The Value Premium

Zhang, JF 2005
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Outline

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   • Production-Based Asset Pricing Framework
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What is the Value Premium?

- Sort all stocks on basis of “Book-to-Market” (BM) ratio:
  - Value stocks (e.g., GE?) have highest BM ratio;
  - Growth stocks (e.g., Google?) have lowest BM ratio;

- **Value has 6% higher average returns/yr vs. Growth;**

- Value stocks derive value from assets-in-place, whereas
  Growth from growth options;

- How could assets-in-place riskier than growth options?
Risk-return relation: $\mathbb{E}[R_j - R_f] = \beta_j \lambda_m$

- $\beta_j$ measures quantity of risk:
  - Higher $\beta_j$ implies greater covariance with market return;
  - Asset pays off in good states;
  - Bad for consumption-smoothing;

- $\lambda_m$ measures market price of risk:
  - Reflects investor preferences;
  - Idiosyncratic risk irrelevant.

...Value returns are more correlated with market return!

Figure: “Low” = Growth
Equilibrium Model (of the Supply-Side)

- Industry equilibrium model with heterogeneous firms;
- Idiosyncratic (firm-level) and aggregate (economy-wide) productivity shocks to generate cross-section of returns:
  1. Idiosyncratic shocks $\implies$ firm-level heterogeneity;
  2. Aggregate uncertainty $\implies$ un-diversifiable risk in economy.
- Prices exogenous function of industry output;
- Cash-flows/returns are endogenously determined by firms’ characteristics!
Zhang’s Story

1. Asymmetric, costly reversibility of capital stock:
   - Hampers dividend smoothing;
   - Disinvesting in bad times more risky;

2. Counter-cyclical market risk premium;
   - Increase market risk premium when Value looks riskiest;

...Makes assets-in-place look riskier than growth options, especially in bad times!
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Zhang
The Value Premium
Discrete time, infinite-horizon:
- Firms live forever, no bankruptcy, entry/exit, etc.;

Industry composed of a continuum of (stock price) value-maximizing firms that produce a homogenous product:
- Firms ex-ante identical;
- One-sector model;

Firms behave competitively, i.e., take industry price as given.
Technology

- Capital is only input in production: \( y_{jt} = e^{x_t + z_{jt}} k_{jt}^{\alpha} \):
  - \( \alpha \in (0, 1) \Rightarrow \) decreasing returns to scale;
- Two productivity shocks:
  1. Aggregate: \( x_{t+1} = \bar{x}(1 - \rho_x) + \rho_x x_t + \sigma_x \epsilon_{t+1}^x \)
     - Average productivity in economy;
  2. Idiosyncratic: \( z_{jt+1} = \rho_z z_{jt} + \sigma_z \epsilon_{t+1}^z \)
     - Orthogonal, firm-specific component;
- Shocks IID standard normal and independent of each other.
Stochastic Discount Factor

- No consumer side of economy, production side only;
- Model consumer’s IMRS (firm’s IMRT?) directly:

\[
\log M_{t+1} = \log \xi + \gamma_t (x_t - x_{t+1})
\]

\[
\gamma_t = \gamma_0 + \gamma_1 (x_t - \bar{x})
\]

- \( \gamma_t \) is time-varying market price of \( x_t \) risk:
  - \( \gamma_1 < 0 \implies \) counter-cyclical price of aggregate risk;
  - Aggregate productivity below trend, higher compensation for risk-taking;
  - Habit or LRR interpretation valid?
Industry Demand

• Output price as function of industry output:

\[ P(Y_t) = Y_t^{-\eta} \]

• Demand curve fixed and independent of state of economy;
• Industry output/price fluctuates with aggregate state and depends on the cross-sectional distribution of firms.
Asymmetric Adjustment Costs

- Asymmetric and quadratic capital adjustment costs:
  \[ h(i_{jt}, k_{jt}) \equiv \frac{1}{2} \theta_{jt} \left( \frac{i_{jt}}{k_{jt}} \right)^2 k_{jt}; \]

- \[ \theta_t \equiv \theta^+ \cdot \chi\{i_{jt}>0\} + \theta^- \cdot \chi\{i_{jt}<0\}; \]

- Higher per unit cost in contracting than expanding capital stocks
  \( (\theta^- > \theta^+ > 0). \)
Profits and Dividends

\[ \pi(k_{jt}, z_{jt}; x_t, P_t) = P_t y_{jt} - f \cdot \chi_{\{y_{jt}>0\}}; \]
- \( f \) is a nonnegative fixed cost of production;

\[ d_{jt} \equiv \pi_{jt} - i_{jt} - h(i_{jt}, k_{jt}); \]
- Firms are all-equity financed;
- What about holding cash?
Let $v$ denote the market value of the firm:

$$
v(k_{jt}, z_{jt}; x_t, P_t) = \max_{i_{jt}, k_{jt+1}} \mathbb{E}_t \sum_{\tau = t}^{\infty} M_\tau d_{j\tau}
$$

Dynamic programming problem can be formulated as:

$$
v(k_{jt}, z_{jt}; x_t, P_t) = \max_{i_{jt}} \left\{ d_{jt} + \mathbb{E}_t [M_{t+1} v_{jt+1}] \right\}
$$

s.t.

$$
k_{jt+1} = i_{jt} + (1 - \delta) k_{jt}
$$
$$
z_{jt+1} = \rho_z z_{jt} + \sigma_z \epsilon^{z}_{t+1}
$$
$$
x_{t+1} = \bar{x}(1 - \rho_x) + \rho_x x_t + \sigma_x \epsilon^{x}_{t+1}
$$
$$
P_{t+1} = \Omega (P_t, x_t, x_{t+1})
$$
$$
M_{t+1} = \beta e^{\gamma_t (x_t - x_{t+1})}
$$
Beta–Pricing Model

Risk-return relation:  \( \mathbb{E}_t [R_{jt+1} - R_{ft}] = \beta_{jt} \lambda_{mt} \)

- \( R_{jt+1} \equiv v_{jt+1} / (v_{jt} - d_{jt}) \)
- \( R_{ft} = 1 / \mathbb{E}_t [M_{t+1}] = \beta^{-1} e^{- (1 - \rho_x) \sigma_{mt} (x_t - \bar{x}) - \frac{1}{2} \sigma_{mt}^2} \)
- \( \lambda_{mt} \equiv \text{Var}_t [M_{t+1}] / \mathbb{E}_t [M_{t+1}] = e^{\frac{1}{2} \sigma_{mt}^2} \left( e^{\frac{1}{2} \sigma_{mt}^2} - 1 \right) \)
- \( \sigma_{mt} \equiv \sigma_x \gamma_t \)
- \( \beta_{jt} \equiv -\text{Cov}_t [R_{jt+1}, M_{t+1}] / \text{Var}_t [M_{t+1}] \)
Equilibrium

A recursive competitive equilibrium is an industry price, investment and value functions for the firm, and a law of motion for the cross-sectional distribution of firms \( \{P^*, i^*, v^*, \Gamma^*\} \) s.t.:

1. **Optimality:** Given prices, \( i^*(k_t, z_t; x_t, P_t^*) \) solves the firm’s value-maximization problem and \( v^*(k_t, z_t; x_t, P_t^*) \) is the associated value function;

2. **Market Clearing:** \( P_t^* = Y_t^{-\eta} \);

3. **Aggregate Consistency:** The LOM for the cross-sectional firm distribution, \( \mu_{t+1} = \Gamma^* (\mu_t, x_t, x_{t+1}) \), is consistent with optimal firm behavior.
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Calibration and Results

- Some kind of calibration to match time-series moments of interest rates and various market returns;
  - I’m not going to discuss this...

- Implied cross-sectional returns (BM portfolio means, variances and market betas) consistent with the data;

- Argue that both counter-cyclical market price of risk and costly capital reversal essential ingredients.
The only source of heterogeneity is the firm-level productivity shock; Growth corresponds to:

1. High individual productivity;
2. High profitability;

Vice versa for Value.

Figure: “Value” ("Growth") portfolio corresponds to top (bottom) 30% of book-to-market ratios.
Investment Over the Business Cycle

- All firms invest in good times;
- Growth firms (nearly) always invest and grow faster than Value firms;
- Value firms disinvest in bad times;
- How does Value and capital stock line up?
Productivity, Flexibility and the Value Premium

1. Costly reversibility of capital stock:
   - Prevents dividend smoothing by firms;
   - In bad times, Value firms will be disinvesting;
   - If hit by another bad agg. shock, Value firms face even steeper adjustment costs, further decreasing their dividends/returns;
   - Hence, Value dividends/returns co-vary more closely with economic downturns, making them look more risky;
   - In good times, negligible dispersion of risk ($\beta^{Value} - \beta^{Growth}$).

2. Counter-cyclical market risk premium:
   - Market price of risk increases precisely when the dispersion of risk is maximized!
Using Model to Motivate Empirical Work

- This is a single-sector partial equilibrium model;
- Zhang uses results from model to motivate empirical analysis;
- No (worthwhile) empirical analysis in this paper.
Predictability of Value Premium

1. “Value spread” \((BM_H - BM_L)\) predicts Value Premium;
2. Value Premium is countercyclical:
   - Negatively correlated with aggregate productivity shock;
   - Why are results so weak at monthly frequency?

Figure: \(R_{t+1}(Value - Growth) = \beta X_t + \epsilon_{t+1}\) from monthly simulation.
Eqm Effects and Industry Returns Predictability

- In equilibrium, the cross-sectional distribution of firms over state-space affects the LOM for prices, thus firms’ value;
- Firm-level risk irrelevant, but distn across firms important;
- Goyal & Santa-Clara ("Idiosyncratic Risk Matters!", 2003):
  - Model predicts x-sectional return vol forecasts market return;
  - Consistent with empirical evidence in GS.

\[
R_{t+1}^{\text{w}} = a + b \times (x_t - \bar{x}) + c \times \sigma_t^2 + \epsilon_{t+1}
\]

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Equilibrium model of asset pricing linking behavior of risk and returns to fundamentals of the real economy;

Heterogeneity arises from idiosyncratic productivity shocks;

- Value corresponds to low productivity;

Excess capacity in downturns hampers dividend smoothing;

Countercyclical market risk premium exacerbates effect;

- 3 & 4 both make sense;

Matches important moments including Value Premium;

Rich set of testable implications.
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Understanding Firm-Level Risk

This is a model of lucky firms versus unlucky firms:

- All firms are ex-ante identical;
- Some firms are Value, others Growth depending on luck;
- Given Stationarity, luck will eventually wear off;
- Value will eventually become growth and vice versa;
- Value has unused capital because used to be productive;
- I find this rather unsatisfactory... In the data, do firms cycle between Growth/Value status? Or is there something non-stationary going on? A firm life-cycle?
Value in the Data?

- Do Value stocks actually correspond to low productivity firms in the data?
  - If this is not the case then model does not make any sense;
- Bazdresch et al. (WP, 2009) side-step issue:
  - We do not observe firm-level productivity;
  - We do observe investment rates;
  - Sort firms on the basis of investment rates.
Estimating Firm-Level Productivity Risk

- Zhang has common, exogenous firm-level productivity spec.;
- Bachman & Bayer (WP, 2009) actually estimate firm-level Solow residuals using German data;
- Phillipon & Franco (REStat, 2007) does something similar;
Zhang has common, exogenous firm-level productivity spec.;
Bachman & Bayer (WP, 2009) actually estimate firm-level Solow residuals using German data;
Phillipon & Franco (REStat, 2007) does something similar;

BB find that firm-level productivity risk is time-varying and correlated with aggregate shocks. This model?
- Constant variance of prod. shocks assumed;
- Agg. prod. innovations affect all firms the same way;
- How does x-sectional distn ($\mu_t$) vary over business cycle ($x_t$)?

Estimate production function for each firm (or different BM deciles) and see if Value and firm-level risk really do line up?
Other Forms of Firm-Level Heterogeneity?

1. Financing frictions (Gomes, Yaron & Zhang, RFS, 2006):
   - Time-varying costs of issuing debt and equity.

2. What about distress risk in neoclassical framework?
   - Allow firms to endogenously default in this model?
   - Would need bond issuance by firm.
   - Very weak empirical evidence (Campbell et al., JF, 2008);

3. Other characterizations?
   - Generating ideas (Kogan & Papanikolaou, WP, 2009);
   - Durability of product (Gomes, Kogan & Yogo, JPE, 2009).
Interpreting Figure 4: A Peso Problem?

- Large expected Value Premium consistent with Value Spread of 16, a 2.5 stdev event in model.

**Figure:** Value Spread and Premium over the business cycle.
And in the Data?

- Value Spread ≈ 5 in data, never equals 16 in-sample;
- Should I interpret this as a Peso problem?

**Figure:** Log BM series for Value/Growth Firms (Cohen et al., JF, 2003).
More Data Qs

- What does the distribution of the Value Spread look like in the data?
- How has this distribution changed over time and with the business cycle?
- This model has a counter-cyclical Value Spread;
- What about other equilibrium models?
Figure 4 Again: Where’s Model 3?

- Where is the model with *symmetric adjustment cost* and counter-cyclical market price of risk??
- Suspect, given the results in Bazdresch et al. (WP, 2009);
- Why not impose symmetric adjustment cost and structural estimate remaining parameters?
A Bit More of a Corporate Flavor...

- Another awfully titled paper “Anomalies” (Li et al., RFS, 2008) documents empirical evidence:
  1. Dividends highly persistent;
  2. Payout policy between equity and bond holders:
     - New equity share (negatively) predicts future returns (Baker & Wurgler, JF, 2000);
     - New debt issuance has smaller negative impact;
     - “Positive stock-price drift” follows payout to shareholders but not payout to bondholders.

- Extend current model to include:
  1. Payout policy and trade-off between dividends and share repurchases;
  2. Incorporate a defaultable bond and consider debt/equity policy.