Anomaly definitions from Kozak et al. (2020), Haddad et al. (2020), Kozak (2020), Kozak and Santosh (2019), and Giglio et al. (2020).

Anomaly Characteristics

Anomaly definitions and descriptions are heavily based on the lists of characteristics compiled by Hou et al. (2015); Kogan and Tian (2015); McLean and Pontiff (2016); Novy-Marx and Velikov (2016). All accounting variables are properly lagged. For annual rebelancing, returns from July of year t to June of year $t+1$ are matched to variables in December of $t-1$. Returns from January to June of year t are matched to variables in December of year $t-2$. Financial variables with a subscript "Dec" below are computed using the same timing convention. For monthly rebalancing, returns are matched to the latest quarterly report lagged one month. Additional lagging (if required) is reported for each variable below individually. All subindices below are measured in months. Time subscript t refers to time at which a portfolio is formed.

1. **Size** (*size*). Follows Fama and French (1993). size = ME_{Jun}. The CRSP end of June price times shares outstanding. Rebalanced annually.

2. **Value (annual)** (*value*). Follows Fama and French (1993). value = BE/ME. At the end of June of each year, we use book equity from the previous fiscal year and market equity from December of the previous year. Rebalanced annually.

3. **Gross Profitability** (*prof*). Follows Novy Marx (2013a). prof = GP/AT, where GP is gross profits and AT is total assets. Rebalanced annually.

4. **Value-Profitability** (*valprof*). Follows Novy Marx (2013b). valprof = rank(value) + rank(prof). Sum of ranks in univariate sorts on book-to-market and profitability. Annual book-to-market and profitability values are used for the entire year. Rebalanced monthly.

5. **Piotroski's F-score** (*F-score*). Follows Piotroski (2000). F-score = $1_{\text{IB}>0}+1_{\Delta\text{ROA}>0}+1_{\text{CFO}>0}+1_{\text{CFO}>\text{IB}}+1_{\Delta\text{DTA}<0|\text{DLTT}=0|\text{DLTT}_{-12}=0}+1_{\Delta\text{ATL}>0}+1_{\text{EqIss}\leq 0}+1_{\Delta\text{GM}>0}+1_{\Delta\text{ATO}>0}$, where IB is income before extraordinary items, ROA is income before extraordinary items scaled by lagged total assets, CFO is cash flow from operations, DTA is total long-term debt scaled by total assets, DLTT is total long-term debt, ATL is total current assets scaled by total current liabilities, EqIss is the difference between sales of of common stock and purchases of common stock recorded on the cash flow statement, GM equals one minus the ratio of cost of goods sold and total revenues, and ATO equals total revenues, scaled by total assets. Rebalanced annualy.

6. **Debt Issuance** (*debtiss*). Follows Spiess and Affleck-Graves (1999). debtiss = $1_{\text{DLTISS}\leq 0}$. Binary variable equal to one if long-term debt issuance indicated in statement of cash flow. Updated annually.

7. **Share Repurchases** (*repurch*). Follows Ikenberry et al. (1995). repurch = $1_{\text{PRSTKC}>0}$. Binary variable equal to one if repurchase of common or preferred shares indicated in statement of cash flow. Updated annually.

8. **Share Issuance (annual)** (*nissa*). Follows Pontiff and Woodgate (2008). nissa = $\text{shrout}_{\text{Jun}}$ / $\text{shrout}_{\text{Jun}-12}$, where shrout is the number of shares outstanding. Change in real number of shares outstanding from past June to June of the previous year. Excludes changes in shares due to stock dividends and splits, and companies with no changes in shrout.

9. **Accruals** (*accruals*). Follows Sloan (1996). accruals = $\frac{\Delta\text{ACT}-\Delta\text{CHE}-\Delta\text{LCT}+\Delta\text{DLC}+\Delta\text{TXP}-\Delta\text{DP}}{(\text{AT}+\text{AT}_{-12})/2}$, where ΔACT is the annual change in total current assets, ΔCHE is the annual change in total cash and short-term investments, ΔLCT is the annual change in current liabilities, ΔDLC is the annual change in debt in current liabilities, ΔTXP is the annual change in income taxes payable, ΔDP is the annual change in depreciation and amortization, and $(\text{AT} + \text{AT}_{-12})/2$ is average total assets over the last two years. Rebalanced annually.

10. **Asset Growth** (*growth*). Follows Cooper et al. (2008). growth = $\text{AT}/\text{AT}_{-12}$. Rebalanced annually.

11. **Asset Turnover** (*aturnover*). Follows Soliman (2008). aturnover = SALE/AT. Sales to total assets. Rebalanced annually.

12. **Gross Margins** (*gmargins*). Follows Novy Marx (2013a). gmargins = GP/SALE, where GP is gross profits and SALE is total revenues. Rebalanced annually.

13. **Dividend Yield** (*divp*). Follows Naranjo et al. (1998). divp = $\text{Div}/\text{ME}_{\text{Dec}}$. Dividend scaled by price. Both are measured in December of the year $t-1$ or $t-2$ (for returns in months prior to July). Rebalanced annually.

14. **Earnings/Price** (*ep*). Follows Basu (1977). ep = $\text{IB}/\text{ME}_{\text{Dec}}$. Net income scaled by market value of equity. Updated annually.

15. **Cash Flow / Market Value of Equity** (*cfp*). Follows Lakonishok et al. (1994). cfp = $(\text{IB} + \text{DP})/\text{ME}_{\text{Dec}}$. Net income plus depreciation and amortization, all scaled by market value of equity measured at the same date. Updated annually.

16. **Net Operating Assets** (*noa*). Follows Hirshleifer et al. (2004). noa = ((AT - CHE) - (AT - DLC - DLTT - MIB - PSTK - CEQ)) / AT_{-12}, where AT is total assets, CHE is cash and short-term investments, DLC is debt in current liabilities, DLTT is long term debt, MIB is non-controlling interest, PSTK is preferred capital stock, and CEQ is common equity. Updated annually.

17. **Investment** (*inv*). Follows Chen et al. (2011); Lyandres et al. (2007). inv = $(\Delta\text{PPEGT} + \Delta\text{INVT})/\text{AT}_{-12}$, where ΔPPEGT is the annual change in gross total property, plant, and equipment, ΔINVT is the annual change in total inventories, and AT_{-12} is lagged total assets. Rebalanced annually, uses the full period.

18. **Investment-to-Capital** (*invcap*). Follows Xing (2008). invcap = CAPX/PPENT. Investment to capital is the ratio of capital expenditure (Compustat item CAPX) over property, plant, and equipment (Compustat item PPENT).

19. **Invetment Growth** (*growth*). Follows Xing (2008). growth = CAPX/CAPX$_{-12}$. Investment growth is the percentage change in capital expenditure (Compustat item CAPX).

20. **Sales Growth** (*sgrowth*). Follows Lakonishok et al. (1994). sgrowth = SALE/SALE$_{-12}$. Sales growth is the percent change in net sales over turnover (Compustat item SALE).

21. **Leverage** (*lev*). Follows Bhandari (1988). lev = AT/ME$_{\text{Dec}}$. Market leverage is the ratio of total assets (Compustat item AT) over the market value of equity. Both are measured in December of the same year.

22. **Return on Assets (annual)** (*roaa*). Follows Chen et al. (2011). roaa = IB/AT. Net income scaled by total assets. Updated annually.

23. **Return on Equity (annual)** (*roea*). Follows Haugen and Baker (1996). roea = IB/BE. Net income scaled by book value of equity. Updated annually.

24. **Sales-to-Price** (*sp*). Follows Barbee Jr et al. (1996). sp = SALE/ME$_{\text{Dec}}$. Total revenues divided by stock price. Updated annually.

25. **Growth in LTNOA** (*gltnoa*). Follows Fairfield et al. (2003). gltnoa = GRNOA - ACC. Growth in Net Operating Assets minus Accruals. NOA = (RECT + INVT + ACO + PPENT + INTAN + AO - AP - LCO - LO) / AT, GRNOA = NOA - NOA$_{-12}$, ACC=((RECT - RECT$_{-12}$) + (INVT - INVT$_{-12}$) + (ACO - ACO$_{-12}$) - (AP - AP$_{-12}$) - (LCO - LCO$_{-12}$) - DP) / ((AT + AT$_{-12}$) / 2), where RECT = Receivables, INVT = Total Inventory, ACO = Current Assets, AP =Accounts Payable, LCO = Current Liabilities (Other), DP = Depreciation and Amortization, AT = Assets, PPENT = Property, Plant, and Equipment (net), INTAN = Intangible Assets, AO = Assets (Other), LO = Liabilities (Other). Updated annually.

26. **Momentum (6m)** (*mom*). Follows Jagadeesh and Titman (1993). mom = $\sum_{l=2}^{7} r_{t-l}$. Cumulated past performance in the previous 6 months by skipping the most recent month. Rebalanced monthly.

27. **Industry Momentum** (*indmom*). Follows Moskowitz and Grinblatt (1999). indmom = rank($\sum_{l=1}^{6} r_{t-l}^{\text{ind}}$). In each month, the Fama and French 49 industries are ranked on their value-weighted past 6-months performance. Rebalanced monthly.

28. **Value-Momentum** (*valmom*). Follows Novy Marx (2013b). valmom = rank(B/M) + rank(Mom). Sum of ranks in univariate sorts on book-to-market and momentum. Annual book-to-market values are used for the entire year. Rebalanced monthly.

29. **Value-Momentum-Profitability** (*valmomprof*). Follows Novy Marx (2013b). valmomprof = rank(B/M) + rank(Prof) + rank(Mom). Sum of ranks in univariate sorts on book-to-market, profitability, and momentum. Annual book-to-market and profitability values are used for the entire year. Rebalanced monthly.

30. **Short Interest** (*shortint*). Follows Dechow et al. (1998). shortint = Shares Shorted / Shares Outstanding. Updated monthly.

31. **Momentum (1 year)** (*mom12*). Follows Jagadeesh and Titman (1993). mom12 = $\sum_{l=2}^{12} r_{t-l}$. Cumulated past performance in the previous year by skipping the most recent month. Rebalanced monthly.

32. **Momentum-Reversal** (*momrev*). Follows Jagadeesh and Titman (1993). momrev = $\sum_{l=14}^{19} r_{t-l}$. Buy and hold returns from $t-19$ to $t-14$. Updated monthly.

33. **Long-term Reversals** (*lrrev*). Follows DeBondt and Thaler (1985). lrrev = $\sum_{l=13}^{60} r_{t-l}$. Cumulative returns from $t-60$ to $t-13$. Updated monthly.

34. **Value (monthly)** (*valuem*). Follows Asness and Frazzini (2013). valuem = $\text{BEQ}_{-3}/\text{ME}_{-1}$. Book-to-market ratio using the most up-to-date prices and book equity (appropriately lagged). Rebalanced monthly.

35. **Share Issuance (monthly)** (*nissm*). Follows Pontiff and Woodgate (2008). nissm = shrout_{t-13} / shrout_{t-1}, where shrout is the number of shares outstanding. Change in real number of shares outstanding from $t-13$ to $t-1$. Excludes changes in shares due to stock dividends and splits, and companies with no changes in shrout.

36. **PEAD (SUE)** (*sue*). Follows Foster et al. (1984). sue = $\frac{\text{IBQ}-\text{IBQ}_{-12}}{\sigma_{\text{IBQ}_{-24}:\text{IBQ}_{-3}}}$, where IBQ is income before extraordinary items (updated quarterly), and $\sigma_{\text{IBQ}_{-24}:\text{IBQ}_{-3}}$ is the standard deviation of IBQ in the past two years skipping the most recent quarter. Earnings surprises are measured by Standardized Unexpected Earnings (SUE), which is the change in the most recently announced quarterly earnings per share from its value announced four quarters ago divided by the standard deviation of this change in quarterly earnings over the prior eight quarters. Rebalanced monthly.

37. **Return on Book Equity** (*roe*). Follows Chen et al. (2011). roe = $\text{IBQ}/\text{BEQ}_{-3}$, where IBQ is income before extraordinary items (updated quarterly), and BEQ is book value of equity. Rebalanced monthly.

38. **Return on Market Equity** (*rome*). Follows Chen et al. (2011). rome = $\text{IBQ}/\text{ME}_{-4}$, where IBQ is income before extraordinary items (updated quarterly), and ME is market value of equity. Rebalanced monthly.

39. **Return on Assets** (*roa*). Follows Chen et al. (2011). roa = $\text{IBQ}/\text{ATQ}_{-3}$. Net income scaled by total assets. Updated quarterly.

40. **Short-term Reversal** (*strev*). Follows Jegadeesh (1990). strev = r_{t-1}. Return in the previous month. Updated monthly.

41. **Idiosyncratic Volatility** (*ivol*). Follows Ang et al. (2006). ivol = std($R_{i,t} - \beta_i R_{M,t} - s_i \text{SMB}_t - h_i \text{HML}_t$). The standard deviation of the residual from firm-level regression of daily stock returns on the daily innovations of the Fama and French three-factor model using the estimation window of three months. Lagged one month.

42. **Beta Arbitrage** (*beta*). Follows Cooper et al. (2008). beta = $\beta_{t-60:t-1}$. Beta with respect to the CRSP equal-weighted return index. Estimated over the past 60 months (minimum 36 months) using daily data and lagged one month. Updated monthly.

43. **Seasonality** (*season*). Follows Heston and Sadka (2008). season = $\sum_{l=1}^{5} r_{t-l\times 12}$. Average monthly return in the same calendar month over the last 5 years. As an example, the average return from prior Octobers is used to predict returns this October. The firm needs at least one year of data to be included in the sample. Updated monthly.

44. **Industry Relative Reversals** (*indrrev*). Follows Da et al. (2013). indrrev = $r_{-1} - r_{-1}^{\text{ind}}$, where r is the return on a stock and r^{ind} is return on its industry. Difference between a stocks' prior month's return and the prior month's return of its industry (based on the Fama and French 49 industries). Updated monthly.

45. **Industry Relative Reversals (Low Volatility)** (*indrrevlv*). Follows Da et al. (2013). indrrevlv = $r_{-1} - r_{-1}^{\text{ind}}$ if vol ¡ NYSE median, where r is the return on a stock and r^{ind} is return on its industry. Difference between a stocks' prior month's return and the prior month's return of its industry (based on the Fama and French 49 industries). Only stocks with idiosyncratic volatility lower than the NYSE median for month are included in the sorts. Updated monthly.

46. **Industry Momentum-Reversal** (*indmomrev*). Follows Moskowitz and Grinblatt (1999). indmomrev = rank(industry momentum) + rank(industry relative-reversals low-vol). Sum of Fama and French 49 industries ranks on industry momentum and industry relative reversals (low vol). Rebalanced monthly.

47. **Composite Issuance** (*ciss*). Follows Daniel and Titman (2006). ciss = $\log(\frac{\text{ME}_{t-13}}{\text{ME}_{t-60}}) - \sum_{l=13}^{60} r_{t-l}$, where r is the log return on the stock and ME is total market equity. Updated monthly.

48. **Price** (*price*). Follows Blume and Husic (1973). price = log(ME/shrout), where ME is market equity and shrout is the number of shares outstanding. Log of stock price. Updated monthly.

49. **Firm Age** (*age*). Follows Barry and Brown (1984). age = log(1 + number of months since listing). The number of months that a firm has been listed in the CRSP database.

50. **Share Volume** (*shvol*). Follows Datar et al. (1998). $\text{shvol} = \frac{1}{3}\sum_{i=1}^{3} \text{volume}_{t-i}/\text{shrout}_t$. Average number of shares traded over the previous three months scaled by shares outstanding. Updated monthly.

51. **Cash flow duration** (*dur*). Follows **?**. $\text{dur} = \sum_t \text{PV}_0(t \times \text{CF}_t)/P_0$. Present value of expected cashflows. Cashflows' components (from clean surplus identity, ROE and book equity growth) are forecasted using AR(1). Sums are discounted using a constant discount rate. Rebalanced monthly.

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