# A Data Appendix

**$\hat{\alpha}_{CAPM}$ (risk-adjusted return)** - in Table 4, refers to the risk-adjusted return following Brennan et al. (1998): $\overline{\alpha}_t^{CAPM} = (Ret_t - RF_t) - \beta_{t-1;\ t-36} \cdot (MKT_t - RF_t)$. $\beta_{t-1;\ t-36}$ is the firm-level beta estimated in each month $t$ by regressing the firm's monthly excess returns on the market excess returns in months $t$-1 to $t$-36. Other alphas are computed in a similar fashion using the respective factor.

**$\beta^{Q}_{t-3,\ t-1}$ (portfolio beta)** - in Table 9, past market beta is used as a conditioning variable for each credit rating quintile portfolio. The past beta is from fitting the CAPM to daily returns to the quintile portfolios in the past three months.

**C-GARCH (Component GARCH)** - following Adrian and Rosenberg (2008), I estimate

$$MKT_{t+1} - RF_{t+1} = \theta_1 + \theta_2 \cdot s_t + \theta_3 \cdot l_t + \sqrt{\nu_t} \cdot \epsilon_{t+1} \tag{A-1a}$$

$$\ln(\sqrt{\nu_t}) = s_t + l_t \tag{A-1b}$$

$$s_t = \theta_4 \cdot s_{t-1} + \theta_5 \cdot \epsilon_t + \theta_6 \cdot (|\epsilon_t| - \sqrt{2/\pi}) \tag{A-1c}$$

$$l_t = \theta_7 + \theta_8 \cdot l_{t-1} + \theta_9 \cdot \epsilon_t + \theta_{10} \cdot (|\epsilon_t| - \sqrt{2/\pi}) \tag{A-1d}$$

where $s_t$ is the short-run volatility component and $l_t$ is the long-run volatility component.

**Cred (credit rating)** - Standard and Poor's rating (splticrm variable in the Compustat adsprate file). The credit rating is coded as 1=AAA, 2=AA+, 3=AA, ... , 21=C, 22=D.

**CVEarn/CVCFO (earnings/cash flows volatility)** - coefficient of variation (standard deviation over the average) of quarterly earnings/cash flows measured in the past 12 quarters. Earnings are EPS (epspiq over prccq lagged by one quarter). Cash flows are operating income before depreciation (oibdpq) less the change in current assets (actq) plus the change in current liabilities (lctq) less the change in short-term debt (dlcq) plus the change in cash (cheq). The cash flows are scaled by average total assets (atq) in the past two years. All variables are from the Compustat quarterly file.

**DEF (default spread)** - defined as the yield spread between Moodys Baa and Aaa corporate bonds. The yields are obtained from the Federal Reserve Economic Data (FRED) database at https://fred.stlouisfed.org/.

**Disp (analyst forecast dispersion)** - the standard deviation of all outstanding earnings-per-share forecasts for the current fiscal year scaled by the absolute average value of the outstanding earnings forecasts (zero-mean forecasts and forecasts by only one analyst excluded). Earnings forecasts are from the IBES Summary file.

**DIV (dividend yield)** - dividend yield of the CRSP market index, defined as the cumulative difference between its cum-dividend and ex-dividend return in the past 12 months.

**EDF (expected default frequency)** - "naïve" version of Merton (1974) EDF used in Bharath and Shumway (2008)

$$EDF = \Phi(-\frac{\ln((E+D)/D) + (Ret_{t-1} - 0.5 \cdot \sigma_V^2) \cdot T}{\sigma_V \cdot \sqrt{T}}, \tag{A-2}$$

where $E$ is firm equity (Compustat items prcc times csho), $D$ is long-term debt (dltt) plus short-term debt (dlc), $Ret_{t-1}$ is cumulative monthly return in the past calendar year (monthly return is from CRSP monthly file), $T$ is set to 1 (year), and $\sigma_V$ (volatility of total firm value) is

$$\sigma_V = \frac{E}{E+D} \cdot \sigma_E + \frac{D}{E+D} \cdot (0.05 + 0.25\sigma_E), \tag{A-3}$$

where $\sigma_E$ (volatility of equity value) is standard deviation of daily stock returns in the past calendar year (from CRSP daily files) multiplied by $\sqrt{250}$ to make it annual (at least 100 valid observations are required, approximately 250 trading days per year are assumed).

**Error (analyst forecast error)** - the absolute value of the difference between the one-year-ahead consensus forecast and actual earnings divided by actual earnings. All variables are from the IBES Summary file.

**FFO (funds from operations)** - funds from operations, which equal pre-tax income) (Compustat item pi) plus depreciation (dp) divided by total assets (at).

**FVIX (aggregate volatility risk factor** - factor-mimicking portfolio that tracks the daily changes in the VIX index. Following Ang, Hodrick, Xing, and Zhang (2006), I

regress the daily changes in VIX on the daily excess returns to the five portfolios sorted on past sensitivity to VIX changes:

$$\Delta VIX_t = \gamma_0 + \gamma_1 \cdot (VIX1_t - RF_t) + \gamma_2 \cdot (VIX2_t - RF_t) + \\ + \gamma_3 \cdot (VIX3_t - RF_t) + \gamma_4 \cdot (VIX4_t - RF_t) + \gamma_5 \cdot (VIX5_t - RF_t), \quad \text{(A-4)}$$

where $VIX1_t, \ldots, VIX5_t$ are the VIX sensitivity quintiles described above, with $VIX1_t$ being the quintile with the most negative sensitivity.

The fitted part of the regression above less the constant is my aggregate volatility risk factor (FVIX factor):

$$FVIX_t = \hat{\gamma_1} \cdot (VIX1_t - RF_t) + \hat{\gamma_2} \cdot (VIX2_t - RF_t) + \hat{\gamma_3} \cdot (VIX3_t - RF_t) + \\ + \hat{\gamma_4} \cdot (VIX4_t - RF_t) + \hat{\gamma_5} \cdot (VIX5_t - RF_t). \quad \text{(A-5)}$$

The returns are then cumulated to the monthly level to get the monthly return to FVIX.

The return sensitivity to VIX changes ($\beta_{\Delta VIX}$) I use to form the base assets is measured separately for each firm-month by regressing daily stock excess returns in the past month on daily market excess returns and the VIX index change using daily data (at least 15 non-missing returns are required):

$$Ret_t - RF_t = \alpha + \beta_{MKT} \cdot (MKT_t - RF_t) + \beta_{\Delta VIX} \cdot \Delta VIX_t. \quad \text{(A-6)}$$

**IVol (idiosyncratic volatility)** - the standard deviation of residuals from the Fama-French (1993) model, fitted to the daily data for each firm-month (at least 15 valid observations are required).

**Max (maximum daily return)** - maximum daily return (from CRSP) in the previous month.

**MB (market-to-book)** - equity value (share price at the end of the fiscal year, prcc, times number of shares outstanding, csho) divided by book equity (ceq) plus deferred taxes (txdb), all items from Compustat annual files.

**Mom (cumulative past return)** - cumulative return to the stock between month t-2 and t-12, returns are from CRSP monthly returns file.

**Lev (leverage)** - long-term debt (dltt) plus short-term debt (dlc) divided by equity value (prcc times csho), all items from Compustat annual file.

**LR** - factor-mimicking portfolio for innovations to long-run volatility $l_t$ from C-GARCH above. The base assets are quintiles based on stocks historical sensitivity to innovations to long-run volatility. Historical sensitivity is from stock-by-stock regressions of stock excess returns on the three Fama-French factors and the innovation to $l_t$. The factor-mimicking portfolio is the fitted value from the regression of innovation to $l_t$ on the base assets returns minus the constant from the same regression.

**OpLev (operating leverage)** - ratio of cost of goods sold (cogs item from Compustat annual) plus sales, general, and administrative expenses, (SG&A, xsga item) to book value of equity (ceq) plus deferred taxes (txdb).

**O-score** - the probability of bankruptcy measure from Ohlson (1980), computed as

$$O = -1.32 - 0.407 \cdot \ln TA + 6.03 \cdot \frac{TL}{TA} - 1.43 \cdot \frac{WC}{TA} + 0.076 \cdot \frac{CL}{CA} - 1.72 \cdot I(TL > TA)$$
$$-2.37 \cdot \frac{NI}{TA} - 1.83 \cdot \frac{FFO}{TA} + 0.285 \cdot I(NI < 0 \ \& \ NI_{-1} < 0) - 0.521 \cdot \frac{NI - NI_{-1}}{|NI| + |NI_{-1}|}, \tag{A-7}$$

where $TA$ is the book value of total assets (Compustat item at), $TL$ is the book value of total liabilities (lt), $WC$ is working capital (wcap), $CL$ are current liabilities (lct), $CA$ are current assets (act), $NI$ is net income (ni), $NI_{-1}$ is the previous year net income, $FFO$ are funds from operation (pi plus dp), $I(TL > TA)$ is the dummy variable equal to one if the book value of total liabilities exceeds the book value of total assets, and equal to zero otherwise, $I(NI < 0 \ \& \ NI_{-1} < 0)$ is the dummy variable equal to one if the net income was negative in the two most recent years, and equal to zero otherwise. All items from Compustat annual files.

Estimated probability of bankruptcy can then be obtained from O-score as

$$Prob = \frac{e^O}{1 + e^O} \tag{A-8}$$

**R&D/TA (R&D-to-assets)** - ratio of R&D expenses (xrd item from Compustat annual) to total assets (at item).

**R&D/Size (R&D-to-market)** - ratio of R&D expenses (xrd item from Compustat

annual) to market value of equity (share price at the end of the fiscal year, prcc, times number of shares outstanding, csho).

**Realized (realized market volatility)** - the square root of the average squared daily return to the market portfolio (CRSP value-weighted index) within each given month.

**Rev (reversal)** - stock return in the past month, from CRSP monthly files.

**SG&A (SG&A to book value)** - sales, general, and administrative expenses, (SG&A, xsga item from Compustat annual) to book value of equity (ceq item) plus deferred taxes (txdb item).

**Size (market cap)** - shares outstanding times price, both from the CRSP monthly returns file.

**SR** - factor-mimicking portfolio for innovations to long-run volatility $s_t$ from C-GARCH above. See **LR** for the factor-mimicking procedure.

**SUE flex** is the slope ($\gamma_2$) from the firm-by-firm regression of earnings announcement returns on SUE squared (controlling for the level of SUE):

$$CAR_t = \gamma_0 + \gamma_1 \cdot SUE_t + \gamma_2 \cdot SUE_t^2 \tag{A-9}$$

The regression uses data from quarters $t$-1 to $t$-20 (at least 12 valid observations are required). Earnings announcement days are from Compustat quarterly file. Cumulative abnormal returns (CAR) are size and book-to-market adjusted cumulative daily returns between the day prior to the earnings announcement and the day after the earnings announcement. SUE is the difference between the announced EPS (epspiq over prccq lagged by one quarter) and average EPS in the past eight quarters, scaled by the standard deviation of EPS in the past eight quarters.

**TARCH (expected market volatility)** - from the TARCH(1,1) model (see Glosten, Jagannathan, and Runkle, 1993) fitted to monthly returns to the CRSP value-weighted index:

$$Ret_t^{CRSP} = \gamma_0 + \gamma_1 \cdot Ret_{t-1}^{CRSP} + \epsilon_t, \quad \sigma_t^2 = c_0 + c_1\sigma_{t-1}^2 + c_2\epsilon_{t-1}^2 + c_3 \cdot I(\epsilon_{t-1} < 0) \tag{1}$$

The regression estimated for the full sample. I take the square root out of the volatility forecast to be consistent with our measure of idiosyncratic volatility.

**TB (Treasury bill rate)** - the 30-day T-bill rate from the FRED database at https://fred.stlouisfed.org/.

**TERM (term spread)** - the yield spread between the ten-year and the one-year Treasury constant-maturity bond from the FRED database at https://fred.stlouisfed.org/.

**TVol Sens** - the sensitivity ($\gamma$) of firm's returns to changes in total firm-specific volatility, from firm-specific regressions of the form

$$Ret_t - RF_t = \alpha + \beta \cdot (MKT_t - RF_t) + \gamma \cdot \Delta Vol_t \tag{A-10}$$

The regression is estimated using monthly data from months $t$-1 to $t$-60 (at least 24 valid observations are required). Volatility ($Vol_t$) is estimated separately each month by computing the standard deviation of daily returns (at least 15 non-missing returns are required).

**VIX** - the VIX index, defined as the implied volatility of at-the-money options on S&P 100 (current ticker VXO). VIX is computed by CBOE and obtained from WRDS.

**Z-score** - the measure of financial health from Altman (1968), computed as

$$Z = 1.2 \cdot \frac{WC}{TA} + 1.4 \cdot \frac{RE}{TA} + 3.3 \cdot \frac{EBIT}{TA} + 0.6 \cdot \frac{MVE}{TL} + \frac{S}{TA}, \tag{A-11}$$

where WC is working capital (Compustat item wcap), TA is book value of total assets (at), RE are retained earnings (re), EBIT are earnings before taxes and interest (ni less xint less txt), MVE is the market value of equity (prcc times csho), TL is the book value of total liabilities (lt), and S are sales (sale). All items from Compustat annual files.