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# What determines AI?

Tim DeStefano
with
Jaehan Cho, Hanhin Kim and Jin Paik

HARVARD BUSINESS SCHOOL

HARVARD CATALYST
THE HARVARD CLINICAL AND TRANSLATIONAL SCIENCE CENTER

HARVARD John A. Paulson School of Engineering and Applied Sciences

KIET Korea Institute for Industrial Economics & Trade

# Recent developments in AI

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- Artificial intelligence (AI) is becoming a realistic technology choice for firms
  - OECD 2020; Schmelzer 2020; Iansiti and Lakhani 2020; Agrawal et al 2020
- AI expected to profoundly impact the economy, disrupt the way firms compete and organize
  - Brynjolfsson & McAfee 2014; Agrawal et al 2018; Goldfarb et al 2020; Iansiti & Lakhani 2020
- Differences in technology diffusion can lead to disparities at the aggregate level
  - Niebel, 2018; Fernald, 2014; Timmer et al., 2011; O'Mahoney, Van Ark, & Timmer, 2008
- To date limited empirical evidence on AI adoption due to the lack and preliminary nature of survey work conducted by national statistically offices
  - Cho et al. 2021; Zolas et al. 2020; Rammer et al. 2021

# Objective

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- Provide empirical analysis on the drives of AI adoption for firms in South Korea
- Novel firm level data from South Korea on firm level AI use in 2017 and 2018

**1) Which firm characteristics are relevant for AI adoption?**

- When firms adopt AI, they are faced with a cost/benefits tradeoff
    - (Zolas et al 2020; Cho et al 2021; Chen et al 2021)

**2) What technologies are complementary for AI adoption?**

- Literature infers data collection devices, computing (cloud) and data practices
    - (Goldfarb et al 2020; Verganti et al 2020; Iansiti and Lakhani 2020)

# Data and Empirical Strategy

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*Data*

- KOSTAT data comprehensive surveys on business activities in South Korea across all sectors
- Period 2017-2018 for sample of 11,063 firms
- Detail information on firm financials and technology use

*Empirical Strategy*

$$\Delta y_{it} = \beta_0 + \beta_1 X_{it=2017} + n_j + n_l + \varepsilon_{it}$$

- $\Delta\, y_{il}$ AI adoption of firm *i* between 2017 to 2018
- $X_i$ a vector of firm characteristics for the year 2017
- Industry ($n_j$) and region ($n_l$)

# State of AI adoption in South Korea

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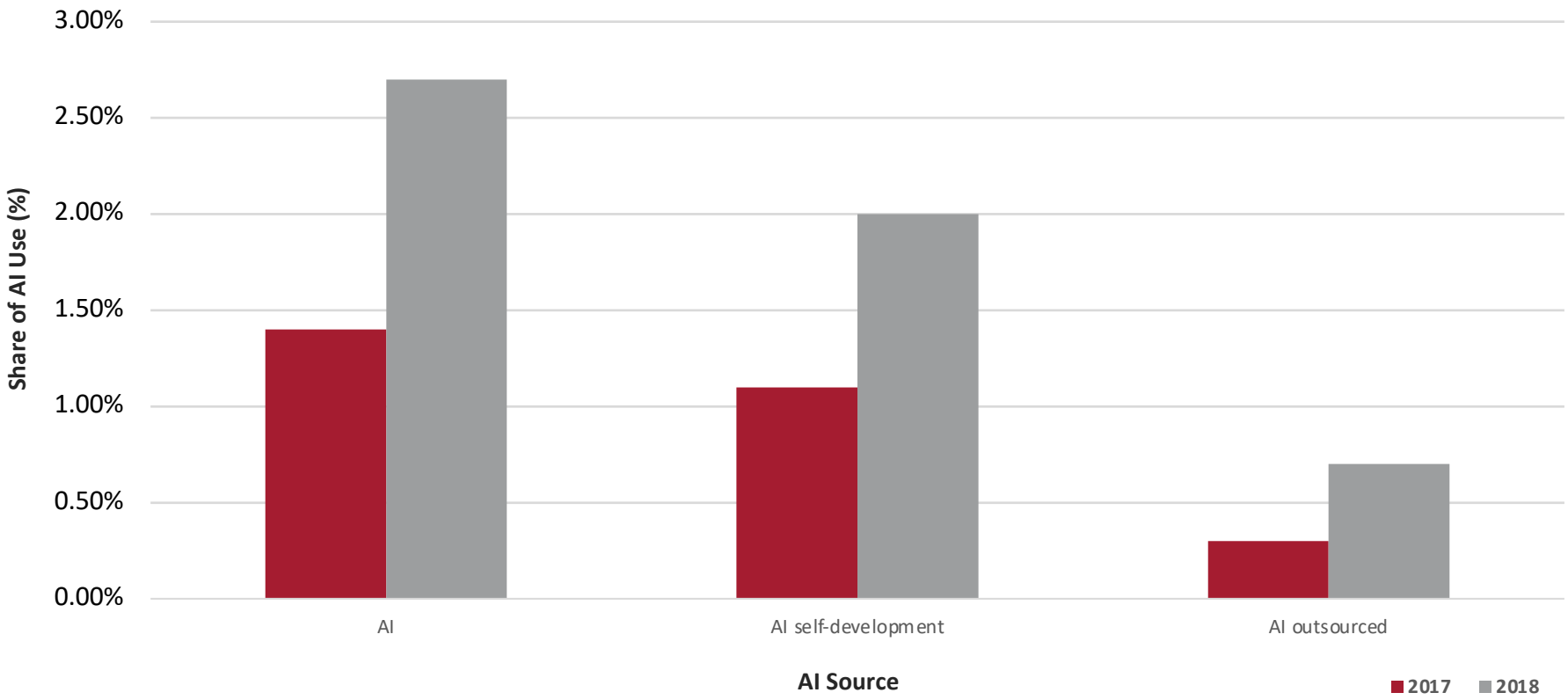

# AI adoption by application

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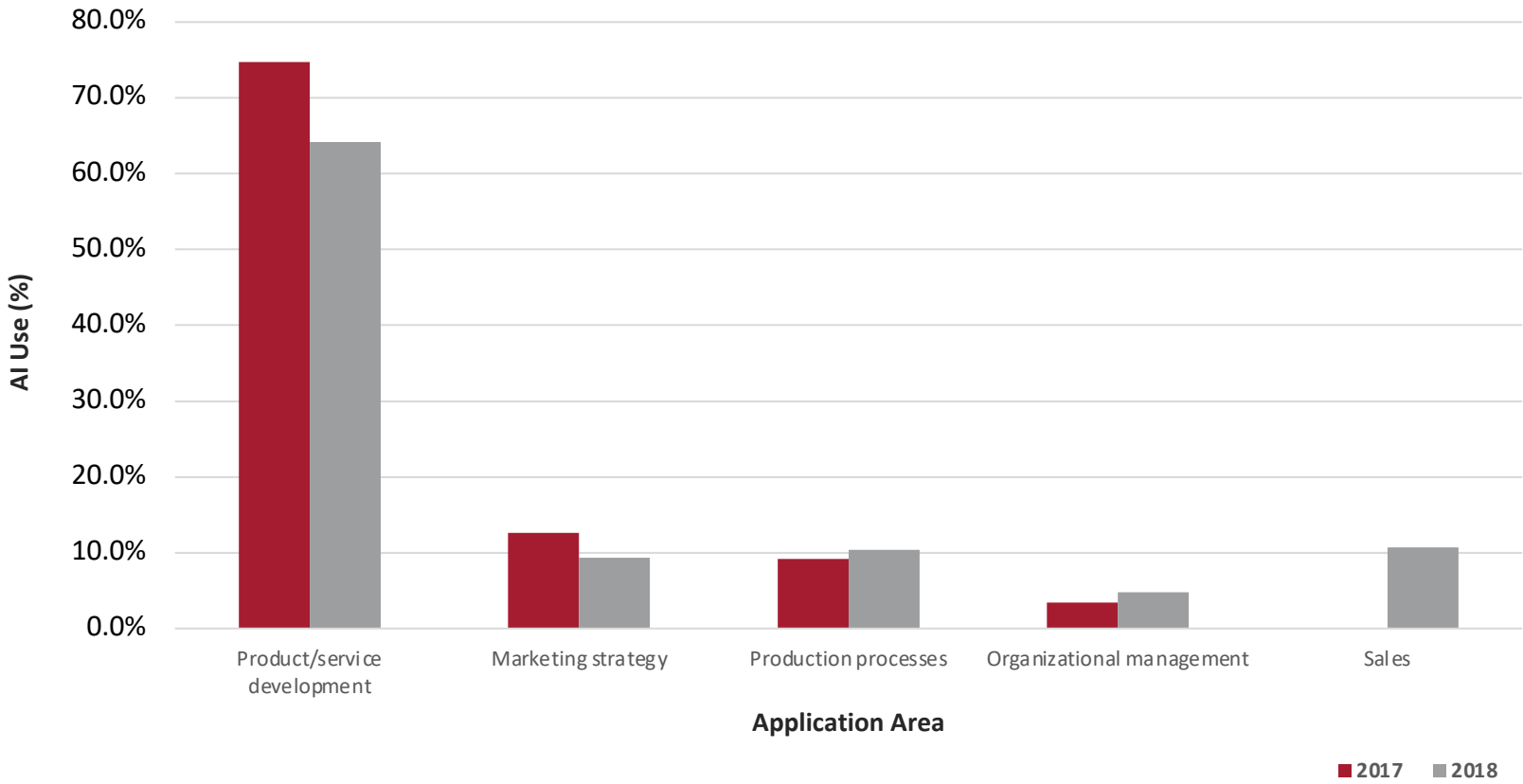

# AI use by sector

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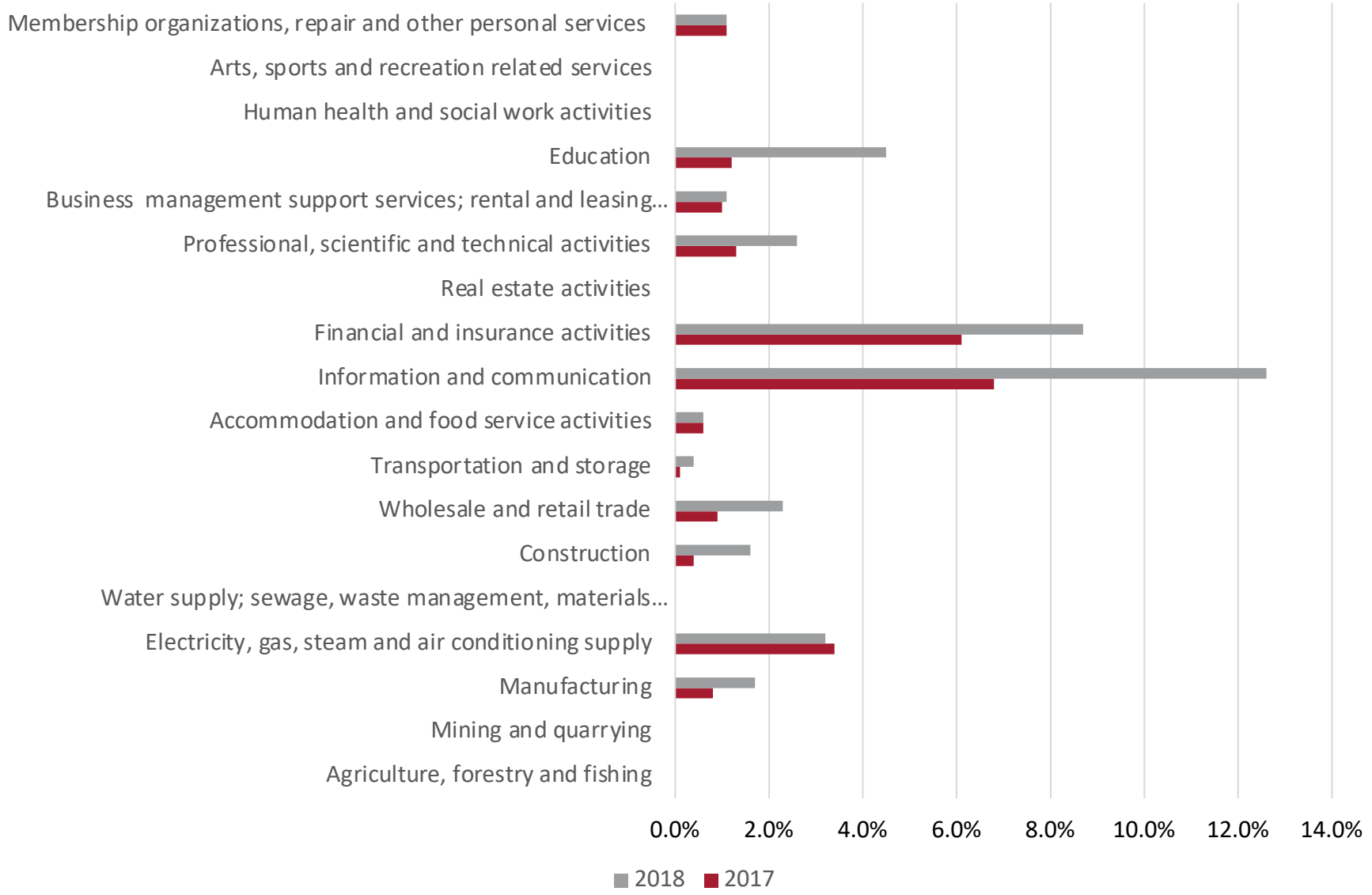

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# Firm determinants of AI adoption

## Regression analysis

# Firm characteristics and AI adoption

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| Dependent variable: AI adoption | Model One | Model Two |
|---|---|---|
| Estimation method | OLS | Probit |
| Log(Sales) | 0.012*** | 0.006*** |
| | [0.002] | [0.001] |
| Log(Labor Productivity) | -0.008*** | -0.003*** |
| | [0.002] | [0.045] |
| Intangible Intensity | 0.081*** | 0.036*** |
| | [0.030] | [0.009] |
| Multi-Establishment | 0.004 | 0.004** |
| | [0.003] | [0.002] |
| Log(Age+1) | -0.002 | -0.001 |
| | [0.002] | [0.001] |
| Foreign Ownership | -0.004* | -0.002 |
| | [0.003] | [0.002] |
| Observations | 11,063 | 9,300 |
| R-squared | 0.039 | |

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# Do other technologies matter for AI adoption

# Ex-ante or contemporaneously

# AI adoption and complementary ICTs

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| Dependent variable: AI adoption | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| | Technology adoption **before** AI adoption | | Technology adoption **during** AI adoption | |
| Estimation method | OLS | Probit | OLS | Probit |
| Big data in 2017 | 0.021 | 0.005 | | |
| | [0.022] | [0.006] | | |
| Cloud in 2017 | 0.001 | 0.001 | | |
| | [0.019] | [0.004] | | |
| IoT in 2017 | 0.051** | 0.019* | | |
| | [0.022] | [0.010] | | |
| Mobile (5G) in 2017 | 0.030* | 0.011 | | |
| | [0.017] | [0.007] | | |
| Big data adoption: 2017-2018 | | | 0.232*** | 0.087*** |
| | | | [0.029] | [0.019] |
| Cloud adoption: 2017-2018 | | | 0.058*** | 0.014** |
| | | | [0.022] | [0.007] |
| IoT adoption: 2017-2018 | | | 0.089*** | 0.024*** |
| | | | [0.021] | [0.008] |
| Mobile adoption (5G): 2017-2018 | | | 0.011 | 0.002 |
| | | | [0.021] | [0.003] |
| Observations | 11,063 | 9,300 | 11,063 | 9,300 |
| R-squared | 0.046 | | 0.171 | |

# Conclusion

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- AI adoption is occurring but amongst a minority of firms
- Those that adopt are intangible intensive and large
- IoT or other technologies that facilitate data collection important prerequisite for AI adoption
  - Cloud, big data and IoT are contemporaneously occurring alongside AI
- The importance of complements implies substantial barriers to adoption
  - AI occurs in an ecosystem of technology
- Current policy approach to technology adoption are capital incentive schemes
- Policy makers should not think of firms as defined by bricks in mortar but as bundles of data and intangibles

# Questions?


175 N. Harvard Street
Suite 1350
Boston, MA 02134
lish@harvard.edu

# Technology definitions

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| Technology type | Definitions |
|---|---|
| **Artificial Intelligence** | A technology enables machines to become intelligent, including the ability to learn, deduce, perceive, and understand natural language through computer programs, to perceive, analyze, determine response and act appropriately in its environment. For a given set of human-defined objectives, make predictions, recommendations or decisions influencing real or virtual environments (OECD, 2019b). |
| **Internet of Things (IoT)** | Smart sensors and services that communicate information between people to people, people to things and things to things by interconnecting all objects via the Internet. (OECD 2017b). |
| **Cloud Computing** | Cloud computing is a service, delivered by third party providers which "enables pay as you go on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (NIST 2011) |
| **Big Data** | The practice of collecting, processing and analyzing large volumes of digital data on a massive scale. The types of data may include numerical, text and imagery data (both structured and unstructured). (OECD 2017b). |
| **Mobile** | The next-generation mobile technologies and services being deployed (including 5G). |

# AI adoption and reorganization

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| Dependent variable: AI adoption | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 |
|---|---|---|---|---|---|---|---|---|
| | Organizational change **before** AI adoption | | | | Organizational change **during** AI adoption | | | |
| Estimation method | OLS | Probit | OLS | Probit | OLS | Probit | OLS | Probit |
| **Reorganize in 2017** | 0.000 | 0.001 | | | | | | |
| | [0.006] | [0.004] | | | | | | |
| Move in 2017 | | | -0.011 | -0.004 | | | | |
| | | | [0.014] | [0.007] | | | | |
| Downsize in 2017 | | | 0.001 | 0 | | | | |
| | | | [0.009] | [0.006] | | | | |
| Expand in 2017 | | | 0.003 | 0.004 | | | | |
| | | | [0.011] | [0.008] | | | | |
| **Reorganize in 2017** | | | | | 0.017** | 0.012** | | |
| | | | | | [0.008] | [0.006] | | |
| Move between 2017-2018 | | | | | | | 0.044 | 0.024 |
| | | | | | | | [0.029] | [0.017] |
| Downsize between 2017-2018 | | | | | | | 0.011 | 0.009 |
| | | | | | | | [0.010] | [0.008] |
| Expand between 2017-2018 | | | | | | | 0.015 | 0.01 |
| | | | | | | | [0.012] | [0.008] |
| Observations | 11,063 | 9,300 | 11,063 | 9,300 | 11,063 | 9,300 | 11,063 | 9,300 |
| R-squared | 0.039 | | 0.039 | | 0.039 | | 0.04 | |