# The Impact of AI Talents on Hedge Fund Performance

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# Motivation

THE WALL STREET JOURNAL.

## Letting the Machines Decide

New Wave of Investment Firms Look to 'Artificial Intelligence' in Trade Decisions

*By Scott Patterson*

Updated July 13, 2010 12:01 am ET

Bloomberg

## The Massive Hedge Fund Betting on AI

Forbes

Feb 15, 2019, 01:48am EST | 18,821 views

## The Revolutionary Way Of Using Artificial Intelligence In Hedge Funds

# Motivation

**Machines have succeeded in many tasks**

- Image recognition
- Text interpretation and translation
- Game playing
- Automatic driving

**Artificial Intelligence sweeps in hedge fund industry**

- *"Over half of hedge fund respondents (56%) used AI to inform investment decisions – nearly triple the 20% reported a year earlier"*
- *"Around two-thirds of those using AI were doing so to generate trading ideas and optimize portfolios"*

– BarclayHedge's Hedge Fund Sentiment Survey (2018)

# Example of Hedge Funds adopt AI techniques

**Marshall Wace combines alternative data and AI to generate investment ideas**

- Satellite images of parking lots
- Mobile phone geolocations

# Research Objectives

## Research Questions

1. Can AI help hedge funds improve performance?
2. Can AI help hedge funds manage risk?
3. Will AI affect hedge funds' trading behavior?

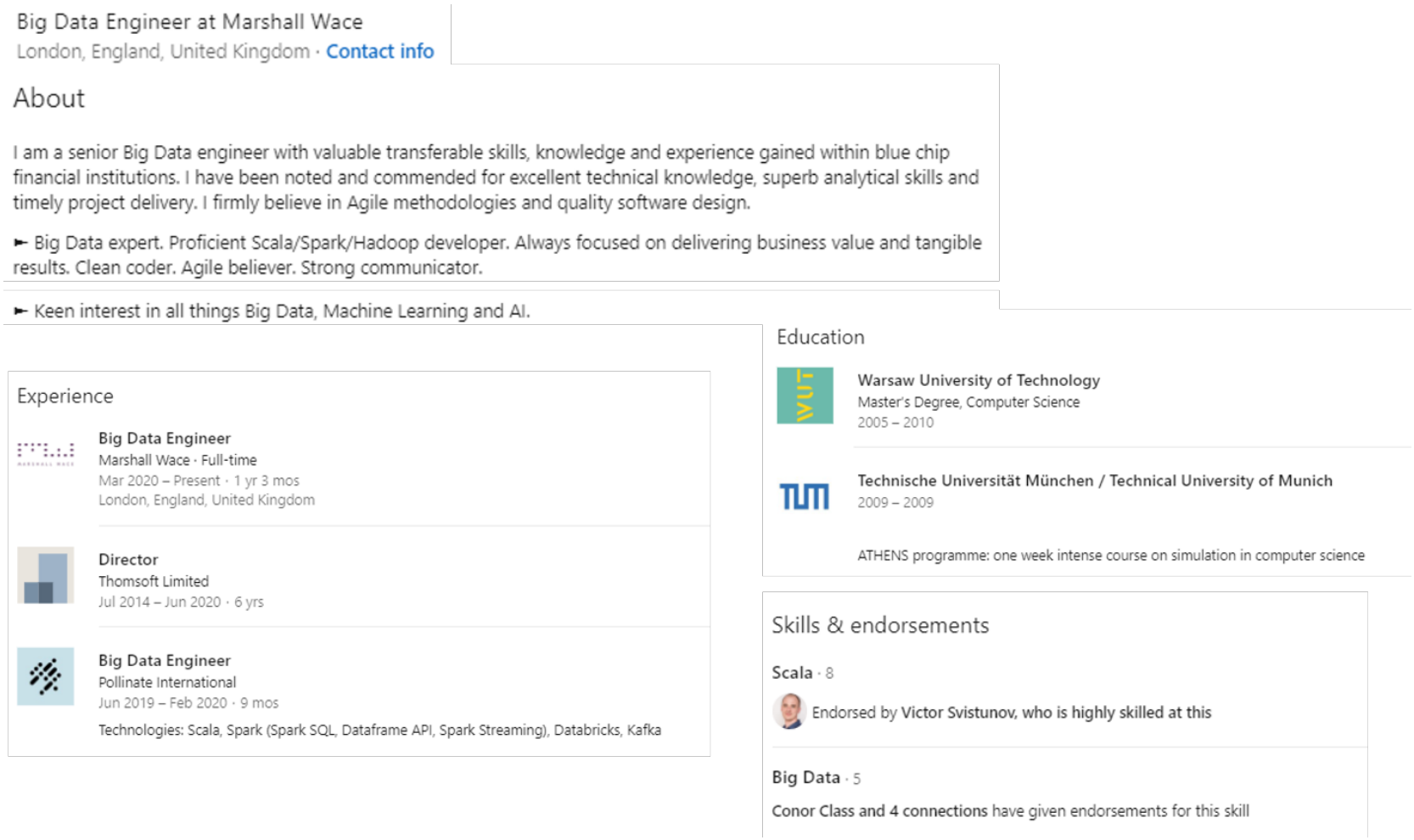
## Challenges

- It is hard to observe:
  - whether hedge funds adopt AI techniques
  - when hedge funds adopt AI techniques
  - the extent of AI adoption
- Could be just for the purpose of advertising

# Research Objectives

## Identify through employment of AI talents

- Most of employees are available on social network
- Multi-dimension of employee profile



# Findings

**Employment of AI talents is associated with annual improvement of alpha by 2.64%, and the improvement is more pronounced when:**

- AI employees have previously worked in the tech industry
- AI employees earned a Ph.D. degree

**AI improves the procedure of portfolio optimization and risk management**

- Reduction in total fund risk
- Increase in the Sharpe ratio and information ratio

**Employment of AI talents change funds' trading behavior**

- Funds hold a larger number of securities
- Fewer local stocks
- Shift more weights on certain industry such as consumer goods industry

# Contributions

**Factors Affected Hedge Fund Performance**

- Managers (e.g., Li, Zhang, and Zhao 2011), Fund Characteristics (e.g., Teo 2009; Aggarwal and Jorion 2010), Financial Contracting Mechanisms (e.g., Agarwal, Daniel, and Naik 2009), Redemption Restrictions (e.g. Aragon 2001; Aragon, Martin, Shi 2019), and Regulatory Disclosures (e.g. Shi, 2017)

**Technology Innovation on Firm Value and Productivity**

- Firm growth and industry concentration (e.g., Kogan, Papanikolaou, Seru, and Stoffman 2017, Babina, Fedyk, He, and Hodson 2021), Labor Market (e.g., Grennan and Michaely 2021), Credit Market (Fuster, Goldsmith-Pinkham, Ramadorai, and Walther 2020), Equity Analysis (Grennan and Michaely 2020)

# Contributions

**Human Capital on Firm Outcomes**

- Public Firm Return (Fedyk and Hodson 2020), Marketing (Kostovetsky and Manconi 2018)

# Data and Features

**Fund Return and Characteristics from Union Hedge Fund Data**

- Eurekahedge, HFR, Morningstar, and Lipper TASS

**Fund Holding and Location from 13F, CRSP, and WhaleWisdom**

- Classify hedge fund firms manually following Agarwal, Fos, and Jiang 2013

**Information of AI Talents from Hand Collect Data from LinkedIn**

- Companies under three industries: Financial Service, Capital Market, and Investment Management
- Omit large financial companies with more than 200 current employees
- Manually match to IDs in the Union Hedge Fund Data and 13F separately based on name, location, and key person in the company
- Including Title, Introduction, Employment History, Education, Skills, Endorsement, Interest, etc

# Identify AI Talents

Search current and previous employees of hedge fund companies in the matched sample that contains AI-related keyword

**AI keywords: Glossary of Artificial Intelligence from Wikipedia**

- **AI and Synonyms:** Artificial Intelligence, AI, A.I.
- **Sub-field under AI:** Deep Learning, Machine Learning, Association Rule Learning, Reinforcement Learning, Natural Language, Big Data, etc
- **Techniques used in AI:** Decision Tree, Random Forest, K-means, Apriori, eclat, Word Embedding, Bag-of-words, Neural Network, K-fold Cross Validation, NLP, etc
- **Softwares specifically for AI developers:** Tensorflow, Pytorch, etc

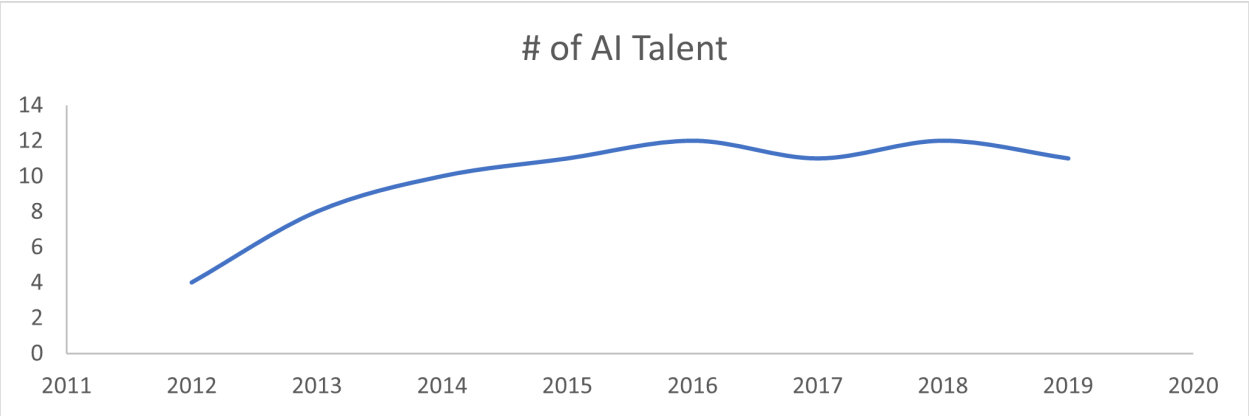
# Identify AI Talents

**Separate targeted employees into:**

- **AI Employee**: Employee with AI-related word in job title or job description. e.g. Data Scientist currently on machine learning projects
- **AI Candidate**: Employee with AI-related word in Introduction, Education, Top-10 Endorsed Skills

**Define AI Hedge Fund Company with at least one AI Employee and:**

- **More than 50 employees:** Three AI Employee and AI Candidates
- **10 - 50 employees:** Two AI Employee and AI Candidates
- **Less than 10 employees** One AI Employee and AI Candidates



# Summary Statistics

| | Union Sample | 13F Sample |
|---|---|---|
| *All Fund Companies* | 5643 | 1872 |
| *Companies in Linkedin* | 1229 | 765 |
| *AI Companies in Linkedin* | 226 | 55 |

| | AI Funds | | | Non-AI Funds | | |
|---|---|---|---|---|---|---|
| | N | Mean | Median | N | Mean | Median |
| *Management Fee (%)* | 1,091 | 1.51 | 1.5 | 5,893 | 1.44 | 1.5 |
| *Incentive Fee (%)* | 1,091 | 15.85 | 20 | 5,893 | 14.92 | 20 |
| *Leveraged* | 1,091 | 15.52 | 1 | 5,893 | 6.96 | 1 |
| *Lockup (day)* | 1,091 | 62.23 | 0 | 5,893 | 70.68 | 0 |
| *Redemption Frequency (day)* | 1,091 | 46.27 | 30 | 5,893 | 54.10 | 30 |
| *Redemption Advance Notice Period (day)* | 1,091 | 28.07 | 30 | 5,893 | 30.79 | 30 |
| *High Water Market* | 1,091 | 0.76 | 1 | 5,893 | 0.68 | 1 |
| *Hurdle Rate* | 1,091 | 0.24 | 0 | 5,893 | 0.22 | 0 |

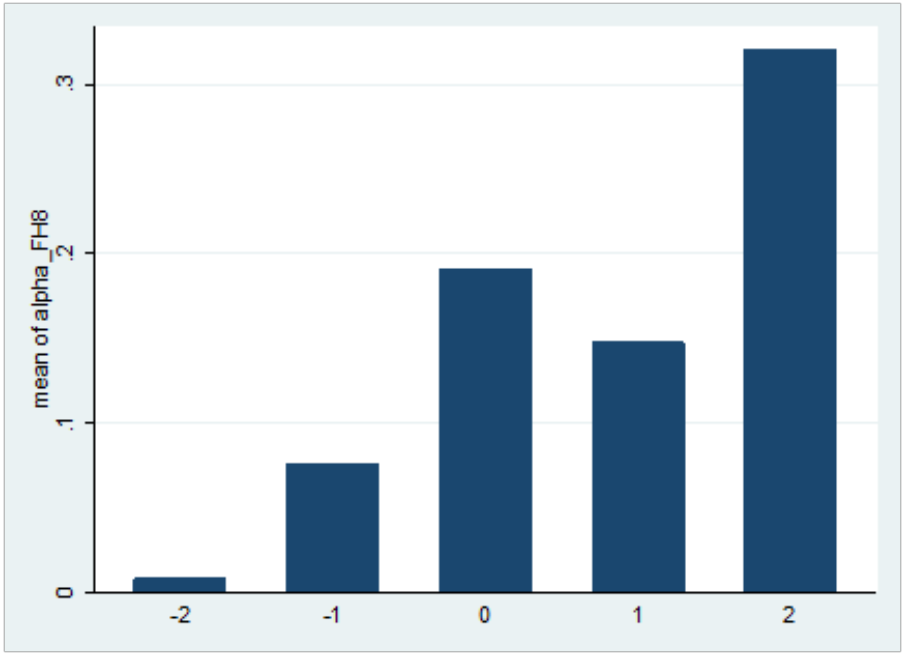
# Style Breakdown

- Funds with style of Relative Value, Global Macro, CTA are more likely to adopt AI techniques

| | AI Fund | | Non-AI Fund | | Difference |
|---|---|---|---|---|---|
| | # of Funds | % | # of Funds | % | % |
| *Long Short* | 333 | 32.78 | 1,844 | 36.35 | -3.57*** |
| *Relative Value* | 174 | 17.13 | 750 | 14.78 | 2.34*** |
| *Global Macro* | 162 | 15.94 | 420 | 8.28 | 7.67*** |
| *CTA* | 119 | 11.71 | 190 | 3.75 | 7.98*** |
| *Multi Strategy* | 65 | 6.40 | 373 | 7.35 | -0.96 |
| *Long Only* | 58 | 5.71 | 451 | 8.89 | -3.18*** |
| *Event Driven* | 44 | 4.33 | 404 | 7.96 | -3.63*** |
| *Market Neutral* | 25 | 2.46 | 112 | 2.21 | 0.25 |
| *Other* | 20 | 1.97 | 315 | 6.21 | -4.24*** |
| *Emerging Markets* | 14 | 1.38 | 203 | 4.00 | -2.62*** |
| *Short Bias* | 2 | 0.20 | 11 | 0.22 | -0.02 |

# AI talents on Fund Performance

- The performance of Hedge funds improves after adopting AI techniques




| | Pre-AI | | | Post-AI | | | Difference |
|---|---|---|---|---|---|---|---|
| | *# obs.* | *mean* | *sd* | *# obs.* | *mean* | *sd* | |
| *Eight-Factor Model Alpha* | 9,619 | 0.04 | 4.20 | 7,317 | 0.23 | 3.65 | 0.19*** |

# AI talents on Fund Performance

- The performance of Hedge funds improves after adopting AI techniques

| | *Fung-Hsieh Eight-Factor Alpha* | |
|---|---|---|
| $AI_{i,t}$ | 0.233** | 0.220** |
| | (2.410) | (2.258) |
| $Fundsize_{i,t-1}$ | | -0.264*** |
| | | (-4.500) |
| $Fundsize^2_{i,t-1}$ | | 0.139*** |
| | | (2.492) |
| $Logfundsize_{i,t-1}$ | -0.190*** | |
| | (-8.030) | |
| Fund fixed effects | Yes | Yes |
| Time fixed effects | Yes | Yes |
| Observations | 324,757 | 325,082 |
| R-squared | 0.055 | 0.054 |

# Cross-Section of Fund Performance

- Performance improvement is concentrated among funds with
  - greater percentage of AI employees
  - AI employee with Ph.D. degree
  - AI employee from tech industry
  - fund styles that have less AI competition

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | *Fung-Hsieh Eight-Factor Alpha* | | | | | | | |
| | Percentage of AI Employee | | AI Employee with a Ph.D. | | AI Competitiveness | | Transferred from Tech Industry | |
| | High | Low | Yes | No | High | Low | Yes | No |
| $AI_{i,t}$ | 0.32*** | 0.02 | 0.29** | 0.03 | 0.12 | 0.30*** | 0.36** | 0.06 |
| | (2.61) | (0.15) | (2.50) | (0.22) | (0.77) | (2.70) | (2.56) | (0.43) |
| $Logfundsize_{i,t-1}$ | -0.18*** | -0.19*** | -0.18*** | -0.19*** | -0.24*** | -0.20*** | -0.18*** | -0.19*** |
| | (-7.66) | (-7.21) | (-7.73) | (-7.12) | (-7.64) | (-6.21) | (-7.66) | (-7.31) |
| Fund fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 304,359 | 285,847 | 305,070 | 285,136 | 93,694 | 231,011 | 294,393 | 301,938 |
| R-squared | 0.05 | 0.06 | 0.05 | 0.06 | 0.09 | 0.06 | 0.05 | 0.06 |

# AI Talents on Portfolio Optimization

- AI could be a potential solution to the optimization challenge
  - Kinn 2018, Ban, Karoui, and Lim 2018
- AI technology improves the efficiency of funds' portfolio diversification

| | (1) *Total Risk* | (2) *Market Risk* | (3) *Isdiosyncratic Risk Carhart4* | (4) *Idiosyncratic Risk FH8* |
|---|---|---|---|---|
| $AI_{i,t}$ | -0.002*** | 0.008 | -0.002*** | -0.001*** |
| | (-2.923) | (0.465) | (-3.480) | (-2.746) |
| $Lagfundsize_{i,t-1}$ | -0.000* | -0.000** | -0.000** | -0.000* |
| | (-1.757) | (-2.215) | (-2.323) | (-1.925) |
| Fund fixed effects | Yes | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes | Yes |
| Observations | 291,925 | 291,925 | 292,284 | 292,284 |
| R-squared | 0.769 | 0.710 | 0.748 | 0.731 |

# AI Talents on Portfolio Optimization

- AI could be a potential solution to the optimization challenge
  - Kinn 2018, Ban, Karoui, and Lim 2018
- AI technology improves the efficiency of funds' portfolio diversification

| | (1) *Sharpe Ratio* | (2) *Info Ratio Carhart4* | (3) *Info Ratio FH8* |
|---|---|---|---|
| $AI_{i,t}$ | 0.099** | 0.124*** | 0.123** |
| | (2.503) | (2.792) | (2.193) |
| $Lagfundsize_{i,t-1}$ | -0.000*** | -0.000*** | -0.000*** |
| | (-5.989) | (-5.399) | (-5.458) |
| Fund fixed effects | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes |
| Observations | 291,887 | 291,887 | 292,182 |
| R-squared | 0.254 | 0.212 | 0.187 |

# AI Talents on Fund Investment Behavior

Allow funds to process a large amount of information

- Hedge funds hold a greater number of securities

Use alternative and unstructured data to generate investment ideas

- Hedge funds invest more in the sector with more unstructured and alternative data

Rely more on public information

- Hedge funds hold less local stocks

# AI Talents on Fund Investment Behavior

Allow funds to process a large amount of information

- Hedge funds hold a greater number of securities after the employment of AI talents

| | (1) | (2) |
|---|---|---|
| | *Log of Number of Holding* | |
| $AI_{i,t}$ | 0.31** | 1.33*** |
| | (2.17) | (48.81) |
| $Logcompanysize_{i,t-1}$ | 0.32*** | 0.37*** |
| | (18.75) | (98.36) |
| Company FE | Yes | No |
| Time FE | Yes | Yes |
| Observations | 29,715 | 29,718 |
| R-squared | 0.90 | 0.31 |

# AI Talents on Fund Investment Behavior

Use alternative and unstructured data to generate investment ideas

- Hedge Hedge funds invest more in the industry that allow AI build information advantages from massive public information

| | (1) *Consumer Goods* | (2) *Health Care* | (3) *Utility* | (4) *Financial* | (5) *Real Estate* |
|---|---|---|---|---|---|
| $AI_{i,t}$ | 0.78** | 0.68 | -1.09 | -0.36 | 0.16 |
| | (2.53) | (1.53) | (-1.41) | (-0.23) | (0.21) |
| $LogCompanysize_{i,t}$ | -0.53*** | -0.70*** | 0.14 | -1.97*** | -0.83*** |
| | (-2.97) | (-3.43) | (0.35) | (-6.31) | (-3.08) |
| Observations | 15,460 | 15,708 | 16,363 | 23,990 | 9,169 |
| R-squared | 0.71 | 0.47 | 0.63 | 0.68 | 0.63 |

# AI Talents on Fund Investment Behavior

Rely more on public information

- Hedge funds hold fewer local stocks after the employment of AI talents

| | (1) *Log Distance* | (2) *Within 50km* | (3) *Within 100km* | (4) *Within 200km* |
|---|---|---|---|---|
| $AI_{i,t}$ | 0.060*** | -0.009*** | -0.005* | -0.008** |
| | (6.799) | (-3.726) | (-1.722) | (-2.548) |
| $Logcompanysize_{i,t-1}$ | 0.013*** | 0.002*** | -0.001 | 0.001 |
| | (3.522) | (4.010) | (-0.989) | (1.484) |
| Observations | 22,093 | 22,093 | 22,093 | 22,093 |
| R-squared | 0.008 | 0.005 | 0.005 | 0.006 |

# Robustness

- Performance improvement is associated with adopting AI technique but not algorithm trading

| | (1) | (2) |
|---|---|---|
| | *Fung-Hsieh* | *Eight-Factor Alpha* |
| $AI_{i,t}$ | 0.24** | |
| | (2.46) | |
| $Algorithmictrading_{i,t}$ | -0.03 | -0.02 |
| | (-0.42) | (-0.24) |
| $Logfundsize_{i,t-1}$ | -0.19*** | -0.19*** |
| | (-8.02) | (-7.98) |
| Observations | 324,757 | 324,757 |
| R-squared | 0.055 | 0.055 |

# Alternative Performance Measure

- Performance improvement is revealed in alternative performance measures

| | (1) *Raw Returns* | (2) *Market Model* | (3) *FF3* | (4) *Carhart4* | (5) *Carhart + Liq* | (6) *FH7* | (7) *Style Adjusted* |
|---|---|---|---|---|---|---|---|
| $AI_{i,t}$ | 0.18* | 0.22** | 0.19** | 0.19** | 0.20** | 0.26*** | 0.15* |
| | (1.69) | (2.44) | (2.12) | (2.06) | (2.07) | (2.68) | (1.88) |
| $Logfundsize_{i,t-1}$ | -0.22*** | -0.20*** | -0.17*** | -0.17*** | -0.16*** | -0.20*** | -0.21*** |
| | (-9.66) | (-8.21) | (-7.33) | (-7.94) | (-7.38) | (-7.93) | (-10.52) |
| Observations | 362,365 | 324,787 | 324,787 | 324,787 | 324,787 | 324,767 | 362,365 |
| R-squared | 0.16 | 0.09 | 0.08 | 0.08 | 0.07 | 0.08 | 0.03 |

# Conclusion

- **Employment of AI talents improves the annual performance**
  - 2.64% of alpha annually
  - The improvement is more pronounced when funds hire more AI talents, adopt deeper AI techniques, and in styles with less competition
- **AI improves the procedure of portfolio optimization and risk management**
  - Reduction in total fund risk
  - Increase in the Sharpe ratio and information ratio
- **Employment of AI talents changes funds' trading behavior**
  - Allow fund to process a large amount of information
  - Use Alternative and unstructured data to generate investment ideas
  - Rely more on public information