RELATIONSHIP BETWEEN THE ALTMAN Z-SCORE AND THE SOLVENCY RATIO OF VIETNAM'S INSURERS

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1. Altman Z-score

The Z-score formula for predicting bankruptcy was published in 1968 by Edward I. Altman, who was, at the time, an Assistant Professor of Finance at New York University. The formula may be used to predict the probability that a firm will go bankrupt. In its initial test, the Altman Z-Score was found to be 72% accurate in predicting bankruptcy two years prior to the event. In a series of subsequent tests, the model was found to be approximately 80-90% accurate in predicting bankruptcy one year prior to the event. The Z-score uses multiple corporate income and balance sheet values to measure the financial health of a company.

The Z-score is a linear combination of four or five common business ratios, weighted by coefficients. The coefficients were estimated by identifying a set of firms that had declared bankruptcy and then collecting a matched sample of firms that had survived, with matching by industry and approximate size (assets).

Altman applied the statistical method of discriminant analysis to a dataset of publicly-held manufacturers. The estimation was originally based on data from publicly-held manufacturers, but has since been re-estimated based on other datasets for private manufacturing, non-manufacturing and service companies.

The original data sample consisted of 66 firms, half of which had filed for bankruptcy. All businesses in the database were manufacturers; and small firms with assets of less than US$1m were eliminated.

The original Z-score formula was as follows:

$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5$

where:

X_1 = Working capital / Total assets; measures liquid assets in relation to the size of the company.

X_2 = Retained earnings / Total assets; measures profitability that reflects the company's age and earning power.

X_3 = Earnings before interest and taxes / Total Assets; measures operating efficiency apart from tax and leveraging factors. It recognizes operating earnings as being important to long-term viability.

X_4 = Market value of equity / Book value of total liabilities; adds market dimension that can show up security price fluctuation as a possible red flag.

X_5 = Sales/ Total Assets considered as a standard measure for sales turnover (it varies greatly from industry to industry).

The probability that a firm may go bankrupt depends on the Z index as follows.

$Z > 2.99$: "Safe" zone

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1.8 < Z < 2.99: "Grey" zone

Z < 1.8: "Distress" zone

The Z-scores gained wide acceptance and has been used in a variety of contexts and countries, although it was designed originally for publicly-held manufacturing companies with assets of more than US$1m. Later variations by Altman were designed to be applicable to privately-held companies and summed up in the Altman Z'-score formula as follows:

$Z' = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.420X_4 + 0.998X_5$

The possibility of bankruptcy of privately-held manufacturers depends on the Z' index:

Z' > 2.9: "Safe" zone

1.23 < Z' < 2.9: "Grey" zone

Z' < 1.23: "Distress" zone

The Z-score was initially employed to predict the probability of bankruptcy in the USA. Yet, after tested by European economists, this model was found to be appropriate to the European economy. Thus, after developing the Z'-score, Altman and his colleagues, J. Hartzell and M. Peck, concentrated on developing a model predicting the bankruptcy of companies out of the US economy, especially the ones from emerging markets. The Z"-score was designed to be applicable to non-manufacturing and service companies.

$Z" = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$

The possibility of bankruptcy of non-manufacturing companies depends on the Z" index as follows:

Z" > 2.6: "Safe" zone

1.1 < Z" < 2.6: "Grey" zone

Z" < 1.1: "Distress" zone

The Z"-score employs four ratios instead of five ratios of the original Z-score model. The omission of the X_5 in Z"-score is merely because it represents the asset turnover which varies greatly from industry to industry. Taking the industry of services and trading for example, its revenue may be tremendous yet its assets value may be low and vice versa. Thus, the X_5 in Z"-score was left out and the remainder have been shifted up to a higher level compared with the Z-score. However, the coefficient of 3.25 has been added to the Z"-score with a view to standardizing the Z" index according to the Standard & Poor's Ratings.

In addition to the said model of predicting the probability of bankruptcy, Altman, R. Halderman and P. Narayanan developed a new model, a Zeta-score with seven ratios from X_1 to X_7 in 1977. This model was born to meet changes in the scope of companies and was found to be approximately 90% accurate in predicting bankruptcy five years prior to the event. If the Z-score mainly researches on manufacturers with assets of not less than US$10m, the Zeta-score aims at those with assets of not less than US$20m.

So far, we have gone over some points in Z-score by Altman et al. We realize it is impossible to analyze this model intensively as well as figure out adjustments to fit the Vietnam's economy in this paper. Thus, we just ponder whether the Z-

score's results are identical to the solvency ratios imposed by the Ministry of Finance on Vietnam's insurers.

2. Solvency ratios of Vietnam's insurers

An insurance company is deemed as a financial institution that is licensed to mobilize capital and invest in the economy. Any mistake in mobilization and investment may result in a serious financial crisis; and the close-down of AIG in 2008 is a typical example. Hence, in order to maintain a healthy economy, the financial safety net must be firmly secured by means of solvency ratios.

As set forth in the insurance law, an insurer is deemed solvent once its solvency margin is not lower than the minimum solvency margin.

The minimum solvency margin of non-life insurance companies must be greater than:

- 25% of the gross premium retained at the point of calculating the solvency margin.
- 12.5% of the gross underlying premium and the reinsurance premium at the point of calculating the solvency margin.

The solvency margin of an insurer is the difference between the assets' value and liabilities payable at the point of calculating the solvency margin. The liquidity of assets when calculating the solvency margin is defined as follows:

(1) Assets whose book value is accepted wholly

- Monies, government bonds

- Investment-linked insurance policies

(2) Assets whose book value is not accepted

- Investments in the incorporation of other insurers extracted from the equity capital

- Contingency funds, if any

- Bad debts, non-returnable loans as per the applicable laws after taking away an amount for contingency fund

- Intangible fixed assets excluding software

- Advances, fiduciary loans, deposits, office equipment, stationeries, in-company receivables

- Premium and reinsurance premium receivables that are two years overdue after taking away an amount for a corresponding provision for bad debt as allowed by law

- Loans and investments on behalf of shareholders or persons involved as provided in the Article 4 of the Companies Law, excluding bank loans

(3) Assets whose book value is reduced partly

a. Investments:

- Corporate bonds underwritten: Subtracting 1% of the book value

- Corporate bonds not underwritten: Subtracting 3% of the book value

- Listed shares: Subtracting 15% of the book value

- Unlisted shares: Subtracting 20% of the book value

- Investment in property development for corporate use: Subtracting 8% of the book value

- Investment in property development for lease, and guaranteed commercial loans: Subtracting 15% of the book value

- Investment in non-insurance companies: Subtracting 20% of the book value

b. Receivables:

- Premiums and reinsurance premiums receivables that are 90 to 364 days overdue after taking away an amount for provision for bad debts as required by law: Subtracting 30% of the book value

- Premiums and reinsurance premiums receivables that are a year to under two years overdue after taking away an amount for provision for bad debts as required by law: Subtracting 50% of the book value

c. Tangible fixed assets and intangible ones namely software and inventories: Subtracting 25% of the book value

d. Other assets: Subtracting 15% of the book value

3. Relation between the Z-score and the solvency ratios

Through the 2009 stats of the Ministry of Finance regarding the Vietnam's insurance market, it is possible to sum up the balance sheets and business performance statements of the non-life insurance market by the end of 2009 as follows:

By the Table 1, the minimum solvency margin of the non-life insurance business by the end of 2009 may be calculated as follows:

25% x VND11,296b = VND2,824b

The rate of 25% of the actually retained cost is chosen in this formula due to the fact that the product of the above calculation is indeed higher.

The calculation of solvency margin is more complicated. In accordance with the guideline on

Table 1: The brief summary of the balance sheets and business performance statements of the non-life insurance business by Dec.12, 2009

(VND billion)

Assets	Dec. 31, 2009	Performance statements	Dec. 31, 2009
A. Short-term assets	**18,482**	1. Premium receivables	**13,661**
1. Cash	**236**	2. Reinsurance premium received	**-**
2. Short-term financial investment	**17,372**	3. Reinsurance premium paid	**2,365**
3. Receivables	**874**	4. Net revenue from insurance policies	
B. Long-term assets	**8,393**	**5. Gross expenditure on insurance policies**	**11,296**
4. Fixed assets	**6,452**	**6. Net profit from insurance policies**	**7,845**
5. Long-term financial investment	**1,941**	7. Revenue from financial activities	**3,451**
Gross asset value	**26,875**	8. Expenditures on financial activities	
CAPITAL	**Dec. 31, 2009**	**9. Profit from financial activities**	**6,506**
A. Payable	**9,899**	10. Pre-tax gross profit	
6. Short-term debts	**2,802**	11. Corporate income tax (25%)	**1,302**
7. Long-term debts	**-**	12. After-tax profit	
8. Technical provision	**7,097**		**5,204**
B. Owner's capital	**16,976**		**8,655**
9. Investment	**13,376**		**2,164**
10. Undistributed profit	**3,600**		**6,491**
Gross capital	**26,875**		

Source: Ministry of Finance (2010), Thị trường bảo hiểm Việt Nam năm 2009 (Vietnamese insurance market in 2009), Hà Nội

Table 2: Investment structure of Vietnam's non-life insurance business in 2009

Investment	Amount (VND billion)	As %
Bank deposits	10,148	52.6
Government bonds	825	4.3
Corporate bond underwritten	308	1.6
Corporate bond/stock not underwritten	1,876	9.7
Investment in other companies	2,160	11.2
Investment in realty	502	2.6
Lending	96	0.5
Investment in mutual fund	2,593	13.4
Others	805	4.1
Total	19,313	100

Source: Ministry of Finance (2010), Thị trường bảo hiểm Việt Nam năm 2009 (Vietnamese insurance market in 2009), Hà Nội

the calculation of the solvency margin and the Table 2, we may produce the result of VND14,253b.

Accordingly, the solvency ratio is as follows: VND14,253b/ VND2,824b = 5.04

This is a quite high ratio in comparison with the usual ratio of four onwards, which may represent a secured solvency. Accordingly, Vietnam's general insurance companies are financially competent enough to assume any financial liabilities.

4. Z-score used for defining the financial safety of general insurance companies in Vietnam

Firstly, it is necessary to define constituents of the Z-score. Via the Tables 1 and 2, the X ratios are calculated as follows:

X_1= (18,482 - 2,802)/26,875 =15,680/26,875

X_2 = 3,600/26,875

X_3 = 8,655/26,875

X_4 = 13,376/9,899

X_5 = 11,296/26,875

Then, let us ponder what type of business general insurance companies are. In fact, because general insurance companies in Vietnam are in form of joint-stock companies, it is possible to choose the Z-score for publicly-held companies. Yet, Viet-

nam's general insurance companies are not manufacturers but financial services providers. Thus, we may choose the Z"-score appropriate to other types of business.

In the event that we employ the Z-score with the above-stated X ratios, we have the following equations.

$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5$

$Z = 3.2 > 2.99$

This result lies within the zone of safety.

In case the Z"-score is employed with the X_1 to X_4 as above, the results will be:

$Z" = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$

$Z" = 7.8 > 2.6$

This result also lies in the zone of safety.

On the whole, the solvency ratio, the Z-score and the Z"-score all produce different results concerning the financial safety net during the operation of Vietnam's general insurance companies.

5. Conclusion

In order to define the financial safety of insurers, authorities may employ the solvency ratio that is quite complicated and requires adequate data regarding insurers' investments. Thus, it is very difficult for investors to calculate this ratio. Meanwhile, it is much easier if the Z-score or Z"-score is employed. Accordingly, investors themselves may define probability of bankruptcy of insurers by spotting the Z index or Z" index.

However, the ratios of the Z-score are based on researches conducted within the USA. Thus, it should be amended to fit the Vietnam's market. As we foresee, the number of Vietnam's insurers could jump higher in the time to come; hence, it is necessary to work out a simple but efficient instrument to help investors define the financial safety net, thereby predicting the bankruptcy probability of listed companies. The Z-score ratios must be researched and amended by Vietnam's authorities so as to fit both the insurance sector and others. If so, investors shall be more confident to make an investment and authorities will have an effective tool to manage the stock market more stringently■

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