Global Factor Data Analysis

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Factor Selection and Interpretation

Market Equity (Size)
- Small firms offer higher returns as compensation for greater risk, limited financing options and investor visibility
- Often linked with illiquidity and constrained access to capital

R&D to Sales
- Reflects a firm's commitment to innovation and future growth potential
- Markets may underprice R&D due to uncertainty and intangible nature of investment
- R&D intensity is often higher in small, early-stage firms

Liquidity of Book Assets
- High asset liquidity reduces financial constraints and improves borrowing capacity
- Firms with more liquid balance sheets can better absorb shocks or fund growth without costly external finance

Key Interactions and Correlations
- Small firms tend to have higher R&D intensity and lower asset liquidity
- R&D-intensive firms often hold less liquid, intangible assets
- Asset liquidity is positively correlated with firm size, and negatively with R&D intensity
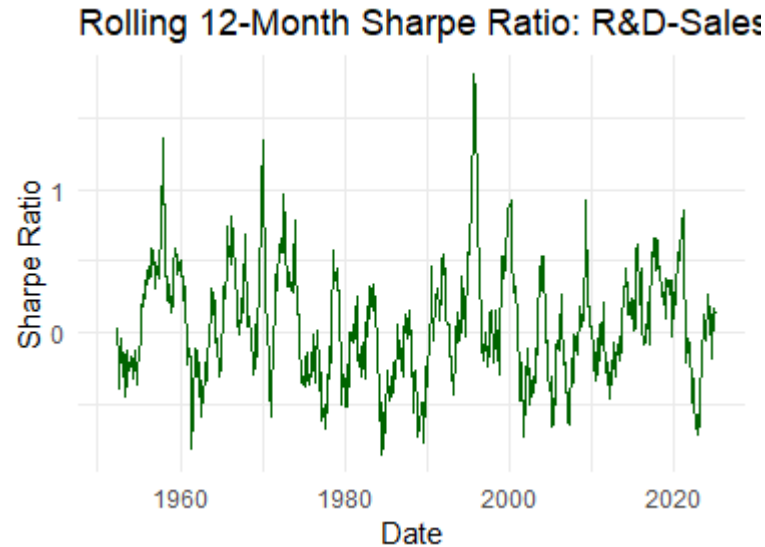
Historical Performance & Risk Analysis

■ Market Equity


■ R&D to Sales

■ Liquidity to Book Assets
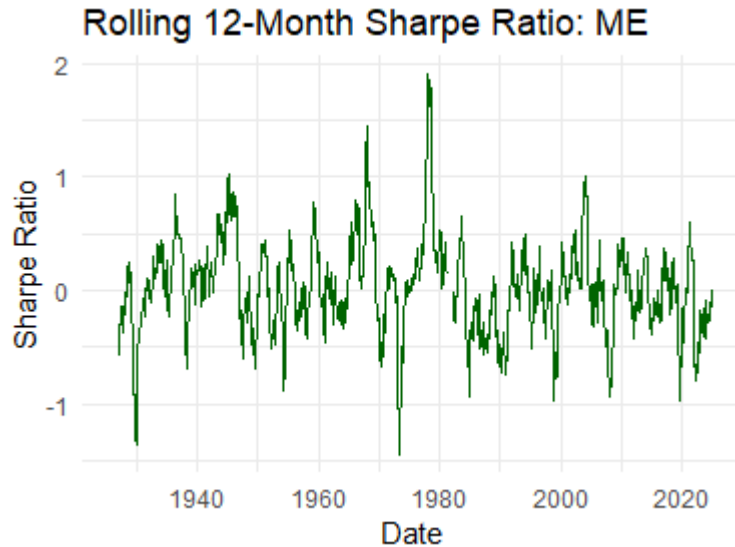
■ Sharpe ratio for Market Equity ranged from -1.44 (1973) to 1.90 (1978), reflecting the impact of macroeconomic cycles — from the oil crisis to recovery.

■ The size premium is highly cyclical, underperforming in downturns but rebounding in recoveries, highlighting its time-varying risk-adjusted nature.

■ Sharpe ratio ranged from -0.84 (Jun 1984) to 1.80 (Jul 1995), reflecting a turnaround from post-recession uncertainty to strong optimism around innovation during the 1990s tech boom.

■ The factor's performance is highly sensitive to economic cycles and investor sentiment toward R&D-heavy firms.
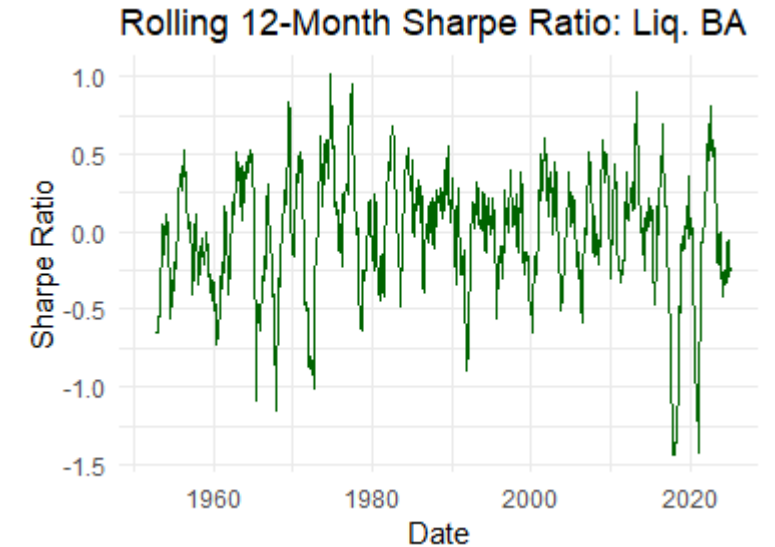
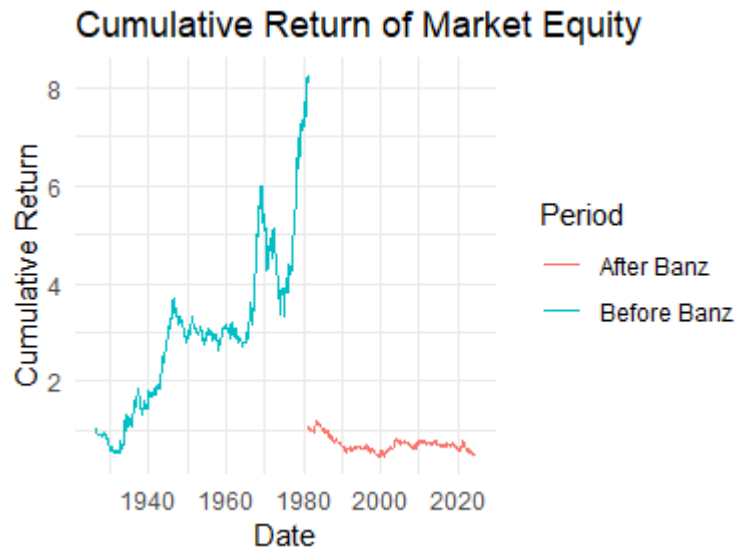■ Sharpe ratio ranged from -1.44 (Oct 2017) to 1.01 (Sep 1974), performing best during credit stress when firms with liquid assets had a financing edge.

■ The factor underperforms in liquidity-rich environments, highlighting its dependence on tight credit conditions to deliver strong risk-adjusted returns.
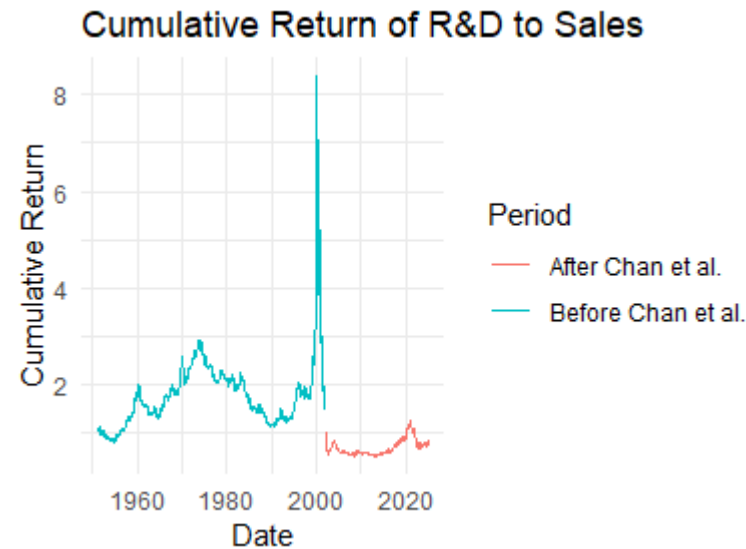
Historical Performance & Risk Analysis

■ Market Equity

Cumulative Return of Market Equity

■ R&D to Sales

Cumulative Return of R&D to Sales

■ Liquidity to Book Assets

Cumulative Return of Liq. to Book Assets

Country	period	Mean_Return	Std_Dev	Sharpe_Ratio
USA	B. Banz	0.004	0.041	0.095
USA	A. Banz	-0.001	0.028	-0.032
AUT	A. Banz	0.001	0.039	0.020
IND	A. Banz	0.002	0.045	0.046

Country	period	Mean_Return	Std_Dev	Sharpe_Ratio
USA	B. Chan.	0.002	0.049	0.046
USA	A. Chan.	0.000	0.040	0.002
AUT	A. Chan.	-0.003	0.052	-0.053
IND	A. Chan.	0.000	0.038	0.010
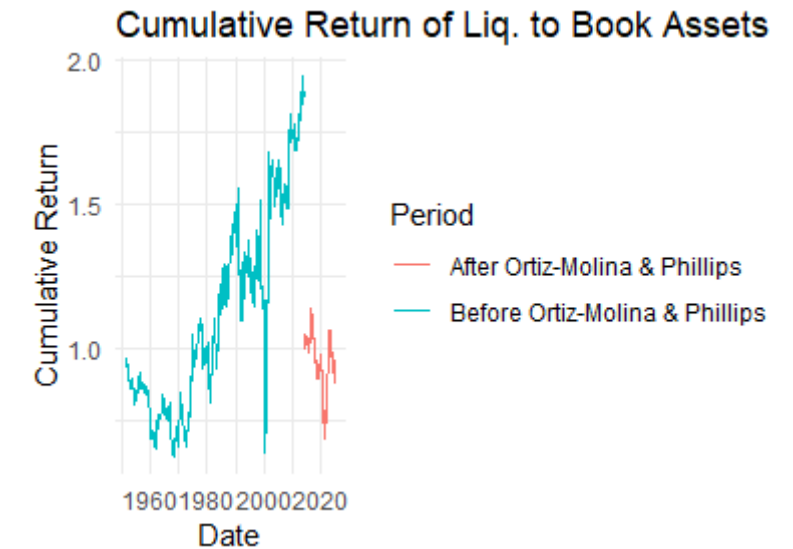
Country	period	Mean_Return	Std_Dev	Sharpe_Ratio
USA	B. Ortiz-Molina & Phillips	0.001	0.034	0.042
USA	A. Ortiz-Molina & Phillips	-0.001	0.026	-0.026
AUT	A. Ortiz-Molina & Phillips	0.004	0.045	0.079
AUT	B. Ortiz-Molina & Phillips	0.003	0.051	0.060
IND	A. Ortiz-Molina & Phillips	0.000	0.025	0.010
IND	B. Ortiz-Molina & Phillips	0.006	0.053	0.107

■ For all three factors the Sharpe ratio after publication decreases in the U.S.

Historical Performance & Risk Analysis

- **Market Equity**

Country	period	Sharpe_Ratio	BM_Sharpe_Ratio	Gold_Sharpe_Ratio
USA	B. Banz	0.0954	0.0821	0.3285
USA	A. Banz	-0.0324	0.1886	0.0841
AUT	A. Banz	0.0202	0.0993	0.0841
IND	A. Banz	0.0464	0.1625	0.0841

- Before Banz (1981), the Market Equity factor outperformed the S&P 500 in the U.S., suggesting a strong size premium that was likely underexploited pre-publication.

- After publication, the factor underperformed benchmarks across all countries, supporting the idea of post-publication decay and limited size effect outside the U.S.

- **R&D to Sales**

Country	period	Sharpe_Ratio	BM_Sharpe_Ratio	Gold_Sharpe_Ratio
USA	B. Chan et al.	0.0457	0.1117	0.1158
USA	A. Chan et al.	0.0018	0.1598	0.1966
AUT	A. Chan et al.	-0.0528	0.1018	0.1966
IND	A. Chan et al.	0.0101	0.1625	0.1966

- Before publication, R&D-to-Sales had modest risk-adjusted returns, but both the benchmark and gold outperformed.

- After publication, the R&D factor's Sharpe collapsed, while gold delivered the strongest performance, outperforming both the benchmark and the factor.

- **Liquidity to Book Assets**

Country	period	Sharpe_Ratio	BM_Sharpe_Ratio	Gold_Sharpe_Ratio
USA	B. Ortiz-Molina & Phillips	0.0415	0.1092	0.1435
USA	A. Ortiz-Molina & Phillips	-0.0257	0.2364	0.1614
AUT	A. Ortiz-Molina & Phillips	0.0792	0.0768	0.1614
AUT	B. Ortiz-Molina & Phillips	0.0603	0.1102	0.1435
IND	A. Ortiz-Molina & Phillips	0.0102	0.2496	0.1614
IND	B. Ortiz-Molina & Phillips	0.1073	0.0892	0.1435

- The Liquidity of Book Assets factor underperforms gold across countries and time periods, with signs of post-publication decay in the U.S. and India.

- Gold consistently delivers higher Sharpe ratios and often beats benchmarks, making it a stable and effective alternative to traditional equity factors.

Spanning Regression

- Market Equity

  - CAPM: Market risk premium (Mkt_RF) is found to be a statistically significant* factor
    Adjusted R-squared: 0.14

  - FF3 Model: All the three factors of Mkt_RF, Small minus big (SMB), and High (HML) minus low are found to be statistically significant*
    Adjusted R-squared: 0.86

  - Hou et al.: Four factors of market excess return, size, investment, and return on equity factors are found to be statistically significant*
    Adjusted R-squared: 0.77

- R&D to Sales

  - CAPM: Market risk premium (Mkt_RF) is found to be a statistically significant* factor
    Adjusted R-squared: 0.06

  - FF3 Model: All the three factors of Mkt_RF, Small minus big (SMB), and High (HML) minus low are found to be statistically significant*
    Adjusted R-squared: 0.41

  - Hou et al.: Four factors of size, investment, return on equity, and expected growth factor return are found to be statistically significant*
    Adjusted R-squared: 0.36

- Liquidity to Book Assets

  - CAPM: Market risk premium (Mkt_RF) is found to be a statistically significant* factor
    Adjusted R-squared: 0.20

  - FF3 Model: All the three factors of Mkt_RF, Small minus big (SMB), and High (HML) minus low are found to be statistically significant*
    Adjusted R-squared: 0.66

  - Hou et al.: Four factors of market excess return, size, investment, and expected growth factor return are found to be statistically significant*
    Adjusted R-squared: 0.59

*5% significance level

Spanning Regression

- The FF3 model was the best among standard models, but showed low explanatory power for R&D to Sales (adj. R-squared of 0.41) and Liquidity to Book Assets (adj.R-squared of 0.66)

- To address this, we added R&D Capital to Book Assets (RDC) to better capture firm-level innovation using a fundamentals-based proxy and also added the Amihud illiquidity measure (AMI) to represent market liquidity risk, which complements size and explains additional variation.

- The extended model improved explanatory power for all three factors, with substantial gains for R&D to Sales and Liquidity.

- Market Equity
  - Extended Model: FF3 + RDC + AMI. The factors if Mkt_RF, SMB, and AMI are found to be statistically significant*
    Adjusted R-squared: 0.87

- R&D to Sales
  - Extended Model: FF3 + RDC + AMI. The factors of Mkt_RF, HML, RDC, and AMI are found to be statistically significant*
    Adjusted R-squared: 0.86

- Liquidity to Book Assets
  - Extended Model: FF3 + RDC + AMI. The factors of Mkt_RF, SMB, HML, and RDC are found to be statistically significant*
    Adjusted R-squared: 0.73

- The extended model markedly boosts explanatory behavior especially for R&D to Sales (adj. R sq. from 0.41 to 0.86) and for Liquidity of book assets (adj. R sq. from 0.66 to 0.73) while also maintain a strong R sq. for market equity factor (Adj. R sq. from 0.86 to 0.87)

*5% significance level

Bibliography

Amihud, Y. (2002). Illiquidity and stock returns: Cross-section and time-series effects. *Journal of Financial Markets*, *5*(1), 31–56. https://doi.org/10.1016/S1386-4181(01)00024-6

Banz, R. W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics*, *9*(1), 3–18. https://doi.org/10.1016/0304-405X(81)90018-0

Chan, L. K. C., Lakonishok, J., & Sougiannis, T. (2001). The Stock Market Valuation of Research and Development Expenditures. *The Journal of Finance*, *56*(6), 2431–2456.

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, *33*(1), 3–56. https://doi.org/10.1016/0304-405X(93)90023-5

Hou, K., Mo, H., Xue, C., & Zhang, L. (2021). An Augmented q-Factor Model with Expected Growth*. *Review of Finance*, *25*(1), 1–41. https://doi.org/10.1093/rof/rfaa004

Jensen, T. I., Kelly, B., & Pedersen, L. H. (2023). Is There a Replication Crisis in Finance? *The Journal of Finance*, *78*(5), 2465–2518. https://doi.org/10.1111/jofi.13249

Li, D. (2011). Financial Constraints, R&D Investment, and Stock Returns. *The Review of Financial Studies*, *24*(9), 2974–3007. https://doi.org/10.1093/rfs/hhr043

Ortiz-Molina, H., & Phillips, G. M. (2014). Real Asset Illiquidity and the Cost of Capital. *Journal of Financial and Quantitative Analysis*, *49*(1), 1–32. https://doi.org/10.1017/S0022109014000210