CHICAGO BOOTH

The University of Chicago Booth School of Business

Intangible Assets

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Quantitative Portfolio Management

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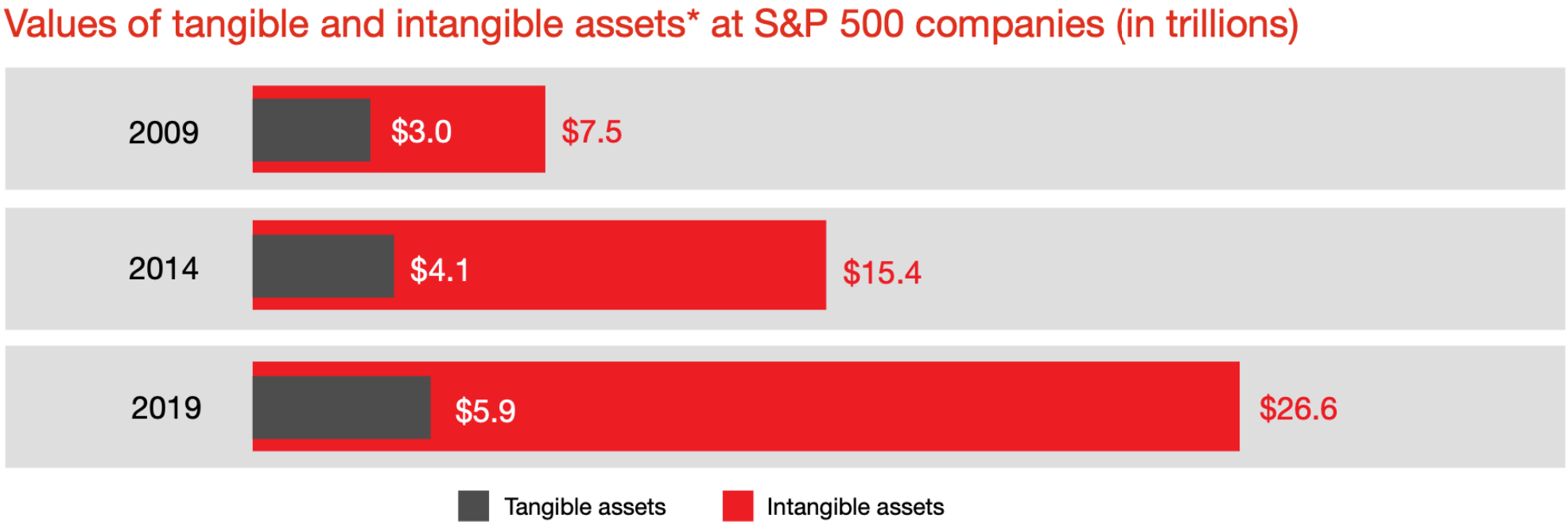
Why Intangibles

- Value accrues to intangible assets has increased significantly in recent years as companies adapt to “information revolution” with virtual business models[1]



Source: Company reports, PwC analysis

*Implied market value of intangibles = Market cap + Book value of total liabilities - Book value of tangibles

1. Per PwC Analysis

Accounting Rules

- However, accounting rules treat internally developed vs. acquired intangible assets asymmetrically
- Internally generated R&D does not always appear on Balance Sheet and book value of intangible assets (including goodwill) are mostly acquired as a result[1]

	IFRS	GAAP
Internally Generated Intangibles	Research costs are immediately expensed / development costs may be capitalized	Not capitalized except for internally developed software
Acquired Intangibles	Capitalized	Capitalized

1. Per PwC Analysis, KPMG Insights

Main Economic Ideas

- Therefore, we want to test the idea of whether companies / investors tend to overprice these intangible assets during acquisitions, given the risks of change in consumer sentiment, regulation, and technology, which would lower future expected returns and cost of capital
- Examples:
  - 2001 AOL Time Warner merger led to $99B goodwill impairment in 2002 after the dot-com bubble burst
  - 2016 Valeant Pharmaceuticals under SEC investigation following its aggressive R&D acquisitions
  - 2016 Yahoo! wrote down $1.1B Tumblr acquisition by $482 million after it failed to to monetize Tumblr effectively through its user base
  - 2019 Kraft Heinz wrote down $15.4B on Kraft and Oscar Mayer brands due to changing consumer taste

Economic Interpretations

- **Risk-Based**
  i. Valuation risks of internally developed intangibles as their fair values have not been independently assessed in the active market
  ii. Risks associated with the outcome of the investment (change in market conditions, consumer sentiment, and technological feasibility)
  iii. Risks of infringement by competitors

- **Behavioral**
  i. Acquisition bias as investors might be overly optimistic about the synergies, growth prospects, and intrinsic value associated with acquired intangibles
  ii. Investors may overly focus on accounting metrics and undervalue internally-developed intangibles
  iii. Short-termism

Connection to Existing Research

Intangible intensity and stock price crash risk

Kai Wu*, Seiwai Lai

School of Finance, Central University of Finance and Economics, China

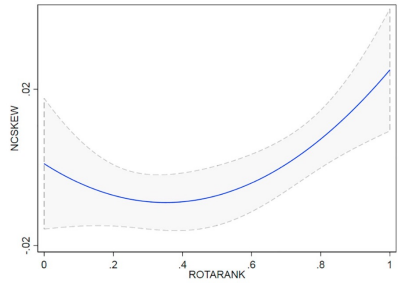


Fig. 2. Nonlinear relationship between intangible intensity and crash risk.

Variable Definition:
The intangible intensity is decomposed into definite-life intangible intensity FLRANK (a), indefinite-life intangible intensity INFLRANK (b), and goodwill intensity GWRANK (c).
ROTA=EBITDA/NETPPE=(a)+(b)+(c)

How does intangible intensity affect crash risk?
- Goodwill impairments
- High information asymmetry

Intangible Value*

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May 4, 2022

Signal Construction:
$B_{it}^{INT} = B_{it} - GDWL_{it} + INT_{it} \rightarrow B_{it}^{INT}/M$

Key Findings:
- A value portfolio that **adds intangible capital** to book assets prior to sorting provides **much stronger performance** in all periods.
- Each leg of intangible value outperforms traditional value that is **industry-sorted**.
- Outperformance is more pronounced when **financials, utilities, and public service firms are dropped** during portfolio formation.

The Stock Market Valuation of Research and Development Expenditures

Author(s): Louis K. C. Chan, Josef Lakonishok and Theodore Sougiannis

Source: *The Journal of Finance*, Dec., 2001, Vol. 56, No. 6 (Dec., 2001), pp.
Published by: Wiley for the American Finance Association

Key Findings:
- Using R&D/sales as signal **does not generate a spread in average returns** or alphas.
- Market is skeptical about firms with high R&D/MarketCap, giving them low valuations.
- The evidence on an association between **R&D intensity measured relative to sales and future returns** is **not strong.**
- The clearest evidence that high R&D plays a distinctive role arises from stocks with **high R&D relative to the market value of equity.**

Strategy Construction

Baseline signal:

signal = - intan

Control industry:

Technology sector

Control size:

Signal = $\frac{-\text{Intan}}{\text{at}}$

Adjust current asset:

Signal = $\frac{-\text{Intan}}{\text{at}-\text{act}}$

- "Intan" represents the value of total intangible asset on a company's balance sheet
- Negative sign captures our main economic idea: penalize companies with high intangible assets

- Different industries may have different number of patents, copyright, etc. on average
- Make apple-to-apple comparison within only one industry for intangible assets

- Larger firms may have greater number of intangible assets
- Add denominator "at", representing total assets, to our signal to control for different firm size

- Current assets such as account receivable, etc. is frequently changed by daily operations
- Exclude "act", representing total current asset, from our signal denominator

Strategy Construction (cont'd)

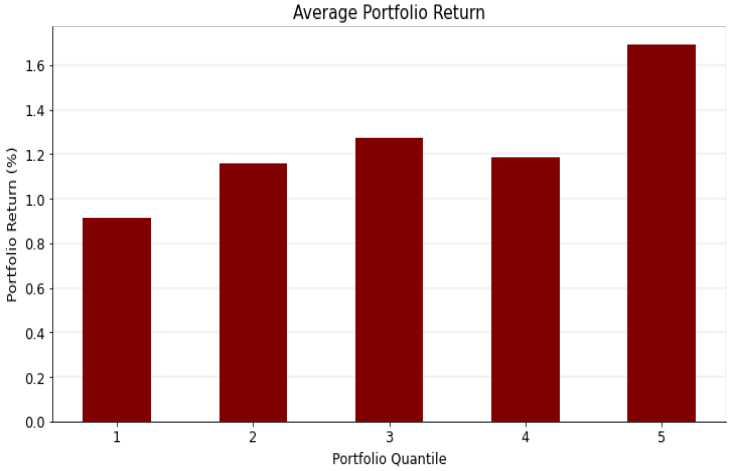
However, it could also be possible that the market has priced in our economic idea: those tech firms with proportionally high intangible assets has already been penalized by a discounted valuation

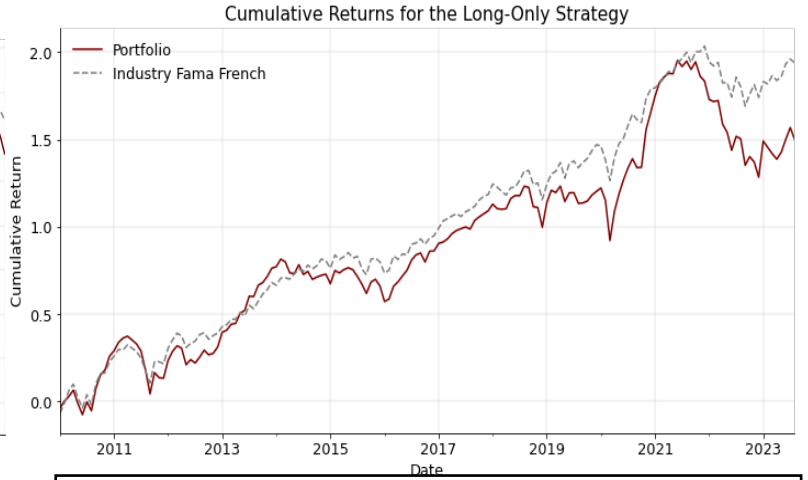
To compensate for potentially repeated penalization, we add a **value signal** = $\frac{\textbf{at} - \textbf{lt}}{\textbf{mkvalt}}$ ($\frac{\textbf{book equity value}}{\textbf{maket capitalzation}}$)

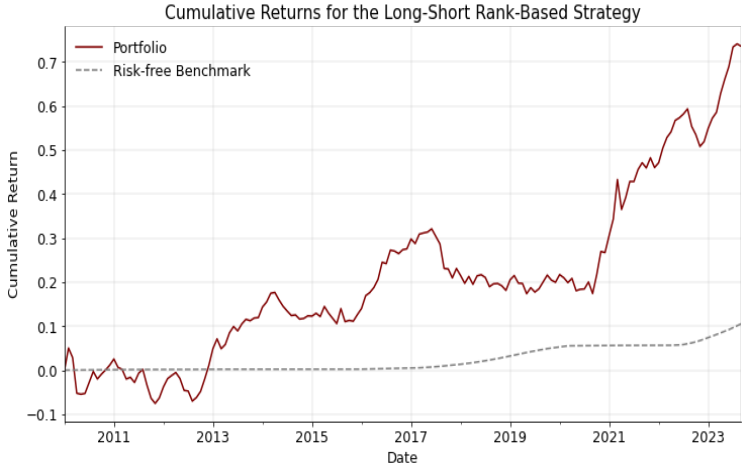
Combined signal = 50% $\frac{-\textbf{Intan}}{\textbf{at}-\textbf{act}}$ **+ 50%** $\frac{\textbf{at} - \textbf{lt}}{\textbf{mkvalt}}$ (after normalizing signal value to z-score)

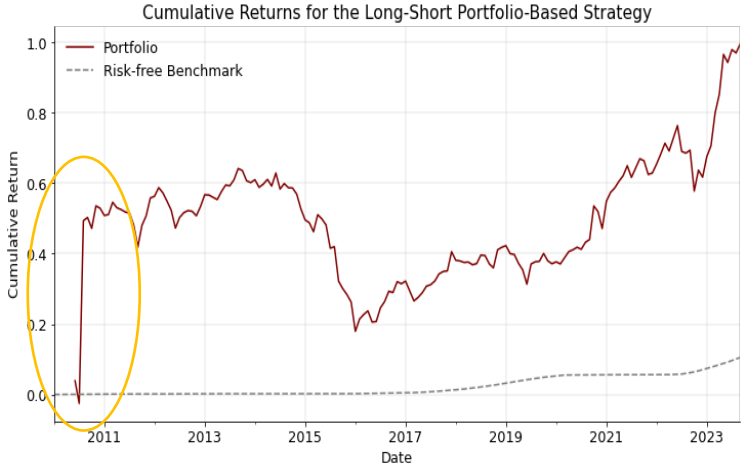
- ➔ High intangible asset, high current valuation: penalize the most 
- ➔ High intangible asset, low current valuation: fine, has been penalized 
- ➔ Low intangible asset, high current valuation: fine, fairly priced 
- ➔ Low intangible asset, low current valuation: reward the most 

Result: Combined Signal









Observations on Performances:

- Positive relationship between the quintile rank and portfolio performance (Fig 1)
- Outperform risk-free benchmark
- Periods of outperformance and underperformance compared to FF industry portfolios

Result: Combined Signal (cont'd)

```
------------------------------------------------------------------
> Running Factor Regressions: Table 1  - 3 Fama-French Factors
------------------------------------------------------------------

=====================================================================
                 (1)       (2)       (3)       (4)       (5)       (6)
---------------------------------------------------------------------
const          0.0084   -0.0030   0.0042**  0.0086   -0.0007   0.0049***
               (0.0051) (0.0025)  (0.0017)  (0.0052)  (0.0018)  (0.0017)
mktrf          -0.1208  1.2845*** 0.0257    -0.1435   1.0980*** -0.0054
               (0.1137) (0.0550)  (0.0382)  (0.1229)  (0.0429)  (0.0401)
hml                                         -0.0900   -0.2133*** 0.1016**
                                            (0.1568)  (0.0547)  (0.0512)
smb                                         0.1227    0.9031***  0.1233*
                                            (0.2151)  (0.0751)  (0.0702)
R-squared      0.0071    0.7752    0.0029    0.0104    0.8836    0.0602
R-squared Adj. 0.0008    0.7737    -0.0035   -0.0087   0.8814    0.0421
N              160       160       160       160       160       160
R2             0.01      0.78      0.00      0.01      0.88      0.06
=====================================================================
Standard errors in parentheses.
* p<.1, ** p<.05, ***p<.01
(1): Long-Short Value Weights ~ CAPM Model
(2): Long-Only Rank Weights ~ CAPM Model
(3): Long-Short Rank Weights ~ CAPM Model
(4): Long-Short Value Weights ~ 3-Factor Fama French Model
(5): Long-Only Rank Weights ~ 3-Factor Fama French Model
(6): Long-Short Rank Weights ~ 3-Factor Fama French Model
Annualized Information Ratios:
                      1      2      3      4      5      6
Alpha             0.101 -0.036  0.051  0.103 -0.009  0.058
Std(resid)        0.217  0.105  0.073  0.217  0.076  0.071
Information Ratio 0.464 -0.345  0.700  0.474 -0.114  0.826
```

```
------------------------------------------------------------------
> Running Factor Regressions: Table 2  - 5 Fama-French Factors + Momentum
------------------------------------------------------------------

=====================================================================
                 (1)       (2)       (3)       (4)       (5)       (6)
---------------------------------------------------------------------
const          0.0099*  0.0008    0.0047*** 0.0108** 0.0015    0.0053***
               (0.0053) (0.0017)  (0.0017)  (0.0052)  (0.0016)  (0.0017)
mktrf          -0.1529  1.1153*** -0.0020   -0.2217*  1.0658*** -0.0461
               (0.1257) (0.0403)  (0.0412)  (0.1294)  (0.0393)  (0.0409)
hml            0.0965   -0.0881   0.0725    -0.0449   -0.1898*** -0.0180
               (0.2133) (0.0684)  (0.0700)  (0.2232)  (0.0678)  (0.0706)
smb            -0.0090  0.6994*** 0.1349*   -0.0664   0.6582***  0.0982
               (0.2437) (0.0781)  (0.0800)  (0.2432)  (0.0739)  (0.0769)
rmw            -0.2542  -0.4934*** 0.0145   -0.2911   -0.5199*** -0.0091
               (0.2886) (0.0925)  (0.0947)  (0.2865)  (0.0870)  (0.0906)
cma            -0.3468  -0.1391   0.0615    -0.1937   -0.0290   0.1595
               (0.3178) (0.1019)  (0.1043)  (0.3244)  (0.0985)  (0.1026)
umd                                         -0.3180*  -0.2287*** -0.2035***
                                            (0.1615)  (0.0491)  (0.0511)
R-squared      0.0232   0.9030    0.0625    0.0474    0.9151    0.1506
R-squared Adj. -0.0085  0.8998    0.0320    0.0100    0.9117    0.1173
N              160      160       160       160       160       160
R2             0.02     0.90      0.06      0.05      0.92      0.15
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Alpha             0.119  0.010  0.057  0.130  0.018  0.064
Std(resid)        0.215  0.069  0.071  0.213  0.065  0.067
Information Ratio 0.551  0.143  0.801  0.611  0.279  0.949
```

Observations on Alphas:

- increases and becomes more significant as more factors are included: performance is unexplained when adding more factors
- most significant for rank-based portfolios and long-short portfolios
  - These portfolios use signal more effectively
  - long-short strategies fit our economic idea more, because a high ratio is viewed as a notably adverse signal, outweighing the positive implications of a low ratio.

Result: Combined Signal (cont'd)

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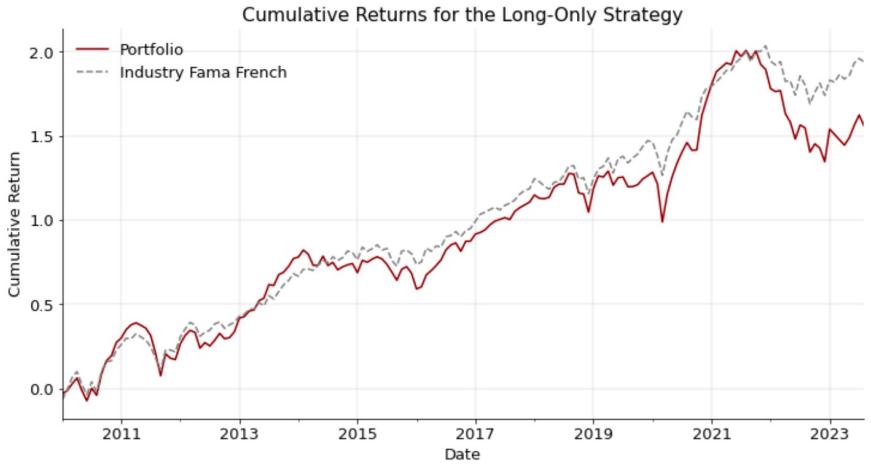
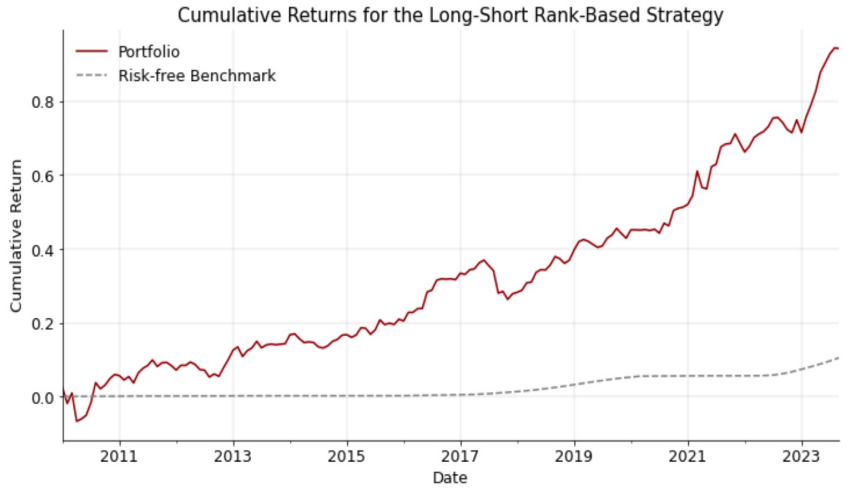
Std(resid)      0.215  0.069  0.071  0.213  0.065  0.067
Information Ratio 0.551 0.143  0.801  0.611  0.279  0.949
```

Observations on Betas:

- By the left figure, the betas of CAPM and 3-Factor FF model are more significant for rank-based strategy (2), (3), (5), (6).
- Positive and significant SMB for rank-based strategy (2), (3), (5) shows it prefers smaller companies.
- Consistently negative and significant UMD shows it potentially performs better during market downturns.
- There is not much consistent patterns in the Betas, which suggests factors have limited explanatory power regarding the signal performance.

Comparison: Without Value Signal





> Running Factor Regressions: Table 1 – 3 Fama-French Factors

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	(0.0031)	(0.0024)	(0.0015)	(0.0031)	(0.0017)	(0.0015)
mktrf	0.0435	1.2713***	-0.0271	0.0368	1.0904***	-0.0359
	(0.0684)	(0.0531)	(0.0334)	(0.0727)	(0.0403)	(0.0356)
hml				-0.2217**	-0.2623***	-0.0942**
				(0.0928)	(0.0514)	(0.0454)
smb				0.0745	0.8870***	0.0589
				(0.1273)	(0.0706)	(0.0623)
R-squared	0.0025	0.7839	0.0042	0.0378	0.8938	0.0319
R-squared Adj.	-0.0038	0.7825	-0.0021	0.0193	0.8917	0.0133
N	160	160	160	160	160	160
R2	0.00	0.78	0.00	0.04	0.89	0.03

Standard errors in parentheses.
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Annualized Information Ratios:

	1	2	3	4	5	6
Alpha	0.069	-0.031	0.073	0.065	-0.005	0.073
Std(resid)	0.131	0.101	0.064	0.128	0.071	0.063
Information Ratio	0.528	-0.303	1.147	0.511	-0.072	1.156

Observations on Performances:

- Higher alpha for single-signal strategy
- Beta still inconsistent

Potential explanations:

- Traditional value metrics (e.g., B/M ratio) cancel out certain intangible signal
- B/M is not an ideal valuation factor due to the high volatility of the technology sector
- Timing of the data

Implications for Further Research

1. Use the strategy in other sectors
2. more focusd on accounting quality (z score, f score, accruals – CFO) and valuation risks