measures of systematic and unsystematic risks.

corporate spending on property insurance lines such as coverage on physical assets (PBOC, 1998).[2] As at the end of 1998, 25 insurance companies were operating in China, of which four were state-owned insurers, nine were stock companies, three were international-Chinese joint ventures, and nine were branches of foreign insurance corporations (China Insurance Regulatory Commission [CIRC], 1999).

Many industry commentators (e.g., Ma et al., 1998; A. M. Best, 1999; Shen, 2000) forecast that the corporate demand for insurance in the PRC is likely to grow in line with the country's rapidly expanding rate of inward investment and developing economic infrastructure. Future growth in discretionary corporate insurance procurement in the PRC is also subject to other factors. These include the ongoing reform of state-owned enterprises (SOEs), China's accession to the World Trade Organization (WTO), and the increase in the number of companies seeking public listing status on the domestic stock exchanges (e.g., Ma et al., 1998; Shen, 2000).[3] In addition, property insurance spending is expected to increase as the market reforms introduced since the mid-1980s have granted Chinese company managers more discretion to make decisions independently of state officials (Tam, 2000).

Currently, the CIRC, as the insurance industry regulator, has responsibility for the licensing of new entrants to the insurance market, policy contract design (e.g., format, terms, and premium rates), monitoring company solvency, and sales practices (Shen, 2000). The CIRC inherited most of these duties from its predecessor (the PBOC), while its legal authority stems mainly from the Insurance Law (1995). However, the 1995 law and supporting insurance industry regulations limit the ability of insurers to greatly vary their property underwriting practices (e.g., via the levels of deductible) by imposing a standard set of premium rates and terms.[4] Consequently, insurers operating in the PRC do not have much scope to vary policy contract conditions to protect themselves effectively against information asymmetries (between themselves and insureds). This inability of PRC-based insurers to charge risk-commensurate premium rates implies that, prima facie, high-risk companies are unlikely to be seriously

[2] In China, property insurance can cover losses arising from fire, explosions, and environmental hazards (e.g., floods, tornadoes, snowstorms, and earthquakes) depending on the type of policy procured (Ma et al., 1998). Corporate spending on property insurance in the PRC normally includes premiums paid for the insurance of fixed assets (excluding land), inventories, and other tangible assets (e.g., office fittings). In the PRC, land is state-owned, so it is not subject to private damages (tort) claims (e.g., from pollution). In addition, intangible assets (e.g., brands) are not currently insurable in the PRC, so they are excluded from our study.

[3] The PRC has two major stock exchanges—Shanghai (SHSE) and Shenzhen (SZSE)—with a combined listing of 976 companies at the end of 1999. We thus drew our sample data from these markets (see "Data Description" section).

[4] The CIRC not only sets the benchmark premium rates for the majority of corporate insurance products, but also imposes a universal set of contract terms for property insurance policies (Shen, 2000). In addition, the CIRC issues guidelines on risk rating and applicable classified premium rates (e.g., based on the type of business). The Insurance Law (1995) also restricts the ability of insurers to realize competitive advantages by giving their customers premium rebates. As a result, insurance premium rates in China are expected to be influenced less by competitive market forces and differences in the risk-rating practices of underwriters than might be the case in some more developed countries (such as the United States).

deterred from purchasing insurance.[5] This feature thus provides us with an opportunity to investigate differences in the managerial insuring behavior of both low- and high-risk Chinese companies. In addition, over the period of our analysis (1997–1999), neither legislative nor regulatory changes greatly affected premium rates in the Chinese market (Shen, 2000). Therefore, the regulation of premium rates in the PRC means that the variations of corporate insurance spending are more likely to reflect the degree of managerial discretion over insurance purchasing decisions (i.e., whether to insure and the extent of insurance) rather than the confounding changes in insurance companies' underwriting practices and/or market prices. In other words, in China, annual total insurance premiums will primarily vary because of company-specific differences in the volume of coverage.[6] As such, our empirical results are unlikely to be confounded by institutional factors that are outside the control of company managers.

HYPOTHESES DEVELOPMENT

In this section, we examine whether the demand for property insurance in the PRC is influenced by the systematic, unsystematic, and insolvency risk profile of publicly listed companies.[7]

Systematic Risk

Company managers have incentives to monitor systematic (market) risk because of their potential impact on the cost of capital and traded value of companies (Borde et al., 1994). Companies are likely to have different levels of systematic risk because they have variable cross-sectional exposures to physical asset losses arising from property risks, environmental hazards, and so on (e.g., Doherty, 1997). Some physical asset–based risks (e.g., regional property damage arising from floods or earthquakes, such as on China's densely populated eastern coast) could be closely correlated with movements in the market value of companies. Indeed, recent environmental catastrophes in China (e.g., the unprecedented Yangtze River floods in 1998 and the Tangshan earthquake in 1976) suggest that asset losses can be widespread over large geographical areas and thus have major adverse economic implications for Chinese financial markets.[8] Thus, company investors may not be able to easily diversify systematic risk,

[5] However, managers in high-risk companies will have the choice to adopt alternative risk management solutions to commercial insurance (e.g., self-insurance) if the premium rate offered in the market is deemed greater than the expected value of prospective losses.

[6] To some degree, the level of annual premiums paid by Chinese companies may also vary because of differences in expected claims costs arising from (omitted) firm-specific effects (e.g., in terms of potential adverse selection/moral hazard problems). However, by using a fixed-effects panel design that allows the intercept to vary cross-sectionally, we can capture the potential influence of omitted variables (see "Multivariate Models").

[7] The academic literature reports that these three types of corporate risk are common influences on the insurance purchasing decisions of managers (e.g., Adams and Hillier, 2000). This study does not examine other corporate risks (e.g., operational and liability risks) because they are either difficult to define or not easy to measure from publicly available sources in emerging economies such as the PRC (e.g., Stalvies, 1997).

[8] For example, in the 1998 flood the insurance industry paid out RMB 7.6 billion for insured property losses. It is also reported that because of the rapid industrialization, increasingly worsening environment (e.g., the destruction of forest and green lands along the Yangtze

thereby encouraging managers to purchase property insurance.[9] By contrast, many catastrophe risks (e.g., the frequent floods caused by seasonal rises in the level of the Yangtze River) that could result in severe potential asset losses for Chinese companies can be transferred to commercial insurers via the purchase of property insurance. Niehaus (2002) contends that primary insurers can then transfer much of their underwritten catastrophe exposures to the international reinsurance markets. The absence of developed domestic derivative markets and the general lack of risk management expertise in the PRC (e.g., see Karmel, 1996; Long et al., 1999) further suggests that publicly listed companies are likely to seek commercial insurance solutions ex ante to mitigate their long-term systematic risks, particularly those associated with environmental catastrophes. The amount of insurance purchased is also likely to be positively linked to the systematic risk profile of Chinese publicly listed companies. Consequently, we hypothesize that:

Hypothesis 1a: *Other things being equal, the higher their systematic risk, the greater the likelihood that companies will purchase property insurance.*

Hypothesis 1b: *Other things being equal, the higher their systematic risk, the greater the likelihood that companies will purchase more property insurance.*

Unsystematic Risk

Cox and Griepentrog (1988) contend that the efficient diversification of corporate risks could be inhibited by market frictions such as the costs of information gathering, transaction costs, the indivisibility of investments, and the heterogeneous expectations of investors. Indeed, the nascent Chinese securities markets appear to be acutely afflicted by market imperfections such as high transaction costs and severe equity price volatility (e.g., Karmel, 1996; Long et al., 1999; Sun et al., 2002). Xu and Wang (1999) also report that in the PRC, share ownership in publicly listed companies tends to be highly concentrated rather than diversified.[10] As a consequence, investors' portfolios (particularly in emerging markets such as the PRC) are likely to contain a high degree of unsystematic as well as systematic risk (Zhang, 1998). Under freely competitive conditions, company-specific unsystematic risks (e.g., property fire damage) can be transferred ex ante to insurance markets that have a comparative advantage over noninsurance companies in risk pooling and other risk management services (e.g., claims settlement) (Doherty, 2000). Therefore, the ex ante managerial decision to insure property risks and the subsequent amount of insurance procured could be influenced by

River), and global warming, severe flooding has occurred more frequently in recent years than in previous years (CIRC, 1999).

[9] The severe impact of catastrophe on market-based (systematic) risks is further evident from other countries in the Far East. For example, the 1995 Kobe earthquake in Japan triggered a sharp fall in the Nikkei index, the collapse of the Osaka stock market, and the bankruptcy of major companies—most notably, Barings Bank (e.g., Stoll, 1995).

[10] For instance, at the end of 1998, the top three shareholders in PRC-based publicly listed companies held about 57 percent of the total number of shares in issue. Thus, many publicly listed companies in China appear to be dominated by large shareholders (e.g., Xu and Wang, 1999).

companies' unsystematic risks profile.[11] The availability of property insurance coverage also enables managers of companies with high unsystematic risk to realize ex post economic advantages (e.g., less volatile net cash flows) following an asset-debilitating loss such as that arising from fire damage. In addition, the greater the potential exposure to asset loss, the more property insurance coverage managers are likely to purchase in order to facilitate post-loss investment in positive net present value projects. The growth in international captive insurance markets has also substantially increased the risk management options of noninsurance parent companies. However, in emerging economies such as the PRC, the captive insurance market is presently underdeveloped compared with that in the United States and United Kingdom (Adams and Hillier, 2000). This limitation thus restricts the availability of noncommercial insurance solutions to corporate unsystematic risks in China. Therefore, we propose the following hypotheses:

Hypothesis 2a: *Other things being equal, the higher their unsystematic risk, the greater the likelihood that companies will purchase property insurance.*

Hypothesis 2b: *Other things being equal, the higher their unsystematic risk, the greater the likelihood that companies will purchase more property insurance.*

Insolvency Risk

The inability of company managers to manage business risks effectively could result in financial distress or insolvency (MacMinn, 1987; Grillet, 1992; Doherty, 2000). In emerging markets, such as the PRC, economic uncertainties enhance the risk of debt default and so increase the market cost of capital for companies (Karmel, 1996; Xu and Wang, 1999). Although publicly listed companies rarely become bankrupt in China (e.g., due to government intervention), this does not mean that such entities are free from the risk for financial distress. For them, the risk of loss is mainly manifest in the high indirect financial distress costs associated with the loss of goodwill and difficulty in raising external capital. Indeed, Warner (1977) argues that the indirect costs of financial distress are often greater than the direct costs.

Mayers and Smith (1982) argue, however, that the purchase of insurance can help managers in highly leveraged companies avoid the costs of financial distress and reduce agency costs (e.g., monitoring expenditures) by indemnifying holders of debt contracts against ex post dilution in the value of their fixed claims (e.g., due to catastrophe). Grillet (1992) and Grace and Rebello (1993) suggest that insurance purchases may also perform an important role in signaling the quality of corporate financial condition to prospective investors and other stakeholders (e.g., creditors). As a result, insurance may enable company managers to increase their debt financing capacity.[12]

[11] It could be argued that the unsystematic risk of a company can be endogenous (i.e., affected by the use of property insurance). We tested for this possibility in sensitivity tests using a Hausman specification test (see "Sensitivity Tests"); this proved to be insignificant at conventional levels.

[12] This raises the possibility of a two-way linkage between a firm's insolvency risk and its insurance use. We also tested for this possibility in sensitivity tests using the Hausman specification test, and the result was not statistically significant (see "Sensitivity Tests"). Nonetheless, caution in interpreting our results is still advised.

Mayers and Smith (1982) and MacMinn (1987) also contend that physical asset–based insurance is a rational post-loss financing option that highly leveraged companies can employ to mitigate the underinvestment incentive. That is, the possibility that after an accidental loss, projects with an expected positive net present value might be rejected because managers feel that the benefits of such an investment will be realized by debt holders with fixed claims and not by the shareholders (with whom managerial interests might be closely aligned via equity options). Therefore, the ex ante purchase of insurance can help reduce information asymmetry (agency) costs in the monitoring of contractual compliance and the bonding of investment decisions (e.g., Grace and Rebello, 1993). Furthermore, we expect that the level of insurance purchased will be directly related to the potential ex post agency costs of raising debts (e.g., monitoring expenditures). As a result, we hypothesize that:

Hypothesis 3a: *Other things being equal, the higher their leverage, the greater the likelihood that companies will purchase property insurance.*

Hypothesis 3b: *Other things being equal, the higher their leverage, the greater the likelihood that companies will purchase more property insurance.*

Control Variables

The purchase of insurance can be influenced by other company-specific factors (Hoyt and Khang, 2000). In this study, we examine the sensitivity of three key control variables—company size, state ownership, and geographical location—on our results. Briefly, our motivation for selecting these variables is as follows.

Small companies are more likely to purchase property insurance than large companies for three main reasons. First, the expected direct costs of financial distress are not usually proportional to size (Warner, 1977). Second, small companies tend to gain more from insurers' real services (e.g., loss prevention) than do large companies (Hoyt and Khang, 2000). Third, small entities are not normally well-diversified, so they are particularly susceptible to business risks (Barnea et al., 1985). The findings of some other studies (e.g., Yamori, 1999; Hoyt and Khang, 2000) also support the inverse relation between company size and the corporate decision to purchase insurance. Therefore, we expect that small companies are more likely not only to purchase property insurance, but also to buy relatively more insurance than large companies, other things being equal.

State ownership might also influence Chinese companies' insurance decisions. In China, the state owns roughly one-third of total market capitalization and is present in about 90 percent of PRC-based publicly listed companies (China Securities Regulatory Commission [CSRC], 2000). State ownership is traditionally viewed as contributing to, if not causing, corporate operational inefficiency (Vickers and Yarrow, 1998; Xu and Wang, 1999). Therefore, it is unlikely that an inefficient state shareholder will encourage managers to purchase property insurance to alleviate asset-loss risks. In addition, Sun et al. (2002) report that the state, as a controlling shareholder in some companies, could provide financial resources and other benefits (e.g., business contacts, banking support, or subsidies). This implies that where the state is a major shareholder, managerial incentives to purchase property insurance to hedge asset-loss risks could be reduced because of potential "charity hazard" effects (i.e., the possibility of seeking

government financial assistance in the event of a major catastrophic loss) (Browne and Hoyt, 2000). This reasoning suggests that in the Chinese corporate sector, state shareholdings could to some extent substitute for the use of property insurance. Therefore, we expect an inverse relation between the level of state shareholdings and the likelihood/extent of the use of property insurance.

As mentioned earlier, systematic/unsystematic risks and hence the corporate purchase of property insurance may vary across geographical regions. For example, an environmental disaster (e.g., earthquake or flood) in the economically developed coastal areas of China (e.g., Shanghai or Beijing) could have a major impact on the share prices of companies located there. Indeed, Sun et al. (1999) report that the coastal areas of China have been more successful in attracting foreign capital than internal regions because they enjoy preferential investment status under the state's current economic reform program. Not surprisingly, therefore, industry commentators (e.g., Shi and Su, 2000) suggest that the risk management awareness of company managers in China's coastal zones is likely to be greater than elsewhere. This implies that managers of companies located in China's east coast regions are more likely to use property insurance than their counterparts in companies operating elsewhere in the country. However, the literature is not clear as to whether locational factors will influence the financial extent of property insurance. As such, geographical location is used as a selectivity bias identifier variable in our probit model (e.g., see Ireland and Lennox, 2002).

RESEARCH DESIGN

Data Description

From the 745 companies listed on the SHSE and SZSE at the end of 1997, we excluded 87 companies that had material asset reorganizations between 1997 and 1999, as such activity could distort the interpretation of our results.[13] In addition, we excluded six publicly listed financial services companies (e.g., banks and investment companies) from our sample because they account and report under different rules from other companies and are active in the trading of risk management products/services. Moreover, we excluded 17 companies with dual listing status on both SHSE/SZSE and the Hong Kong Stock Exchange (HKSE) to avoid the potentially confounding effects that institutional differences (e.g., with regard to legislation and degree of financial market development) could have on the empirical results (e.g., Naser and Wallace, 1995). We then identified 96 companies disclosing annual property insurance spending in their annual financial statements and conducted a telephone-based survey of financial directors/treasurers in the remaining 539 companies, which resulted in 146 responses.[14] We had to exclude an additional seven companies with missing annual accounting

[13] To avoid the effect of structural changes before and after listing, each company in our sample had to be listed for two full accounting years during the research period (1997–1999). The most prevalent forms of corporate structural reorganization in China include asset swaps and divestitures among associated companies. We determined the materiality of such asset reorganization by applying the official criteria laid down by the CSRC—i.e., a more than 30 percent change in the value of physical assets.

[14] While constituting only 3 percent of the total general insurance premium generated in 1997, liability insurance is not currently a major insurance line for companies and is hence outside the scope of this study (see PBOC, 1998, pp. 637-638). A copy of the telephone survey instrument is also available from Zou upon request.

data, giving us useable data covering 235 nonfinancial companies for 1997–1999 (approximately 32 percent of the population over the period of analysis). This enabled us to compile an unbalanced panel data set of 668 company/year observations.[15] The period 1997–1999 represents the earliest and latest years for which complete data were available at the time our study was carried out. We obtained company-specific noninsurance accounting data from the *Genius Securities Information Database* (GSID). In addition, we computed measures of systematic risk (i.e., betas) from financial markets information supplied by the *Huaxia Yirong Securities Information System*. Data on the GSID are derived from the audited annual financial statements of PRC-based publicly listed companies and so are assumed to be reliable.[16] We also adjusted the share price data used in the calculation of company betas for dividends, rights offerings, and share splits over the period 1997–1999 to make the time-series data more comparable. Finally, to eliminate variations due to annual price changes, we adjusted all monetary values by China's retail purchase index (RPI) (base year = 1997).

To examine the extent to which our sample of companies is representative of the population, we also collected data on company size and leverage for companies not included in the current sample. We then conducted a Mann-Whitney U-test to compare the medians of size and leverage between the sample companies and the nonincluded companies year by year (see Table 1, Panel B). Clearly, we found no statistically significant differences in company size and capital structure between these two groups in two-tailed tests. However, we could not obtain information on other firm-specific financial and operational characteristics (see "Variables" below) for the nonincluded companies. Nonetheless, the average and median of state ownership in our sample are both about 30 percent (see Table 1, Panel A), which is similar to the reported average level of state shareholding for all companies listed in the SHSE and SZSE (CSRC, 2000). Therefore, it appears that the ownership structure of our sample companies is representative of the total population.

Variables

We used two dependent variables (*INSCHO* and *INS*) in our study. *INSCHO* is a dummy variable taking the value of 1 for companies purchasing property insurance and 0 for otherwise. *INS* is a continuous measure of the extent of property insurance usage, which is defined as the total corporate spending on voluntary property insurance in the current year scaled by the book value of insurable physical assets (e.g., buildings, plants, equipments, office fittings, and inventories).

The explanatory (independent) variables that we used in this study are as follows. Systematic risk (SYS_{it}) is measured by the company beta factor (β_{it}).[17] This value was

[15] The panel comprised 203 cases in 1997, 234 cases in 1998, and 231 cases in 1999.

[16] Graham (1996) reports that the audits of many publicly listed Chinese companies, particularly those issuing shares to foreign investors, are usually performed by international auditing firms, such as PricewaterhouseCoopers and KPMG Peat Marwick. In addition, DeFond et al. (2000) observe the growing professional nature of external auditing in China in recent years. Thus, the data used in this study are considered to be reliable.

[17] In the PRC, share price volatility varies between shares held by domestic investors (A-shares) and those held by foreign investors (B-shares). We computed the betas for the 50 or so companies that held both A-shares and B-shares in the period of analysis from the average monthly

TABLE 1
PRC-Based Publicly Listed Companies, 1997–1999

Panel A: Key Descriptive Statistics

Variables[1]	Mean	Median	Std. Dev.	Skewness	Kurtosis	Min	Max	N
INS	0.0026	0.001	0.004	3.789	19.940	0.000	0.033	668
SYS	1.056	0.980	0.537	0.788	4.661	−0.930	3.740	668
UNSYS	9.875	9.362	3.924	1.484	7.574	0.228	36.071	668
LEV	1.027	0.851	0.719	1.311	5.153	0.019	4.337	668
SIZE	127.86	80.22	134.68	2.676	12.106	11.93	1,034.00	668
STATE	0.297	0.299	0.257	0.189	1.677	0.000	0.886	668
GEOG	0.634	0.000	0.482	−0.556	1.308	0.000	1.000	668

Note: SIZE is measured in million RMBs.

Panel B: Comparison of Sample Firms With Nonincluded Firms (Mann-Whitney U-test)

		Sample		Nonincluded Firms		z-statistic
	Year	No. of Firms	Median	No. of Firms	Median	(two-tailed)
ln*SIZE*	1997	203	11.180	542	11.080	1.304
	1998	234	11.310	651	11.280	0.471
	1999	231	11.400	745	11.380	0.308
LEV	1997	203	0.847	542	0.867	−0.291
	1998	234	0.836	651	0.825	0.144
	1999	231	0.859	745	0.844	0.156

Panel C: *INS* Groups (N = 668)

	INS Groups							
	0	0.000-0.005	0.005-0.010	0.010-0.015	0.015-0.020	0.020-0.025	0.025-0.030	0.030-0.035
Frequency	75	512	48	12	9	5	4	3
%	11.23	76.64	7.19	1.80	1.35	0.75	0.60	0.44

computed by regressing the market risk premium on the total risk premium of company *i* in the manner prescribed by Berndt (1991, pp. 34-35) as follows:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_{it}(R_{Mt} - R_{ft}) + \varepsilon_{it}. \quad (1)$$

returns on the two types of shareholdings weighted by the proportion of registered equity capital. We chose SHSE and SZSE A-share indexes as the market portfolio for A-share companies in these two markets, respectively. Also, we chose the SHSE and SZSE composite indexes (which include both A-share and B-share companies) as the market portfolio for B-share companies in the two markets.

TABLE 1 Continued

Panel D: Descriptive Statistics: Insurance Users Versus Nonusers (N = 668)[2, 3]

		Users ($n_1 = 593$)		Nonusers ($n_2 = 75$)		
Variables	Predicted Sign	Mean	Std. Dev.	Mean	Std. Dev.	*t*-statistic
SYS	Users > Nonusers	0.501	0.286	0.494	0.302	0.173
UNSYS	Users > Nonusers	0.500	0.286	0.501	0.299	−0.006
LEV	Users > Nonusers	0.515	0.280	0.379	0.318	3.519***
SIZE	Users < Nonusers	0.511	0.287	0.414	0.279	2.756***
STATE	Users < Nonusers	0.504	0.284	0.471	0.275	0.982

Notes:

[1] *INS* = extent of property insurance use, defined as annual corporate property insurance spending scaled by total book value of insurable physical assets; *SYS* = systematic risk—the company beta, as measured by the regression coefficient between the risk return of each company's shares and market return; *UNSYS* = unsystematic risks, as measured by the difference between the standard deviation of return and systematic risks; *LEV* = insolvency risks—represented by the ratio of debt (long-term plus short-term)-to-equity (i.e., leverage); *SIZE* = company size—the book value of total assets; *STATE* = state shareholdings, defined as the fraction of the number of state-held shares over the total shares in issue; *GEOG* = geographical location—dummy variable, inland economic zones = 0, coastal economic zones = 1. The rank-transformed equivalents of the metric variables are used.

[2] A chi-square test of the independence between the insurance participation decision and geographical location of companies is significant at the 0.05 level (one-tailed), suggesting the possible geographical difference in the insuring behavior of publicly listed Chinese companies.

[3] ***Statistically significant at the 0.01 level (one-tailed).

In Equation (1), R_{it} and R_{Mt} are the respective monthly return on the shares of company i and the market portfolio in period t (t = 1997–1999);[18] R_{ft} is the risk-free rate of return, as measured by the interest rate of three-month bank savings; α_{it} is the constant; and ϵ_{it} is an error term.[19]

We calculated unsystematic risk ($UNSYS_{it}$) as in Copeland and Weston (1992, pp. 198-199) as follows:

$$UNSYS_{it}^2 = \sigma_{it}^2 - \beta_{it}^2 \sigma_{Mt}^2. \quad (2)$$

In Equation (2), σ_{it}^2 is the computed variance of companies' monthly returns over the period 1997–1999 (i.e., total risk); β_{it}^2 represents the square of the computed beta for company i (as per Equation [1]); and σ_{Mt}^2 is the computed variance of the market indexes' monthly returns over the sample period 1997–1999.

[18] Due to the high cost and time involved in the collection of daily/weekly trading data, we had to use monthly share returns data. As in Borde et al. (1994), we calculated a beta for each company/year using 12 months' data.

[19] In the finance literature, returns on short-term treasury bonds are usually used as a measure of the risk-free rate of return. However, such measures are not available in the PRC because government-issued treasury bonds are normally for mid-term or long-term (typically three to five years). Thus, we used the Chinese government's guaranteed three-month interest rate for bank savings. This rate of interest is also subject to frequent review and modification by the PBOC to reflect changing macroeconomic circumstances.

Insolvency risk (LEV_{it}) is measured by the debt (long-term plus short-term)-to-equity ratio (i.e., leverage).

The control variables include measures of company size (*SIZE* = the book value of total assets), state shareholdings (*STATE* = the fraction of the number of ordinary shares held by the state relative to the total number of common shares in issue), and geographical location (*GEOG* = a dummy variable that is coded as 1 for the coastal economic zone and 0 otherwise).

Rank Transformations

Our data are highly skewed; however, the existence of zeros and negative values in the data set precluded us from taking log or square root transformations to mitigate the problem of skewness (see Table 1, Panel A). Therefore, as in Kane and Meade (1998) and Ireland and Lennox (2002), we take rank transformations of the metric variables (i.e., *INS*, *SYS*, *UNSYS*, *LEV*, *SIZE*, and *STATE*) and replace them with the rank equivalents in our analysis.[20]

Multivariate Models

As in Colquitt and Hoyt (1997) and Cummins et al. (2001), we followed a two-step procedure to determine the linkage between corporate risks and the purchase of property insurance by Chinese listed companies. In the first stage of our multivariate analysis, we used a probit model to examine the effect of company-specific characteristics on the probability of purchasing property insurance (hereafter, the participation decision model). In the second part of our multivariate analysis, we employed a panel data model incorporating Heckman's two-step sample selection correction procedure to analyze the linkage between corporate risks and the financial extent of the use of property insurance (hereafter, the volume decision model). The rationale for our approach is threefold. First, the separate analysis of the decision to buy insurance and the amount of insurance purchased could yield interesting insights into those factors that influence the ex ante and ex post decision-making activities of managers (Colquitt and Hoyt, 1997).[21] Second, a conventional ordinary least-squares (OLS) lin-

[20] For the vector $[X_{t,1}, X_{t,2}, \ldots, X_{t,n}]$ of variable X for year t, we replaced each value of X_t with its corresponding rank (ranging from 1 to n in ascending sequence) divided by $n + 1$. We then aggregated observations, which resulted in pooled data that are uniformly distributed between zero and one. Kane and Meade (1998) demonstrate that rank transformations have advantages of preserving comparative information, avoiding arbitrary sample trimming and improving fit. As a result, rank transformations generally perform better than log or square root transformations in resolving the problem of skewed data.

[21] In this study, we assume that there is a conjoint theoretical linkage between the insurance participation and volume decisions. However, Cummins et al. (2001) argue that the interrelation between the hedging participation and volume decisions could be influenced by relative differences in transaction costs. For example, they argue that in the case of derivatives hedging, the participation decision may be influenced by the large fixed costs associated with engaging in such activity (e.g., costs of expertise). By contrast, the volume hedging decision could be influenced by differences in managers' attitudes toward risk and marginal cost considerations. Consequently, the hedging participation and volume decisions may not necessarily be positively related. However, a similar argument may not necessarily hold for insurance trading. This is because the purchase of commercial insurance is generally easier (and hence less costly in terms of fixed costs) to obtain compared with establishing an in-house derivatives

ear regression model does not accommodate the binary nature of the dependent variable representing the participation decision (e.g., Greene, 1999). Third, a single Tobit model is considered to be inappropriate in the present study, as it cannot investigate separately the linkages between companies' risks and the insurance participation and volume decisions of managers (e.g., Colquitt and Hoyt, 1997; Cummins et al., 2001).

The probit insurance participation decision model used in this study is thus:

$$Y_{it}^{*} = \beta_0 + \beta_1 SYS_{it} + \beta_2 UNSYS_{it} + \beta_3 LEV_{it} + \beta_4 SIZE_{it} + \beta_5 STATE_{it} + \beta_6 GEOG_{it} + \beta_7 YEAR_{97} + \beta_8 YEAR_{98} + \varepsilon_{it} \quad (3)$$

In Equation (3), the latent variable, Y_{it}^{*}, is not observable; its observable counterpart is Y_{it} (*INSCHO*), which is equal to 1 if $Y_{it}^{*} > 0$, denoting a company purchasing property insurance, and 0 if $Y_{it}^{*} \leq 0$, denoting a company not purchasing property insurance; $YEAR_{97}$ and $YEAR_{98}$ are year dummy variables included in the regression to control for possible time-related effects; and $\varepsilon_{it} \sim N(0,1)$ is a disturbance term. All other variables are as defined in the previous two sections.

Greene (1999) argues that a major advantage of using a panel data design is that it controls for omitted (unobservable) company-specific effects (e.g., differences in intercompany risk management expertise) and/or period-specific effects (e.g., insurance underwriting cycles). As such, a panel data design helps produce more reliable (consistent) and informative (robust) parameter estimates than a separate single period and/or simple pooled analysis. Subject to the different assumptions made about the distribution of these effects, the main estimation techniques are usually the fixed- and random-effects (error components) models. The former model treats omitted company-specific variables as constant over time and/or period-specific variables as invariant across companies. By contrast, the random-effects model treats company and period-specific factors as random.

To determine the most appropriate regression model for the insurance volume decision model, we followed a two-stage diagnostic procedure (see Table 4, Panel B). First, we conducted Wald and Lagrange Multiplier (LM) tests to examine the relative efficiency of the heterogeneous fixed/random-effects estimation against the homogeneous pooled OLS model. The Wald F-statistic ($F_{212,374} = 17.61$) and the LM chi-square value ($\chi^2_{(2)} = 360.97$) were both statistically significant at the level 0.01 (one-tailed). This suggests that fixed/random-effects models are more efficient than the pooled cross-sectional OLS model. Second, we performed a Hausman specification test, which is based on the differences between the coefficients estimated from fixed- or random-effects models, to determine which kind of panel model—fixed- or random-effects—should be used in this study. We found the computed chi-square statistic ($\chi^2_{(6)} = 17.16$) to be statistically significant at 0.01 (one-tailed), indicating that the null hypothesis of zero correlation between the unobservable company-specific effects and the explanatory variables in the model can be rejected. In this case, the fixed-effects model can still

function. Indeed, Nance et al. (1993) argue that (information and transaction costs) scale economies that exist in derivatives hedging appear to be less pronounced in the trading of insurance. Mayers and Smith (1982) also suggest that the loading fees in transacting insurance can be positively related to the size of the risk insured against, thereby implying that the marginal cost of transacting insurance will be proportional to the magnitude of the risk covered.

derive consistent estimates but the random-effects model cannot; therefore, we used a fixed-effects model in this study. In addition, a random-effects model is deemed not to be appropriate because our sample is not randomly drawn from a large population (Baltagi, 1995). The fixed-effects volume decision model with Heckman's sample selection correction that we employed is expressed as:

$$INS_{it} = \alpha_0 + \alpha_i + \gamma_t + \beta_1 SYS_{it} + \beta_2 UNSYS_{it} + \beta_3 LEV_{it} + \beta_4 SIZE_{it} + \beta_5 STATE_{it} + \beta_6 \lambda_{it} + \delta_{it}. \quad (4)$$

In Equation (4), α_i represents the time-invariant firm-specific effects that capture the unobservable differences among companies; γ_t is the firm-invariant period-specific effects that capture the time-related changes; λ_{it} is the inverse Mill's ratio generated by the first-step probit participation decision model that controls for the possible sample selection bias in the volume decision model where only companies purchasing insurance are selected; α_0 is the intercept; δ_{it} is an error term that is assumed to have a zero mean and constant variance; and $_{it}$ are the company/year observations over the period 1997–1999. All other variables are as defined in the previous section. Sun et al. (2002, p. 15) report that once firm-specific time-invariant effects are controlled for, possible variations due to industry effects can also be minimized.

RESULTS

Descriptive and Univariate Results

Panel A of Table 1 gives the descriptive statistics for the dependent and independent variables for the pooled company/year sample of PRC-based publicly listed companies for the period 1997–1999. Clearly, Panel A shows that many variables were highly skewed and had zero/negative values. As such, our use of rank transformations ("Rank Transformations") appears to be justified. In addition, *LEV* and *SYS* varied the most in our sample. This suggests that some PRC-based publicly listed companies could be exposed to greater insolvency and systematic risks than others and are thereby likely to purchase property insurance. Panel C of Table 1 suggests that roughly 85 percent of the sampled companies purchased some amount of property insurance over the research period, though the level of property insurance premiums was generally low relative to the book value of total physical assets insured. Panel D reports the means of the metric independent variables for insurance users/nonusers plus *t*-tests of the differences between the variable means for insurance users/nonusers. These tests suggest that large companies with higher insolvency risks appear to have a greater tendency to buy property insurance than do their small counterparts with lower insolvency risk. However, we found no significant differences in the systematic and unsystematic risks profile between property insurance users and nonusers. A chi-square (χ^2) test of the independence between the insurance purchasing decision and geographical location of companies was significant at the 0.05 level ($\chi^2_{(1)} = 3.90$, one-tailed), suggesting a geographical difference in corporate insuring behavior.

Table 2 presents the correlation coefficients between the dependent and independent variables for the pooled firm/year observations for 1997–1999. The pair-wise correlation coefficients (Spearman rank) reported in Table 2 revealed statistically significant positive associations between the insurance participation (*INSCHO*) and *LEV* and *SIZE* ($p \leq 0.01$, two-tailed). This suggests that large and highly leveraged

TABLE 2
PRC-Based Publicly Listed Companies, 1997–1999—Correlation Coefficient Matrix, Variance Inflation Factors, and Condition Index

Panel A: Correlation Coefficients

	INSCHO	*INS*	*SYS*	*UNSYS*	*LEV*	*SIZE*	*STATE*	*GEOG*
INSCHO	–							
INS	–	–						
SYS	0.007	−0.073*	–					
UNSYS	0.003	0.038	0.050	–				
LEV	0.149***	−0.076*	−0.026	0.076*	–			
SIZE	0.106***	−0.089**	0.023	0.104***	0.301***	–		
STATE	0.035	0.004	−0.020	−0.027	0.013	0.072*	–	
GEOG	−0.080**	−0.212***	0.008	−0.047	0.131***	0.273***	−0.197***	–

Panel B: Variance Inflation Factors (VIFs) and Condition Index

	Probit Model	Volume Model
SYS	1.005	1.004
UNSYS	1.028	1.026
LEV	1.119	1.116
SIZE	1.210	1.129
STATE	1.063	1.003
GEOG	1.145	–
Largest condition index	10.544	10.775

Notes:
1. *INS* = extent of property insurance use, defined as annual corporate property insurance spending scaled by total book value of insurable physical assets; *SYS* = systematic risk—the company beta, as measured by the regression coefficient between the risk return of each company's shares and market return; *UNSYS* = unsystematic risks, as measured by the difference between the standard deviation of return and systematic risks; *LEV* = insolvency risks, represented by the ratio of debt (long-term plus short-term)-to-equity (i.e., leverage); *SIZE* = company size—the book value of total assets; *STATE* = state shareholdings, defined as the fraction of the number of state-held shares over the total shares in issue; *GEOG* = geographical location—dummy variable, inland economic zones = 0, coastal economic zones = 1. The rank-transformed equivalents of the metric variables are used.
2. We computed reported correlations using the Spearman rank test among the rank-transformed equivalents of corresponding variables (except for the nonmetric variables). The number of cases involved in the calculation of correlation with *INS* was 593 observations; otherwise there were 668 observations.
3. ***Statistically significant at the 0.01 (two-tailed), **statistically significant at the 0.05 (two-tailed), and *statistically significant at the 0.10 (two-tailed).

Chinese companies are more likely to insure than small and lowly leveraged companies. However, different from what we hypothesized, neither *SYS* nor *UNSYS* exhibited a statistically significant association with the property insurance participa-

tion decision. When we turned to the financial extent of property insurance purchased, it was interesting that large companies appeared to insure to a lesser extent than small companies, though the former seems more likely to take out property insurance in the first place. In addition, the amount of insurance purchased was unexpectedly negatively associated with *SYS* and *LEV*. Furthermore, the negative correlation between *INSCHO*, *INS*, and *GEOG* implies that Chinese listed companies incorporated in coastal areas appear to be less likely to use property insurance than their counterparts in inland areas. Otherwise, different from our expectation, *STATE* did not appear to be an important factor affecting the property insurance purchasing decisions of Chinese companies.

The statistically significant correlations between some of the independent variables reported in Panel A of Table 2 raise the possibility of multicollinearity. The correlation coefficients between pairs of independent variables were generally low (all less than 0.4), suggesting that a serious collinearity problem is unlikely (e.g., see Judge et al., 1982, p. 620). However, collinearity can be present between more than two independent variables. To test for this, we computed variance inflation factors (VIFs) of each independent variable and the condition index for each model (see Panel B of Table 2). The calculated VIFs were all less than 2, and the (largest) condition index in both models was about 10. Therefore, we conclude that multicollinearity is not a severe problem in this study (e.g., Kennedy, 1998, p. 190).

Multivariate Results

To allow for potential interactions among the independent variables, we used two multivariate regression models—the probit participation decision model and the fixed-effects volume decision model. We analyze the results (including diagnostics) below.

Participation Decision Model Results. We estimated Equation (3) and calculated several diagnostic statistics. Table 3 shows the parameter estimates and test statistics. The coefficient for *LEV* was positive and significant ($p \leq 0.01$, one-tailed), supporting the hypothesis (Hypothesis 3a) that companies with an expected high probability of financial distress are more likely to hedge through property insurance than companies at a lower risk of insolvency. Indeed, Ma et al. (1998) also report that in China it is becoming increasingly common for major creditors to request collateralized assets-related insurance coverage to give them ex ante protection against ex post losses.

However, *UNSYS* was inconsistent with our prior expectations (Hypothesis 2a), while *SYS*, albeit "correctly" signed, was insignificant. This suggests that insolvency risk appears to be the most important risk-related determinant of corporate insurance decisions in China. Inconsistent with our expectations, but consistent with the results of our correlation analysis, company size had a positive and statistically significant influence on a company's probability to purchase property insurance ($p \leq 0.01$, one-tailed). However, contrary to what was hypothesized, companies based in the inland regions of China appeared to have a greater propensity to insure than those incorporated in the coastal regions ($p \leq 0.01$, one-tailed). This finding suggests that inland-based companies may face a greater risk for asset loss (e.g., because of poor loss prevention systems and/or limited hedging options) than do companies located in coastal areas. Otherwise, *STATE* did not appear to have an important influence on the property insurance purchasing decisions of Chinese managers. Furthermore, the two time

TABLE 3

PRC-Based Publicly Listed Companies, 1997–1999—Multivariate Results of the Probit Participation Decision Model (pooled data—668 company/year observations)

Variable	Predicted Signs (+/−)	Coefficient Estimates	Standard Errors	*t*-statistics	*p*-value
Intercept	+/−	0.171	0.048	3.601	0.000***
SYS	+	0.013	0.039	0.330	0.371
UNSYS	+	−0.014	0.040	−0.346	0.365
LEV	+	0.143	0.041	3.502	0.000***
SIZE	−	0.104	0.043	2.412	0.007***
STATE	−	−0.008	0.043	−0.192	0.423
GEOG	+	−0.076	0.023	−3.291	0.000***
$YEAR_{97}$	+/−	−0.047	0.032	−1.492	0.136
$YEAR_{98}$	+/−	−0.007	0.028	−0.250	0.802

Test statistics:

$\chi^2 = 30.62$, d.f. = 8 (Reject hypothesis that all parameters are zero at 0.01 level, one-tailed)

Pseudo-$R^2 = 0.32$

LM test: $\chi^2 = 0.10$, d.f. = 1, *p*-value = 0.758 (Cannot reject hypothesis of homoskedasticity)

Notes:

1. The univariate probit participation decision model estimated is:

$$Y_{it}^* = \beta_0 + \beta_1 SYS_{it} + \beta_2 UNSYS_{it} + \beta_3 LEV_{it} + \beta_4 SIZE_{it} + \beta_5 STATE_{it} + \beta_6 GEOG_{it} + \beta_7 YEAR_{97} + \beta_8 YEAR_{98} + \varepsilon_{it}$$

where the observable dummy variable $INSCHO_{it} = 1$ if the latent variable $Y_{it}^* > 0$, denoting a company with an insurance purchase, and 0 if $Y_i^* < 0$, denoting a company without an insurance purchase; SYS_{it} = systematic risks, measured by company betas; $UNSYS_{it}$ = unsystematic risks, measured by the difference between the standard deviation of return and systematic risks; LEV_{it} = insolvency risks, represented by the ratio of debt (long-term plus short-term)-to-equity (i.e., leverage); $SIZE_{it}$ = the book value of log of total assets; $STATE_{it}$ = state shareholdings, defined as the fraction of the number of state-held shares over the total shares in issue; $GEOG_{it}$ = geographical region dummy variable, with 1 for coastal areas and 0 for otherwise; $YEAR_{97}$ and $YEAR_{98}$ = year dummy variables to control for time-related effects; and $\varepsilon_{it} \sim N(0,1)$ = a disturbance term.

2. Coefficient estimates reported in the table above are marginal effects of corresponding variables computed at the means of all observations (see LIMDEP version 7.0).

3. *** Statistically significant at 0.01(one-tailed). Reported *p*-values are one-tailed except when the predicted sign of a variable is indeterminate.

dummies were not statistically significant at conventional levels. This implies that there have not been (material) time-related changes regarding the managerial decision to use property insurance among our sample of publicly listed Chinese companies.

The diagnostics included a χ^2 statistic for testing the null hypothesis that the regression coefficients (excluding the intercept) are jointly zero. The computed $\chi^2_{(8)}$ value of 30.62 allowed us to reject this null hypothesis. We calculated a second χ^2 statistic using an LM test for heteroskedasticity that compared the estimated model with

an alternative model that allows for multiplicative heteroskedasticity regarding *SIZE* in the disturbance term. The calculated $\chi^2_{(1)}$ of 0.10 was insignificant at the level of 0.10 or less, meaning that we cannot reject the null hypothesis. In addition, the calculated pseudo-R^2 was 0.32, indicating that the probit model has limited predictive power.

Volume Decision Model Results. We examined the linkage between the financial extent of property insurance use and corporate risks, as noted in the "Multivariate Models" section, by estimating a fixed-effects panel model with Heckman's sample selection correction. Only those sample companies that purchased property insurance were included in this model (n = 593). Table 4 presents the results.

First, we conducted White's test to check for the presence of heteroskedasticity in the volume decision model. The computed χ^2 value (d.f. = 225) was statistically significant ($p \leq 0.01$, one-tailed), indicating the presence of heteroskedasticity in the volume decision model. Thus, we estimated and reported the two-way fixed-effects model using White's heteroskedasticity corrected covariance matrix to derive consistent parameter estimates.

The results of the volume decision model indicated that, consistent with our Hypothesis 1b, *SYS* was now positive and statistically significant at the 0.01 level in a one-tailed test. This indicates that Chinese companies facing greater systematic risk—for example, from flood, earthquake, and other environmental catastrophe risks—appear to buy more property insurance than companies with low systematic risk. Therefore, Chinese managers could perceive that increasing property insurance coverage is a cost-effective solution to potentially severe market risk exposure (such as that arising from a severe flood in the Yangtze River basin).

However, contrary to what we hypothesized (Hypothesis 3b), *LEV* was now negative and statistically significant at the 0.10 level (one-tailed). Interestingly, therefore, leverage plays a positive part in Chinese companies' decision to participate in property insurance but a negative role in determining the amount of property insurance

TABLE 4

PRC-Based Publicly Listed Companies, 1997–1999—Multivariate Results of the Fixed-Effects Volume Decision Models With Heckman's Sample Selection Correction (panel data—593 company/year observations)

Panel A

Variable	Expected Sign	Coefficient Estimates	Standard Errors	*t*-statistics	*p*-value
SYS	+	0.046	0.018	2.557	0.005***
UNSYS	+	−0.031	0.016	−1.889	0.030**
LEV	+	−0.099	0.073	−1.363	0.086*
SIZE	−	−0.393	0.083	−4.728	0.000***
STATE	−	0.035	0.046	0.761	0.223
λ	+/−	−0.392	0.284	−1.383	0.167
Adjusted R^2			0.903		

TABLE 4 Continued

Panel B: Diagnostics

A Wald test for a pooled OLS model versus a fixed-effects model, $F_{212,374} = 17.61$, is significant at the 0.01 level (one-tailed), suggesting that a heterogeneous fixed-effects model is superior to the pooled OLS model.

An LM test for a pooled OLS model versus a random-effects model, $\chi^2_{(2)} = 360.97$, is significant at the 0.01 level (one-tailed), suggesting that a heterogeneous random-effects model is superior to the pooled OLS model.

A Hausman test for a random-effects model versus a fixed-effects model, $\chi^2_{(6)} = 17.16$, is significant at the 0.01 level (one-tailed), indicating that the unobservable company-specific effects are correlated with the explanatory variables. Thus a fixed-effects model is better than a random-effects model.

A White test for heteroskedasticity resulted in $\chi^2_{(225)} = 384 > 277$ (critical value at 0.01 level, one-tailed), suggesting the presence of heteroskedasticity in the disturbance term, and consequently, White's heteroskedasticity-corrected standard errors were reported to derive hetroskedasticity-consistent estimates.

Test for normality of residuals: Jarque-Bera test: $\chi^2_{(2)} = 59.0$, p-value = 0.000, indicating that normality is rejected.

Test for functional misspecification error and omitted variables: Ramsey's RESET (up to order 3) $F_{2,372} = 1.890$, p-value = 0.153, indicating that the null hypothesis of no misspecification error cannot be rejected.

Notes:

1. The two-way fixed-effects model estimated in this study is

$$INS_{it} = \alpha_0 + \alpha_i + \gamma_t + \beta_1 SYS_{it} + \beta_2 UNSYS_{it} + \beta_3 LEV_{it} + \beta_4 SIZE_{it} + \beta_5 STATE_{it} + \beta_6 \lambda_{it} + \delta_{it}$$

where INS_{it} = the financial extent of insurance use (defined as annual corporate spending on property insurance scaled by total insurable physical assets); α_i is time-invariant firm-specific effects to capture the unobservable difference among companies; γ_t is firm-invariant period-specific effects to capture the time-related changes; SYS_{it} = systematic risks, measured by company betas; $UNSYS_{it}$ = unsystematic risks, measured by the difference between the standard deviation of return and systematic risks; LEV_{it} = insolvency risks, represented by the ratio of debt (long-term plus short-term)-to-equity (i.e., leverage); $SIZE_{it}$ = the book value of total assets; $STATE_{it}$ = state shareholdings, defined as the fraction of the number of state-held shares over the total shares in issue; λ_{it} is the inverse Mill's ratio generated by the first-stage probit model to control for the possible sample selection bias in the volume decision model where only companies purchasing insurance are included; and δ_{it} is an error term that is assumed to have a zero mean and constant variance.

2. ***Statistically significant at 0.01 (one-tailed), **statistically significant at 0.05 (one-tailed), and *statistically significant at 0.10 (one-tailed). Reported p-values are one-tailed except when the predicted sign of a variable is indeterminate.

3. The high-adjusted R^2 is attributable to the inclusion of firm-specific effects. Dropping these dummies reduces the adjusted R^2 to roughly 0.15.

purchased. This suggests that although major creditors (e.g., commercial banks) are likely to require insurance for collateralized assets, the amount of insurance coverage purchased does not appear to give them adequate ex ante protection against ex post asset losses. Therefore, in China neither creditors nor company managers seem

to be able to use property insurance to effectively reduce the risk for financial distress associated with high financial leverage. This could reflect that company managers and/or those banks providing commercial loans may be underestimating the probability/magnitude of potential asset losses (e.g., because of a lack of information and/or inadequate expertise in risk assessment). Indeed, Leung and Young (2002) report that Chinese banks have only recently begun introducing sound risk assessment/management procedures on credit exposures. Another possibility is that the decision regarding the amount of property insurance purchased can be affected by other factors (e.g., the severe cash flow constraints faced by highly leveraged companies) (Haushalter, 2000). As a result, it is plausible that managers in highly leveraged companies might seek to curtail operating expenses (including insurance) in order to meet obligations under debt contracts (see "Sensitivity Tests").

Consistent with our correlation analysis, *UNSYS* was unexpectedly negative and statistically significant at the 0.05 level (one-tailed). This implies that many Chinese companies might be underinsuring their unsystematic (asset-loss) risks (e.g., fire damage) through risk retention strategies rather than using (potentially costly) commercial property insurance solutions. Indeed, Browne and Hoyt (2000) recognize that managerial perceptions of risk and insurance (and even company managers' past loss experiences) could have an important impact on the demand for flood insurance in the United States. Similarly, in emerging economies such as that of China, problems associated with managers' (accurately) assessing risk exposure and recognizing the post-loss financing capabilities of property insurance could be exacerbated by generally low entrepreneurial ability/expertise.

Consistent with the finding of Hoyt and Khang (2000), *SIZE* was now negative and statistically significant as expected ($p \leq 0.01$, one-tailed). This finding suggests that though large Chinese companies appear to be more likely to purchase property insurance, they tend to buy relatively less property insurance coverage than small companies. This could indicate that large Chinese companies are realizing economies by selectively retaining some (e.g., high frequency low magnitude) risks and insuring other (e.g., low frequency high magnitude) risks via the commercial insurance market. By contrast, commercial insurers' services (e.g., loss prevention advice) and risk pooling capacity are likely to be more valuable to small publicly listed Chinese companies than are their larger counterparts, given their greater susceptibility to business risks and generally limited risk management expertise. Again, the level of state ownership (*STATE*) did not appear to significantly affect the corporate purchase of property insurance.

Sensitivity Tests

We also used two alternate (accounting-based) risk measures—growth in annual turnover and profit ($\Delta SALE$ and $\Delta PROFIT$)—as proxies for unsystematic/systematic risk.[22] We then replicated our two-stage analysis. In unreported results, $\Delta SALE$ and $\Delta PROFIT$ were not significant in the probit participation decision model; instead, the two measures were negative in the volume decision model, with the latter being significant at the 0.05 level (one-tailed). The results of other variables were qualita-

[22] We thank an anonymous referee for raising this issue. Details of the unreported sensitivity tests are available from Zou upon request.

tively unaffected. This suggests that while experiencing corporate sales and/or profit growth, Chinese managers tend to reduce the extent of property insurance use. By contrast, when suffering from decreases in sales/profits (e.g., due to increased market competition), company managers tend to increase the extent of property insurance use. However, we feel that these two accounting-based ex post measures could capture aspects of (uninsurable) unsystematic/systematic risk (e.g., due to changes in market competition or poor management) rather than risk related to (insurable) potential asset losses caused by an accidental disaster.

Next we tested for the possibility that the extent of property insurance usage by our sample of Chinese companies could be affected by their cash flow situation. We partitioned our sample of insuring companies into two groups—those with and without cash flow constraints. A company is defined as having constrained cash flow if it is above the 75th percentile of the sample leverage (i.e., 1.40) and concomitantly below the 25th percentile of internal cash balance (i.e., 0.16). A company's internal cash balance is measured by the amount of year-end cash and cash equivalents (e.g., short-term bank deposits) scaled by total assets. We conducted both a sample *t*-test and a Mann-Whitney test to compare the level of *INS* between the above two groups. In both tests, the computed *t*- and *z*-statistics were negatively significant at the 0.01 level (one-tailed). This finding thus lends some support for the notion that while facing severe cash-flow constraints, managers might cut back business expenditures (including insurance premiums) in order to meet obligations under debt contracts (Haushalter, 2000). It could also help explain the observed negative relation between leverage and the amount of insurance usage.

The use of property insurance as a risk management mechanism in turn may change a company's risk profile—that is, a two-way causal linkage may exist between *INS* and *SYS*, *UNSYS*, and *LEV*. If this is the case, then our estimations could be biased and inconsistent. Therefore, as suggested in Maddala (1992, p. 395), we performed an omitted-variable version of the Hausman specification test to investigate the endogeneity of the three corporate risk measures used in our analysis. First, we introduced three instrument variables—*MARSD* (the annual standard deviation of market return), *PHY* (the proportion of physical assets in total assets), and *INTCOV* (interest cover—the ratio of annual interest expenses incurred to earnings before interest and tax [EBIT])—as correlated variables for the systematic, unsystematic, and insolvency risks, respectively. However, these instrument variables are not directly influenced by property insurance usage.[23] Second, we replaced these three risk measures with their instruments in the probit model to regenerate the inverse Mill's ratio for the volume model use. Third, we regressed the three risk measures on all the exogenous variables (i.e., *MARSD*, *PHY*, *INTCOV*, *SIZE*, *STATE*, the inverse Mill's ratio, and fixed-effects) to derive fitted values as their refined instruments. Fourth, we estimated the volume

[23] *MARSTD* is the benchmark for computing company betas; *PHY* could proxy for a firm's unsystematic risk related to potential physical asset losses; and *INTCOV* could proxy for a firm's insolvency risk. Both *MARSTD* and *PHY* are exogenous relative to corporate property insurance usage. While insurance may (potentially) increase debt and thereby increase interest expenses, the presence of insurance may also lead creditors to lower the rate of interest charged. In addition, *INTCOV* is also affected by EBIT. Therefore, the relation between *INTCOV* and insurance usage is unwarranted, and we feel that it is reasonable to assume that *INTCOV* is contemporaneously uncorrelated with the error term.

decision model by regressing *INS* on the three corporate risks measures, their refined instrument variables, *SIZE*, *STATE*, the inverse Mill's ratio, and fixed-effects. We then conducted an F-test with a null hypothesis that the coefficients of three instrument variables are jointly zero. The computed *F*-statistic ($F_{3,369} = 1.694$) was insignificant at the 0.10 level (one-tailed). Therefore, we found no evidence to reject the null hypothesis that *SYS*, *UNSYS*, and *LEV* are contemporaneously uncorrelated with the error term. In other words, simultaneous-equation bias is unlikely to be a serious problem in this study.

As recommended by Kennedy (1998, p. 98), we also performed a Ramsey's regression specification error test (RESET) to examine whether our model suffered from functional misspecification error and/or omitted variable bias. We regressed the residuals from the volume model on the independent variables and the square/cubic of the fitted dependent variable. The null hypothesis of no omitted variables cannot be rejected at the 0.10 level or less ($F_{2,372} = 1.890$, one-tailed). Kennedy (1998) further reports that the RESET test is useful for detecting nonlinearity in the data. The lack of significance of the RESET statistic, however, suggested that the linear specification that we adopted in this study is appropriate.[24]

CONCLUSION

In this study, we used company-level panel data to empirically investigate the linkage between corporate risks and the purchase of property insurance in China. Our study contributes to the academic literature in two main regards. First, our study is the first of its kind to directly test the relation between corporate risks and the use of insurance in a major emerging market—China. Second, our panel data design helps overcome some of the data and research method-based limitations (e.g., inability to control for unobservable intercompany differences that might influence the corporate insurance purchasing decision) encountered in previous cross-sectional research.

In the probit analysis, we found that the decision to purchase property insurance by Chinese publicly listed companies is positively related to company size and insolvency risk. However, systematic and unsystematic risks and the presence of state ownership do not appear to be important determinants of the corporate insurance participation decision. In addition, companies incorporated in less economically developed inland regions are more likely to buy property insurance than their counterparts in the more prosperous coastal areas. This suggests that risk management expertise and hedging options may be limited in inland-based companies compared with companies operating in the more economically vibrant coastal regions.

The results from the fixed-effects volume decision model indicate that the extent of property insurance use is positively related to systematic risk and inversely related to company size, insolvency, and unsystematic risk. This suggests that systematic risk (e.g., frequent and severe flood hazard) appears to be the major risk class considered by Chinese managers in deciding an appropriate amount of property insurance to purchase. By contrast, insolvency and unsystematic risks appear to be underinsured.

[24] A Jarque-Bera test of the normality of residuals of the volume model rejected the normality assumption of residuals (see Table 4, Panel B). The non-normality (kurtosis) issue thus remains one of the main limitations of our study.

Combining the findings regarding insolvency risk from the participation and volume decision models, it appears that Chinese company managers may not fully appreciate the (direct and indirect) costs of financial distress arising from increased leverage and the role that insurance can play in alleviating such costs. The positively significant influence of insolvency risks on the corporate insurance decision in China could reflect creditors' desire for managers to take out insurance to cover the ex post risks associated with collateralized assets prior to loan approval. However, the inverse relation between leverage and the amount of insurance coverage indicates that the level of creditor-induced insurance coverage may be insufficient to adequately compensate them for accidental losses ex post. It is also interesting to note that small Chinese companies tend to insure more of their corporate risks relative to large companies despite their lower propensity to insure in the first place. A possible explanation for this observation is that large companies may discriminate between those classes of risk that they insure externally and those that they self-insure. This could also reflect different managerial tolerances to risk in companies of varying size. However, the presence of state ownership does not appear to significantly affect the corporate insurance decision.

We consider that our research findings have important implications for various groups that are interested in the Chinese corporate sector (and emerging insurance markets in general). For example, the negative relation between property insurance purchases and unsystematic and insolvency risks suggests that the creditors and/or shareholders may have to monitor more closely the risk management practices in Chinese corporations. In addition, the empirical relation that appears to exist between company size, geographical location, and the corporate purchase of property insurance in China could also help insurance suppliers (including foreign insurers) to better target potential commercial insurance customers. For instance, insurers may wish to better reflect on the risk management needs of inland-based companies and small enterprises in their product innovation and market strategies. Finally, we acknowledge that interpretation of our results should be tempered by recognition of the limitations in our study such as the short time-series of data used (1997–1999) and potential endogeneity issue. Therefore, we advise some caution in interpreting our results. Nonetheless, we believe that the results of our research could contribute important insights into the purchase of property insurance in a major emerging economy and help stimulate further research in other developing countries.

REFERENCES

Adams, M. B., and D. Hillier, 2000, The Effect of Captive Insurer Formation on Stock Returns: An Empirical Test from the UK, *Journal of Banking and Finance*, 24: 1787-1807.

A. M. Best., 1999. *1999 Best's Insurance Reports—International* (N.J.: Oldwick).

Baltagi, B. H., 1995, *Econometric Analysis of Panel Data* (Chichester, England: John Wiley).

Barnea, A., R. A. Haugen, and L. W. Senbet, 1985, *Agency Problems and Financial Contracting* (Englewood Cliffs, N.J.: Prentice Hall).

Berndt, E. R., 1991, *The Practice of Econometrics: Classic and Contemporary* (New York: Addison-Wesley).

Borde, S. F., K. Chambliss, and J. Madura, 1994, Explaining Variation in Risk Across Insurance Companies, *Journal of Financial Services Research*, 8: 177-191.

Browne, M. J., and R. E. Hoyt, 2000, The Demand for Flood Insurance: Empirical Evidence, *Journal of Risk and Uncertainty*, 20: 291-306.

China Insurance Regulatory Commission (CIRC), 1999, *China Insurance Yearbook 1998* (Beijing: China Insurance Press Publishing).

China Securities Regulatory Commission (CSRC), 2000, *Database* (Beijing: China Securities Regulatory Commission).

Colquitt, L. L., and R. E. Hoyt, 1997, Determinants of Corporate Hedging Behavior: Evidence from the Life Insurance Industry, *Journal of Risk and Insurance*, 64: 649-671.

Copeland, T. E., and J. F. Weston, 1992, *Financial Theory and Corporate Policy* (New York: Addison-Wesley).

Cox, L. A., and G. L. Griepentrog, 1988, Systematic Risk, Unsystematic Risk, and Property-Liability Rate Regulation, *Journal of Risk and Insurance*, 55: 606-627.

Cummins, J. D., R. D. Phillips, and S. D. Smith, 2001, Derivatives and Corporate Risk Management: Participation and Volume Decisions in the Insurance Industry, *Journal of Risk and Insurance*, 68: 51-90.

DeFond, M. L., T. J. Wong, and S. H. Li, 2000, The Impact of Improved Auditor Independence on Audit Market Concentration in China, *Journal of Accounting and Economics*, 28: 269-305.

Doherty, N. A., 1997, Financial Innovation in the Management of Catastrophic Risk, *Journal of Applied Corporate Finance*, 10: 84-95.

Doherty, N. A., 2000, *Integrated Risk Management: Techniques and Strategies for Managing Corporate Risk* (New York: McGraw-Hill).

Grace, M. F., and M. J. Rebello, 1993, Financing and the Demand for Corporate Insurance, *The Geneva Papers on Risk and Insurance: Theory*, 18: 147-172.

Graham, L. E., 1996, Setting a Research Agenda for Auditing Issues in the People's Republic of China, *The International Journal of Accounting*, 31: 19-37.

Greene, W. H., 1999, *Econometric Analysis* (Englewood Cliffs, N.J.: Prentice Hall).

Grillet, L., 1992, Organizational Capital and Corporate Insurance Hedging, *Journal of Risk and Insurance*, 59: 462-469.

Harrington, S. E., 1984, The Impact of Rate Regulation on Prices and Underwriting Results in the Property-Liability Insurance Industry: A Survey, *Journal of Risk and Insurance*, 51: 577-623.

Harrington, S. E., and P. M. Danzon, 2000, Rate Regulation, Safety Incentives, and Loss Growth in Workers' Compensation Insurance, *Journal of Business*, 73: 569-595.

Haushalter, G. D., 2000, Financing Policy, Basis Risk, and Corporate Hedging: Evidence from Oil and Gas Producers, *Journal of Finance*, 55: 107-151.

Heckman, J., 1979, Sample Selection Bias as a Specification Error, *Econometrica*, 47: 153-161.

Hoyt, R. E., and H. Khang, 2000, On the Demand for Corporate Property Insurance, *Journal of Risk and Insurance*, 67: 91-107.

Insurance Law, 1995, Beijing: The Chinese Government.

Ireland, J. C., and C. S. Lennox, 2002, The Large Audit Firm Fee Premium: A Case of Selectivity Bias, *Journal of Accounting, Auditing and Finance*, 17: 73-91.

Judge, G. G., R. C. Hill, W. E. Griffiths, H. Lutkepohl, and T. Lee, 1982, *Introduction to the Theory and Practice of Econometrics* (New York: John Wiley).

Kane, G. D., and N. L. Meade, 1998, Ratio Analysis Using Rank Transformation, *Review of Quantitative Finance and Accounting,* 10: 59-74.

Karmel, S. M., 1996, Securities Markets and China's International Economic Integration, *Journal of International Affairs,* 49: 525-556.

Kennedy, P., 1998, *A Guide to Econometrics* (Oxford, England: Blackwell).

Leung, M. K., and T. Young, 2002, China's Entry to the WTO: Managerial Implications for Foreign Banks, *Managerial and Decision Economics,* 23: 1-8.

Long, D. M., J. D. Payne, and C. Y. Feng, 1999, Information Transmission in the Shanghai Equity Market, *Journal of Financial Research,* 22: 29-45.

Ma, Y. W., Z. J. Lin, and M. Z. Ma, 1998, *Encyclopaedia of Insurance Business* [in Chinese] (Beijing: China Financial Publishing House).

MacMinn, R. D., 1987, Insurance and Corporate Risk Management, *Journal of Risk and Insurance,* 54: 658-677.

MacMinn, R. D., and L.-M. Han, 1990, Limited Liability, Corporate Value and the Demand for Liability Insurance, *Journal of Risk and Insurance,* 57: 581-607.

Maddala, G. S., 1992, *Introduction to Econometrics* (N.J.: Prentice Hall).

Mayers, D., and C. W. Smith, 1982, On the Corporate Demand for Insurance, *Journal of Business,* 55: 281-296.

Nance, D. R., C. W. Smith, and C. W. Smithson, 1993, On the Determinants of Corporate Hedging, *Journal of Finance,* 48: 267-284.

Naser, K., and R. S. O. Wallace, 1995, Firm-Specific Determinants of the Comprehensiveness of Mandatory Disclosure in the Corporate Annual Reports of Firms Listed on the Stock Exchange of Hong Kong, *Journal of Accounting and Public Policy,* 14: 311-368.

Niehaus, G., 2002, The Allocation of Catastrophe Risk, *Journal of Banking & Finance*, 26: 585-596.

People's Bank of China (PBOC), 1998, *China Financial Yearbook 1997* (Beijing: China Financial Publishing House).

People's Bank of China (PBOC), 2000, *China Financial Yearbook 1999* (Beijing: China Financial Publishing House).

Shen, L., 2000, China's Insurance Market: Opportunity, Competition and Market Trends, *The Geneva Papers on Risk and Insurance: Issues and Practice,* 5: 335-355.

Shi, J. X., and W. H. Su, 2000, Competitive Strategies: A Survey on the Property Insurance Markets in China, *Shanghai Insurance* [in Chinese], 4: 31-33.

Stalvies, C., 1997, Continuity by Design: Embedding Operational Risk Functions in the Organisational Structure, *Journal of the Society of Fellows,* 12: 104-130.

Stoll, H. R., 1995, Lost Barings: a Tale in Three Parts Concluding with a Lesson, *Journal of Derivatives,* 3: 109-115.

Sun, H., P. Hone, and H. Doucouliagos, 1999, Economic Openness and Technical Efficiency: A Case Study of Chinese Manufacturing Industries, *Economics of Transition,* 7: 615-636.

Sun, Q., W. H. S. Tong, and J. Tong, 2002, How Does Government Ownership Affect Firm Performance? Evidence from China's Privatization Experience, *Journal of Business, Finance & Accounting*, 29: 1-28.

Tam, O. K., 2000, Models of Corporate Governance for Chinese Companies, *Corporate Governance*, 8: 53-65.

Vickers, J., and G. Yarrow, 1998, *Privatization: An Economic Analysis* (Cambridge, Mass.: MIT Press).

Warner, J. B., 1977, Bankruptcy Costs: Some Evidence, *Journal of Finance*, 32: 337-347.

Xu, X. N., and Y. Wang, 1999, Ownership Structure and Corporate Governance in Chinese Stock Companies, *China Economic Review,* 10: 75-98.

Yamori, N., 1999, An Empirical Investigation of the Japanese Corporate Demand for Insurance, *Journal of Risk and Insurance*, 66: 239-252.

Zhang, G., 1998, Ownership Concentration, Risk Aversion and the Effect of Financial Structure on Investment Decisions, *European Economic Review,* 42: 1751-1778.