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Did the Global Financial Crisis Change Equity Markets for the Better or Worse?

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The Question at Hand

- The Global Financial Crisis of 2007-2009 is widely considered the most important event in financial markets since the Great Depression of 1929. Now that roughly a decade has past since the this catastrophic event, investors and asset managers must ask themselves what has changed in the aftermath of the GFC, and what new opportunities and risks have evidenced themselves?
- To answer these questions we will examine the extensive data from the Northfield's "corporate sustainability" model as described in diBartolomeo (*Journal of Investing*, 2010). In this variation on the contingent claims analysis approach (Merton, 1974), the rights of a corporate shareholder are described as a call option and a put option on the assets of firm.
- In the presentation we will compare the data from before and after the GFC both in market wide summary and sector level so as to illustrate what has and has not changed in terms of corporate sustainability, and in particular the stability of the financial system. The differences from before and after the GFC indicate material change in some but not all sectors of the economy. These changes imply differences in sector level equity returns, and variation in the expected returns to equity investing styles and factors such as "value" and "quality."

The Sustainability Model in Brief

- The key input to the process is the volatility of the firm's assets, which is equivalent to "How volatile would the firm's equity be if the firm had no debt?"
- The Northfield dataset derived from this measure starts in 1992 and continues to the present day for all US companies and non-US companies traded in the USA in ADR form.
- By equating the value of the two option portfolio to the firm's stock price, we can solve for the implied expiration date of the options *which is the market expectation of the survival time of the firm.*

Basic Contingent Claims Literature

- Merton (1974) poses the equity of a firm as a European call option on the firm's assets, with a strike price equal to the face value of the firm's debt
  - Alternatively, lenders are short a put on the firm assets
  - Default can occur only at debt maturity
- Black and Cox (1976) provide a "first passage" model
  - Default can occur before debt maturity
  - Firm extinction is assumed if asset values hit a boundary value (i.e. specified by bond covenants)
- Leland (1994) and Leland and Toft (1996)
  - Account for the tax deductibility of interest payments and costs of bankruptcy
  - Estimate boundary value as where equity value is maximized subject to bankruptcy

Reverse the Concept: Sustainability

- Instead of trying to estimate how likely it is that firm goes bankrupt, let's reverse the logic
- We will actually estimate the "market implied expected life" of firms using contingent claims analysis
- Firms with no debt can now be included since it is possible that they get some debt in the future and default on that
- A quantitative measure of the fundamental and "social" concept of *sustainability*

Our Basic Option Pricing Exercise

- Underlying is the firm's assets with asset volatility determined from the factor model as previously described
- Solve numerically for the "implied expiration date" of the option that equates the option value to the stock price
  - *Market implied expected life of the firm*
- Include a term structure of interest rates so that as the implied expiration date moves around, the interest rate changes appropriately
- If you choose Black-Scholes as your option model, then you can solve BS for the implied time to expiration using a Taylor series approximation
- More complex option models allow for stochastic interest rates

Filling in with "Distance to Run"

- For firms with no debt or negative book value, we simply assume that non-survival will be coincident with stock price to zero, since a firm with a positive stock price should be able to sell shares to raise cash to pay debt
  - If you have a stock with 40% a year volatility you need a 2.5 standard deviation event to get a -100 return
  - Convert to probability under your distributional assumption
- We convert both measures to the median of the distribution of future survival in years
  - What is the number of years such that the probability of firm survival to this point in time is 50/50
  - Highly skewed distribution so we upper bound at 300 years
- Z-score the "median of life" for both measures and map the distance to run Z-scores into the "option method" distribution for firms with no debt

Data Sample

- Use a simple Merton model (Black-Scholes European options)
- Use equity volatilities from Northfield US Fundamental Model
  - One year horizon for risk forecast
  - "Near horizon" model are more suitable but less history available
- Estimate monthly for all firms in Northfield US equity universe from December 31, 1991 to December 31, 2017
- Study three samples:
  - All
  - Financial firms
  - Non-financial firms
- Sources of Time series variation
  - Stock prices, debt levels, Northfield risk forecasts
  - Mix of large and small firms, 4660 <= N <= 8309

Summary As of 2010

- Current life expectations for all (5068) firms in years
  - Median 23, Mean 22.18, Cap Weighted 25.71
- Financials firms only (1132)
  - Median 24, Mean 21.69, Cap Weighted 18.95
  - Surprising (or maybe not) cap-weighted is a lot lower
- Non-Financials (3936)
  - Median 23, Mean 22.33, Cap Weighted 27.36
- Highlights:
  - AIG 7, Citicorp 6, GS 6
  - IBM 30, MSFT 32
  - RD 30/39, XOM 54

Full Sample Summary Statistics

- Calculate the cross-sectional mean, cap weighted mean and median for 313 months, average sample = 6134 companies
  - Time series average of the monthly medians, 15.42
  - Time series average of the monthly means, 17.46
  - Time series average of cap weighted means 17.83
  - Time series average of revenue weighted means, 6.21
- Start point December 31, 1991
  - Mean 8.97, Median 8, Revenue Weight 4.18, Cap Weight 9.70
- End point, December 31, 2017
  - Mean 32.62, Median 27, Revenue Weight 10.80, Cap Weight 32.48
- *Overall, expected lives of firms have gotten a lot longer*

What Accounts for Longer Lives

- Equity capitalization values have outpaced increases in corporate debt.
  - As of 12/31/1991 aggregate corporate debt security issuance was $1.24 Trillion, while at 12/31/2017 this level was $6.137 Trillion (+394%)
  - As of 12/31/1991 the level of the S&P 500 was 387 while at 12/31/2017 it was 2948 (+660%)
  - With higher equity market valuations it is easier for firms to issue new share equity and use the cash to pay off debt.
- Expectations of equity market volatility have declined
  - The start of the sample period was a recession in the US economy with high volatility in financial markets
  - The current expected volatility is materially lower.
  - At the low point of volatility expectations in July of 2016, the expected life values peaked with a median of 36 years and an average of 41.5 years, roughly 25% higher than the end of the sample period at 12/31/2017

Let's Compare Pre and Post GFC

- For the period from 12/31/1991 through 12/31/2006 (PRE)
  - The average number of companies per was 6807
  - The median expected life was 12.23
  - The average expected life was 12.65
  - The cap-weighted average expected life was 13.81
  - The revenue weighted average expected life was 4.82
- For the period from 12/31/2009 through 12/31/2017 (POST)
  - The average number of companies per was 5066 (-25.52%)
  - The median expected life was 21.34 (+74.55%)
  - The average expected life was 26.38 (+108.56%)
  - The cap-weighted average expected life was 26.48 (+100.84%)
  - The revenue weighted average expected life was 9.02 (+87.20%)
- Obviously a lot of improvement but there is more to the story

Sector Level Full Sample Period

- Financials (average sample size = 1504)
  - Time series average of the monthly medians, 19.56
  - Time series average of the monthly means, 16.98
  - Time series average of cap weighted means 17.02
  - Time series average of revenue weighted means 6.48
- Non Financials (average sample size = 4628)
  - Time series average of the monthly medians, 14.48
  - Time series average of the monthly means, 17.55
  - Time series average of cap weighted means 18.03
  - Time series average of the revenue weighted means 5.84
- Note that for the full time series, financial firms were expected to survive longer than non-financials
  - This flipped during the GFC with non-financials have longer life expectations

"Too Big to Fail" is Really Real

- In both the financial and non-financial sectors, the revenue weighted expected lives are far below other measures of central tendency
  - Large firms that are important to the national or global economy operate with expectations of government "bailouts" in the event of trouble and so are willing to take on much higher levels of operating risk.
  - Large firms financial firms often operate globally taking advantage of weak regulation in some jurisdictions.
  - It's much easier for large firms to negotiate with labor unions and other stakeholders for cost concessions.
  - Large firms have more diversified businesses and are seen as safer by bondholders and hence are able to borrow more through the bond market.

- *During the GFC, it was argued that this effect was allowed to get out of hand and financial firms in particular took advantage with the effect being a material increase in systemic risks*

Systemic Risks of The Financial Sector

- PRE GFC for the Financial Sector (12/31/1991 through 12/31/2006)
  - Average number of firms 1709, Median expected life 15.99
  - Mean 13.03, Cap Weighted 13.13, Revenue Weighted 4.70
- POST GFC for the Financial Sector (12/31/2009 through 12/31/2017)
  - Average number of firms 1203 (-29.6%)
  - Median expected life 27.33 (+70.88%)
  - Mean 25.25 (+93.87%)
  - Cap Weighted 25.14 (+91.46%), Revenue Weighted 9.85 (+109.51%)
- Post GFC regulation of the financial system has focused on reducing systemic risk This seems to be a mixed outcome.
  - *Revenue weighted expected life has increased a lot more than the median*
  - *Revenue weighted expected life in finance has increased more than in non-finance (109 vs 81%)*
  - *But the number of firms has dropped by 30%, increasing concentration risks*

Implications for Bond Investors

- For corporate bond investors, the post-GFC world *seems to be less risky.*
  - Expected lives of firms are up a lot so individual firms seem better positioned to manage their debt load.
  - However, the number of companies that are publicly traded has declined substantially (-30% in finance and -24% in non-financial firms) relative to the PRE GFC average.
  - This concentration of corporate activity is likely to increase default correlation across firms and make diversification more difficult.
- The "Duration Times Spread" method of estimating portfolio credit spread risk is now predominant among practitioners.
  - DTS has heroic assumptions regarding credit correlations, similar to the Gaussian Copula method which is often blamed for a lot of problems with credit ratings during the GFC

    https://www.northinfo.com/Documents/849.pdf

Implications for Equity Investors

- The simplest model of equity valuation, the Gordon dividend discount model assumes that companies survive in perpetuity.
  - To the extent that companies have finite life expectations the Gordon DDM provides an upward biased estimate of value.
  - The bias is more pronounced for companies where expected financial payoffs are further in the future (i.e. "Growth" stocks), providing one of the reasons that "value" investing seems to provide overall better returns historically.
  - As expected lives increase, the relative effect of this bias declines, reducing the impact of this effect on the Growth/Value return spread.
  - https://www.northinfo.com/documents/776.pdf

- "Sustainability" has been associated with superior long term returns.
  - Companies that are expected to survive longer are considered of higher "quality" and have been shown to produce a positive alpha on the order of 3%
  - https://www.northinfo.com/documents/846.pdf

Conclusions

- Over the sample period from 12/31/1991 to 12/31/2017, the empirical data arising from the "expected life" method suggests that companies are now expected to survive far longer than in the PRE GFC period.
- This increase arises from three contributors
  - A material relative increase in the market value of equity relative to the book value of debt. It is now easier for firms to sell equity to raise cash and pay off debt if they choose to do so.
  - A decline in the expected volatility of equity securities. The effect peaked in 2016 and has risen since then.
  - A decline in the leverage at large financial firms purportedly reducing systemic risk.
- Offsetting this apparent improvement is an increase in concentration risk as the number of firms has declined substantially.