Stock Delistings and Average Cross-Sectional Idiosyncratic Stock Volatility

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Annual Meeting of the Midwest Economics Association
Minneapolis, MN
March 28, 2015
Log-return on stock $i$ is represented as:

$$\ln(R^i) = \text{drift} + \underbrace{\text{Systematic Risk}}_{\beta_i \times \sigma_m \times W_t} + \underbrace{\text{Idiosyncratic Risk}}_{\sigma_i \times Z^i_t}$$

- $W_t$: source of systematic risk (common across stocks)
- $Z^i_t$: source of idiosyncratic risk (specific to stock $i$)

We study average of $\sigma_i$’s over all stocks and call it **average idiosyncratic volatility (AIVOL)**
Figure: AIVOL and Market Volatility, 1962–2011
Reasons to Study AIVOL

Average idiosyncratic volatility (AIVOL):

- Influences effectiveness of portfolio diversification and performance of portfolio managers (Campbell et al., 2001; Bennett & Sias, 2006)

- Affects efficiency of capital allocation via stock market (Durnev et al., 2003; Hamao et al., 2007)

- Predicts future stock market returns (Goyal & Santa-Clara, 2003; Guo & Savickas, 2006)

- Reflects intensity of "creative destruction" (Chun et al., 2008)

- Is a priced risk factor (Ang et al., 2006; Fu, 2009; Guo & Savickas, 2010)
Literature Review

- **Time-series behavior of AIVOL:**
  - Campbell et al. (2001): positive trend between 1962 and 1997
  - Bennett & Sias (2006), Brandt et al. (2010): reversal in trend around 2000
  - Bekaert et al. (2012): no evidence of positive trend

- **Factors influencing AIVOL:**
  - Xu & Malkiel (2003): institutional stock ownership
  - Fama & French (2004): number of new stock listings
  - Bennett & Sias (2006): stock market composition
  - Wei & Zhang (2006): level and volatility of return on equity
  - Brown & Kapadia (2007): riskiness of publicly traded subsample of the economy
  - Cao et al. (2008): level and variance of corporate growth options
  - Irvine & Pontiff (2009): idiosyncratic volatility of cash flows, intensity of competition
  - Bekaert et al. (2012): industry turnover, growth options, R&D spending, market variance, industrial production shocks, bond yield spread
Main Findings

- AIVOL is positively associated with **contemporaneous** number of:
  - Newly listed stocks
  - Delisted stocks

- AIVOL is positively associated with **lagged** number of:
  - Newly listed stocks
  - Delisted stocks

- The results for stock **delistings** are novel, strong, and robust:
  - We account for autocorrelation of AIVOL
  - We control for aggregate financial/economic variables
  - We perform several specification tests
Important Attributes of AIVOL Estimation Approach

- $AIVOL_{t, t+\tau}$ is average cross-sectional idiosyncratic stock volatility over time period $[t, t + \tau]$

- $AIVOL_{t, t+\tau}$ is unobservable and must be estimated

- To estimate $AIVOL_{t, t+\tau}$, stock prices need to be observed only at two time moments: $t$ and $t + \tau$

- We use stock prices adjusted for stock splits, reverse splits, etc.

- When estimating $AIVOL_{t, t+\tau}$, we do not consider stocks that were:
  - Newly listed between $t$ and $t + \tau$
  - Delisted between $t$ and $t + \tau$
Our financial model features three types of assets:
- Many risky assets called **stocks**
- A diversified portfolio of stocks called **market index**
- A riskless asset (e.g., T-Bill) with risk-free interest rate $r > 0$

Market index’s price, $M_t$, follows a geometric Brownian motion:

$$\frac{dM_t}{M_t} = \mu_m dt + \sigma_m dW_t$$

- **Drift** $\mu_m = r + \delta \sigma_m$
- $\delta$: market risk premium
- $\sigma_m > 0$: market volatility
- $W_t$: standard Brownian motion, source of **systematic risk**
Price of stock $i$, $S^i_t$, follows a geometric Brownian motion:

$$\frac{dS^i_t}{S^i_t} = \mu_i dt + \beta_i \sigma_m dW_t + \sigma_i dZ^i_t$$

- $W_t$: standard Brownian motion, source of systematic risk
- $Z^i_t$: standard Brownian motion, source of idiosyncratic risk
- $W_t$ and $Z^i_t$ are mutually independent
- Drift $\mu_i = r + \delta \beta_i \sigma_m + \gamma \sigma_i$
- $\gamma$: idiosyncratic volatility premium
- $\beta_i$: beta of stock $i$, $\beta_i \sim i.i.d. UNI[\kappa_\beta, \kappa_\beta + \lambda_\beta]$
- $\sigma_i$: idiosyncratic volatility of stock $i$, $\sigma_i \sim i.i.d. UNI[0, \lambda_\sigma]$

**AIVOL** = $\frac{\lambda_\sigma}{2}$, where $\lambda_\sigma$ is estimated using GMM-based approach of Khovansky & Zhylyevskyy (2013)
Data

- Source: Center for Research in Security Prices (CRSP)
- Time frame: 1962–2011
- We construct 12 time series of annual AIVOL estimates. Each series has 49 observations and is based on non-overlapping periods falling on a particular month:
  - January series, 49 periods:
    - first Wednesday of January 1962–first Wednesday of January 1963
    - first Wednesday of January 1963–first Wednesday of January 1964
    ... 
    - first Wednesday of January 2010–first Wednesday of January 2011
  ... 
  - December series, 49 periods:
    - first Wednesday of December 1962–first Wednesday of December 1963
    ... 
    - first Wednesday of December 2010–first Wednesday of December 2011
- For same periods, we construct time series of numbers of new stock listings and delistings using CRSP stock header files
Before running regressions, we test all time series for unit root and find them to be stationary

Contemporaneous regressions have following form:

$$\ln(AIVOL_t) = a_0 + a_1 \cdot \ln(n_t) + a_2 \cdot \ln(AIVOL_{t-1}) + a_3 \cdot \text{nasdaq}_t + \epsilon_t$$

$n_t$: number of new listings OR number of delistings during period $t$

<table>
<thead>
<tr>
<th>Log of Stock Numbers</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Newly Listed</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coeff.($a_1$)</td>
<td>(Std.Err.)</td>
<td></td>
</tr>
<tr>
<td>January series</td>
<td>0.1903**</td>
<td>(0.0756)</td>
</tr>
<tr>
<td>February series</td>
<td>0.1812**</td>
<td>(0.0682)</td>
</tr>
<tr>
<td>March series</td>
<td>0.2510**</td>
<td>(0.0998)</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>December series</td>
<td>0.2032**</td>
<td>(0.0861)</td>
</tr>
<tr>
<td><strong>Delisted</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coeff.($a_1$)</td>
<td>(Std.Err.)</td>
<td></td>
</tr>
<tr>
<td>January series</td>
<td>0.4350***</td>
<td>(0.0848)</td>
</tr>
<tr>
<td>February series</td>
<td>0.3304***</td>
<td>(0.0795)</td>
</tr>
<tr>
<td>March series</td>
<td>0.3591***</td>
<td>(0.1036)</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>December series</td>
<td>0.3972***</td>
<td>(0.0935)</td>
</tr>
</tbody>
</table>
Lagged Regression Results

- We regress AIVOL on first lag of number of new listings or delistings. Regressions have following form:

\[ \ln(\text{AIVOL}_t) = b_0 + b_1 \cdot \ln(n_{t-1}) + b_2 \cdot \ln(\text{AIVOL}_{t-1}) + b_3 \cdot \text{nasdaq}_{t-1} + \epsilon_t \]

- \(n_{t-1}\): number of new listings OR number of delistings during \(t - 1\)

<table>
<thead>
<tr>
<th>First Lag of Log of Stock Numbers</th>
<th>Newly Listed</th>
<th>Delisted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff. ((b_1))</td>
<td>(Std.Err.)</td>
</tr>
<tr>
<td>January series</td>
<td>0.1418*</td>
<td>(0.0734)</td>
</tr>
<tr>
<td>February series</td>
<td>0.1645**</td>
<td>(0.0663)</td>
</tr>
<tr>
<td>March series</td>
<td>0.2671***</td>
<td>(0.0963)</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>December series</td>
<td>0.2561***</td>
<td>(0.0850)</td>
</tr>
</tbody>
</table>

- Regressions are also run for delistings differentiated by delisting reason: merger, stock-issue exchange, pre-announced liquidation, drop
Selected Aggregate Variables That May Affect AIVOL

- **MABA**: average ratio of market value of assets to book value of assets among publicly traded firms
- **RD**: average ratio of research and development expenditures to sales
- **Small**: percentage of total market capitalization attributable to smallest (by market value) quartile of firms
- **Std(SP500)**: standard deviation of daily returns on S&P 500 index
- **VIX**: VIX index (measures implied volatility of S&P 500 index options)
Contemporaneous Regression with New Listings and AV Controls

Estimated regressions:

$$\ln(AIVOL_t) = a_0 + a_1 \cdot \ln(n_t) + a_2 \cdot av_t + a_3 \cdot \ln(AIVOL_{t-1}) + a_4 \cdot nasdaq_t + \epsilon_t$$

$n_t$: number of newly listed stocks during period $t$

$av_t$: aggregate variable for period $t$

<table>
<thead>
<tr>
<th>Aggregate Variable</th>
<th>Coeff.($a_2$) (Std.Err.)</th>
<th>Log # of New Listings</th>
<th>Coeff.($a_1$) (Std.Err.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(MABA)</td>
<td>-0.0470 (0.1331)</td>
<td></td>
<td>0.1951** (0.0868)</td>
</tr>
<tr>
<td>ln(RD)</td>
<td>0.0871** (0.0331)</td>
<td></td>
<td>0.1397** (0.0655)</td>
</tr>
<tr>
<td>Small</td>
<td>-0.6094** (0.2803)</td>
<td></td>
<td>0.2089** (0.0784)</td>
</tr>
<tr>
<td>Std(SP500)</td>
<td>0.4216*** (0.1508)</td>
<td></td>
<td>0.2733*** (0.0926)</td>
</tr>
<tr>
<td>VIX</td>
<td>0.0296** (0.0121)</td>
<td></td>
<td>0.2511*** (0.0897)</td>
</tr>
</tbody>
</table>

Note: We use time series for annual periods starting in January

• Each regression fails at least one specification test: RESET, alternative Durbin, or Fan & Li (1999) test
Contemporaneous Regression with Delistings and AV Controls

Estimated regressions:

\[
\ln(AIVOL_t) = a_0 + a_1 \cdot \ln(n_t) + a_2 \cdot av_t + a_3 \cdot \ln(AIVOL_{t-1}) + a_4 \cdot nasdaq_t + \epsilon_t
\]

- \( n_t \): number of delisted stocks during period \( t \)
- \( av_t \): aggregate variable for period \( t \)

<table>
<thead>
<tr>
<th>Aggregate Variable</th>
<th>Coeff. ((a_2)) (Std.Err.)</th>
<th>Log # of Delistings</th>
<th>Coeff. ((a_1)) (Std.Err.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(MABA)</td>
<td>-0.0777 (0.1299)</td>
<td>0.4425*** (0.1445)</td>
<td></td>
</tr>
<tr>
<td>ln(RD)</td>
<td>0.0476** (0.0233)</td>
<td>0.3563*** (0.1234)</td>
<td></td>
</tr>
<tr>
<td>Small</td>
<td>0.0633 (0.2417)</td>
<td>0.4474** (0.1695)</td>
<td></td>
</tr>
<tr>
<td>Std(SP500)</td>
<td>0.1840*** (0.0600)</td>
<td>0.4015*** (0.1277)</td>
<td></td>
</tr>
<tr>
<td>VIX</td>
<td>0.0142* (0.0075)</td>
<td>0.4137*** (0.1250)</td>
<td></td>
</tr>
</tbody>
</table>

*Note: We use time series for annual periods starting in January*

- Log # of delistings remains statistically significant in all cases
- Regressions for ln(MABA) and Small fail alternative Durbin test at 5% level
Estimated regressions:

\[ \ln(AIVOL_t) = b_0 + b_1 \cdot \ln(n_{t-1}) + b_2 \cdot av_{t-1} + b_3 \cdot \ln(AIVOL_{t-1}) + a_4 \cdot nasdaq_{t-1} + \varepsilon_t \]

- \( n_{t-1} \): number of newly listed stocks during period \( t - 1 \)
- \( av_{t-1} \): aggregate variable for period \( t - 1 \)

<table>
<thead>
<tr>
<th>Lagged:</th>
<th>Aggregate Variable</th>
<th>Log # of New Listings</th>
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<tr>
<td></td>
<td>Coeff.((b_2))</td>
<td>(Std.Err.)</td>
</tr>
<tr>
<td>ln(MABA)</td>
<td>0.2643</td>
<td>(0.1823)</td>
</tr>
<tr>
<td>ln(RD)</td>
<td>0.0871**</td>
<td>(0.0343)</td>
</tr>
<tr>
<td>Small</td>
<td>-0.4768**</td>
<td>(0.2002)</td>
</tr>
<tr>
<td>Std(SP500)</td>
<td>0.0956</td>
<td>(0.2161)</td>
</tr>
<tr>
<td>VIX</td>
<td>0.0073</td>
<td>(0.0153)</td>
</tr>
</tbody>
</table>

*Note:* We use time series for annual periods starting in January

- Lagged log # of new listings loses statistical significance when a lagged aggregate variable is added to a regression
- Each regression fails at least two specification tests out of three performed
Lagged Regression with Delistings and AV Controls

Estimated regressions:

\[ \ln(AIVOL_t) = b_0 + b_1 \cdot \ln(n_{t-1}) + b_2 \cdot av_{t-1} + b_3 \cdot \ln(AIVOL_{t-1}) + b_4 \cdot nasdaq_{t-1} + \varepsilon_t \]

- \( n_{t-1} \): number of delisted stocks during period \( t - 1 \)
- \( av_{t-1} \): aggregate variable for period \( t - 1 \)

<table>
<thead>
<tr>
<th>Lagged:</th>
<th>Aggregate Variable</th>
<th>Log # of Delistings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff. ((b_2))</td>
<td>(Std.Err.)</td>
</tr>
<tr>
<td>ln(MABA)</td>
<td>0.0791</td>
<td>(0.1231)</td>
</tr>
<tr>
<td>ln(RD)</td>
<td>0.0343</td>
<td>(0.0226)</td>
</tr>
<tr>
<td>Small</td>
<td>0.1775</td>
<td>(0.2597)</td>
</tr>
<tr>
<td>Std(SP500)</td>
<td>-0.0054</td>
<td>(0.1142)</td>
</tr>
<tr>
<td>VIX</td>
<td>-0.0018</td>
<td>(0.0096)</td>
</tr>
</tbody>
</table>

*Note: We use time series for annual periods starting in January*

- Lagged log # of delistings remains statistically significant in all cases
- Each regression passes all specification tests performed
Conclusion

- Number of delistings is positively associated with AIVOL of surviving stocks, both contemporaneously and with a lag.

- Results for delistings are robust to accounting for other variables that can influence AIVOL, including aggregate variables.

- Possible mechanism underlying our results:
  - Delistings can indicate changes in economic environment, including changes in the number of competitors. Under Cournot competition, such changes can contribute to variability of firm profits and stock valuations.
  - Delistings can increase investor uncertainty about future firm profitability. The model of Pástor & Veronesi (2003) would then predict a rise in individual idiosyncratic volatilities and an increase in AIVOL as a result.

- Number of delistings is an important variable to keep track of for financial practitioners and investors.
Thank you!
Questions?
Appendix: Number of New Stock Listings, 1962–2011

Figure: # of new listings for annual periods starting in December
Appendix: Number of Stock Delistings, 1962–2011

**Figure:** # of delistings for annual periods starting in December
Appendix: Selected Aggregate Variables and AIVOL

These regressions focus on aggregate variables and do not include log numbers of new listings and delistings as regressors.

- **Contemporaneous regressions:**
  \[ \ln(AIVOL_t) = a_0 + a_1 \cdot av_t + a_2 \cdot \ln(AIVOL_{t-1}) + a_3 \cdot nasdaq_t + \epsilon_t \]

- **Lagged regressions:**
  \[ \ln(AIVOL_t) = b_0 + b_1 \cdot av_{t-1} + b_2 \cdot \ln(AIVOL_{t-1}) + b_3 \cdot nasdaq_{t-1} + \epsilon_t \]

<table>
<thead>
<tr>
<th></th>
<th>Contemporaneous</th>
<th>Lagged</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cof.(a&lt;sub&gt;1&lt;/sub&gt;)</td>
<td>(Std.Err.)</td>
</tr>
<tr>
<td>ln(MABA)</td>
<td>0.0945</td>
<td>(0.1336)</td>
</tr>
<tr>
<td>ln(RD)</td>
<td>0.0997***</td>
<td>(0.0360)</td>
</tr>
<tr>
<td>Small</td>
<td>-0.5328**</td>
<td>(0.2471)</td>
</tr>
<tr>
<td>Std(SP500)</td>
<td>0.2877***</td>
<td>(0.1031)</td>
</tr>
<tr>
<td>VIX</td>
<td>0.0205*</td>
<td>(0.0107)</td>
</tr>
</tbody>
</table>

*Note:* We use time series for annual periods starting in January.