Evaluating the risk of life insurer insolvency: implications from the US for the European Union

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Abstract

Insolvencies of life insurers in Europe have been virtually nonexistent. The deregulation of European markets, however, is likely to dramatically alter that situation. The goal of this study is two-fold: first, to identify significant variables in the early detection of financially distressed life insurers; and second, to consider the importance of these variables to the evaluation of life insurer insolvency risk in the European Union (EU). The availability of a data sample approaching the universe of insurers in the US allows us to stratify a large sample in order to make reasonable inferences regarding the factors likely to influence insolvency experience in the EU. The most significant findings for EU consumers, regulators, and insurers relate to the importance of capital and surplus, geographic focus, asset mix, and leverage in determining the likelihood of insurer bankruptcy. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

The financial condition of US life insurers has received widespread attention, especially with the failure of two large insurers, Mutual Benefit Life and Executive Life, both in 1991. Failures of the magnitude of these two life insurers and the increased frequency of life insurer insolvency suggest that a reexamination of the risk profiles of life insurers is warranted. Prior studies have been constrained by a lack of data on both insolvent and solvent life insurers. Additionally, the results of these studies have not been consistent, either in the level of classification accuracy or in the variables they identify as significant insolvency predictors.

Insolvencies of life insurers in Europe have been virtually nonexistent (see Hogan, 1995, p. 344). However, the deregulation of the European insurance market which is resulting from the adoption and implementation of the European Union (EU) Insurance Directives to harmonize regulation among EU Member States is likely to dramatically alter that situation.1 As reported in The European Insurance Handbook, ‘the opportunities for life insurers are significant, but at the same time competition is set to increase. Insurers will have to fight harder for market share’ (Dickson and Bardwell, 1991). As this statement suggests, the European life insurance market is changing to one with many similarities to the more competitive life insurance market in the US.

The similarities between the US life insurance market and the emerging harmonized market in the EU are striking. In the 1990s, life insurance premiums in the EU were approximately $200 billion compared to US life insurance premiums of $220 billion. Over 1000 life insurers operate in the EU, which is similar to the situation in the US. An early warning system, similar to that used in the US, has been proposed for the EU. Primary regulatory oversight is led by the state of domicile in the US, and would rest with the regulator in the home country in the EU. Clifford Chance (1993) suggests that US insurers believe that their experience in the US market will assist them in the single EU market. Therefore, it appears reasonable to expect that the important insolvency factors identified in this study will be important in the increasingly competitive single insurance market of the EU.2 Hence, a careful analysis of the factors that have affected life insurer insolvency in the US should yield some valuable information for the assessment of potential insolvency risk in the EU’s changing life insurance market.

The goal of this study is 2-fold: first, to identify significant variables in the early detection of financially distressed life insurers; and second, to consider the importance of these variables to the evaluation of life insurer insolvency risk in markets,

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1 Member States include all EU countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the United Kingdom. The European Economic Area Agreement effectively includes Norway, Iceland and Liechtenstein in the single insurance market as well.

2 For further discussion of similarities between the two markets, see Dickson and Bardwell (1991), Clifford Chance (1993), and Hogan (1995).
such as those in the EU, where insolvencies have been infrequent, but where deregulation and increased competition promise to alter the situation in the near future.

The paucity of insolvencies among EU life insurers precludes a direct analysis of insolvency risk based on a large sample of insolvent European insurers. However, the availability of a data sample approaching the universe of insurers in the US allows us to stratify the sample in order to make some reasonable inferences regarding the factors that are likely to influence insolvency experience outside the US. The analysis uses logistic regression to estimate important insolvency factors. The study utilizes a data sample that approaches the universe of US life insurers, namely, the National Association of Insurance Commissioners’ (NAIC) database.

2. Importance of solvency monitoring

Detection of financial distress of insurers is important to several parties including regulators, consumers, agents, and insurers. Regulators: the protection of policyholders from losses due to insurer insolvency is a primary purpose of insurance regulation (Harrington and Nelson, 1986). Detecting insurers that are likely to experience financial distress helps insurance regulators decide the extent of regulatory attention to focus on particular firms.

Consumers/policyholders: the counterparty risk faced by insurance buyers is similar to that faced by bondholders — namely, the risk of default. The limited availability of financial information on insurers and securities limits the ability of policyholders to evaluate default risk accurately. Even with complete financial information, most consumers lack the ability to evaluate default risk. Further, moral hazard exists in that monitoring by policyholders to detect high-risk insurers is reduced with the existence of financial solvency guaranty funds like those in the US.

Agents: liability for placing coverage with an insurer that later becomes insolvent is an exposure that is directly related to the frequency and severity of insurer insolvencies. Early detection of financially impaired insurers should help agents meet this duty.3

Insurers: assessments for insolvencies that are levied on remaining solvent insurers suggest that detection of financially troubled insurers is important to sound insurers (Staking and Babbel, 1995). Mayers and Smith (1982) and Smith and Stulz (1985) address attempts by managers of corporations to reduce the variability of operating cash flows by favoring less risky investment projects, diversifying into new lines of business, and using financial hedges. The motivation for such attempts stems partly from personal costs to managers that may result in the event of corporate bankruptcy. Thus, early detection of financial distress is important to life insurers to avoid insolvency, and to their managements to minimize personal costs.

3 In addition to insurance agents, financial analysts and rating organizations have an interest in the solvency position of insurers.
3. The single European insurance market

3.1. Treaty of Rome, directives, EU Commission

The objective of the Treaty of Rome, signed in 1957 by six founding Member States, was the establishment of a common market. Several provisions of the Treaty had important implications for the establishment of an integrated European insurance market. Article 52 called for the abolition of restrictions on nationals of one Member State from establishing themselves in another. Article 59 provided for the abolition of restrictions on Member State nationals who are established in one Member State from providing services in another. However, the realization of these provisions has been far from immediate.

A series of Directives followed the Treaty of Rome and is targeted at harmonizing regulatory requirements across Member States. A further major step was the enactment of the Single European Act in 1986. This act amended the Treaty of Rome and set forth a deadline of December 31, 1992 by which the single market was to be achieved.

The goals of the single market in insurance defined by the EU Commission4 were:

1. the freedom for consumers to choose any insurance policy from any insurer authorized in any Member State;
2. the freedom for insurers authorized in any one Member State to market policies throughout the EU under the principles of freedom of establishment and freedom to provide services; and
3. the freedom for insurers to compete equally on price, product and service, all unnecessary barriers to competition being removed.

The EU legislation covering direct insurance can be divided into three generations: freedom of establishment; freedom of services; and introducing both freedoms on the basis of home country control. Each of these generations has been matched by a specific Directive (see Dickson and Bardwell, 1991), pp. 10–11:

1. First Life Insurance Establishment Directive (adopted: March 5, 1979);
   - right for any EU insurer to establish itself in any foreign Member State;
   - freedom from more onerous restrictions than those applied to local competitors;
   - common solvency margins to apply throughout the EU;
2. Second Life Insurance Services Directive (adopted: November 8, 1990);
   - freedom to provide services cross-border under the ‘cumul’ rule5;

4 See Clifford Chance (1993), pp. 2. The EU Commission in Brussels is the community’s executive arm.
5 Cumul is based on the Latin ‘accumulare’, which means ‘to accumulate’. It refers to a situation where an insurer, established in a host Member State and able through its branch there to insure risks in that State, can also cover the same risks from an establishment in another Member State. The cumul rule has been abolished under the Third Directive. Therefore, insurers are allowed to provide their services in another Member State both through a local establishment or directly from the home Member State.
   - introduces concept of a single license;
   - abolition of ‘cumul’ rule;
   - home state supervision of financial soundness.

3.2. EU solvency requirements

Guarantee funds are allocated net worth accounts. They correspond most closely to the minimum capital and surplus requirements imposed by US state insurance statutes (Hogan, 1995, pp. 353). Under Article 20 of the First Life Insurance Directive, the guarantee fund is established to be one-third of the minimum solvency margin as specified in Article 19, but not less than the following:
1. 800 000 units of account (ECU);
2. 600 000 units of account (ECU) in the case of mutual associations and mutual-type associations.

Although the guarantee fund may be higher based on the calculations described in Article 19, the minimum level for any insurer is that described above. Hence, these amounts are used in censoring the data set for the insolvency analysis in this study.

Article 24 details the provisions for regulatory action should an insurer fail to maintain the required minimum guarantee fund. Specifically, Article 24 states:

If the solvency margin falls below the guarantee fund as defined in Article 20, or if the latter is no longer constituted as laid down in that Article, the supervisory authority of the head-office Member State shall require the undertaking to submit a short-term finance scheme for its approval. It may also restrict or prohibit the free disposal of the assets of the undertaking. It shall inform the authorities of other Member States in whose territories the undertaking is authorized of any measures and the latter shall, at the request of the former, take the same measures.

A Member State can set more stringent solvency requirements. However, these higher standards can be applied only to the Member State’s own domestically based insurers. Also, Member States cannot require prior approval of rates and forms for any insurer selling in their market (see Hogan, 1995, pp. 342).

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6 The term ‘guarantee fund’ as used here should not be confused with the state guaranty funds that exist in each state in the US. The state guaranty funds are mechanisms for covering the financial loss that policyholders and claimants sustain when an insurer fails. No uniform guaranty fund system like that in the US has been established in the EU. In most Member States no such system exists presently.

7 Based on exchange rates on March 1, 1996 (ECU 1 = US$ 1.25), the requirements would be $1 million and $750 000, respectively.
3.3. Responsibility for regulatory oversight

Under the Third Life Insurance Directive, a single license regime is established. An insurer’s home Member State license is valid whether business is carried on through a branch, agency or through the provision of cross-border services. The insurer must simply notify the host Member State authorities that it intends to write business in that Member State and file required documents. Sole responsibility for the financial supervision of an insurer’s entire business within the EU rests with the insurer’s home Member State. However, it also obliges any host country to notify the home Member State’s supervisory authorities if it suspects that the insurer’s activities might affect the insurer’s financial solvency. It is left up to the home Member State to decide whether any action is necessary. The home Member State is solely responsible for withdrawing authorization.

The EU Insurance Committee was established by the Insurance Committee Directive (91/675/EEC). The Committee consists of the supervisory authorities of each of the Member States and is chaired by a Commission representative. The Committee began work January 1, 1992. The Insurance Committee has two main functions. First, it acts in a regulatory capacity to assist the EU Commission in exercising its powers under the Directives. Second, it acts in an advisory capacity to the EU Commission on the application of the Directives. The Committee seeks to achieve coordination between the insurance supervisory authorities of the Member States. Particularly important is the coordination of activities related to the financial oversight of insurer operations. The committee has proposed an ‘early warning system’ to supervise life insurers. This system would be similar to the IRIS (Insurance Regulatory Information System) approach used by the NAIC (see Hogan, 1995, pp. 343).

Although the framework for a single insurance market in the EU was completed in July 1994, barriers still remain to the realization of this single market. Two of these barriers which have relevance to insurer solvency include:

1. it is unclear to what extent host Member States will be able to intervene in the control of insurance operations in their country; 8
2. it is uncertain to what extent home Member State regulators will be able to effectively monitor non-domestic business and to take any necessary remedial action (see Clifford Chance, 1993, pp. 56–67).

A proposal for a Council Directive for winding-up or liquidation procedures was introduced in 1989, but is not yet adopted. This proposal sets out common procedures for the compulsory winding-up of insurance activities in the case of both solvent and insolvent insurance operations.

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8 Also of concern is the relative ability of some Member States to monitor effectively the operations of their domestic insurers operating in a variety of host Member States. Do the supervisory authorities have the requisite expertise and financial resources to do their jobs effectively? Differential accounting practices across Member States also present monitoring problems for supervisory authorities. Finally, a uniform definition of financial distress is yet to be established.
Analysis by the Commission reported in the early 1980s showed that if insurance products were sold throughout the EU at the average prices of the four lowest cost producer countries, consumers would save ECU 2.45 billion (US$ 3.08 billion). Prices would need to fall by 51% in Italy, 32% in Spain, 31% in Belgium, but by a minimal amount in Holland and Britain to achieve similar price levels (Dickson and Bardwell, 1991, pp. 5). This type of situation clearly suggests that harmonization of requirements and the general deregulation resulting from the EU Directives is likely to create significant competitive pressures in some of the EU countries, thus increasing the likelihood of insolvency for life insurance companies.

The virtual absence of insolvencies among EU life insurers precludes a direct analysis of insolvency risk based on a large sample of insolvent European insurers. Yet, the dramatic insurance market changes described are likely to have a significant impact on life insurer solvency in the EU. Postponing solvency research until a sufficient number of insurer failures occur in the EU does not appear prudent.

4. Prior research

Beginning with Trieschmann and Pinches (1973), insurer insolvency studies used matched-pair samples of relatively small size, applied multiple discriminant analysis (MDA) and/or logit, produced relatively high classification (low error) rates, often used a validation method, and grouped insurer insolvencies over a period of from five to 20 years. BarNiv and Hershbarger (1990) review the literature on insurer solvency.

Table 1 summarizes several insurer insolvency studies (property-liability and life-health) by sample composition, methodology, classification error rates, validation method, time period of insolvencies, and type of insurers examined. Ambrose and Carroll (1994) applied logistic regression analysis to matched-pair samples of life insurers. The authors found that IRIS ratios generally do not distinguish between solvent and insolvent insurers when used alone. However, using additional financial variables in conjunction with IRIS ratios provides significant improvement in predicting solvency status. Brockett et al. (1994) applied a neural network model to 60 property-liability insurers that became insolvent in 1991 or 1992, and a sample of 183 solvent insurers matched according to size, line of business, and state of domicile. The method provided classification rates of 73, 95 and 89% for insolvent, solvent, and the overall sample of insurers, respectively.

Huang et al., (1994) also applied a neural network method for forecasting insurer financial distress. The authors examined a large, nonmatched-pair sample of solvent and insolvent life-health insurers and obtained classification rates that were substantially lower than rates found by the majority of previous researchers that used matched-pair samples. Their study did not attempt to identify important measures of insolvency other than from among IRIS ratios. Carson and Hoyt (1995) used a large, nonmatched-pair sample and also obtained relatively low classification rates compared to those based on matched-pair samples. The study also reported significant changes in important variables from those identified in previous studies that had examined matched-pair samples and earlier time periods.
Table 1
Summary of selected previous insurance research: sample selection, methodology, classification error rates, validation method, time period of failures and type of insurers

<table>
<thead>
<tr>
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<tbody>
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<td><strong>Sample</strong></td>
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<tr>
<td>Matched-pair sample</td>
<td>No∗</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<td># Distressed firms</td>
<td>26</td>
<td>12</td>
<td>29</td>
<td>28</td>
<td>26</td>
<td>60</td>
<td>28</td>
<td>80</td>
</tr>
<tr>
<td># Nondistressed firms</td>
<td>26</td>
<td>69</td>
<td>29</td>
<td>28</td>
<td>26</td>
<td>183</td>
<td>1.824</td>
<td>1.605</td>
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<td><strong>Primary methodology</strong></td>
<td>MDA</td>
<td>Regression</td>
<td>MDA</td>
<td>Log</td>
<td>Log</td>
<td>Neural net</td>
<td>Neural net</td>
<td>Logit</td>
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<td><strong>Classification errors</strong></td>
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<tr>
<td>Distressed (Type-I)</td>
<td>0.08</td>
<td>0.17</td>
<td>0.10</td>
<td>0.07</td>
<td>0.24</td>
<td>0.27</td>
<td>0.29</td>
<td>0.20</td>
</tr>
<tr>
<td>Nondistressed (Type-II)</td>
<td>0.04</td>
<td>0.07</td>
<td>0.24</td>
<td>0.11</td>
<td>0.29</td>
<td>0.05</td>
<td>0.28</td>
<td>0.28</td>
</tr>
<tr>
<td>Overall</td>
<td>0.06</td>
<td>0.09</td>
<td>0.17</td>
<td>0.09</td>
<td>0.26</td>
<td>0.11</td>
<td>0.28</td>
<td>0.28</td>
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<tr>
<td><strong>Validation method</strong></td>
<td>Sb</td>
<td>None</td>
<td>Jackknifec</td>
<td>Ad</td>
<td>Holdoute</td>
<td>Holdoute</td>
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<td><strong>Time period of failures</strong></td>
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</tr>
<tr>
<td><strong>Type of insurers</strong></td>
<td>P-L</td>
<td>P-L</td>
<td>P-L</td>
<td>L-H</td>
<td>L-H</td>
<td>P-L</td>
<td>L-H</td>
<td>L-H</td>
</tr>
</tbody>
</table>

* Randomly matched.
  † Simulated sample.
  $ Lachenbruch method.
  ‡ Additional solvent sample.
  § Same time period holdout sample.
  ¶ Later time period holdout sample.
  # 25% holdout of full sample.
In addition, Browne and Hoyt (1995) identified factors exogenous to individual insurers that are statistically related to the overall rate of property-liability insurer insolvencies. Cummins et al. (1995) found that the predictive accuracy of risk-based capital measures is low for a large sample of solvent and insolvent property-liability insurers; accuracy improved significantly, however, when size and organizational form variables were added to their logistic regression model. Lamm-Tennant et al. (1996) provides point estimators for measuring the probability of insolvency. Downs and Sommer (1999) provide evidence regarding the risk-subsidy and monitoring hypotheses for the relation between insider ownership and risk-taking in the property-liability insurance industry. Cummins et al. (1999) showed that cash flow simulation variables add explanatory power to solvency prediction models. Browne et al. (1999) identified factors exogenous to individual insurers that are statistically related to the overall rate of life-health insurer insolvencies.

5. Research methodology

5.1. Empirical method

The statistical methodology used here to estimate the insolvency factors is logistic regression. The logit model classifies observations into one group or the other based upon a logistic application of regression analysis and a critical value of $Z$.

The logit model constrains the probability of failure to the $(0, 1)$ interval by assuming that the relationship between the categorical binary dependent variable and the explanatory variables follows a logistic response function, expressed in (Eq. (1)) as:

$$P_i = \frac{1}{1 + e^{-Z}}$$  (1)

where $P_i$ is the probability of firm failure, and $Z = X\beta$. Logistic regression overcomes some of the limitations of MDA. While MDA and logistic regression are parametric in nature, other methodologies, such as recursive partitioning, are nonparametric methods.

5.2. Sample and data

This research provides empirical results based on information from the NAIC database. This source contains data on approximately 1900 life insurers. The NAIC data span the years 1984 to the present, and include extensive financial information from annual statements filed with the NAIC.

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If the assumed transformation function, $F()$, is the cumulative normal probability function, the probit probability model will result, rather than the logit probability model, which uses the cumulative logistic probability function. Both the normal and logistic functions are symmetric with mean and mode at zero. The logit model has been found to be more computationally tractable by Pindyck and Rubenfeld (1991), and, thus, is preferred here.
All insurers with complete data from the NAIC are included in the study, except as described below. To more closely reflect the solvency requirements existing in the EU, insurers with capital and surplus less than $1,000,000 (800,000 ECU) were censored from the data set. An insurer experiencing financial difficulty (but not yet insolvent) may merge with a stronger insurer in order to avoid insolvency. For the years between 1989 and 1992, Best identified 107 mergers that took place in the life insurance industry. Insurers involved in a merger during this study’s sample period are not included in the sample of insurers. Browne and Hoyt (1995) found that the number of insolvent insurers and the number of mergers were not significantly correlated for the property-liability insurance industry. Voluntary retirements of life insurers also are not included, since these retirements may be due to reasons other than financial impairment. The final sample includes 54 insurers that became insolvent from 1989 to 1991, and includes 274 insurers that remained solvent from 1986 through 1992. US life insurer insolvencies were relatively less frequent in the years after 1991. For this reason, and to maintain a short time frame, 1991 is the end of the insolvency sample period.

The A.M. Best definition of ‘financially impaired company’ (FIC) is the basis for determining failed and nonfailed insurers. The date of FIC is that of the first official action taken by the department of insurance in the insurer’s state of domicile.

5.3. Variables in the analysis

Prior insolvency studies relied on intuition, stepwise procedures, factor analysis, and previous research as guidance in the search for important independent variables. We include important variables from previous research, variables related to an insurer’s investment and underwriting operations, and other variables, many of

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10 Article 20 of the First Life Insurance Directive states that the minimum solvency margin should not be less than 800,000 ECU, and not less than 600,000 ECU for mutual associations. Censoring those insurers that had capital and surplus less than $1,000,000 resulted in 331 solvent insurers and 26 insolvent insurers being dropped from the data set.

11 Because of missing or incomplete data for merging insurers, and because of the inability to determine if one of the merging insurers was financially impaired, insurers involved in a merger are not included.

12 Because of the relatively large number of life-health insurers in financial distress over a short period of time, we are able to pool insolvencies from three years instead of from a much longer time period, as was needed in previous insolvency research. The shorter time period reduces the confounding effects of variation in the economic environment across time (see Browne et al., 1999). Data for the solvent insurers is based on 1990, the midpoint of the insolvency period. The calculation of several variables, however, requires data from the previous three years.

13 As stated in Best’s Insolvency Study, Life-Health, 1992, ‘state actions include involuntary liquidation, receivership, conservatorship, cease and desist order, suspension, license revocation, administrative order, supervision or any other action that restricted a company’s freedom to conduct business normally’. Ambrose and Seward (1988) included those insurers ‘for which an assessment had been made by a guaranty fund’.
which were included in prior studies. High correlation warranted care in the choice of variables, and we strove to fit a parsimonious model. Forward stepwise analyses based on the entire set of variables suggested the inclusion of several variables.\(^{14}\) A description of the significant variables and their expected signs is given below.\(^{15}\)

5.4. **CAPSUR — log of capital and surplus (−)**

The insurer may be viewed as a financial intermediary that holds title to a set of assets and sells claims against the assets to policyholders and shareholders, as discussed in Staking and Babbel (1995). Capital (surplus) provides a buffer in the event that losses are larger than expected (or investment returns are lower than expected). Capital also serves to protect policyholders against reverse moral hazard by assuring policyholders that the firm is committed to maintaining solvency without imposing costs on policyholders through a unilateral decision to increase risk.\(^{16}\) Thus, higher levels of capital and surplus suggest lower likelihoods of insolvency. Further, by increasing the amount of capital, the insurer may signal its long-term commitment not to change the level of risk.

5.5. **CAPSURXV — log of mean of capital and surplus to variance of capital and surplus (−)**

As variability in capital and surplus increases, this variable decreases. A firm having relatively high variability in capital and surplus is expected to be more likely to become insolvent than a firm with more stable values of capital and surplus.

5.6. **PREMSURP, RSRVSURP — premium to surplus, reserves to surplus (+)**

A method by which an insurer may increase firm riskiness is by increasing leverage—insurance leverage and/or financial leverage. Capital structure literature suggests that firm value increases with increased leverage up to an optimum point and then declines as leverage extends beyond this optimum level.\(^{17}\) Thus, levels of leverage beyond the optimum level suggest higher likelihoods of insolvency.

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\(^{14}\) The procedure was used at the 0.15 level of significance for entrance into the model. Due to collinearity concerns (measured by variance inflation factors), Log of Total Assets and Real Estate to Total Assets (mean to variance) were removed from further analyses.

\(^{15}\) For a complete listing of variables initially used, see Table 2.

\(^{16}\) Reverse moral hazard is discussed in Staking and Babbel (1995). It refers to the concept that insurers are able to change the risk level of the insurance contract (probability of insolvency) once written; yet, policyholders cannot cancel past coverage, obtain a refund, and transfer past exposures to another insurer without cost.

\(^{17}\) The concept of an interior optimum level of leverage considers the effects of taxes, costs of financial distress or agency costs, and information signaling.
5.7. **REASSET** — real estate to assets (+)

This variable is a measure of an insurer’s exposure to changes in real estate values. Given the declines in real estate during the sample period of insolvencies (1989–1992), it is expected that the larger this variable, the higher the probability of insolvency.

5.8. **CHGAMIX** — change in asset mix (+)

This variable is the average of the percentage change in asset accounts (same as IRIS ratio). The larger the change in the ratio, the greater the expected probability of insolvency.18

5.9. **LICASSET** — liabilities to current assets (+)

This variable is an inverse measure of liquidity. The larger the ratio of liabilities to current assets, the higher the expected probability of insolvency.

5.10. **STATCONC** — state concentration (−/+)

An insurer that is geographically concentrated may gain a competitive advantage over other insurers and, thus, have a lower probability of insolvency. Alternatively, a geographically concentrated life insurer may face a higher likelihood of ruin due to its greater sensitivity to changes in local market conditions, including adverse mortality and morbidity changes, negative regulatory effects or deterioration in the economic environment.

5.11. **DEVNGFO** — standard deviation of net gain from operations (+)

This variable reflects the level of variation in the insurer’s net gain from operations. The greater the variation in net gains the higher the expected probability of insolvency.

5.12. **MUTSTOCK** — mutual or stock insurer (+)

The ownership form of an insurer may be related to an insurer’s propensity for failure. It is expected that stock insurers will have a higher likelihood of insolvency given the different risk incentives that exist among stock and mutual insurers.19

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18 As stated in the NAIC’s description of the IRIS ratios, rapid change in this ratio does not necessarily imply poor management, but may signal that the insurer is rearranging its asset mix due to solvency concerns.

19 A stock insurer owned by a mutual insurer is treated as a mutual insurer; see Mayers and Smith (1994).
Other variables included in the initial search for important variables are listed in Table 2.

6. Empirical results

Results of the empirical analysis are presented in this section. The empirical model and significant variables are discussed first. Significant differences are present between solvent and insolvent insurers in the sample. The empirical model relating

<table>
<thead>
<tr>
<th>Variable</th>
<th>Logit model coefficient</th>
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<tr>
<td>Intercept</td>
<td>2.00</td>
</tr>
<tr>
<td>Logarithm of capital and surplus</td>
<td>–.36*</td>
</tr>
<tr>
<td>Logarithm of mean of capital and surplus to variance of capital and surplus</td>
<td>–.01*</td>
</tr>
<tr>
<td>Reserves to surplus</td>
<td>0.07*</td>
</tr>
<tr>
<td>Real estate to assets (IRISₖ)</td>
<td>15.11*</td>
</tr>
<tr>
<td>Change in asset mix (IRIS₁₁)</td>
<td>14.64**</td>
</tr>
<tr>
<td>Liabilities to current assets</td>
<td>0.06*</td>
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<tr>
<td>Business state concentration</td>
<td>–1.04**</td>
</tr>
<tr>
<td>Standard deviation of net gain from operations</td>
<td>0.01***</td>
</tr>
<tr>
<td>Mutual or stock</td>
<td>0.82</td>
</tr>
</tbody>
</table>

* In addition to the variables above, the following variables also were examined, but were insignificant in the various models:
  * Significant at the 0.10 level.
  ** significant at the 0.05 level.
  *** Significant at the 0.01 level.

Separate account assets to total assets
Premium to surplus
Change in capital and surplus (IRIS₁₁)
Logarithm of assets
Capital and surplus to liabilities
Net gain from operations
Net gain from operations to surplus
Commissions and expenses to premium (IRIS₇)
Age of insurer
Minimum state capital requirement
Business line concentration
Reinsurance to assets
Nonadmitted assets to assets (IRIS₅ₐ)
Investments in affiliates to capital and surplus (IRIS₇₉)
Change in premium (IRIS₇₉)
Change in product mix (IRIS₁₀₉)
the independent variables to the probability of insolvency is presented in Table 2. Summary statistics of the variables used in the empirical model are given in Table 3.

The classification function for the logit model one year prior to insolvency is as follows:

\[
Z \text{ (logit)} = 2.00 - 0.36 \text{CAPSUR}^{**} - 0.01 \text{CAPSURXV}^{***} + 0.07 \text{RSRVSURP}^{***} \\
+ 15.11 \text{REASSET}^{***} + 14.64 \text{CHGAMIX}^{**} + 0.06 \text{LICASSET}^{***} \\
- 1.04 \text{STATCONC}^{**} + 0.01 \text{DEVNGFO}^{*} + 0.82 \text{MUTSTOCK} 
\]

where *** is significant at 0.01, ** is significant at 0.05 and * is significant at 0.10.\(^{20}\)

The coefficients of all variables in the model are significant except the coefficient on MUTSTOCK (\(P\)-value equals 16). A negative coefficient indicates that the larger the variable, the smaller the expected probability of insolvency; a positive coefficient indicates that the larger the variable, the greater the expected probability of insolvency.

The results suggest that one year prior to insolvency, insurers having low capital and surplus, capital and surplus with a low mean and high variance, high reserves to surplus, a high ratio of real estate to assets, high average changes in asset mix, high liabilities to current assets, low geographic concentration, and high variation in net gains from operations are more vulnerable to distress.

The real estate variable, while highly significant, also may be highly temporal, in that it is primarily during the late 1980s and the early 1990s that problem real estate has become a concern for life insurers. Real estate is sensitive to default in periods of economic downturn, which likely is the case around the globe. Findings show that real estate has certain investment characteristics that have led to problems for

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\(^{20}\) The model is significant at the 0.001 level by a chi-square test. The model was run with and without a constant term. Results for coefficients generally were similar.
US insurers, and are likely to have important implications for EU insurers, regulators, and consumers.

Carson and Scott (1996) discussed a relatively new type of risk—the ‘run on the bank’ risk. In the 1980s and 1990s, life insurers introduced accumulation products to compete in interest rate markets with depository financial institutions and money market mutual funds. Guaranteed investment contracts (GICs) resemble bank certificates of deposit, and offer considerable flexibility in the removal of funds (due to surrenderability on short notice). While GICs are popular with pension sponsors (since they may be purchased to replicate defined-benefit pension programs), GICs present the possibility of a ‘run on the bank’ phenomenon—e.g. Mutual Benefit Life.

Mutual Benefit issued GICs and invested relatively large portions of its investment portfolio in high-yield non-investment grade (junk) bonds, commercial mortgages and commercial real estate. These investments and ‘run on the bank’ GIC-withdrawals were at the root of financial problems that precipitated the failure of Mutual Benefit Life during 1991 (see Best, 1992). Similarly, other insurers may suffer liquidity crises that force the removal of high-quality assets from their portfolios and cause losses from selling low-quality assets into illiquid markets (see Browne et al., 1999).

As mentioned earlier, the EU Insurance Committee has proposed an ‘early warning system’ to supervise life insurers. This system would be similar to the IRIS approach used by the NAIC (see Hogan, 1995). Examining the results here, it is important to note that the majority of significant variables from (Eq. (1)) are not part of the set of IRIS ratios. Results of this analysis indicate that EU insurance regulators should focus on a broader set of variables than those that constitute the IRIS ratios and that adopting more financial and cash flow simulation variables (see Cummins et al., 1999) likely would result in superior solvency monitoring. In addition, use of the variables in a multivariate (versus univariate) context improves early detection of insolvency.

A further important consideration is that solvency models such as the one illustrated above should not be viewed as static in nature. Rather, changes in economic conditions, insurer investments, products, regulations, and distribution systems necessitate continuous revision of classification models, in order to provide up-to-date solvency models. Consistent with studies examining property-liability insurers, evidence exists that shifts in important variables related to life insurer solvency occur over time.

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21 IRIS ratios include: Change in Capital and Surplus; Net Gain to Total Income; Commissions and Expenses to Premiums; Investment Yield; Nonadmitted Assets to Assets; Real Estate to Capital and Surplus; Surplus Relief; Change in Premium; Change in Product Mix; Change in Asset Mix; and Change in Reserving Ratio.

22 For example, although most of this study’s significant variables (or close proxies) were used by BarNiv and Hershbarger (1990) for an earlier time period, no overlap of significant variables exists in the 1-year prior models. For a discussion of this point, see Carson and Hoyt (1995). Also, the US life insurer failure rate has varied dramatically over time. During the period 1975–1984 the failure rate averaged approximately nine insurers per year, while from 1985–1994 the failure rate averaged 29 per year.
7. Summary, implications, and conclusions

The availability of a data sample approaching the universe of insurers in the US provided for a censored sample in order to make some reasonable inferences regarding the factors that are likely to influence insolvency experience in the evolving single insurance market environment in Europe. This study identified significant variables that are likely to be relevant in the early detection of financially distressed life insurers in the EU, where insolvencies to date have been infrequent.

Previous insurer bankruptcy studies largely employed matched-pair sampling techniques, and pooled insolvencies over a period of from 5 to 20 years. In contrast, the recent occurrence of a relatively large number of life insurer insolvencies in the US allowed this study to include all insurers with complete NAIC data (solvent and insolvent) over a relatively short time period.

The empirical model for classifying solvent and insolvent firms was significant at the 0.001 level, and several variables were significantly related to the probability of insurer bankruptcy. These variables were different, however, from significant variables found in prior studies, indicating a possible shift in important variables over time.

Both the level and relative variability of capital and surplus were significantly related to the probability of life insurer insolvency. This was true even though the sample was censored to include only insurers that met the current minimum solvency margin requirements in the EU. This finding suggests that the EU Insurance Commission should consider the adequacy of the current minimum EU solvency margin requirement.

The results have implications for managers of insurers. The benefits of a large capital and surplus position have an empirical basis, providing a buffer against larger than expected losses or smaller than expected investment gains. The dangers of holding relatively high proportions of assets in real estate were emphasized, given that distressed insurers carried significantly larger holdings of their assets in real estate. Finally, the leverage measure of reserves to surplus was significant in the model, suggesting that the traditional finance concept of leverage is applicable to insurers — leverage adds a dimension of risk that manifests itself in a higher propensity for failure than for less-levered insurers.

Of particular importance to the EU is the finding that life insurers with high levels of geographic concentration were less likely to fail. Or stated conversely, life

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23 Recall that the sample did not include 357 observations for insurers that had capital and surplus less than $1,000,000. The effect of the censoring was to change the significance of some variables. Namely, the ratio of separate account assets to total assets no longer was significant, and the ratio of premiums to surplus no longer was significant. Additionally, the ratios of liabilities to current assets became significant, as did the business state concentration variable (see Carson and Hoyt, 1995).

24 The findings also may be manifestations of variation across studies in data collection and the structure of the insolvency studies.
insurers that are more geographically diversified are more likely to fail. This finding has important implications for EU insurers since it is commonly believed that the single market environment will lead to greater geographic diversification of European insurers. Opportunities for growth will expand as will the competition that many insurers face. This combination will provide the potential for rapid growth and downward pressure on premiums. It also is noteworthy that the differing accounting systems used in the various Member States also may impede regulators’ ability to identify some of these issues early. Affiliate problems also may increase for EU insurers as they branch into other countries and markets.25

The failure rate among US life insurers has varied dramatically since 1970. Although life insurer failures have been virtually nonexistent in Europe, the deregulation of the European insurance market likely will alter that situation. Empirical models such as the logistic model presented here identify key variables that distinguish between financially sound and unsound life insurers.

Insurer insolvency models would benefit from future research exploring the true costs of type-I errors (misclassifying an insolvent insurer as solvent) and type-II errors (misclassifying a solvent insurer ‘as insolvent’). Additional issues include the relationship of holding company affiliation and insolvency, empirical tests of various agency theory implications for insurer behavior, and the role of executive compensation for insurers.

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References


25 In a recent insolvency study by Best (1992) pp. 69, the top four reasons identified in life insurer insolvencies during the period 1976–1991 were inadequate pricing/surplus (23%), rapid growth (20%), affiliate problems (19%) and overstated assets (18%). Asset, growth, and surplus problems also were the most significant factors in the present study.


