A Data Appendix

Beta (historical portfolio beta) - in Table 8, 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.

CMA (conservative-minus-aggressive, investment factor) – the arbitrage portfolio that buys firms in top 30% in terms of percentage growth in total assets and shorts firms in bottom 30% in terms of asset growth. The returns to the conservative-minus-aggressive strategy are value-weighted, the strategy is followed separately for small firms (below NYSE market cap median) and large firms. The value-weighted returns of the strategy in small and large firms subsample are then added and divided by two. CMA returns are from the website of Kenneth French.[1]

CProf (cash-based operating profitability) – operating profitability (see OProf) with accruals deducted from the denominator. Following Ball et al. (2016), accruals are defined as change in accounts receivable (rect) plus change in inventory (invt) plus change in prepaid expenses (xpp) minus in deferred revenue (drc plus drlt) minus change in accounts payable (ap).

[1] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

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.

DD (distance to default) – "naïve" version of Merton (1974) DD used in Bharath and Shumway (2008), who show that the "naïve" version outperforms more sophisticated versions.

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

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 σ_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 σ_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).

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.

EDP (expected default probability) – expected default probability in the next 12 months from Campbell et al. (2008)

$$EDP = \frac{1}{1 + e^{-CHS}}, \tag{A-4a}$$

$$CHS = -9.16 - 20.26 \cdot NIMTAAvg + 1.42 \cdot TLMTA - 7.13 \cdot ExRetAvg +$$
$$+1.41 \cdot Sigma - 0.045 \cdot RSize - 2.13 \cdot CashMTA + 0.075 \cdot MB - 0.058 \cdot \log(Price), \tag{A-4b}$$

$$NIMTAAvg_t = NIMTA_t + 0.5 \cdot NIMTA_{t-1} + 0.25 \cdot NIMTA_{t-2} + 0.125 \cdot NIMTA_{t-3}, \tag{A-4c}$$

$$ExRetAvg_t = \frac{1-\phi}{1-\phi^{12}} \cdot \sum_{j=0}^{11} \phi^j ExRet_{t-j}, \tag{A-4d}$$

where $\phi = 2^{-\frac{1}{3}}$, NIMTA is net income (niq) over market value of total assets (share price, prcc, times number of shares outstanding, csho plus total liabilities, lt), TLMTA is total liabilities (lt) over market value of total assets (defined as for NIMTA), ExRetAvg is log of gross excess return over value-weighted S&P 500 return, RSize is log of firm's market equity over the total valuation of S&P 500 (both from CRSP), Sigma is square root of the sum of squared daily stock returns over a three-month period, annualized, CashMTA is stock of cash and short-term investments (cheq) over the market value of total assets (defined as for NIMTA), MB is market-to-book (defined below), and Price is price per share winsorized above \$15.

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:

$$\Delta VIX_t = \gamma_0 + \gamma_1 \cdot (VIX1_t - RF_t) + \gamma_2 \cdot (VIX2_t - RF_t) + \\ + \gamma_3 \cdot (VIX3_t - RF_t) + \gamma_4 \cdot (VIX4_t - RF_t) + \gamma_5 \cdot (VIX5_t - RF_t), \qquad \text{(A-5)}$$

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):

$$FVIX_t = \hat{\gamma_1} \cdot (VIX1_t - RF_t) + \hat{\gamma_2} \cdot (VIX2_t - RF_t) + \hat{\gamma_3} \cdot (VIX3_t - RF_t) + \\ + \hat{\gamma_4} \cdot (VIX4_t - RF_t) + \hat{\gamma_5} \cdot (VIX5_t - RF_t). \qquad \text{(A-6)}$$

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):

$$Ret_t - RF_t = \alpha + \beta_{MKT} \cdot (MKT_t - RF_t) + \beta_{\Delta VIX} \cdot \Delta VIX_t. \qquad \text{(A-7)}$$

GProf (gross profitability) – total revenue (sale) minus cost of goods sold (cogs) divided by book value of equity (ceq plus txdb), , all items from Compustat annual files.

IG (investment growth) – the change in capital expenditures (capx item from Compustat) divided by the previous year capital expenditures.

ITA (investment-to-assets) – the annual change in gross PP&E (ppegt item from Compustat) divided by total assets (item at) from the previous year.

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).

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.

MB (market-to-book) – market cap (share price, 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) – in cross-sectional regressions, cumulative return to the stock between month t-2 and t-12, returns are from CRSP monthly returns file.

MOM (momentum factor) – in time-series regressions, the arbitrage portfolio that buys top 30% of recent winners and shorts bottom 30% of recent losers. Winners and losers are defined using cumulative return to the stock between month t-2 and t-12. The returns to the winners-minus-losers strategy are value-weighted, the strategy is followed separately for small firms (below NYSE market cap median) and large firms. The value-weighted returns of the strategy in small and large firms subsample are then added and divided by two. MOM returns are from the website of Kenneth French.[2]

OProf (operating profitability) – total revenue (revt) minus cost of goods sold (cogs) minus SG&A (xsga) plus R&D expenses (xrd) if available, divided by total assets (at) from the previous year.

[2] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

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

$$O = -1.32 - 0.407 \cdot \ln TA + 6.03 \cdot \frac{TL}{TA} - 1.43 \cdot \frac{WC}{TA} + 0.076 \cdot \frac{CL}{CA} - 1.72 \cdot I(TL > TA)$$
$$-2.37 \cdot \frac{NI}{TA} - 1.83 \cdot \frac{FFO}{TA} + 0.285 \cdot I(NI < 0 \ \& \ NI_{-1} < 0) - 0.521 \cdot \frac{NI - NI_{-1}}{|NI| + |NI_{-1}|}, \tag{A-8}$$

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

$$Prob = \frac{e^O}{1 + e^O} \tag{A-9}$$

Prof (profitability) – net income before extraordinary items (ib) divided by book value of equity (ceq plus txdb), all items from Compustat annual files.

RE (retained earnings over market) – retained earnings (re) over market value of equity (csho times prcc_f). If accumulated other comprehensive income (acominc) is available, it is deducted from retained earnings.

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

RMW (robust-minus-weak, profitability factor) – the arbitrage portfolio that buys firms in top 30% in terms of profitability and shorts firms in bottom 30% in terms of profitability. The returns to the robust-minus-weak strategy are value-weighted, the strategy is followed separately for small firms (below NYSE market cap median) and large firms. The value-weighted returns of the strategy in small and large firms subsample are then added and divided by two. RMW returns are from the website of Kenneth French.[3]

[3] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

SG (sales growth) – the change in sales (sale item from Compustat) in percentage of last year's sales: $SG_t = \frac{Sales_t - Sales_{t-1}}{Sales_{t-1}}$.

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 – the slope (γ_2) from the firm-by-firm regression of earnings announcement returns on SUE squared (controlling for the level of SUE):

$$CAR_t = \gamma_0 + \gamma_1 \cdot SUE_t + \gamma_2 \cdot SUE_t^2. \tag{A10}$$

The regression uses data from quarters t-1 to t-20 (at least 12 valid observations are required). Earnings announcement days are from the Compustat quarterly file. Cumulative abnormal returns (CAR) are computed in the three days before, during, and after announcement using CAPM. The CAPM beta is estimated using daily returns in the year before the 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.

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 (γ) of firm's returns to changes in total firm-specific volatility, from firm-specific regressions of the form

$$Ret_t - RF_t = \alpha + \beta \cdot (MKT_t - RF_t) + \gamma \cdot \Delta Vol_t \tag{A-11}$$

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

$$Z = 1.2 \cdot \frac{WC}{TA} + 1.4 \cdot \frac{RE}{TA} + 3.3 \cdot \frac{EBIT}{TA} + 0.6 \cdot \frac{MVE}{TL} + \frac{S}{TA}, \tag{A-12}$$

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.