The agonizingly long death of bankrupt stocks

Mike Lipkin, Columbia, IEOR + Katama Trading, LLC
Richard Sowers, UI, Champaign-Urbana
Xiao Li, Morgan Stanley, NYC

United Airlines: 2001-2005
UALAQ

• United Airlines filed for bankruptcy toward the end of 2002.

• The stock continued trading for 3 more years at prices typically in excess of $1 and spiking even as high as $4.

• Its assets were negligible and its debts were in the $BB.
GM/MTLQQ

• General Motors filed for bankruptcy June 1, 2009
• The stock dropped to nearly $0.50 and rallied to well over $1.00
• Concerned that people misunderstood the potential of GM to be healthy, the ticker was changed to MTLQQ. The last print for the old ticker GM was $1.15!!!
GM/MTLQQ

Motors Liquidation Company (MTLQQ.PK)
UALAQ (bankrupt United A)
Takeaway

• In fact, such spikes and “irrational” prices are unavoidable and natural in bankrupt stocks
• They follow directly from the *hard-to-borrowness* of these stocks (Lipkin + Avellaneda, 2009)


Lehman

• Even down to pennies (all scales) these spikes persist
• Lehman filed Chapter 11 on September 15, 2008
• The following shows the fate of bankrupt Lehman $3^{1/2}$ years later:
• Note that trading in the underlying corresponds to the occurrence of spikes
LEHMQ
Kodak

• Kodak is a very recent bankruptcy
• They filed Jan 19, 2012
• Although the stock dropped to $0.36, it immediately rallied to over $0.50
• Contrast this with GM from earlier
Kodak (EK/EKDKQ)
GM/MTLQQQ

Motors Liquidation Company (MTLQQ.PK)
Facts and stylized facts about bankruptcies

• Bankrupt stocks (almost always) go to $0.00
• They do this not via trading but by a court order
• Before a court makes a final determination on the Chapter 11 filing stock in the company continues to trade- typically on the pink sheets (i.e. XYZ.PK)
• The stock price declines slowly over a long period of time but is punctuated by spikes and frenetic behavior
• Virtually all the active trading occurs during these frenetic periods, volume is virtually non-existent at other times
• These stocks are all HTB
Prior to bankruptcy- already HTB

Oct 19, 2009
CIT

• CIT filed for Chapter 11 on November 1, 2009
• The previous slide shows an options matrix for CIT on Oct 19 of that year
• Let’s look at the April (2010) 1.50 line
  – The calls are .25; the puts are 1.125 (mbbo)
  – The stock is 1.25 (last)
  – 180 days (0.5 y) until expiration
  – Carry = .25 -.875 = -.625
  – “effective interest rate” = -83%
  – “effective dividend rate” = 100%
The mathematical guts

- Our 2009 paper proposed a dynamics for Hard-to-borrow (HTB) stocks

\[ \frac{dS}{S} = \sigma_0 d\Omega + \gamma \lambda dt - \gamma dN_t^\lambda \]

\[ \frac{d\lambda}{\lambda} = \kappa dZ + \alpha (\log \lambda_0 - \log \lambda) dt + \beta \frac{dS}{S} \]

- The model can be seen to contain two coupled SDEs; the top equation describes stock price as an ordinary diffusion coupled with drift and drop due to buy-ins and their completion; the lower equation couples the frequency of buy-ins (a measure of the outstanding short interest) to the stock process directly
Consequences for HTBs

• The consequences of the model for ordinary stocks include:
  – Fat puts and cheap calls where options exist
  – Option pricing as if the stock paid a dividend stream
  – Excess volatility ($\gamma^2\lambda$) and crashes
  – Excess asset prices (as a consequence of increased volatility)
Bankruptcy ansatz

• Now what if a stock has filed for Chapter 11?
• We might make a *simplifying assumption* that virtually all stock trading is buy-in related
• Then the only volatility in the stock will be buy-in related
• So $\sigma_0 = 0$
• What will be the effect on stock dynamics?
Model (slightly rewritten for convenience)

Two-dimensional process:

• Price:
  \[ \frac{dS_t}{S_t} = (\alpha_q + \alpha_h \lambda_t)dt - \gamma dN^{\kappa(t)}(t) \]
  (where \( \kappa(t) = \kappa_q + \kappa_h \lambda_t \))

• Buy-in frequency:
  \[ \frac{d\lambda_t}{\lambda_t} = (\beta_q + \beta_h \lambda_t)dt + \rho dS_t/S_t \]

We will take hard-to-borrowness to be the implied dividend (defect in standard put-call parity) and proportional to \( \lambda \):

\[ \lambda \sim \{(P-(K-S)^+) - (C-(S-K)^+) + KTR\}/(ST) \]
(P=price of put, C=price of call, both at strike K, T=time to expiry, R=interest rate) (In fact \( d_{\text{imp}} = \lambda \gamma \))
In this formulation, the model is triangular; solve for $\lambda$ and then solve for $S$:

$$d\lambda_t = (\beta_q + \beta_h \lambda_t)\lambda_t dt - \rho \gamma \lambda_t dN^{\kappa(t)}(t)$$

$$dS_t/S_t = (\alpha_q + \alpha_h \lambda_t)dt - \gamma dN^{\kappa(t)}(t)$$

Deterministic dynamics of $\lambda$ are explosive; approximately

$$\lambda' = \beta_h \lambda^2$$

Jumps when enough "Poisson-clock" is built up by $\lambda$
Bubbles and HTBs and Bankruptcies

• The topic of asset bubbles has had a long, politically charged history
• The “science” of economics is partly responsible for this
• When the classical theory of economics was being formulated thermodynamics was “adopted” as a paradigm
• Quantities such as prices were considered to be “equilibrium” values
Dynamical Systems

• If economics were to be reformulated today using the “physics of our time” the economy and especially its subsystems would be viewed as driven dynamical systems

• Such systems are characterized by inflows and outflows of moneys and labor and people (energy and heat and particles, etc.)

• Such systems are virtually never in equilibrium- at best they might be in steady-state
Equilibrium Thermodynamics

• The classical approach to bubbles has typically asserted that there is a “fair” price and for “some reason” the market is not achieving this fair price—thus asset prices are in excess.

• A common theory is the Salem witch trial approach to bubbles: *speculators* have caused the excess asset price.

• (in other times speculators are assumed to be small market participants also known as traders)
Dynamical Systems

• Viewing the economy as a driven dynamical system one would look at relatively stable prices as representing a steady-state.

• There would not be “fair” prices... only market prices which might be affected by changing external parameters such as leverage, supply, taxation, etc.

• If these prices were relatively insensitive to change over a mesoscopic (intermediate) length of time one might suppose that the price evolution would be given as the output of some model.
An aside: Oil

• Some people for instance have thought that OIL might be in a bubble
• During the last several years the economies of Europe and much of the world have contracted; perhaps a billion new people have entered the world economy; China’s manufacturing growth rate has decreased, India’s has increased; the US has greatly increased monetary supply; Iran has faced sanctions; Nigeria has had near civil war conditions; etc; etc; etc; and these are dynamically changing
• There is NO equilibrium price for oil
• The steady-state price of OIL may be reducible by changing leverage conditions, increasing supply, etc.
Functional Definition of Bubbles

• In previous talks I have suggested an alternative approach to the study of bubbles
• We recognize a bubble (in hindsight) by observing:
  – that asset prices were excessively volatile (compared to before and after)
  – a large crash often ends the bubble
  – they persist for long periods of time
• Under the equilibrium viewpoint of bubbles the duration, the excess volatility, and the market price of the asset itself are generally unpredictable
• Under the equilibrium viewpoint, why the price is elevated rather than depressed is generally unclear
Functional Definition of Bubbles

• Under the alternative (driven dynamical) view of bubbles, a bubble is a steady-state of significant temporal duration with excess volatility and prices larger than before and after.

• This functional approach suggests that stocks described by HTB dynamics may be in a kind of bubble.

• They also have excess volatility, etc...
Bankrupt stocks are in a bubble

• One place where the classical and alternative views of bubbles tend to agree is in the description of bankrupt stocks
• These stocks are known to have a long-term price of $0.00
• In the equilibrium viewpoint their value is $0.00, but for how long will they persist at non-zero prices?
• In the dynamical viewpoint they are going to $0.00 from their current market price with a time-scale given by a function of buy-in frequency
Model tells us that bubble deflates

- For $\lambda$ large or small, $\log(\lambda_t)$ is approximately a time changed version of
  $$\beta t + \log(1-\gamma)N^\kappa(t)$$
  (with different values of $\beta$, $\gamma$, and $\kappa$ for large vs. small)
- Under stability conditions, $\lambda_t$ tends to zero and
  $$S_t \approx \exp[(\alpha_q t + \kappa_q \ln(1-\gamma))t]$$
  $S$ and $\lambda$ eventually are captured in stable region and tend to zero. If $\kappa_q=0$, then spike frequency also tends to zero.
Simulated trajectory

![Simulated trajectory](image-url)

**Figure 6. Simulated Trajectory**
Conclusions

• It is valuable to reiterate these differences

<table>
<thead>
<tr>
<th>Equilibrium</th>
<th>Dynamical Steady-State</th>
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</thead>
<tbody>
<tr>
<td>Mispricing</td>
<td>Market stable value</td>
</tr>
<tr>
<td>No dynamics</td>
<td>Dynamics provided by modified L-A; spikes, decay form, etc. predictable</td>
</tr>
<tr>
<td>May be the product of manipulators</td>
<td>Natural and characteristic of <em>all</em> bankruptcies</td>
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</tbody>
</table>
Acknowledgments

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