A Speculative-Beta Asset Pricing Framework

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Motivation

- Mainstream asset pricing models built on risk-sharing motive for trade.
- But a large body of empirical work rejects these models.
  - Long swings in price-to-fundamental ratios and mean reversion: booms and busts before Crash '29, Crash '87, LTCM and Asian '98, Quant crisis '07, Dot-Com, Housing, Subprime Mortgage CDOs.
  - Evidence rejecting CAPM-β: value-glamour effects etc...
  - Natural experiments on sentiment affecting prices.

Recent Deviations Not Far Enough

- Recent attempts to move away from risk-sharing, featuring frictions, limits of arbitrage, institutional, aymmetric information or behavioral biases, rely on liquidity or noise traders to generate trade.
- But implications of these models are similar to risk-sharing motive.
  - Either silent on β or it should still be associated with higher expected returns.
  - Higher volatility assets should be associated with higher expected returns.
- But both key relationships actually go the wrong way! (Ang et.al. '06, Frazzini and Pedersen '11)

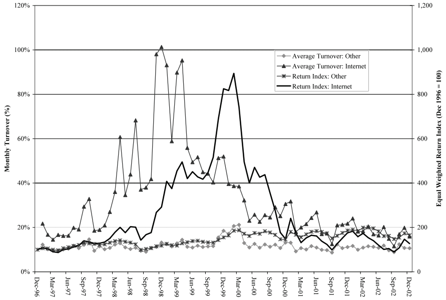
Speculation and Price Levels

- Largely unanalyzed: the speculative motive for trading + asset prices.
- Consensus trading volume in financial markets ($51 trillion in 2005) is excessive relative to risk-sharing or liquidity motives.
- Strong correlation between volume and price level (Hong and Stein '07)
  - South Sea bubble of 1720 loud, Carlos, Neal and Wandschneider (2006).
  - Accounts of stock-market boom of late 1920s emphasize overtrading in anticipation of capital gains in 28-29. New record not set til April 1, 1968.
  - Internet stocks during 1996-2000: (1) price volatility excess of 100% and (2) more than 20% of stock market turnover.

Figure 1: Monthly Prices and Share Turnover of Internet Stocks

The figure plots the average monthly prices and turnover of internet stocks compared to the rest of the market.

Prices and Turnover for Internet and Non-Internet Stocks, 1997-2002



Credit Bubbles and the Financial Crisis

- Credit bubble in AAA/AA tranches of subprime mortgage CDOs important in financial crisis (Coval et al. 09).
- Evidence on optimism/pessimism of market participants (AIG-FP, Moody's v. Paulson) regading the home price appreciation or lack of correlation of regional home prices.
- Recent direct evidence of bubbles in credit, especially in lower-rated credits (Greenwood and Hanson '11) looking at issuance and returns.

My Goal

- Redo asset pricing with the speculative motive (Hong and Stein '07).
- Build on recent work on asset price bubbles due to disagreement and short-sales constraints.
  - Overconfidence, disagreement to break Milgrom-Stokey '82.
  - Binding short constraints for dot-coms and subprimes, institutional restrictions.
- Binding short-sales constraints leads to overpricing (Miller '77, Chen, Hong and Stein '01).
- Resale option arise due to anticipation of binding short-sales constraints with fluctuating beliefs (Harrison and Kreps '78, Scheinkman and Xiong '03, Hong, Scheinkman and Xiong '06).

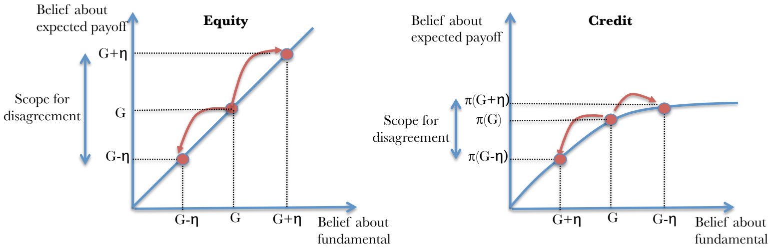
Speculative-ness of Assets

- Hong and Sraer 2011a "Quiet Bubbles" prices debt, in which investors disagree about underlying asset value (home prices for CDOs).
  - Resale option of credit bubbles smaller and quieter than equity bubbles since upside payoff is capped.
- Hong and Sraer 2011b "A Speculative-Beta Asset Pricing Model" prices low versus high beta assets in which investors disagree about market or fundamentals
  - High beta assets are more speculative and command high prices and low expected returns when disagreement is high.

Main Intuition

- Asset sensitivity to disagreement over fundamentals (underlying asset or home prices for CDOs or market/macro fundamental)
- Main intuition:
    - With concave payoff or low beta assets, less scope for disagreement $\Rightarrow$ lower resale option or price and higher expected return.
    - lower resale option $\Rightarrow$ lower turnover, volatility

Concave payoffs reduce the scope for disagreement.



Hong and Sraer '11a: Quiet Bubbles

- Three dates $t = 0, 1, 2$. Risk neutral agents. No discounting.
- Supply Q of risky credit w/ face value of D and date-2 payoff:

$$m_2 = \min\left(D, \tilde{G}_2\right) \quad \text{where} \quad \tilde{G}_2 = G + \epsilon_2, \quad \text{and} \quad \epsilon_2 \sim \Phi(.).$$

- Expected payoff with unbiased belief:

$$\pi(G) = E[m_2|v] = \int_{-\infty}^{D-G} (G + \epsilon_2)\phi(\epsilon_2)d\epsilon_2 + D\left(1 - \Phi\left(D - G\right)\right).$$

- Works more generally with any concave payoff function $\pi()$.

Agents' Beliefs

- Two groups of agents (A and B) w/ homogenous priors about fundamental.

$$\tilde{V}_2 = G + b + \epsilon_2, \quad \text{where } b \text{ is aggregate bias}$$

- At t=1, agents beliefs about fundamental becomes:

$$\begin{cases} G + b + \eta^A + \epsilon_2 & \text{for group A agents} \\ G + b + \eta^B + \epsilon_2 & \text{for group B agents} \end{cases}$$

- Where η^A and η^B are i.i.d. with normal C.D.F. $\Phi()$.

Leverage and Trading Costs

- Reduced form view of leverage: cost of borrowing.
  - Agents endowed with 0 liquid wealth but large illiquid wealth W (pledgeable at date 2).
  - Access to an imperfectly competitive credit market: banks charge > 0 interest rates for risk-free loans (parameter μ larger cheaper is leverage).
- Quadratic trading costs to have finite positions:

$$c(\Delta n_t) = \frac{(n_t - n_{t-1})^2}{2\gamma},$$

- Short-sales constraints
- Trading costs allow equilibrium to exist – results similar in CARA/Gaussian framework.

Moments

Construct a dynamic equilibrium and analyze following moments:

1. Ex ante mispricing: P_0 relative to no short-sales constraint / no aggregate bias (b=0) prices.
2. Price volatility between 0 and 1:

$$\sigma_P = \int_{\eta^A,\eta^B} \left(P_1(\eta^A,\eta^B) - m\right)^2 d\Phi(\eta^A) d\Phi(\eta^B)$$

$m = \int_{\eta^A,\eta^B} P_1(\eta^A,\eta^B) d\Phi(\eta^A) d\Phi(\eta^B)$ is average date-1 price.

3. Share turnover between 0 and 1:

$$\mathbb{T} = \int_{\eta^A,\eta^B} \mathcal{T}(\eta^A,\eta^B) d\Phi(\eta^A) d\Phi(\eta^B)$$

with $\mathcal{T}(\eta^A,\eta^B) = \left| n_1^A(\eta^A,\eta^B) - n_0^A(\eta^A,\eta^B) \right|$

Date-1 Equilibrium

1. Both groups are long (low leverage/high supply/small shocks):

$$\left|\pi(\eta^A) - \pi(\eta^B)\right| < \frac{2Q}{\mu\gamma}$$

$$\Rightarrow P_1 = \mu\frac{\pi(\eta^A) + \pi(\eta^B)}{2} \text{ and } \mathcal{T} = \frac{\mu\gamma}{2}\left|\pi(\eta^A) - \pi(\eta^B)\right|$$

2. Group i sidelined (high leverage/low supply/large relative shock):

$$\pi(\eta^i) - \pi(\eta^j) \geq \frac{2Q}{\mu\gamma}$$

$$\Rightarrow P_1 = \mu\pi(\eta^i) - \frac{Q}{\gamma} \text{ and } \mathcal{T} = Q$$

Date-0 Equilibrium

- Agents select date-0 holdings anticipating date-1 equilibrium.
- Market clearing condition ($n_0^A + n_0^B = 2Q$) gives P_0.
- Symmetric equilibrium: $n_0^A = n_0^B = Q$.

$$P_0 = \int_{-\infty}^{\infty} \left[\underbrace{\left(\mu\pi(y) - \frac{2Q}{\gamma} \right) \Phi\left(\underline{x}(y)\right)}_{\text{short-sales constraint}} + \underbrace{\int_{\underline{x}(y)}^{\infty} \mu\pi(x) d\Phi(x)}_{\text{no short-sales}} \right] d\Phi(y) - \underbrace{\frac{Q}{\gamma}}_{\text{supply}}$$

Equilibrium Moments: Bubble

- Bubble can be decomposed in two terms:

$$\text{bubble} = \underbrace{\int_{-\infty}^{\infty} \left(\int_{-\infty}^{\underline{x}(y)} \left(\mu\pi(y) - \mu\pi(x) - \frac{2Q}{\gamma} \right) d\Phi(x) \right) d\Phi(y)}_{\text{resale option}} + \underbrace{\hat{P}_0 - \bar{P}_0}_{\text{optimism}}$$

- $\bar{P}_0$ is the price when $b = 0$ and no short-sales constraint
- $\hat{P}_0$ is the no-short-sales constraint price with aggregate bias b.

Equilibrium Moments

- Mechanical link between turnover and volatility and mispricing:
    - Turnover maximized when short-sales constraints are binding.
    - Resale option maximized when short-sales constraints are binding.
    - Price volatility also higher since average of beliefs lower volatility then volatility of max beliefs.

Comparative Statics: Credit Riskiness

Proposition 1: An increase in D leads to larger mispricing, larger turnover and larger volatility.

- Intuition: as D increases, credit becomes more disagreemeent sensitive.
  $\Rightarrow$ Larger resale option
  $\Rightarrow$ Larger mispricing
  $\Rightarrow$ Larger turnover, volatility.
- Thus, credit bubbles are quiet – and small.
- In the pure resale option framework, loudness and prices go hand in hand.

Comparative Statics: Optimism

Proposition 2: An increase in b leads to larger mispricing, **lower** turnover and **lower** volatility.

- Intuition: as b increases, credit becomes safer in the agents' eyes.
  $\Rightarrow$ credit becomes less disagreemeent sensitive.
  $\Rightarrow$ lower resale option
  $\Rightarrow$ lower turnover, volatility.
- Lower resale option, but larger bubble from optimism.
- When optimism rises, credit bubbles quieter **and** larger.
- Optimism decouple turnover/volatility and price.
- Important: b leaves unchanged an equity bubble.

Evidence of Quiet Credit Bubbles

- However, the credit bubble was quiet: high price but low price volatility and low turnover.

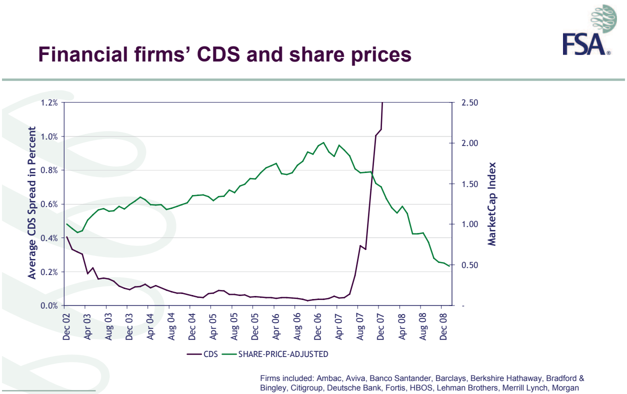
1. ABX prices of CDO tranches, especially AA and AAA, not volatile until beginning of crisis.
2. Little turnover of these securities. (anecdotal evidence)
3. CDS prices for insurance against default of finance companies extremely cheap and not volatile.

Figure 2: ABX Prices

The figure plots the ABX 7-1 Prices for various credit tranches including AAA, AA, A, BBB, and BBB-.

Figure 3: CDS Prices of Basket of Finance Companies

The figure plots the average CDS prices for a basket of large finance companies between December 2002 and December 2008.



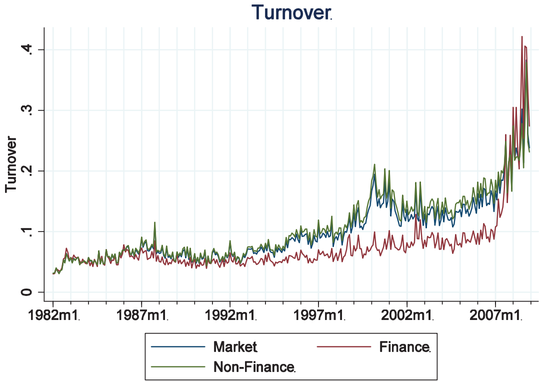
Source: *Moody's KMV, FSA Calculations*

Firms included: Ambac, Aviva, Banco Santander, Barclays, Berkshire Hathaway, Bradford & Bingley, Citigroup, Deutsche Bank, Fortis, HBOS, Lehman Brothers, Merrill Lynch, Morgan Stanley, National Australia Bank, Royal Bank of Scotland and UBS.

CDS series peaks at 6.54% in September 2008.

Figure 4: Monthly Share Turnover of Finance Stocks

The figure plots the average monthly share turnover of finance stocks compared to the rest of the market.



Implications

- Our model offers a new take on the crisis.
- Credit bubbles are potentially harder to detect and more dangerous. Associated with lower volatility and turnover – quiet bubbles.
- Also suggests a Taxonomy of Bubbles based on this loudness criterion.

Hong and Sraer '11b: A Speculative-Beta Asset Pricing Model

- Dynamic model of trading with T dates $t = 0, 1, 2 \ldots T$.
- N stocks that pay off a final dividend distributed at date T according to $\tilde{d} \sim \mathcal{N}(\bar{d}, \Sigma)$ where $\bar{d} \in \mathbb{R}^N$ and $\Sigma \in \mathbb{R}^N \times \mathbb{R}^N$.
- The dividend process has the following structure:

$$\forall i \in \{1, ..., N\}, \qquad \tilde{d}_i = \delta_i \tilde{z} + \tilde{\epsilon}_i,$$

  where $\tilde{z} \in \mathbb{R}$ is the common risk factor, $\mathbb{E}[\tilde{z}] = \bar{z}$, $(\tilde{z}) = v$, $\mathbb{E}[\tilde{\epsilon}_i] = 0$, $\mathbb{E}[\tilde{\epsilon}_i{}^2] = \sigma_\epsilon^2$ and where for all $i \neq j$, $\tilde{\epsilon}_i \perp \tilde{\epsilon}_j$.
- Set $\bar{d}_i = \delta_i \bar{z}$.
- Supply of shares of the asset to one for all assets.

Investors' Beliefs

- Two groups of investors, A and B, each with a mass $1/2$.
- Investors have one-period mean-variance utility functions.
- At date 0, homogenous priors regarding the mean vector $\bar{d}$.
- At date t, revise their beliefs about the value of the common factor at date T.
- To simplify, group A thinks it is $\bar{z} + \lambda_t$, while group B think it is $\bar{z} - \tilde{\lambda}_t$, where $\tilde{\lambda}_t = \tilde{\lambda}_{t-1} + \eta_t$ and $\tilde{\eta}_t$ is distributed according to $\mathcal{N}(0, 1)$.
- Correct expectations about the variance of the risk factor process.
- Assume short-sales constraints.

Special Case of 2 Assets

- We illustrate this model in the context of a two assets and two periods model.
- Assume without loss of generality that $\delta_1 > \delta_2 > 0$.
- Let $v_\epsilon = \frac{v}{\sigma_\epsilon^2}$.
- Call r the per-period risk-free rate.
- We can solve the model backwards.
- (1) find the date-1 equilibrium prices for both assets conditional on the realization of $\tilde{\lambda}_1$
- (2) find the date-0 equilibrium prices for both assets, anticipating the date-1 distribution of prices.

Speculative-Based Asset Pricing Line

- Average period return of asset 2 – the asset with the lower exposure to aggregate cash flow — can be written down as:

$$\mathbb{E}[\tilde{R}_2] = \underbrace{\frac{1}{\gamma} cov(\tilde{R}_2, \tilde{R}_M)}_{\text{CAPM term}} + \underbrace{\int_{\lambda > \frac{v}{\gamma} \frac{\delta_1 \delta_2 + \delta_2^2 + v_\epsilon}{\delta_2}} \left(\frac{v}{\gamma} \left(\delta_1 \delta_2 + \delta_2^2 + v_\epsilon \right) - \lambda \delta_2 \right)}_{\text{speculative option discount } (< 0)}$$

- CAPM holds in our model except when the short-sales constraints are binding.
- Endogenous non-diversification in investor holdings.
- This happens when the interim belief shocks are large enough – precisely when $|\lambda| > \frac{v}{\gamma} \frac{\delta_1 \delta_2 + \delta_2^2 + v_\epsilon}{\delta_2}$.

When CAPM Fails

- When this happens, the expected return is lower since there is an extra-demand for the asset coming from the speculative option.
- This speculative option is all the more large when the asset has a high δ since a higher δ means a larger sensitivity to disagreement.
- Because there is a monotonic relation between δ's and β's in our model, this means that the speculative discount will be larger for assets with larger β's.
- As a consequence, the security market line becomes more flat (and be inverted) than in a standard CAPM approach.

Radically Different Implications

- Proposition 1. An increase in the dispersion of beliefs in the economy (in the sense of a mean-preserving spread of the distribution of the belief shocks λ) lead to a decrease in the expected returns of stocks, and all the more so for stocks with large βs.
- Proposition 2. Higher beta assets also have higher disagreement, higher volatility and greater share turnover.

Conclusion

- Insight for a broader agenda to build a speculation-based asset pricing model (Hong-Sraer 2011a,b).
- Delivers radically different lessons for what we teach our students.
    - Speculative investors like beta and high beta assets command high prices.
    - High volatility assets associated with higher expected returns.
    - Capital budgeting implications in which high beta assets have lower (not higher) hurdle rates.