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Edward I. Altman, PhD: Fifty Years of Z-Scores to Predict the Probability of Corporate Bankruptcy

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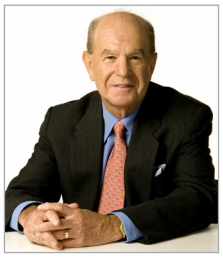
Fifty Years of Z-Scores to Predict the Probability of Corporate Bankruptcy



Edward I. Altman, PhD

Edward I. Altman is the Max L. Heine Professor of Finance, Emeritus at the Stern School of Business, New York University (NYU). He is also director of research in credit and debt markets at NYU's Salomon Center for the Study of Financial Institutions. An internationally recognized expert on corporate bankruptcy, high yield bonds, distressed debt, and credit risk analysis, Altman has won multiple awards for his research and has served as an advisor to numerous government agencies and foreign central banks. His primary areas of research include bankruptcy analysis and prediction, credit and lending policies, and risk management and regulation in banking, corporate finance, and capital markets.

One of the founders of the Journal of Banking and Finance, *Altman also has served as its executive editor. In addition, he has served as an advisory board member and associate editor of academic journals published in the United Kingdom, Poland, the Netherlands, and Mexico. He earned a BA in economics from City College of New York and holds an MBA in business finance and a PhD in finance from the University of California, Los Angeles. He is a founding member of the board of trustees of the Museum of American Finance.*

In August 2019, Edward Altman spoke with members of the Journal of Investment Consulting *Editorial Advisory Board about his Z-score model for predicting the probability of corporate bankruptcies, the more recently developed models and their applications, the evolution of the credit markets, and the current credit cycle. Taking part in the discussion were Inna Okounkova, Columbia University and editor-in-chief of the* Journal*; Edward Baker, Mesirow Financial; Ludwig Chincarini, University of San Francisco and United States Commodity Funds; Tony Kao, SECOR Asset Management; and Philip Fazio, Merrill Lynch.*

Inna Okounkova: What were the major factors that shaped your career? What do you regard as your major achievement, and what was your biggest mistake or disappointment?

Edward Altman: One factor at the beginning of my career had a lot to do with the timing of my doctoral work at UCLA in the mid-1960s. At that time, mainframe computers first became available for social science research on college campuses. At UCLA, there were IBM 360s and a few other possibilities for use in research. I was a graduate student working under my mentor, J. Fred Weston,[1] a finance professor. He casually mentioned that perhaps the area of bankruptcy would be interesting to study because it had not been addressed in a rigorous way since the Great Depression in the 1930s. After reviewing some case studies and learning about the Chapter X and XI processes, I decided to look at the possibility of predicting companies' financial distress.

If I had been a student two years earlier, around 1963 or 1964, I wouldn't have had the computer power to do multivariate analysis, and I wouldn't have had the good fortune of having other professors on my committee who had done some work using multiple discriminant analysis. If I had been a student two years later, I'm convinced that somebody else would have done this work by then. So timing is important when you end up generating new ideas and making breakthroughs. The building of multivariate models that combined financial data and market information on companies' common stock was a major factor that helped shape the beginning of my career.

The second aspect of my research began around 1981 after I had written a number of pieces about bankruptcy and distress prediction. Morgan Stanley asked me to look into the new market for high yield bonds and to assess whether it should get involved in this market. At the time, the high yield bond market was in its infant stage of development, and Morgan Stanley had a negative image of junk bonds.

I didn't take the full-time position Morgan Stanley offered, but they asked me to be a consultant. In this role, I compiled information and built databases about the risk and return attributes of this new market, particularly the fallen angel market and the new issue market for non-investment grade companies.

So this also was a major factor that prompted me to analyze the probability of corporate default as well as the risk-return tradeoff of the most risky fixed income asset class.

In terms of the biggest mistake or disappointment, it seems important to point out that when we published our initial work

in the *Journal of Finance* in 1968, I knew we had to give readers good guidelines about how to use the Z-score model and what its implications were. But I didn't have the foresight to investigate extending the model to estimate the probability of default (PD). The model was simply a technique for classifying whether a company looked more like a failing company or a going concern. It didn't consider the more important issue of PD and, later on, loss given default. I don't know if you would call it a mistake, but at the time I didn't have the insight—and I probably didn't have the technology or the databases—to build a PD capability.

In addition, I published information on zones that identified whether a company was more like a distressed company or a healthy company or somewhere in between—the so-called gray zone. These zones have haunted me over the years because they are no longer relevant in today's market. I probably have characterized these zones as a function of the timing of the model, which was the mid-1960s, and not something that would have longevity. Unfortunately, many people still use these zones, and they are no longer relevant.

Philip Fazio: How do you think the Z-score changed the world of corporate finance, commercial banking, and the bond markets in general?

Edward Altman: That's a great question, Phil, because over time I addressed each of those areas, though not simultaneously, in the evolution of my research around the model. With respect to corporate finance generally, the bankruptcy process is part of the corporate financial environment, and it plays an important role in a company's establishment of its leveraged capital structure and how it addresses the situation when the company does not do well and considers whether to go bankrupt or not. More specifically, in terms of the Z-score model and corporate finance, in 1984 I wrote an article on the question of optimum capital structure built around the well-known tradeoff between the PD and the cost of errors and distress compared with the tax benefits of using debt in the capital structure. I always believed this was a persuasive issue in determining optimal capital structure, but at the time there didn't seem to be much work, beyond what Stewart Myers[2] did at the Massachusetts Institute of Technology (1983, 1984), on how corporate financial managers could use these tradeoffs in a fundamental, practical way to help them decide on their capital structure.

So we established a comparison between the present value of the benefits of leverage in the capital structure—mainly the after-tax benefits of adding leverage to capital structure. You look at each year's potential benefit and compare that with the expected value of financial distress. Although we could articulate the cost of the bankruptcy, some earlier work done at the University of Chicago had concluded that bankruptcy costs were trivial because firms in bankruptcy could restructure. I didn't agree with that conclusion. I wanted to find a way to compare it more rigorously, so we used a Z-score or another model, a 1977 model called Zeta, to establish PD multiplied by the expected bankruptcy cost. Those bankruptcy costs had to be measured in terms of both direct and indirect costs.

On one side of the equation, there was the expected value of bankruptcy costs over time, mainly prior to bankruptcy, and on the other side of the equation was the expected value of tax benefits. It was the unique leverage condition affecting both the PD and the amount of tax benefit that made the two sides of the equation equal. I consider anything beyond that in terms of leverage to be too much leverage. I consider anything less than that inefficient or ineffective for taking advantage of the tax benefits. So we use the Z-score as an estimator of the PD multiplied by the present value of the benefits and costs.

This was one way I argued for the use of bankruptcy prediction models. At the same time, I was trying to quantify the cost of bankruptcy, which starting with 1977 work by Jerold Warner at the University of Rochester was considered trivial. I disagreed because we added the indirect costs as well as the direct costs of bankruptcy. The Z-score was a fundamental part of estimating the present value of the benefits.

With respect to banking, the answer is probably easier. The model had been around for many years and had gained a certain reputation with regard to the lending function. Then the Basel Committee on Banking Supervision issued the Basel II Accords, amending the international banking standards that control how much capital banks should hold to guard against financial risks.[3] This new Basel II Accord was first proposed in 1999. I was in Germany at the time, and somebody came up to me and my colleague Tony Saunders[4] and said, "Guess what, they just proposed a new capital standard that considers the capital cost of expected and unexpected losses from commercial bank lending." That essentially launched what was first a cottage industry and then a more robust effort by consultants and model builders to estimate PD. There were all sorts of attempts, but most of them used the Z-score model as the basis. Then, of course some people said: "Well, we don't want to use that model. It was built in 1966, and it was only for manufacturing companies in the United States."

They wanted a more specific model for particular banks. So many banks decided to build a model based on their own portfolio attributes and perhaps different variables and different weightings for those variables. The basic idea was to use a multivariate approach combining whatever variables a bank thought important so that it could build its own internal rate-based model for estimating PD and determining its recovery rates from loss given defaults internal data, if available. The

commercial banking sector and models of the Z-score type experienced a tremendous spike in interest around the beginning of the discussion of Basel II, and that's continued to this day.

As for the bond markets, it's pretty clear that if you can eliminate defaults—whether you choose high yield or even investment grade bonds—or eliminate major transitions in a firm's risk by choosing companies that have both the yield you aspire to and the risk attributes you desire, you can do very well in the bond market. And Z-score models have been widely used for bond market assessment.

Of course there are other risks involved in the bond markets—for example, liquidity risk, interest-rate risk, and reputation risk—but I think the fundamental use of risk analysis in bond markets is PD. The Z-score model is one model that people use, and there are a lot of good reasons for that.

Inna Okounkova: In terms of the optimal leverage ratio, could you give our readers an idea of the ranges assessed in your 1984 paper? Could you please provide some rules of thumb for determining optimal leverage ratio—maybe by credit rating or some other metric or the Z-score itself?

Edward Altman: That's a tough question because the answer varies depending on the type of company, its business risk and cash flows, and the fundamental variables that go into the Z-score model. A company with a high Z-score—let's say one that hasn't taken on much leverage or has financed internal growth mainly via retained earnings—could assume a lot more leverage than a company with a more volatile earnings stream or low cash flows, in general.

It's hard to specify in general what a company's capital structure should be. But I would say that most companies begin to go beyond their optimum leverage ratio when their debt to cash flow ratio goes above five. That rule of thumb is not part of the Z-score model, but usually when this happens, the company's bond rating or bond rating equivalent from models drops to below B, maybe B minus (B3) or CCC.

If a company goes much beyond that—for example, six, seven, or eight times the debt to earnings ratio before interest, taxes, depreciation, and amortization—it definitely gets into the CCC range. We also found that companies with that much leverage don't always have low Z-scores; they may have other redeeming features that keep them out of that zone—for example, a high stock price relative to total liabilities or a high ratio of retained earnings to total assets. Both of these variables are in the model. Although it's hard to specify the right leverage ratio, the banking regulators have more or less established that they'll be looking over the shoulders of bank lenders when a company's debt to cash flow ratio climbs above six. That's a rule of thumb they use, and I find that pretty good.

Tony Kao: Your work in applying quantitative modeling to credit analysis is truly pioneering. Although your Z model uses multivariate discriminant analysis, most readers or practitioners probably do not realize that you also applied machine learning (i.e., regression tree and recursive partitioning) in analyzing credit in the early or mid-80s (published in the *Journal of Finance* in 1984) way before artificial intelligence became popular in recent years. Why do you think the technique didn't become popular before now?

Edward Altman: Tony knows my work from the eighties well, when we built what was probably one of the first recursive partitioning models. This was a type of machine learning, though we didn't call it that at the time. It was very effective in the laboratory, but it wasn't really embraced by practitioners, probably because like so many machine-learning techniques, the method is essentially a black box.

I think one reason why more sophisticated models are treated cautiously, whether they are machine-learning methods, Merton models[5], or models that are not very transparent about how they determine PD, is the fact that practitioners don't trust, and in many cases, don't understand black boxes. A black box approach is often met with a degree of skepticism: How can I apply this model if I don't understand it? What happens in the event of major stock price changes or macroeconomic activity and I don't know the model's sensitivities to changes in the environment? You're right that practitioners don't abandon the use of fundamentals, but many of them use my model alongside their research on fundamentals. I think one reason why my work has resonated with practitioners is that it contains the variables they do understand. They can check the sensitivity of the Z-score to changes in the variables.

Some practitioners use those outlier examples as a reason not to adopt the model in any fundamental decision-making. I believe these people are mainly taking a bottom-up approach to individual company evaluations rather than a broad portfolio approach that considers large numbers of firms. Besides, if you have an outlier, it's not going to affect the overall results much.

So one answer to your question is skepticism about black boxes. Another explanation is the fact that the Z-score model is so transparent and it has had a good track record over the years. Frankly, I believe the main reason it's used alongside information on fundamentals, as opposed to some other techniques, is that it's free. If practitioners decide to keep it, they haven't lost any money like they would have if they had spent a lot of time building more-sophisticated models.

The fundamentals approach is still taught by the CFA Institute, and it's still included in textbooks. It's a methodology that people get weaned on. Maybe the new generation of quants will

reject it. But up to now, more and more people are using it in combination with models rather than instead of models.

Tony Kao: The Z model was originally built on manufacturing industry data. Why do practitioners use this model for every sector? Have you looked into building a similar model for analyzing the financial sector?

Edward Altman: First of all, there are many other industries besides banking that are relevant for credit analysis, especially if they comprise a fairly significant percentage of the population of available bonds. For example, high yield bonds in the energy industry accounted for around 20 percent of the market in 2016; therefore, a specific model for energy companies would have been value added for managers of high yield bond portfolios, especially if they were sensitive to the index performance relative to their own performance and the index included 20-percent energy holdings. Certainly, models for retail, airline, and telecommunication firms would have been particularly valuable over time, and the manufacturing model I built is probably suboptimal for some of those industries.

With respect to banking, back in the 1980s I was hired by Arthur Andersen, a prominent accounting firm that eventually went bankrupt in 2001 as part of the Enron scandal. In the 1980s, Arthur Andersen asked me to build two types of models. One was the A-score model for audit risk analysis within the firm. The other was a banking model. Frankly, we didn't get great results, and every other banking industry model I've looked at has not had much success. You have to scratch your head and ask why a model you build for manufacturers or telecoms or energy companies can be relatively successful in terms of both testing and predictive accuracy but you can't do that for banks—especially because there are lots of banks and lots of data points over time.

We thought we could do it, and we tried. One element I've always considered a constraining factor about banks is the fact that each banking crisis, though sharing some fundamental similarities, is unique to whatever happened in the past, whether it was related to real estate or to macro events in certain countries. Maybe the model was just not able to discriminate between healthy and unhealthy banks, perhaps because of the bailout process and the too-big-to-fail concept. Whatever the reasons, the structural differences in banking make it much more difficult to build a good model.

If we had been successful in building that model, there would be a lot of interest in it. But I haven't had any success with banking models. Other industries, yes—and manufacturing. I'm as surprised as anyone that the Z-score, created back in the 1960s with a small sample size, is still relatively robust and accurate.

Ludwig Chincarini: Many firms use some form of Z-score and have taken it to another level—Moody's, the S&P 500 Index, Fitch Ratings. Not only do they use the Z-score to indicate when a company could go bankrupt, but some of them go on to start a hedge fund in shorting companies or going long companies. If everyone knows about these indicators, why are they useful for anyone? How can these hedge funds succeed by using these models? What is the market missing? Are there institutional constraints, or is there something else that allows these models to work? Are they still working?

Edward Altman: I have a little history on this topic because I've asked similar questions. Back in the early 1980s, I did a study with a New York University (NYU) professor, Menachem Brenner,[6] who is now an emeritus professor there. We looked at the short selling ability using the Z-score for firms, asking the same question: Can you make money and be profitable with a strategy using the Z-score when it is totally transparent and available for free and anybody can use it simply by reading the literature?

We looked at the first time a firm's score fell below the so-called cutoff score in the Z-score model, dropping from a gray-zone company to a distressed-zone company. We asked whether investment companies could use that as an effective investment strategy, particularly by going short at the time their scores first dropped below the cutoff, even though such an event didn't mean the firms would definitely go bankrupt. It just meant that for the first time, its profile looked more like a distressed company than a nondistressed company.

These were equity short sales, by the way, and we had a fairly large sample. We calculated the scores for probably thousands of companies over several years, and each year we picked portfolios of companies that had the attribute of falling below the cutoff score for the first time. Adjusted for risk, the strategy produced alpha returns by a fairly significant level, though not so much that you would throw away any other strategy. We published this research in the *Journal of Financial and Quantitative Analysis* in 1981. We thought that if enough people read that article, the strategy would become even better known and that as more people used it, the market eventually would become more efficient and less likely to produce those outstanding returns.

I don't know whether using the Z-score model today would produce short-sale or upside benefits, but I can give you some evidence that it's still being used. To be honest, however, unless the Z-score is improved, I don't believe it is sufficient for developing an effective equity or debt strategy. You need other factors, other screens, to complement the Z-score because it's just not powerful enough on its own in this age of hedge funds. These funds weren't around back in the sixties or even the eighties, but today there are many of

them, and there are quants with a pile of money to invest if they show good results.

Nevertheless, there are still some strategies that apparently resonate with investors. Goldman Sachs has been marketing, selling, and profiting from a strategy called "strong balance sheet/weak balance sheet" companies. I think this strategy originated in 2008 because people lost a lot of money in the stock market that year, and they were searching for ways to reduce that negative risk during big downturns. I don't know what population Goldman Sachs currently uses, whether it's all New York Stock Exchange companies or NASDAQ companies, but in the beginning they used mainly industrial S&P 500 companies. Firms with a Z-score in the top 10 percent were considered a buy strategy, and firms with scores in the bottom 10 percent were deemed a short strategy. Goldman produced baskets of these stocks. Investors didn't have to buy the stock of individual companies with scores in the top 10 percent and sell short the stock of companies with scores in the bottom 10 percent; they simply bought the basket of strong and weak balance sheets using the Z-score. As far as I know, Goldman is still using this strategy, and basically it works. That's one example. Nomura Securities, a financial services group based in Asia, has used a similar strategy.

In addition, there's a firm in Europe called STOXX, which is a subsidiary of the German Stock Exchange. There's a STOXX 600 just like there's the S&P 500 in the United States, and the company builds portfolios based on Z-scores. They'll tell an investor, choose the cutoff score—whether it's a Z-score of two, three, or four—and we'll produce for you a group of firms with scores above a certain level on a regular basis. It's almost like a database generation result. They've been doing this since 2014.

So you ask: How can the Z-score model work, given that it's been around so long and it's pretty well known? A few years ago, Bloomberg told me the Z-score model was receiving between 5,000 and 10,000 hits per day. I don't know if those numbers are still accurate, but they indicate people are still using the model a lot. Unfortunately, I don't get one penny from any of those hits, but my point is that the Z-score is still being used even though it's in the public domain and people can download the data and program the model themselves.

Still, I'm sure it's not enough, particularly with regard to the upside. I think there's an asymmetry with respect to negative information and positive information. I'm pretty sure investors in 2008 would have made a lot of money by shorting companies with Z-scores in the lowest 10 percent, but they would have lost a lot of money by not going long with companies that had low Z-scores but survived after the crash. In other words, the firms that did best after the downturn were those that had the lowest Z-scores but did not go bankrupt.

Today, I'm pretty sure you're not going to make a lot of money using the Z-score by itself as a strategy. It needs to be combined with other important factors, and that's what I'm working on today by building a "quality high yield bond strategy" with my colleagues at Classis Capital SIM in Milan, Italy.

Edward Baker: You've been studying the credit markets for a long time, and I'm wondering what you consider the most important change in the character of these markets over the years. Also, what has been your biggest surprise?

Edward Altman: That's a great question—and one I've thought about because of people asking me: "How can we still use a model that was built fifty-something years ago, when the markets have changed so much? Why don't you build a new model with up-to-date data, perhaps with better variables or extensive databases and perhaps with the addition of machine-learning techniques, behavioral data, and social media data?" So I've thought about how things have changed and why, even though I have built other models, the Z-score is still the one that's used the most.

First, let me address the change in the markets. By far the most important change is the introduction of many debt-financing alternatives that weren't available back in the sixties—at that time it was mainly a bank finance market and, of course, investment grade bonds. Now we have high yield bonds, which didn't exist back then, and leveraged loans, and "shadow banking." Today the global high yield bond market is valued at a little under $3 trillion globally, about $1.7 trillion in the United States, plus it's growing a lot in Europe and beginning to grow in Asia. It was always out there in some Latin American countries, for example, that had non-investment grade bonds.

The leveraged loan market also is quite new, even though it's been around now for twenty or thirty years, and we have the collateralized loan obligation market to structure those issues. We also now have probably $500 billion to $700 billion worth of non-bank lending, from shadow banks or private lenders. That industry is booming. The estimate I'm using is one I calculated myself, but also Bank of America Merrill Lynch produced a nice study on the non-bank lending market back in early 2018. None of these markets existed in the sixties.

I'm convinced that U.S. companies, in particular, but also Chinese companies and in general companies around the world are far more leveraged now than they were back in the sixties. That's one structural change. The tolerance for leverage and the encouragement of leverage by corporate boards of directors are much greater now than in the sixties when the debt to equity ratio was much lower and bankruptcies were much less frequent. Virtually no big companies were going bankrupt when I built the model.

But how many U.S. companies go bankrupt every year now? Over the past twenty years, not particularly good years or bad years, an average of twenty billion-dollar companies, in terms of liabilities, have gone bankrupt each year. And in good years—I say good because I love bankruptcies—and in good years the number is close to sixty or seventy.

Much larger companies are going bankrupt these days. They go bankrupt mainly because their operating cash flows are poor or because of the amount of leverage used—especially given that these leveraged finance markets are so plentiful and are responsive to the current credit cycle. So over the years the amount of leverage in the system has increased, and that's why the old Z-score model is still accurate.

One reason we've adapted the Z-score without having to build new models is that instead of using the original zones (which I didn't foresee should be used for twenty to forty years) and the score itself, as was the case in the sixties, we've used the concept of bond rating equivalents. I used bond rating equivalents for the first time in 1989 when I built the mortality rate model for estimating a company's PD. That model is based on the idea that regardless of the score that was in the negative zone devised fifty years ago, what's important is the bond rating equivalent of the score today.

Today, for example, the average score of a B-rated company is approximately 1.6, a score that would have been fairly deep in the distress zone back in 1968. People think that once a company goes into the distress zone, it's destined to fail, and yet B-rated bonds are the dominant junk bonds in circulation today. They are second only to BBBs in terms of the number of issues and dollar amounts.

Now we say a firm with a score of 1.6 looks like a B-rated company, and we can estimate its PD based on the frequency of default of original-issue B-rated companies over the past forty years. This estimate indicates a PD of about 28 percent cumulatively over five years. If you consider CCC-rated companies, the PD is as much as 47 percent cumulatively for five years. Still, if you determine that 28 percent will default in five years, 72 percent will not.

This means a B-rated bond is not necessarily a bad asset class to invest in if you're paid enough to compensate for the risk. So the amount of leverage constitutes a big change in the market, as well as the availability of models that incorporate bond rating equivalent estimates along with the historic frequency of defaults categorized by bond rating. Of course, bond ratings change over time too. Most of the models out there—the bank models, the Merton model, Moody's Kealhofer, McQuown, and Vasicek (KMV) model[7]—include a bond rating equivalent estimate, which, along with empirical data, practitioners use to estimate the distance to default or the PD. It's now a fundamental part of the analysis.

Edward Baker: I wonder if the spreads among credit default swaps (CDSs), which are another more recent innovation, have been useful in enhancing PD.

Edward Altman: Yes. The benefit of a CDS or a Merton model over the Z-score is that they produce real-time estimates. For the Z-score, we need to wait for the next financial statement. As Tony pointed out, one variable in the Z-score model is the market value of equity, which changes all the time. But the other variables change on a quarterly basis at best, so you have to wait. CDS spreads, on the other hand, can change overnight in response to an unexpected event—if the company loses a patent or the chief executive officer gets hit by a truck or the government experiences a coup attempt or a surprising announcement about deficits is made. A CDS is very good in this respect. The KMV model is probably not as sensitive to current events, but it's pretty sensitive because it depends largely on the stock price and its volatility. The downside of CDSs and of the KMV model is their extreme volatility. Big swings in PDs can occur with either of these two metrics almost on a daily or weekly basis.

Then the question becomes whether that information is useful for an investor. I guess it's useful for certain types of investors when they're trading on a short-term basis, but most investors can be whipsawed by buying and selling frequently on the basis of these models.

So, yes, a CDS is effective, but it has a downside particularly also in the area of sovereign default risk. Recently, I've done some work on sovereign default rates and default estimates by using a bottom-up approach—aggregating Z-scores within countries to estimate the health of the private sector and incorporating that with some banking models (Altman and Rijken 2011). Although I have some concern about the banking models out there, we needed some indicator of a country's banking health to come up with an overall assessment of the PD of sovereigns.

Believe it or not, back in 2009 the CDS spreads from Greece weren't much different from the CDS spreads from Germany or France because these countries were all part of the European Union. Nobody was going to fail as a member of the Union. Things changed when there was some question about the implosion of the European Union. The CDS spreads skyrocketed from very low to very high for certain countries in southern Europe. They were correct with respect to Greece but not with most of the other countries. One other thing about CDSs: If a company finds there is a CDS market on its bonds or loans, its PD goes up just because there is a market on its CDSs. This has been established by one of my colleagues,

Marti Subramanyam,[8] and I think others, now that CDSs are actually a contributing factor to bankruptcy risk. That's kind of ironic, isn't it?

Ludwig Chincarini: Ironic, indeed. Speaking of structured products, such as CDSs, do you think the rating agencies are doing a better job now at rating these products than in the past, such as the lead up to the 2008 financial crisis? What do you think about the track record of rating agencies in general?

Edward Altman: I've always argued that the rating agencies do a pretty good job overall; they do a very good job with the initial rating on plain vanilla bonds and loans. They've been doing this work for a hundred years, and that represents a lot of time and resources.

So I don't think they're doing a better job now than they did before. But what they needed to improve on—and probably have, though I don't know by how much—is the re-rating of companies, the maintenance of ratings over time, and rating transitions. I think they still do a poor job with subsequent rating changes after the initial rating was established. The reason is simple. Nobody likes volatility in rating changes. The issuers don't like it. Most investors don't like it, unless of course they are hedge funds that make money on rating changes. Volatility generally is viewed as something to be avoided, especially if a rating changes every two or three months because of some model going up and down and then up again.

As a result, the rating agencies don't make rating downgrades, for example, unless they are absolutely sure the company's credit quality has deteriorated. This means they usually are more than a year late in forecasting the change, and the change they make is usually only about 50 percent or 60 percent of what it should be, based on models. We've actually documented this in a few studies, e.g., Altman and Rijken (2004). Yet the practice continues, and everybody knows it. So maybe the market can make money on it.

Your question, however, may be about whether they have done a better job because of embarrassment related to the most recent financial crisis. I would guess they're probably doing a better job now on the structured products because they did such a terrible job on that. They also may be a little tougher on the plain vanilla ratings today, so we may find more CCC ratings sooner than we did in the past. I haven't actually studied this, but I look at CCCs as an important benchmark of market liquidity.

Inna Okounkova: Is there anything else you would like to discuss before we end the interview?

Edward Altman: I'd like to discuss where we are in the credit cycle. I have a freshly published paper on this subject and the outlook going forward (Altman 2019). We also held a major conference on this topic at NYU Stern in September 2019. The conference was co-sponsored by Kroll Bond Rating Agency. In this paper and in my conference presentation, I pointed to the fact that we are still in a benign credit cycle and we're likely to stay there for the rest of 2019 and possibly beyond, especially with the near-term outlook for positive, albeit slightly reduced, economic growth in the United States and China.

History shows that even with positive growth in gross domestic product (GDP), default rates on U.S. corporate debt start to rise prior to a recession. Because of the enormous buildup in debt—even relative to GDP gains over the years—and the risk-on situation that has pervaded the markets for many years, I expect the next stressed credit cycle to produce the largest dollar amount of defaults in the history of our country—although the default rate may not be as high as it was in 2002, the record year, when in my estimation it was something like 12–13 percent for high yield bonds.

The crisis also may last longer than the previous one because central banks will have fewer tools to bring to bear and any stimulus from the Federal Reserve will take longer to assist in the eventual recovery. I don't expect the next crisis to be as severe or as global as the last, but if real estate and personal mortgage losses also escalate dramatically and China's economy contracts sharply, it might be.

I also would like to emphasize that beyond the Z-score, a good investment strategy requires other indicators to eliminate defaults from a high yield strategy. I'm convinced that a high yield strategy will produce fairly attractive returns over time, as indicated by the performance of the Bank of America Merrill Lynch Index, for example. Over the past twenty-something years, the average annual return has been between 6 percent and 7 percent, and the spread over treasuries has been probably 2 percent to 2.5 percent.

If you eliminate defaults, you're not only going to outperform the indexes by more than 1 percent a year, but you're also going to cut down volatility by 50 percent or more. I'm convinced it can be done. I can't tell you the strategy's secret sauce, but you need to make use of more than the Z-score, although the Z-score or a similar type model will be helpful.

Ludwig Chincarini: Have you learned any great lessons that you would share with people who want to be good investors? What are the three best tools you can offer young investors or even an older investor?

Edward Altman: If you're a practitioner dealing with equity investing and especially debt investing, certain skills are indispensable, whether you have them or your staff has them. In addition to fundamental valuation techniques—discounted

present value, expected returns, multiples, the type of stuff my colleague Aswath Damodaran[9] teaches—you need to know something about debt markets, including the various risks you're susceptible to if you go into these markets. You should have legal counsel when necessary, and if your firm is big enough, it's probably good to hire a bankruptcy lawyer who wants to transfer those skills to a hedge fund. There are folks who do that or vice versa.

I think the modeling we've talked about today is a very important tool for both debt and equity investors. When Bloomberg told me it gets 5,000 to 10,000 hits a day on the Z-score model, I asked if they could tell me who was responsible for these hits. They said the majority were equity investors. I found it surprising that they were equity investors rather than debt investors. I guess the reason is that you can get wiped out if you're an equity investor on the long side and the company goes bankrupt, but if you're a debt investor, you're going to have reasonable recoveries—usually 40 percent on bonds and maybe 50 percent or 60 percent on loans—even if you have a large portfolio of distress credits.

In addition to equity and debt evaluation skills, you need a strong stomach, especially if you take big positions in fewer companies or if you make big bets on whether a company goes bankrupt or not. Once a bankruptcy occurs, the competition among investors in distressed companies gets pretty heavy. You have to be able to play in that league, and those folks are pretty smart and very competitive. You'll find out pretty soon if you have the stomach for it. The people I've worked with over the years, the really good ones who have excellent skills, also have the ability to get into the ring and fight it out when necessary.

ENDNOTES

1. J. Fred Weston (1916–2009) was a Distinguished Professor of Finance and a mainstay of the UCLA Anderson School of Management. Professor Weston was renowned for his path-breaking research on mergers and acquisitions, and he was an institution builder who mentored numerous outstanding graduate students including Nobel Prize-winning economist William F. Sharpe.
2. Stewart C. Myers is the Robert C. Merton Professor of Finance, Emeritus at the MIT Sloan School of Management. His research focuses on the valuation of real and financial assets, corporate finance, and the financial aspects of government regulation of business. He introduced both the tradeoff and pecking order theories of capital structure and was the first to recognize the importance of real options in corporate finance.
3. See "Basel II: Revised International Capital Framework," https://www.bis.org/publ/bcbsca.htm.
4. Anthony Saunders is the John M. Schiff Professor of Finance at NYU Stern. Throughout his academic career, his teaching and research have specialized in financial institutions and international banking.
5. The Merton model is an analytical model used to assess the credit risk of a company's debt. Analysts and investors use the Merton model to understand how capable a company is at meeting financial obligations, servicing its debt, and weighing the general possibility that it will go into credit default. In 1974, economist Robert C. Merton proposed this model for assessing the structural credit risk of a company by modeling the company's equity as a call option on its assets. This model was later extended by Fischer Black and Myron Scholes to develop the Nobel-prize winning Black-Scholes pricing model for options. https://www.investopedia.com/terms/m/mertonmodel.asp.
6. Menachem Brenner is Research Professor of Finance at NYU Stern. His primary areas of research include derivative markets structure, option pricing, inflation expectations, auctions, market efficiency, and liquidity. In 1986, he co-invented (with Professor Dan Galai) the volatility index based on the prices of traded index options and introduced the concept of volatility derivatives, an idea that was implemented twenty years later.
7. "Moody's KMV model is the most popular variant of the Merton model. It measures default risk by 'distance to default' (the number of standard deviation moves required to push the firm's value below the default point within the time horizon being evaluated). Instead of assuming a log-normal distribution of asset values as in the Merton model, KMV uses historical default experience to convert this distance to default measure into expected default frequency." (From Antti Ilmanen, *Expected Returns: An Investor's Guide to Harvesting Market Rewards* (Wiley. Kindle Edition, p. 182.)
8. Marti G. Subrahmanyam is the Charles E. Merrill Professor of Finance, Economics and International Business at NYU Stern. He has published numerous articles and books in the areas of corporate finance, capital markets, and international finance.
9. Aswath Damodaran holds the Kerschner Family Chair in Finance Education and is Professor of Finance at NYU Stern, where he teaches corporate finance and equity valuation. His research interests include information and prices, real estate, and valuation.

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