Diversification in Lottery-Like Features and Portfolio Pricing Discounts

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Efficient-Market Hypothesis: The price of a security is equal to its fundamental value.

However...
- Closed-end fund discounts
- Negative mergers and acquisitions returns
- Conglomerate discounts

Puzzling Fact: A portfolio may be valued less than the sum of its underlying components.
Barberis and Huang (2008)

Key assumptions:
- Cumulative prospect theory (Tversky and Kahneman, 1992)
- Biased probability weighting function

Implication:
- Investors value a small probability of extremely positive payoffs
- Lottery-like (positively skewed) stocks can become overpriced relative to the prediction from the traditional expected utility model
DIVERSIFICATION IN LOTTERY-LIKE FEATURES

- A portfolio with lottery-like holdings:
  - Lottery-like holdings do not simultaneously hit jackpots
  - The portfolio tend to have a smooth return distribution
- Based on Barberis and Huang's model:
  - Lottery-like holdings are traded at a price premium
  - The portfolio is not traded at a price premium
- The portfolio is traded at a discount!
A SIMPLIFIED EXAMPLE

- Lottery-like stocks A and B have the following payoff per share:

\[ R_i = \begin{cases} 
100 & \text{prob } = 1\%, \\
0 & \text{prob } = 99\%. 
\end{cases} \quad (1) \]

- A portfolio: \( 0.5 \times A + 0.5 \times B \)

- Two extreme cases:
  - A and B **always** hit ”jackpot” together
  - A and B **never** hit ”jackpot” together

- Compare \( PRC_p \) and \( 0.5 \times PRC_a + 0.5 \times PRC_b \)
Empirical Design

- "Portfolio": Closed-end fund, acquirer+target, conglomerate
- Lottery-like feature: Max (Bali, Cakici, and Whitelaw, 2011)
  - Clear lottery-like feature: "jackpot"
  - Captures the low probability and extreme return states that drive the results in the model of Barberis and Huang (2008)
- Hitting "jackpots" together CoMax
  - How often two stocks hit Max at the same time
  - Case (1): CoMax=1
  - Case (2): CoMax=0
Main Findings

- **Finding 1**: Portfolios indeed have lower lottery-like features compared to their holdings.
- **Finding 2**: The difference between the lottery-likeness of a portfolio and that of its holdings predicts the portfolio pricing discount.
- **Finding 3**: High tendency of hitting "jackpots" together (high CoMax) mitigates the portfolio pricing discount.
CONTRIBUTION

- Interaction Effect: $\text{Max} \times \text{CoMax}$
- Support Barberis and Huang (2008) from a new perspective
  - Separately evaluate the value of the aggregate portfolio and the values of the underlying components
  - Isolate effects from fundamentals
- Provide a unifying framework for a set of seemingly unrelated asset pricing phenomena
  - Closed-end fund discounts
  - M&A announcement returns
  - Diversification discounts
Related Literature

- Empirical studies testing Barberis and Huang (2008)
- Barberis and Huang (2008)’s framework can provide a unifying way to understand
  - The long-term underperformance of an initial public offering stock (Green and Hwang, 2012); the low average return of distressed stocks (Campbell, Hilscher, and Szilagyi, 2008), of out-of-the-money options (Boyer and Vorkink, 2014), of stocks traded over the counter (Eraker and Ready, 2015); and the lack of diversification in household portfolios (Mitton and Vorkink, 2007; Goetzmann and Kumar, 2008);
The Puzzle

- Closed-end funds...
  - A type of mutual fund
  - Publicly traded
  - Typically invest in other publicly traded securities
  - Different from a open-end fund:
    - Fixed number of shares
    - Investors must sell their shares to other investors rather than redeem them with the fund itself for the net asset value (NAV) per share.

- The closed-end fund puzzle:
  - Closed-end fund shares typically sell at prices lower than the per share market value of assets the fund holds
  - Time-varying discount
CEF: An Example

Enhanced Equity Dividend Trust

- NAV as of 27-Jun-2017: $9.45
- 1 Day NAV Change as of 27-Jun-2017: -$0.01 (-0.11%)
- Morningstar Rating: ★★★★
- Market Price as of 27-Jun-2017: $8.79
- 1 Day Price Change as of 27-Jun-2017: 0.01 (0.11%)
- Distribution Rate as of 27-Jun-2017: 6.38%
- Premium Discount as of 27-Jun-2017: -6.98%

Holdings

- Top 10 Holdings as of 31-May-2017:
  - JPMORGAN CHASE & CO: 3.90%
  - CITIGROUP INC: 3.59%
  - BANK OF AMERICA CORP: 3.56%
  - PFIZER INC: 3.44%
  - DOW CHEMICAL COMPANY (THE): 2.87%
  - ORACLE CORPORATION: 2.86%
  - WELLS FARGO & COMPANY: 2.52%
  - GENERAL ELECTRIC CO: 2.32%
  - ANTHEM INC: 2.29%
  - MERCK & CO INC: 2.24%
SETTING 1: CLOSED-END FUNDS

- Closed-end fund sample
  - Available monthly CEF prices from CRSP, available net asset value (NAV) from COMPUSTAT
  - CEF holding data available from Morningstar
  - US equity closed-end funds, with share code = 14 or 44
  - Exclude data within the first six months after IPO and one month preceding the announcement of liquidation or open-ending (Chan, Jain, and Xia, 2008)

- Closed-end fund premium (discount)

\[
Premium_{i,t} = \left( \frac{Price_{i,t} - NAV_{i,t}}{NAV_{i,t}} \right)
\]

- Only consider top-ten holdings
  - Readily observable on the fund’s website, factsheets, finance media, etc.
  - The entire positions is not likely to be available to investors
CAPTURING CoMax

- **Lottery-likeness:** Average top 5 daily returns within a month (Max5)
- **Fund level Test**
  - **For holdings:** Weighed average Max5 for top10 stocks (Holding_Max5)
  - **For CEFs:** CEF_Max5
  - **Ex_Max5 = CEF_Max5 − Holding_Max5**
- **Holding level Test**
  - Top 10 holdings ⇒ 45 (=10×9/2) stock pairs
  - **Pair_Max5:** Weighted average Max5 for both stocks
  - **Co_Max5:** % of the Max5 that happen at the same day(s)

<table>
<thead>
<tr>
<th></th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
<th>Day 8</th>
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<tbody>
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<td>Stock A</td>
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<tr>
<td>Stock B</td>
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<td>⬤</td>
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</tbody>
</table>

**CoMax(A,B) = 0.4**

- **Co-Maxing out Effect:** Pair_Max5 × Co_Max5
- Aggregate to fund level based on the sum of holding weights
Capturing Lottery-like Features

- Holdings have stronger lottery-like features than the CEF itself
  - Holding_Max5 > CEF_Max5

Table 2

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std Dev</th>
<th>25th Pctl</th>
<th>50th Pctl</th>
<th>75th Pctl</th>
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<tr>
<td>Distribution of Holdng's Max5</td>
<td>0.022</td>
<td>0.016</td>
<td>0.013</td>
<td>0.018</td>
<td>0.030</td>
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<tr>
<td>Distribution of CEF's Max5</td>
<td>0.014</td>
<td>0.010</td>
<td>0.008</td>
<td>0.011</td>
<td>0.015</td>
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<tr>
<td>CEF’s Max5 – Holding’s Max5</td>
<td>-0.009</td>
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<td>(-34.44)</td>
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## Panel Regression

### Table 3

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<th>VARIABLES</th>
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<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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<tbody>
<tr>
<td>Ex_Max5</td>
<td>4.794***</td>
<td>1.068**</td>
<td>0.990***</td>
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<td></td>
<td>(1.416)</td>
<td>(0.486)</td>
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<tr>
<td>Holding_Max5</td>
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<td>-7.906***</td>
<td>-2.065***</td>
<td>-1.211***</td>
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<td>(2.537)</td>
<td>(2.483)</td>
<td>(0.944)</td>
<td>(0.409)</td>
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<tr>
<td>CEF_Max5</td>
<td>6.678***</td>
<td>6.256***</td>
<td>1.357*</td>
<td>1.647**</td>
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<td>(1.759)</td>
<td>(1.895)</td>
<td>(0.777)</td>
<td>(0.662)</td>
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<tr>
<td>Pair_Max5×CoMax5</td>
<td>1.170**</td>
<td>1.003**</td>
<td>0.520***</td>
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<td>(0.468)</td>
<td>(0.402)</td>
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<td>CoMax5</td>
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<td>-0.802**</td>
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<td>(0.933)</td>
<td>(0.463)</td>
<td>(0.381)</td>
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Controls: No, Yes

Fixed Effect: Time, Fund, Time

Observations: 2,330

R-squared: 0.257, 0.695, 0.855, 0.257, 0.262, 0.699, 0.857
Mergers and Acquisition

$$CombinedCAR[-1, 1] = w_A \times CAR_A[-1, 1] + w_T \times CAR_T[-1, 1]$$ (3)

High CoMax between the acquirer and the target improves market reaction towards a lottery-like deal.

Conglomerates

$$Premium_{i,t} = (MEBE_{i,t} - Imputed_{MEBE_{i,t}}) / Imputed_{MEBE_{i,t}}$$ (4)

High CoMax from lottery-like segments reduces diversification discount.
CONCLUSION

- Provide a novel and unifying framework to understand three seemingly irrelevant asset pricing phenomena
  - The diversification in lottery-like features contributes to the portfolio pricing discount
  - Closed-end fund discount, M&A combined announcement return, and Diversification discount
- Support Barberis and Huang (2008) from an alternative prospective
  - Separately evaluate the value of the aggregate portfolio and the values of the underlying components
  - Isolate the effects of firm fundamentals