The Value of AI Innovations in Non-IT Firms

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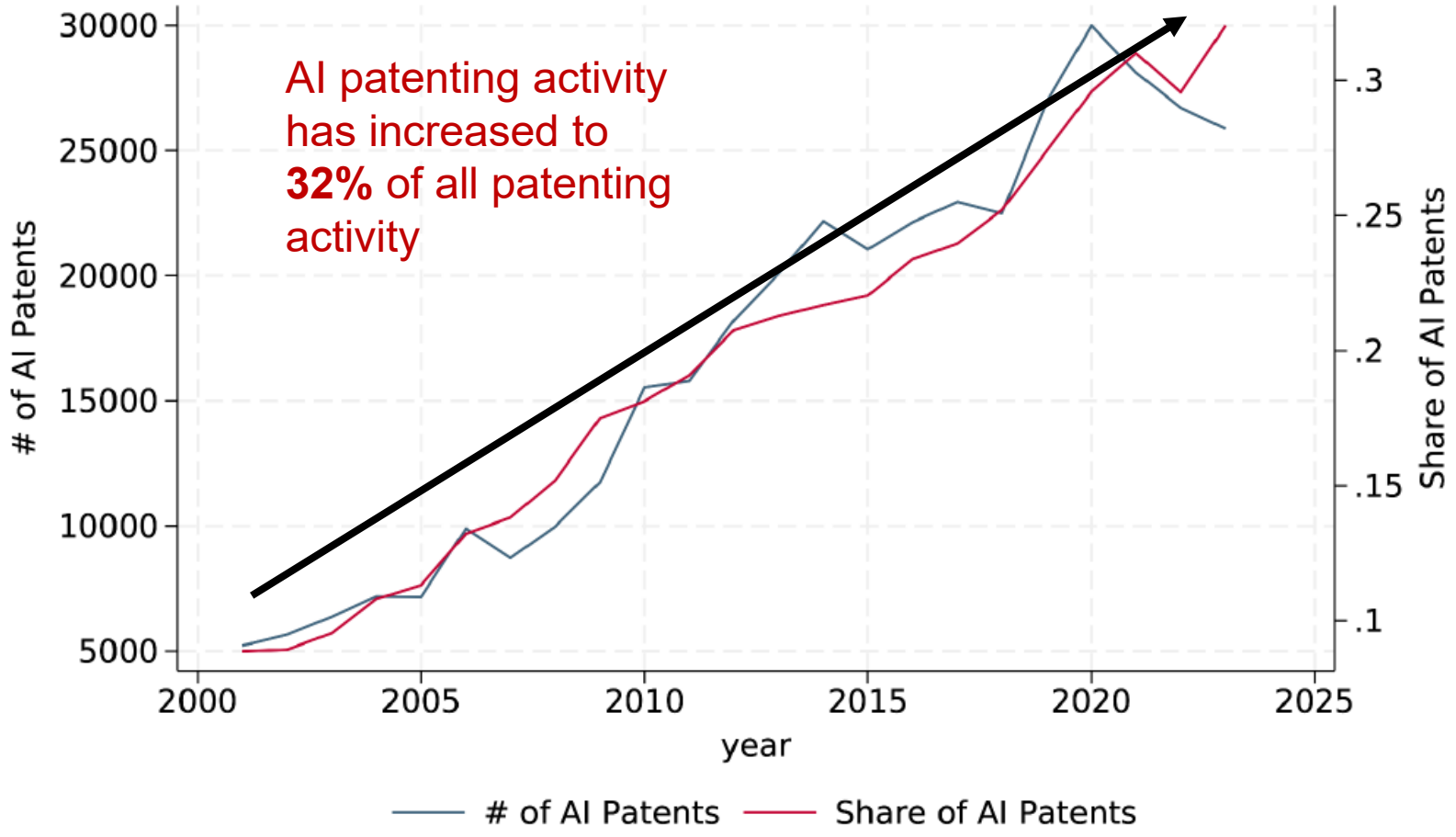
Our Focus in this Study – AI Innovations in Firms

- **AI adoption is rising across firms and organizations**
  - Practitioners and scholars argue that there are large potential benefits of AI technologies across a wide spectrum of the economy
- **Firms can adopt AI technologies in many ways:**
  - Investing in AI software and human capital
  - Acquiring AI start-ups
  - Collaborating with third-parties
- **Our focus in this study is the invention of AI technologies through a study of AI patenting activity**

Why study AI Innovations?

- **AI are an increasingly important driver of research and innovation**
  - Growing number of academic research on AI
  - Rise of AI-powered products and services
- **An opportunity to study the innovation trajectory of general-purpose technologies**
  - A special class of technologies as these technologies are “engines” of economic growth (Bresnahan and Trajtenberg 1995)
  - E.g. steam engines, electricity, computers

AI Innovations Over Time (Figure 1)



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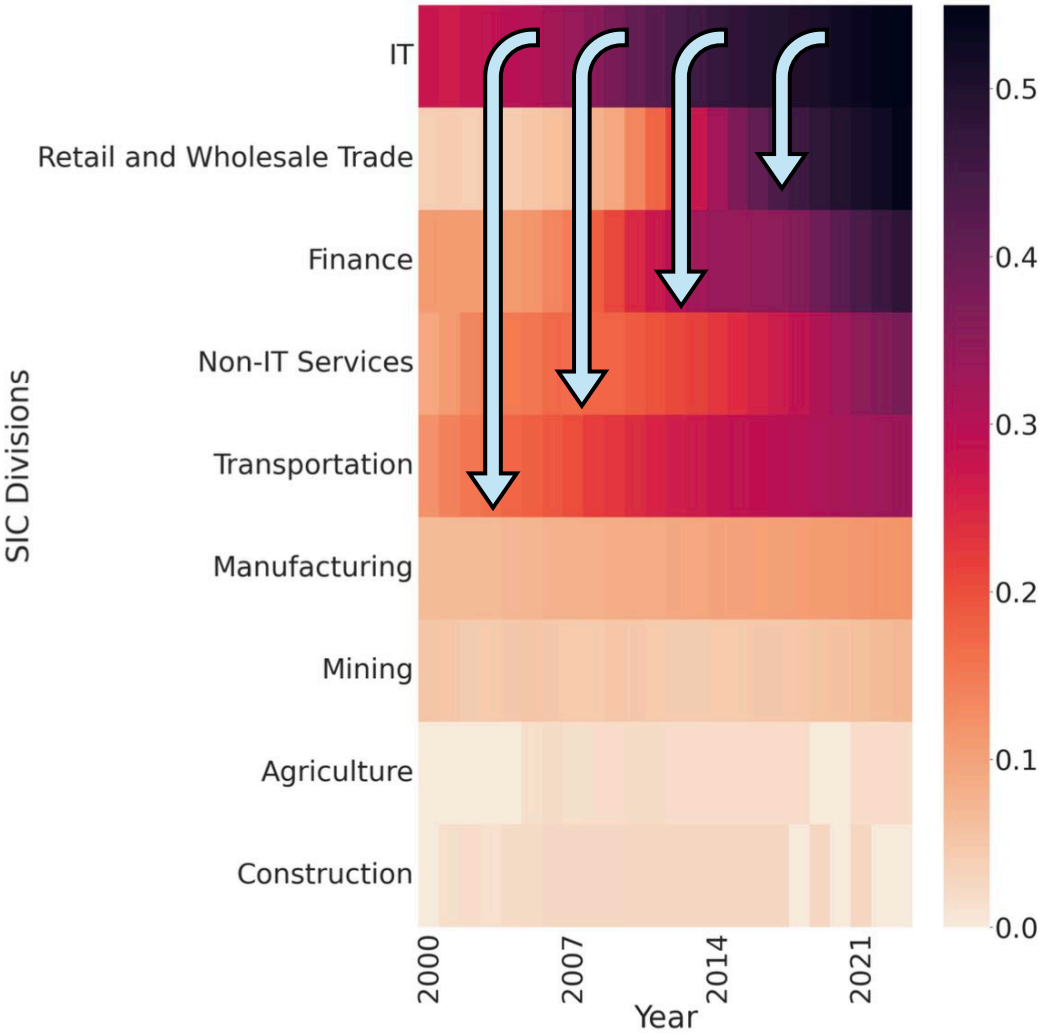
AI as a General-Purpose Technology

- **Recent research argues that AI is a general-purpose technology (Brynjolffson et al, 2017; Goldfarb et al, 2021).**
- **General purpose technologies exhibit several distinctive properties (Bresnahan, 2010):**
  - (1) Wide-use, (2) enables innovation in application sectors and (3) capable of ongoing technical improvement
  - Large potential benefits in technologies that *gradually* unfolds
  - Wide spillovers in inventions across GPT and application sectors
- **Development of AI in application sectors (non-IT industries) is particularly interesting as these sectors:**
  - Less expertise in the core technology
  - But are more knowledgeable about local industry dynamics – customer tastes, business processes – in applying new tech

Wide Spillovers Across Industries (Figure 2)



Consistent with the core AI technologies enabling invention in application sectors, we see growth in AI invention in the non-IT industries

Broad Use Cases for AI Technologies

Research Questions

One of the features of AI is its broad use – that is these technologies are widely applied in many applications outside of its core IT/software sector.

To investigate the development of applications of AI – our study examines three research questions that aim to shed light on the development of AI innovations in non-IT industries (or application sectors of AI)

Who develops AI innovations in non-IT Firms?

What is the value of AI Innovations in non-IT Firms?

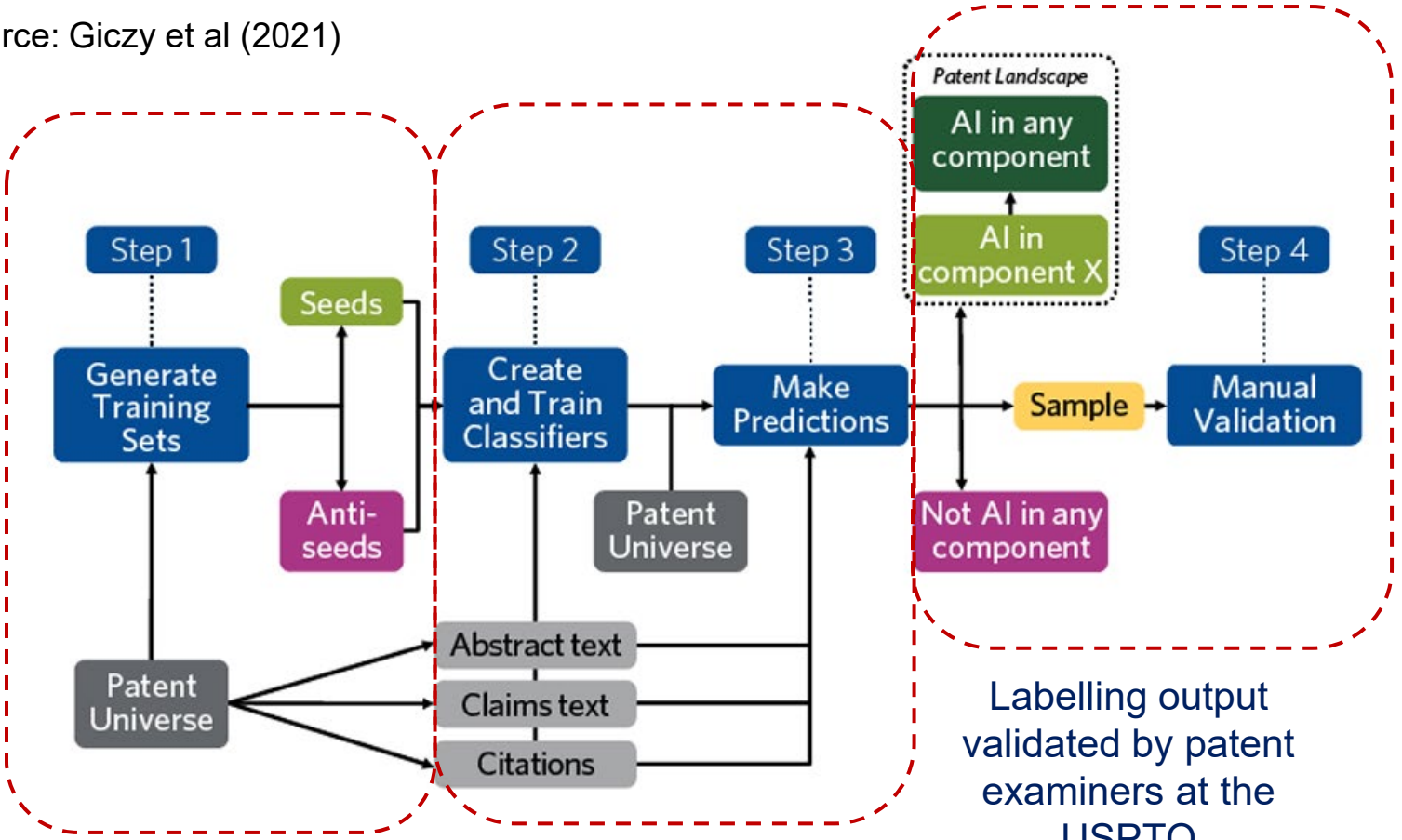
What drives the value of AI Innovations in non-IT firms?

AI Patent Dataset (AIPD)

- **A machine-learning derived categorization of AI patents**
- **Developed by Giczy et al (2021) at the USPTO**
- **Encompassing US patents from 1976 to 2023**
- **Spanning a broad spectrum of AI fields, including:**
  - Machine Learning
  - Natural Language Processing
  - Computer Vision
  - Speech Technology
  - AI Knowledge Processing
  - AI Hardware
  - Evolutionary Computation
  - AI Planning and Control Systems

AI Patent Dataset (AIPD)

Source: Giczy et al (2021)



Training sets developed from seed search queries

Reduce text dimensionality with word2vec and training neural net model with text and citation inputs

Labelling output validated by patent examiners at the USPTO

Example AI Patents (non-IT Industry)

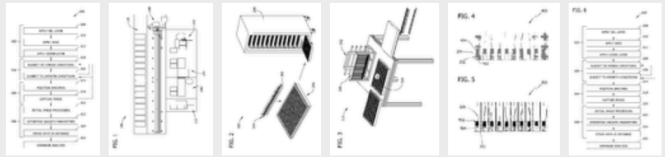
- An Example AI Patent from non-IT firms: An application of computer vision algorithms in monitoring plant growth

Automated system for germination testing using optical imaging

Abstract

A system prepares plant specimens, tracks the plant specimens, captures images of the plant specimens, and evaluates growth parameters of the plant specimens in the captured images. The system prepares receptacles by placing a predetermined quantity of gel, if required by a particular test, into a receptacle and a layer of material, if required by a particular test, on top of the gel. The system separates a quantity of seeds into individual seeds and places an individual seed in each receptacle between the gel layer and the cover layer. The receptacles are then arrayed into decks and carts and subjected to controlled stress conditions and conditions conducive to germination and growth. An image capture device captures backlit images of the receptacles, and a processor analyzes the captured images for growth parameters of the plant specimens and enters those parameters into a database together with a unique identifier of the plant specimen.

Images (6)



Classifications

A01C1/025 Testing seeds for determining their viability or germination capacity

View 1 more classifications

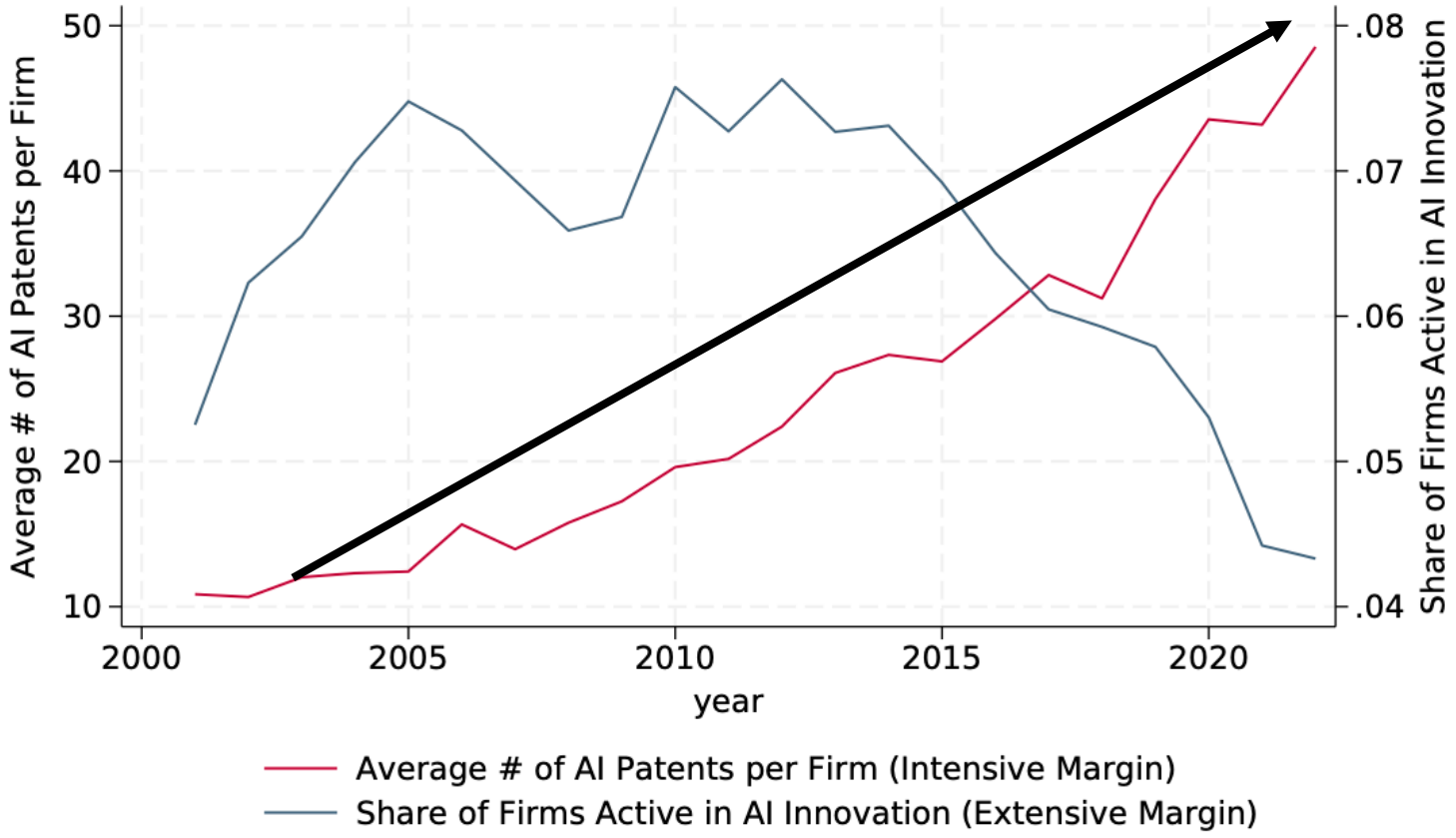
External links: USPTO, USPTO PatentCenter, USPTO Assignment, Espacenet, Global Dossier, Discuss

Who develops AI Technologies in Non-IT Industries?

- **Prior work argues that the superstar effect arises due to complementary technology development (Autor et al, 2017)**
  - This benefits firms that are the first to innovate and can accumulate innovations and skills
  - GPTs require complementary investments to generate value; these technologies are likely to generate superstar firms
  - Prior work shows that a few superstar firms have accumulated technical knowledge and organizational capital in digital technologies (Tambe et al, 2021)

H1a: Existing knowledge in AI technologies is positively related to future AI innovation.

Extensive and Intensive Margin of AI patenting Activity (Figure 3)



Rising concentration in AI patenting activity – suggestive that prior AI knowledge facilitates future AI innovation

Who Initially Engages in AI Innovations?

- **Prior research suggests that local complementary knowledge is also important in developing applications of GPTs (Conti et al, 2019)**
  - Prior knowledge in non-AI technologies could complement the development of AI innovations as well.
- **On the other hand, others argue that firms with a large stock of existing knowledge are less likely to develop technologies in new areas (Christensen, 1997; Henderson and Clark, 1990)**
  - Incumbents tend to lack the right incentives to engage in innovation in new technological areas
  - The rigidness in the innovation architecture limits the incumbent's ability to re-orient the R&D processes to research different technological areas

H1b: Existing knowledge in non-AI technologies is not related to future AI innovation.

Determinants of First AI innovation (Table 3)

10% increase in prior software patenting activity associated with 0.9% increase in probability of initiating AI patenting

D.V.: First AI Patent	(1)	(2)	(3)
Value of Software Patents Stock	0.097***	0.091***	0.091***
	(7.92)	(7.88)	(7.87)
Value of Non-AI Patents Stock	0.040***	0.037***	0.038***
	(10.21)	(9.46)	(9.45)
R&D Intensity	0.146**	0.038	0.016
	(2.52)	(0.62)	(0.24)
Firm Size	0.000	0.004**	0.004**
	(0.30)	(2.18)	(2.09)
Sales Growth	-0.001	0.000	0.000
	(-0.33)	(0.12)	(0.04)
Leverage	-0.011*	-0.007	-0.005
	(-1.74)	(-1.29)	(-1.05)
External Finance	-0.006	-0.007	-0.006
	(-0.99)	(-1.20)	(-1.00)
Capital Intensity	-0.028	0.007	-0.000
	(-0.96)	(0.21)	(-0.01)
Age	0.001***	0.001***	0.001***
	(4.30)	(4.20)	(4.10)
Market Share	-0.039	-0.046**	-0.056*
	(-1.44)	(-2.14)	(-1.98)
Market Concentration (HHI)	0.007		
	(0.46)		
Industry FE	No	Yes	No
Year FE	No	Yes	No
Industry×Year FE	No	No	Yes
Observations	53,911	53,911	53,911
Adjusted R^2	0.122	0.166	0.132

10% increase in prior non-AI patenting activity associated with 0.4% increase in probability of initiating AI patenting

Are AI Innovations Worth More?

- **Prior work argues that innovations are valuable (Kogan et al, 2017)**
  - We examine whether AI innovations are more or less valuable ***compared*** to non-AI innovations.
- **Scholars argue that AI is likely to lead to large productivity benefits:**
  - New products and services
  - Positive feedback loop in innovation
- **On the other hand, there are frictions in AI development**
  - Tends to be long development lags, leading to limited near-term productivity gains (Brynjolfsson et al, 2019)
  - Creates uncertainty in the assessment of AI's value

H2: The value of AI innovations is no different from the value of non-AI innovations.

Market Value of AI Patents (Table 4)

To test the valuation question – we regress the value of patents (Kogan et al, 2017) on an indicator for AI patents with various controls and fixed effects structures.

D.V.: Patent Value	(1)	(2)	(3)
AI Patent	0.196***	0.137***	0.066*
	(2.87)	(2.71)	(1.94)
Firm Size	0.214***	0.274***	0.268***
	(3.34)	(5.79)	(6.04)
Return Volatility	-0.188*	-0.046	-0.053
	(-1.83)	(-0.42)	(-0.51)
R&D Intensity (t)	1.027	1.072	0.894
	(1.05)	(1.56)	(1.35)
R&D intensity (t-1)	-0.952	0.112	0.056
	(-0.97)	(0.20)	(0.10)
R&D intensity (t-2)	0.296	1.134	1.121
	(0.24)	(1.12)	(1.17)
Industry×Year FE	No	Yes	Yes
CPC×Year FE	Yes	No	Yes
Observations	1,582,691	1,582,696	1,582,691
Pseudo R^2	0.265	0.509	0.523

Return Performance of AI innovation

- **As AI innovation is an uncertain process, there is some likelihood that the value of these innovations are not fully priced by investors**
- **Thus we study whether portfolios formed on AI patenting activity predict returns**
  - We form an "AI portfolio" of firms in the top median of innovation activity and top median of AI patenting activity at the end of June each year, and hold the portfolio over the following year
- **We perform return prediction tests:**
  - Monthly calendar portfolio alphas
  - Panel regressions of monthly returns

Return Performance of AI Portfolio (Panel A, Table 5)

We perform calendar portfolio tests on the AI portfolio average with equal weights and value-weights. We use the Fama-French 5 factor risk factors, as well as momentum, and mispricing factors in Stambaugh an Yuan (2017) in the risk model

D.V.: Return	(1) EW FF5	(2) EW FF6	(3) EW FF6+M	(4) VW FF5	(5) VW FF6	(6) VW FF6+M
α	0.455**	0.492***	0.318**	0.311**	0.337***	0.190**
	(2.19)	(2.78)	(2.17)	(2.59)	(3.18)	(2.12)
MKT	1.232***	1.138***	1.175***	1.219***	1.153***	1.189***
	(22.76)	(29.99)	(26.29)	(23.15)	(32.60)	(28.98)
SMB	0.473***	0.480***	0.613***	0.079	0.084	0.189**
	(4.63)	(5.24)	(6.75)	(0.79)	(0.96)	(2.43)
HML	-0.263***	-0.375***	-0.295***	-0.108	-0.186**	-0.156**
	(-2.69)	(-3.96)	(-3.49)	(-1.48)	(-2.48)	(-2.04)
RMW	-0.799***	-0.693***	-0.959***	-0.623***	-0.550***	-0.739***
	(-3.65)	(-4.47)	(-5.83)	(-3.45)	(-4.17)	(-4.98)
CMA	0.146	0.232	0.045	0.039	0.098	-0.077
	(0.78)	(1.51)	(0.30)	(0.26)	(0.77)	(-0.74)
MOM		-0.270***	-0.414***		-0.187***	-0.265***
		(-4.49)	(-5.02)		(-3.72)	(-4.31)
MIS-MGM			0.222*			0.262***
			(1.77)			(2.81)
MIS-PER			0.462***			0.291***
			(3.41)			(3.07)
Observations	269	269	269	269	269	269

Return Performance of AI Portfolio (Panel B, Table 5)

We further show that the portfolio of firms with above median innovation intensity, but below median AI innovation exhibits no statistically significant alphas

Panel B. Firms in the Top Median of Innovation and Bottom Median of AI Patent Intensity

D.V.: Return	(1) EW FF5	(2) EW FF6	(3) EW FF6+M	(4) VW FF5	(5) VW FF6	(6) VW FF6+M
α	0.183	0.204*	0.124	0.072	0.084	0.005
	(1.52)	(1.86)	(1.10)	(0.91)	(1.05)	(0.07)
MKT	1.213***	1.160***	1.169***	1.105***	1.075***	1.082***
	(45.41)	(43.16)	(38.51)	(38.64)	(37.74)	(48.49)
SMB	0.538***	0.542***	0.616***	0.243***	0.245***	0.320***
	(10.13)	(11.09)	(11.43)	(6.45)	(6.90)	(7.85)
HML	-0.115**	-0.178***	-0.067	-0.056	-0.092**	0.027
	(-2.22)	(-3.27)	(-1.38)	(-1.38)	(-2.00)	(0.64)
RMW	-0.359***	-0.300***	-0.491***	-0.116*	-0.082	-0.280***
	(-3.47)	(-3.95)	(-7.31)	(-1.70)	(-1.46)	(-5.80)
CMA	0.180**	0.228***	0.178***	0.167**	0.194***	0.148***
	(2.11)	(3.29)	(2.78)	(2.31)	(2.78)	(2.71)
MOM		-0.151***	-0.303***		-0.086***	-0.247***
		(-3.38)	(-7.11)		(-2.60)	(-7.45)
MIS-MGM			-0.048			-0.065
			(-0.60)			(-1.20)
MIS-PER			0.407***			0.426***
			(7.37)			(8.89)
Observations	269	269	269	269	269	269

Return Performance of AI Portfolio (Table 6)

We further test robustness of the returns result by turning to panel regressions with raw returns as the dependent variable, and control variables in Hirshleifer et al (2017)

D.V.: Return	(1)	(2)
AI Portfolio	0.320**	0.319**
	(2.50)	(2.49)
Log(1+patents)	-0.001	
	(-0.02)	
Beta	0.314**	0.314**
	(2.27)	(2.27)
Log(1+RD/ME)	0.149***	0.149***
	(2.84)	(2.85)
RDG	0.021	0.021
	(1.23)	(1.24)
Log(ME)	0.068	0.067
	(0.69)	(0.71)
Log(BTM)	0.077	0.077
	(1.07)	(1.07)
Momentum	-0.235*	-0.235*
	(-1.89)	(-1.89)
Log(1+AD/ME)	0.266***	0.266***
	(3.47)	(3.48)
Log(1+CapEx/ME)	0.033	0.033
	(0.36)	(0.36)
ROA	0.514	0.514
	(0.82)	(0.82)
AG	-0.137***	-0.137***
	(-2.95)	(-2.95)
NS	-0.117***	-0.117***
	(-2.67)	(-2.68)
IO	-0.018	-0.018
	(-0.46)	(-0.47)
Month×SIC3 FE	Yes	Yes
Observations	166,738	166,738
Adjusted R^2	0.251	0.251

We find that the AI portfolio yields an excess monthly return of 32 basis points.

But overall patenting activity does not predict returns

Why Are AI Innovations Valuable?

- **We argue that there are two sources of value:**

  (1) High innovation spillovers
  (2) Competitive advantages that are conferred from investment in AI

- **Spillover Benefits of AI Innovations :**

  (1) AI technologies developed in non-IT firms benefit from technical improvements in the core technologies from the IT sector that spillover into the non-IT sectors

  H3a: The value of AI innovations increases after the introduction of breakthrough AI technologies.

  (2) Patents that are more highly cited in the future, also tend to exhibit a higher market valuation (Hall et al, 2005). Thus, the potential for greater follow-on innovation could be another channel that explains the value of AI innovations

H3b: AI innovations spur more future innovations compared to non-AI innovations.

Impact of Breakthrough AI Tech on non-IT AI Innovations

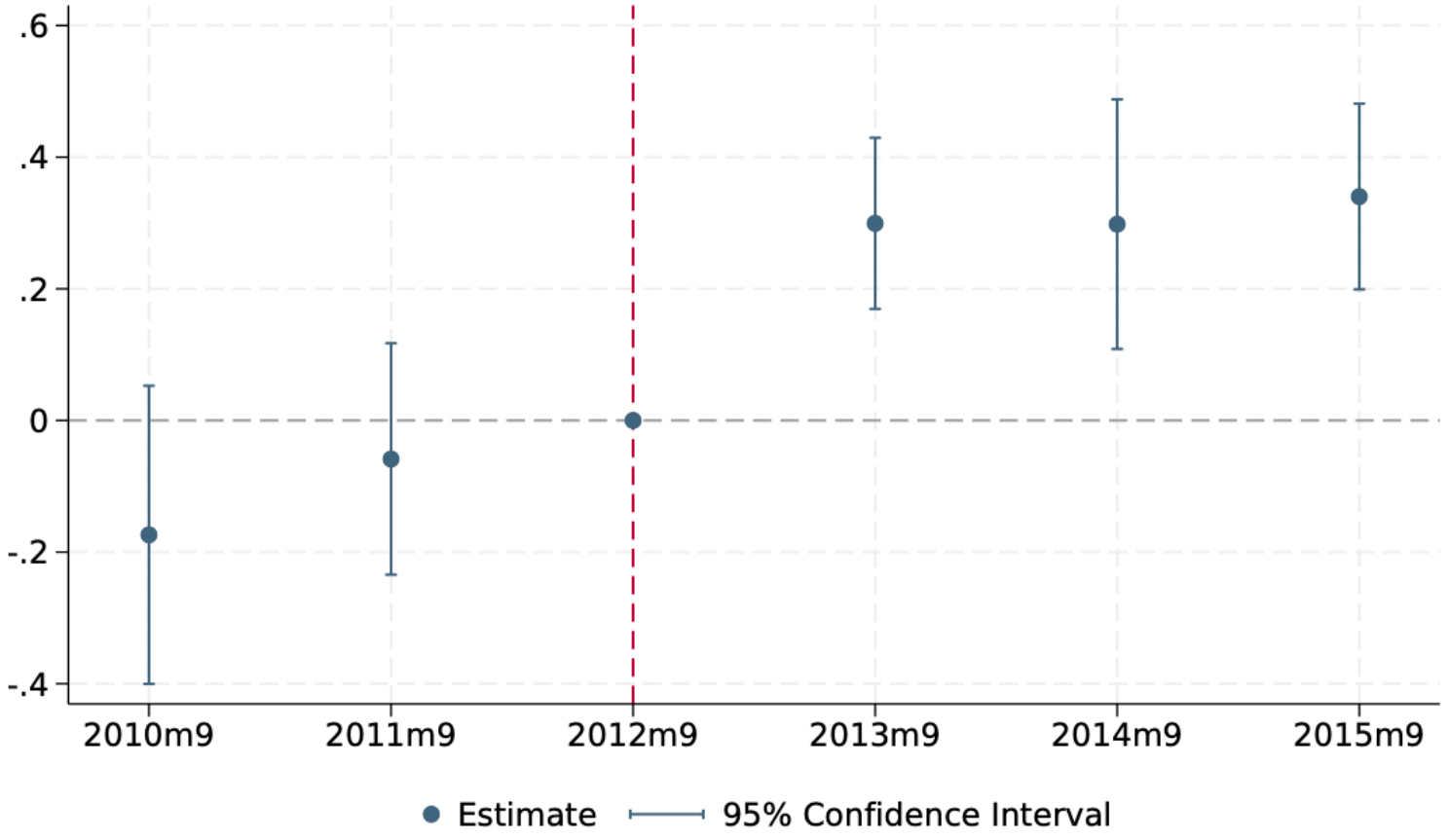
- **We rely on the AlexNet setting**
  - A core algorithm that revolutionized the field of deep learning (LeCun et al, 2015)
  - Introduced in the ImageNet competition on image recognition with substantial accuracy outperformance relative to other algorithms
  - Widely publicized by the press
- **We study the influence on this breakthrough algorithm on the value of AI innovations using a difference-in-difference design**
  - Treatment firms – firms with high AI suitability (using aggregated firm-level exposures from Felten et al, 2021)
  - Post – 2012, the year when AlexNet was first introduced in the ImageNet competition

AlexNet and Value of AI Innovations (Table 7)

We find a 32 – 37% increase in the value of AI patents in high AI exposed firms after AlexNet – suggesting that breakthrough AI algorithms is an important factor of the value of AI innovations in non-IT firms

D.V.: AI Patent Value	(1)	(2)
Post AlexNet×HighAIOE	0.323***	0.375***
	(4.34)	(4.70)
Firm Size	0.149	0.169
	(1.34)	(1.52)
Return Volatility	0.142***	0.137***
	(3.46)	(3.11)
R&D Intensity (t)	-3.567***	-3.455***
	(-2.65)	(-2.67)
R&D intensity (t-1)	-1.644***	-1.567***
	(-2.88)	(-2.79)
R&D intensity (t-2)	0.034	-0.002
	(0.05)	(-0.00)
Firm FE	Yes	Yes
Month FE	Yes	No
CPC×Month FE	No	Yes
Observations	43,329	43,329
Pseudo R^2	0.763	0.774

AlexNet and Value of AI Innovations (Figure 4)



Limited pre-trend and consistent post-trend effects

AI Patents and Forward Citations (Panel A, Table 8)

We find that the AI patents are associated with 22% more citations

D.V.: Forward Citations	(1)	(2)	(3)
AI Patents	0.348***	0.256***	0.224***
	(8.86)	(7.39)	(8.81)
Firm Size	-0.055***	-0.079***	-0.055***
	(-2.92)	(-5.75)	(-3.31)
Return Volatility	-0.016	-0.039	-0.023
	(-0.33)	(-1.03)	(-0.54)
R&D Intensity (t)	0.114	0.086	0.098
	(0.51)	(0.35)	(0.52)
R&D intensity (t-1)	-0.007	-0.126	-0.032
	(-0.03)	(-0.50)	(-0.16)
R&D intensity (t-2)	0.215	0.129	0.167
	(0.84)	(0.46)	(0.73)
Industry×Year FE	Yes	No	Yes
CPC×Year FE	No	Yes	Yes
Observations	1,580,991	1,581,337	1,579,581
Pseudo R^2	0.344	0.340	0.370

AI Patents and Forward Citations (Panel B, Table 8)

And AI patents are also associated with 27% more citations in the same patent technology group – suggesting that these patents are highly influential

D.V.: CPC-Group Citations	(1)	(2)	(3)
AI Patent	0.116***	0.140***	0.278***
	(3.84)	(3.42)	(5.00)
Firm Size	-0.039**	-0.058***	-0.032
	(-2.00)	(-3.09)	(-1.42)
Return Volatility	-0.016	-0.004	-0.000
	(-0.31)	(-0.08)	(-0.01)
R&D Intensity (t)	0.165	0.218	0.279
	(0.72)	(0.71)	(1.00)
R&D Intensity (t-1)	0.217	0.135	0.314
	(0.78)	(0.39)	(0.91)
R&D Intensity (t-2)	0.455	0.454	0.596*
	(1.53)	(1.29)	(1.77)
Industry×Year FE	Yes	No	Yes
CPC×Year FE	Yes	Yes	No
Observations	1,582,691	1,576,489	1,578,484
Pseudo R^2	0.309	0.276	0.263

Forward Citations in AI Patents and Market Value (Panel A, Table 9)

Moreover, the number of forward citation in AI patents are also associated with higher patent values – suggesting that the extent of forward citation is a channel for AI patents' market value.

D.V.: AI Patent Value	(1)	(2)	(3)
Log Citations	0.075***	0.191***	0.076***
	(3.51)	(6.43)	(3.55)
Firm Size	0.314***	0.266***	0.307***
	(4.66)	(3.47)	(4.66)
Return Volatility	0.021	-0.037	0.020
	(0.12)	(-0.28)	(0.12)
R&D Intensity (t)	-1.542	-2.476**	-1.552
	(-0.97)	(-2.34)	(-0.95)
R&D intensity (t-1)	-0.223	-2.295***	-0.164
	(-0.34)	(-6.67)	(-0.25)
R&D intensity (t-2)	3.065	1.472	2.903
	(1.41)	(0.73)	(1.37)
Industry×Year FE	Yes	No	Yes
CPC×Year FE	No	Yes	Yes
Observations	231,779	231,778	231,778
Pseudo R^2	0.572	0.272	0.579

AI Innovations and Competitive Advantage

- **AI innovations can confer important competitive advantages for AI-innovators, which should be priced by investors:**

  (1) AI technologies can enhance firm productivity, which would in turn improve the competitive position of firms.

  (2) AI technologies could also be integrated with existing products and services, to create new product offerings

H4: Firms that invest in AI innovations improve their competitive position relative to peers.

AI Innovations and Return on Sales (Panel A, Table 10)

We find that the sum of the value of granted AI patents are associated with increases in future one-to-two-year ahead return-on-sales

D.V.: ROS	(1) Forward 1 year	(2) Forward 2 years	(3) Forward 3 years
Value of AI Patents	0.003**	0.003**	0.002
	(2.11)	(2.23)	(1.62)
Value of Patents	0.002	0.000	-0.001
	(0.94)	(0.11)	(-0.41)
R&D Intensity	-0.006*	-0.003	-0.002
	(-1.85)	(-0.81)	(-0.54)
Capital Intensity	0.005**	-0.001	-0.001
	(2.48)	(-0.61)	(-0.21)
Intangible Assets Intensity	-0.010***	-0.008***	-0.008***
	(-4.56)	(-3.80)	(-4.07)
Firm Size	-0.019***	-0.046***	-0.056***
	(-2.93)	(-6.10)	(-6.66)
Book-to-Market Ratio	-0.040***	-0.020***	-0.010***
	(-6.24)	(-4.35)	(-2.93)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	51,072	51,072	51,072
Adjusted R^2	0.511	0.503	0.500

AI Innovations and Gross Margins (Panel B, Table 10)

We find that the sum of the value of granted AI patents are associated with increases in future one-to-three-year ahead gross margins

D.V.: Gross Margins	(1) Forward 1 year	(2) Forward 2 years	(3) Forward 3 years
Value of AI Patents	0.003**	0.003**	0.003**
	(2.41)	(2.54)	(2.27)
Value of Patents	0.001	-0.000	-0.001
	(0.64)	(-0.06)	(-0.68)
R&D Intensity	0.007**	0.004	0.003**
	(2.76)	(1.66)	(2.23)
Capital Intensity	0.004**	0.002	0.003
	(2.79)	(1.26)	(1.53)
Intangible Assets Intensity	0.005***	0.004***	0.003*
	(3.27)	(3.27)	(2.06)
Firm Size	-0.028***	-0.038***	-0.040***
	(-5.10)	(-5.48)	(-6.25)
Book-to-Market Ratio	-0.018***	-0.010***	-0.005**
	(-5.91)	(-4.14)	(-2.44)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	50,286	50,286	50,286
Adjusted R^2	0.851	0.853	0.854

AI Innovations and Market Share (Panel C, Table 10)

We find that the sum of the value of granted AI patents are associated with increases in future one-to-three-year ahead sales-based market share

D.V.: Market Share	(1) Forward 1 year	(2) Forward 2 years	(3) Forward 3 years
Value of AI Patents	0.005**	0.004**	0.004**
	(2.72)	(2.12)	(2.40)
Value of Patents	0.004	0.004	0.003
	(1.41)	(1.65)	(1.30)
R&D Intensity	-0.002***	-0.002***	-0.001**
	(-3.17)	(-3.14)	(-2.39)
Capital Intensity	-0.001	-0.001	-0.001
	(-0.71)	(-0.89)	(-0.91)
Intangible Assets Intensity	0.002	0.001	0.002
	(1.43)	(1.10)	(1.45)
Firm Size	0.036***	0.030***	0.025***
	(6.14)	(5.70)	(5.80)
Book-to-Market Ratio	0.000	-0.000	-0.001
	(0.01)	(-0.46)	(-0.86)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	51,072	51,072	51,072
Adjusted R^2	0.855	0.858	0.859

Key Take-aways

- **Who Develops AI Innovations?**
  - The prior stock of non-AI patents and software patents are positively associated with the incident of the first AI patenting activity (complementary knowledge)
- **Value of AI Innovations**
  - AI patents are 6% more valuable then non-AI patents
  - Advances in IT sector (AlexNet) spills over to the non-IT sector – increasing the value of AI patents in high AI suitability non-IT firms
  - Forward citations are 26% higher in AI patents, and these patents are also linked with higher gross margins and market share

Potential Contributions

- **Valuation of innovation:** We contribute to this literature (e.g. Gao et al, 2013, Hirshleifer et al, 2013; Kogan et al, 2017; Fitzgerald et al, 2020) by identifying a group of innovations that are particularly valuable to investors in recent data.

- **Value implications of digital and AI technologies for non-IT firms :** Our findings add to this literature (Chen and Srinivasan, 2024; Babina et al, 2024) by focusing on a specific dimension of AI investment - AI innovations, and we show that these investments are associated with improvements in the competition position of firms, and are also highly valued by investors.

- **Determinants of AI Innovation in non-IT Firms:** whether non-IT firms develop in-house AI technologies is an empirical question due to the accumulated expertise required for developing AI (Tambe et al, 2020) and the complementary benefits of local industry knowledge on developing applications (Conti et al, 2019). We speak to this question by demonstrating substantial AI innovation investment in non-IT firms, and shedding light on the non-IT firms that engage in this activity.

THANK YOU!

Sample Composition (Table IA1)

Panel A: Patent Counts

Category	Number of Patents
Full Sample	
All	1,878,756
AI Patents	390,027
Non-AI Patents	1,488,729
Non-IT Firms	
All	1,587,948
AI Patents	232,616
Non-AI Patents	1,355,332

Panel B: Firm and Firm-Year Counts

Category	Number of Firm-Years	Number of Firms
Full Sample	81,649	9,538
Non-IT Sample	79,142	9,368
Non-IT Firms with Innovations	20,815	3,184
Non-IT Firms with AI Innovations	8,083	1,470

Market Valuation of AI Innovations Within Firm (Table IA5)

D.V.: Patent Value	(1)
AI Patent	0.004**
	(2.14)
Industry×Year FE	No
CPC×Year FE	No
Firm×Year FE	Yes
Observations	1,582,696
Pseudo R^2	0.818

AI Innovations and Sales-to-Employees (Table IA6, Panel B)

D.V.: Sales-to-Employee	(1) Forward 1 year	(2) Forward 2 years	(3) Forward 3 years
Value of AI Patents	0.029	0.031	0.029**
	(0.76)	(1.03)	(2.09)
Value of Patents	-0.070	-0.041	-0.048
	(-1.48)	(-0.94)	(-1.37)
R&D Intensity	0.021	0.017	0.016
	(0.86)	(0.97)	(1.05)
Capital Intensity	0.030	0.029	0.034
	(0.94)	(0.98)	(1.19)
Intangible Assets Intensity	0.002	0.025	0.031
	(0.08)	(0.91)	(1.24)
Firm Size	0.962***	0.664***	0.481**
	(4.96)	(3.48)	(2.79)
Book-to-Market Ratio	-0.134**	-0.148**	-0.155***
	(-2.29)	(-2.51)	(-3.02)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	26,078	26,078	26,078
Adjusted R^2	0.870	0.887	0.889

AI Innovations and Market Concentration (Table IA7, Panel B)

D.V.: HHI	(1) Forward 1 year	(2) Forward 2 years	(3) Forward 3 years
Value of AI Patents	-0.007	-0.028	-0.049**
	(-0.39)	(-1.54)	(-2.49)
Value of Patents	0.011	0.014	0.027
	(0.46)	(0.66)	(1.07)
R&D Intensity	0.024	0.035	0.040*
	(1.14)	(1.65)	(1.96)
Capital Intensity	-0.007	-0.008	-0.006
	(-1.24)	(-1.14)	(-0.77)
Intangible Assets Intensity	0.008	0.000	-0.008
	(0.66)	(0.03)	(-0.53)
Firm Size	-0.020	0.003	0.006
	(-1.15)	(0.16)	(0.30)
Book-to-Market Ratio	-0.001	0.003	-0.002
	(-0.16)	(0.34)	(-0.24)
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1,081	1,081	1,081
Adjusted R^2	0.617	0.628	0.648