



**DEZAN SHIRA & ASSOCIATES**

Your Partner for Growth in Asia

# The Current State of AI in China and Implications for Foreign Investors

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## Section 1

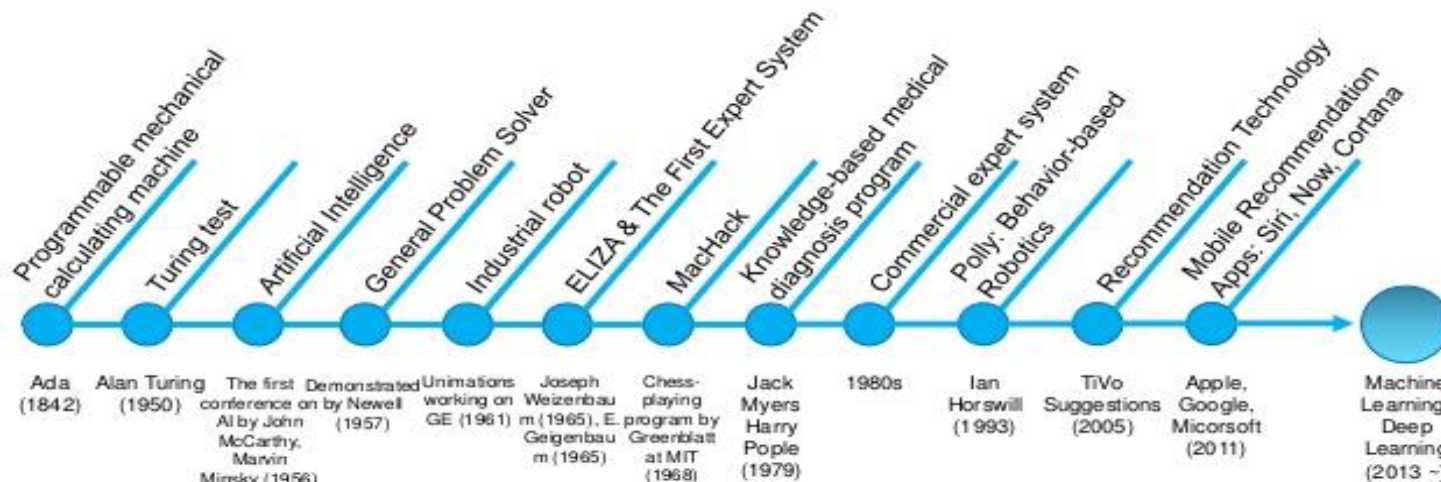
# What is AI?



# The Turing Test

- **Artificial Intelligence:** the science of machines/computers exhibiting intelligent behavior, including “human-like” behavior such as learning, critical reasoning, logical decision-making and displaying knowledge.
- **The Turing Test:** A machine is deemed to be “intelligent” when a human cannot distinguish it from a human

## AI Timeline



# Machine Learning and Deep Learning

- **Machine Learning:** Computers are able to use data and learn from it without being explicitly programmed.
  - Classification – identifying and classifying things (spam/fraud) and people (face/voice)
  - Clustering – comparing similar items, and identifying any unusual behavior that does not fit
  - Predictive – predicting likelihoods of human behavior or issues based on user data or other metadata
  - Ex: Netflix using ML algorithms to generate recommendations for different users based on behavior data.
- **Neural Networks:** Simulation of a human brain where connected nodes between input and output are able to learn and solve more complicated issues.
- **Deep Learning:** Type of ML that includes layers of neural networks, with each layer responsible for solving one aspect of the problem.

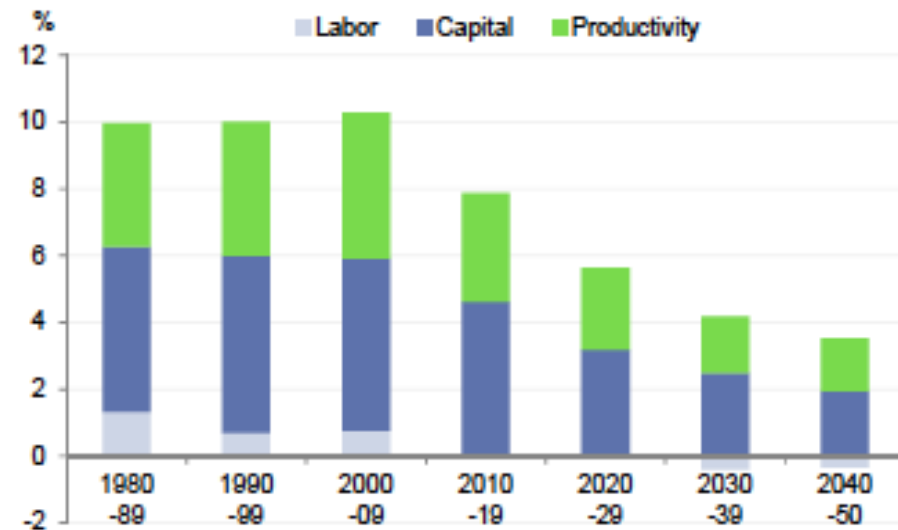
## Section 2

How does AI fit in with China's development goals?



# Labor and Productivity

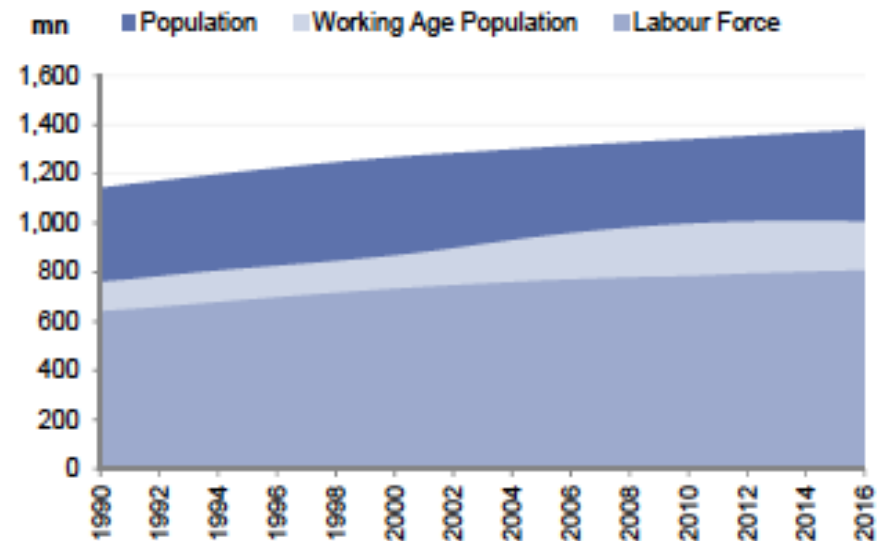
**Exhibit 50: China's GDP has been capital-driven in the past few decades; going forward productivity will play a bigger role**  
**China GDP growth breakdown**



Note: 2010-2019 and beyond are GSe.

Source: NBS. Goldman Sachs Global Investment Research.

**Exhibit 51: ...coupled with an aging population and a stabilized labor supply**  
**China's labor market**

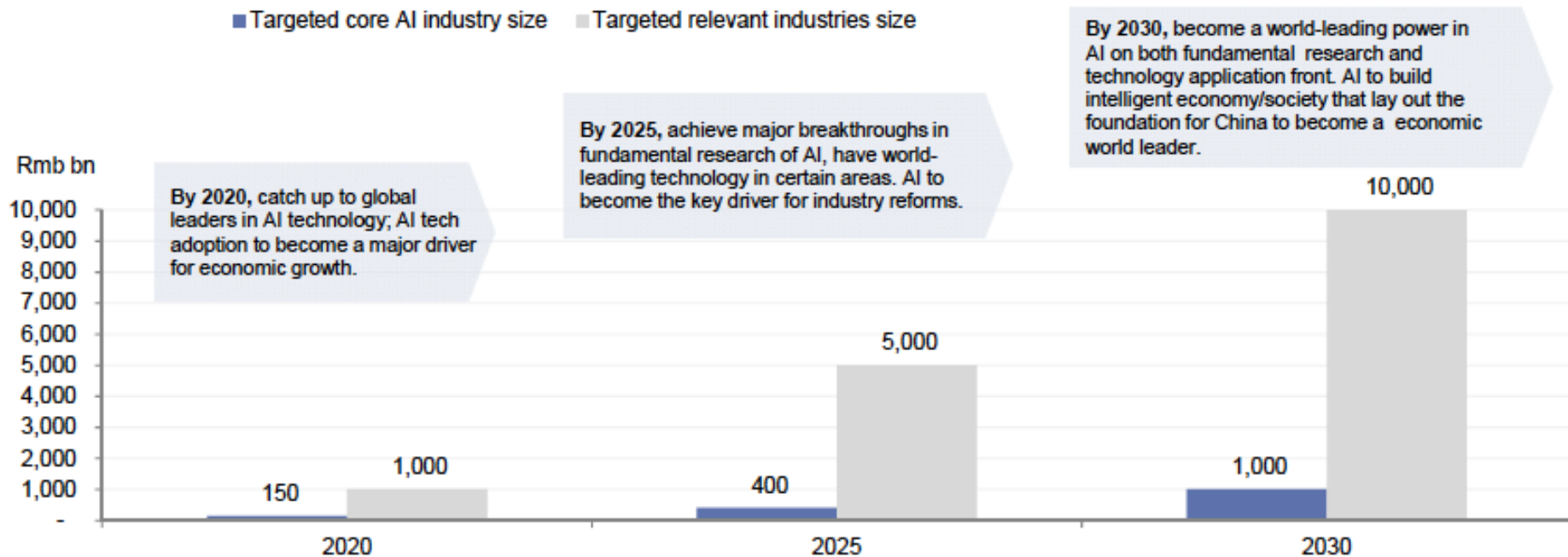


Source: NBS. United Nations. World Bank.

# Intelligence Economy by 2030

## Exhibit 1: China aims to become a world-leading power in AI by 2030

The strategic goals of the national development plan on AI



Source: The State Council.



# Intelligence Economy by 2030

## Exhibit 2: AI-supportive policies in China

Time	Issue body	Policy	Note
2015.5	The State Council	Made in China 2025	The first ten year action plan that calls for green, innovative and intelligent manufacturing in china
2015.7	The State Council	The "Internet+" Action Plan	The plan listed Artificial Intelligence as one of the 11 areas of key focuses.
2016.3	The State Council	The 13th Five-year plan (proposal)	The plan reiterates the importance of focusing on new technological areas such as Artificial intelligence.
2016.5	NDRC	Three-year Implementation Plan for "Internet Plus" Artificial Intelligence	The plan targets the establishment of basic infrastructure and innovation platform, industry system, innovative service system and basic industry standardization of AI in China by 2018, reaching an industry size of hundreds of billions of Rmb.
2017.7	The State Council	The New Plan on Artificial Intelligence Development	The plan states China's goal to catch up to global leaders and achieve world-leading positions in AI by 2030 via solving issues such as a lack of high-end computer chips, software and trained personnel. The government will also play a bigger role through policy support and regulation.

Source: The State Council of People's Republic of China, China National Development and Reform Commission (NDRC).

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# 3-year Implementation Plan for *Internet Plus* Artificial Intelligence

Published by the China National Development and Reform Commission (NDRC) on May 18, 2016.

**Goal:** to create the foundation for AI development, encompassing:

1. Capital funding
2. System standardization
3. IP protection
4. Human capital development
5. International cooperation
6. Implementation arrangement

Section 3.1

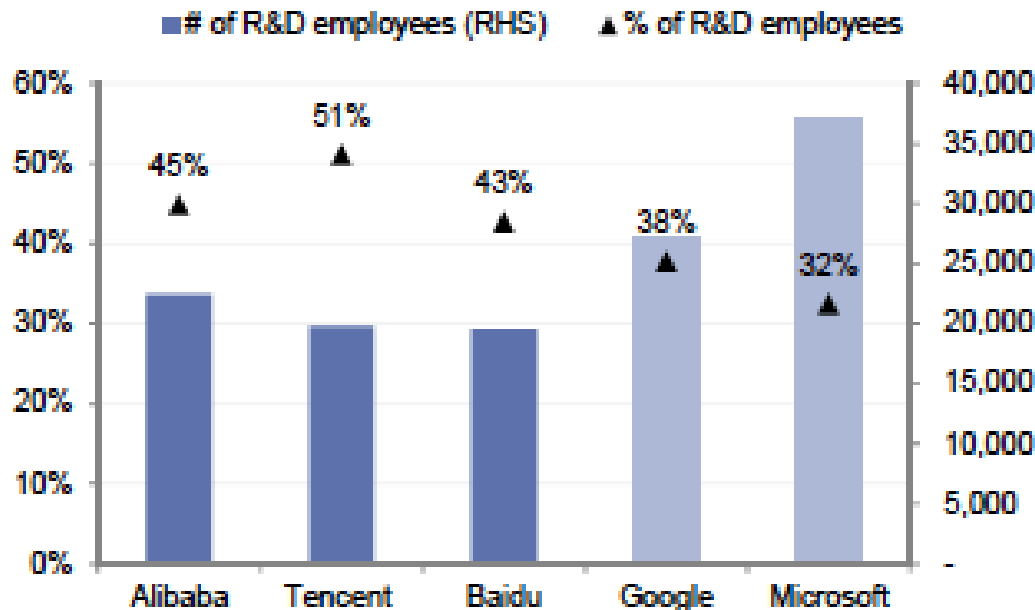
How is China doing  
on AI?

Human Capital



# Human Capital – Talent in AI industry

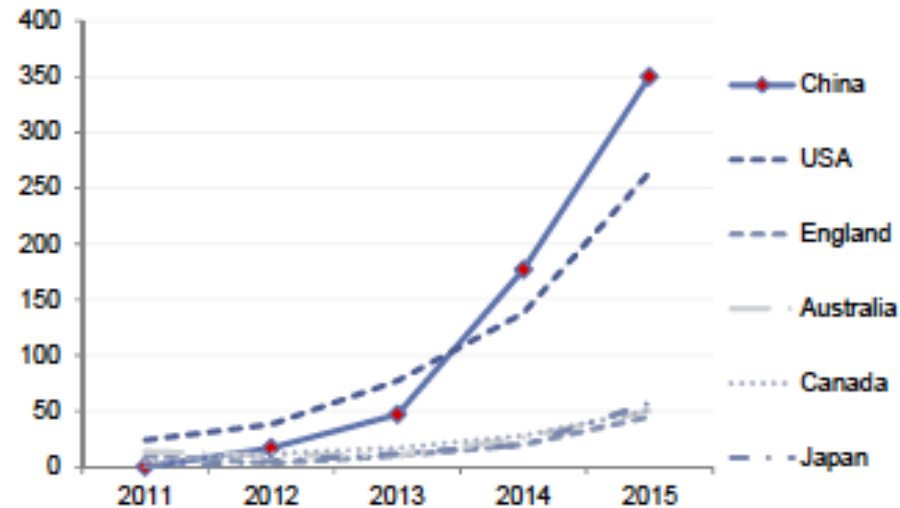
**Exhibit 8: ...yet the China internet giants are equipped with higher percentage of R&D human capital**  
R&D employees



Source: Company data.

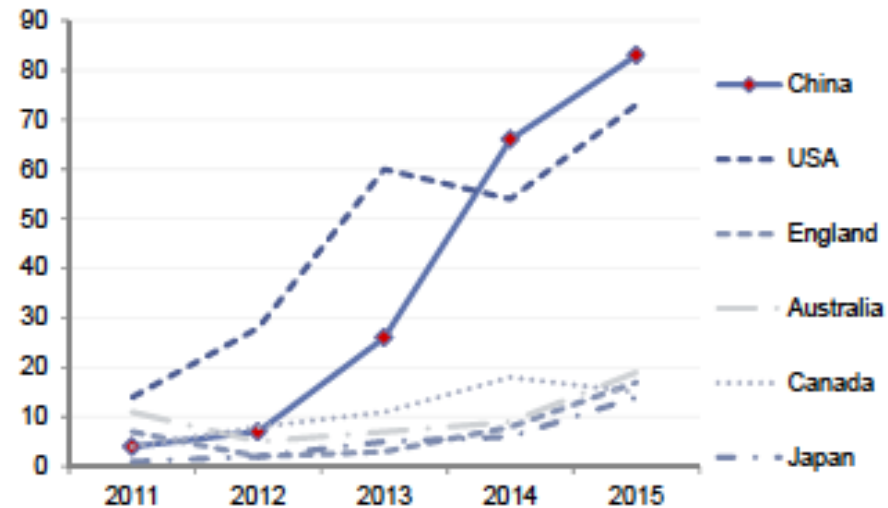
# Human Capital – Publications and citations

**Exhibit 3: China published the most research papers on AI in 2015...**  
Journal articles mentioning “deep learning” or “deep neural network”



Source: US National Science and Technology Council.

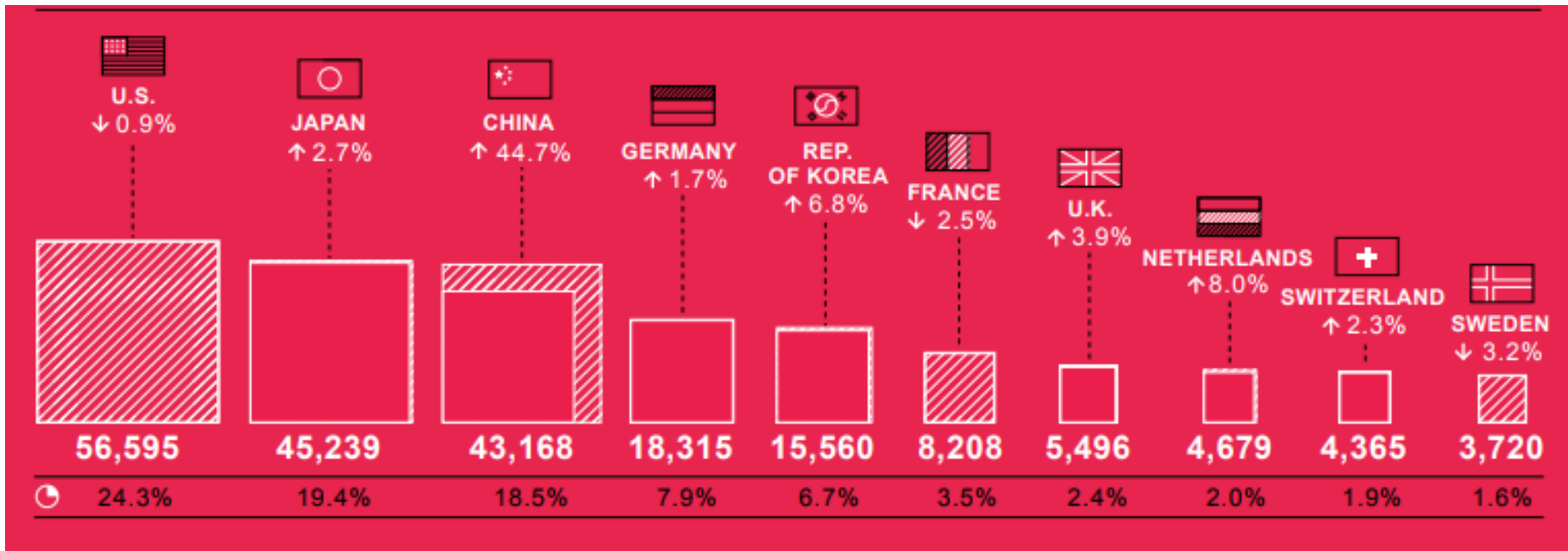
**Exhibit 4: ...with the highest number of cited papers**  
Journal articles cited at least once, mentioning “deep learning” or “deep neural network”



Source: US National Science and Technology Council.

# Human Capital – Patents Filed

Top 10 countries – Number of applications and share of total



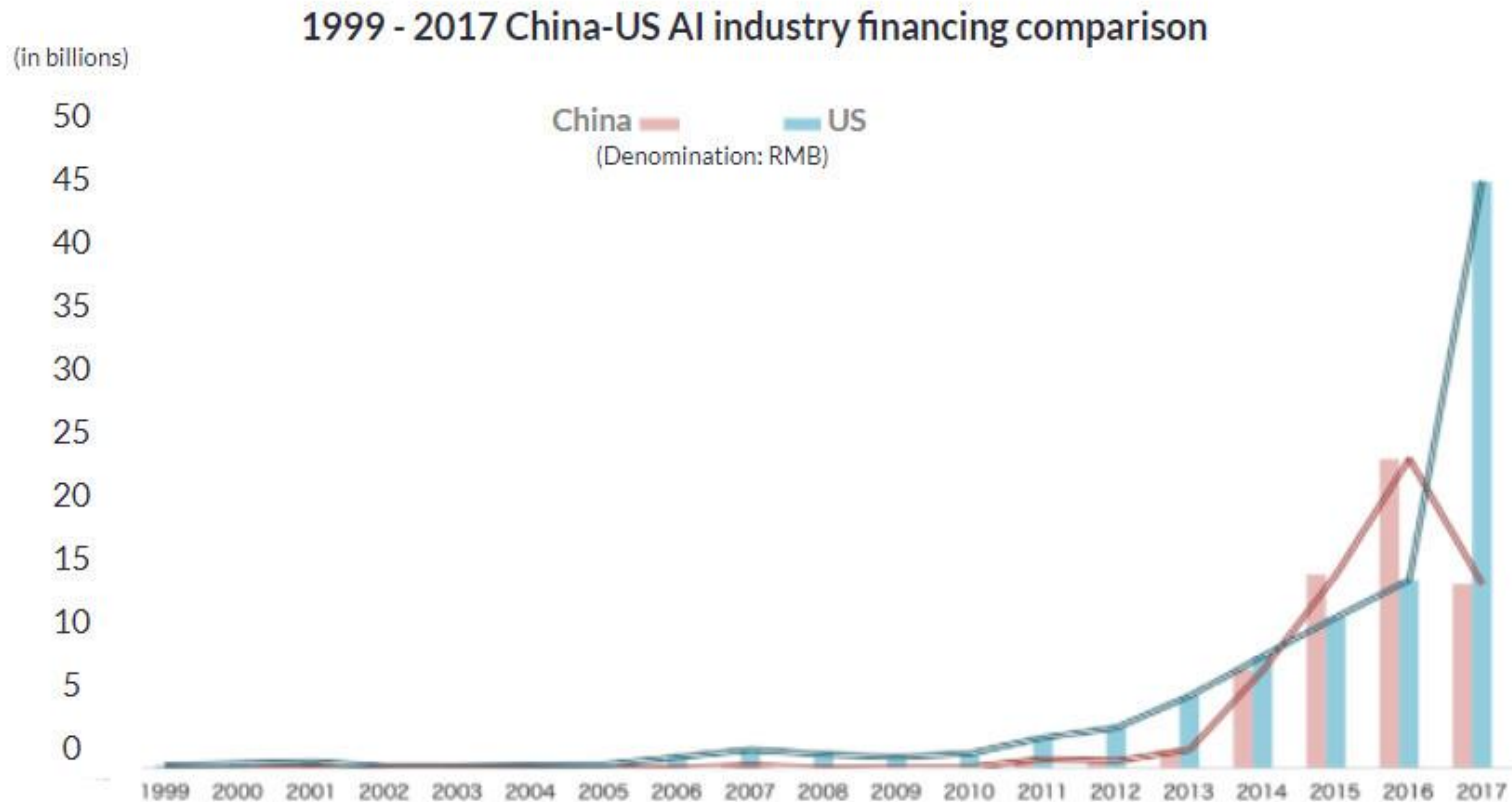
Section 3.2

How is China doing  
in AI?

Investment



# Investment – Funding

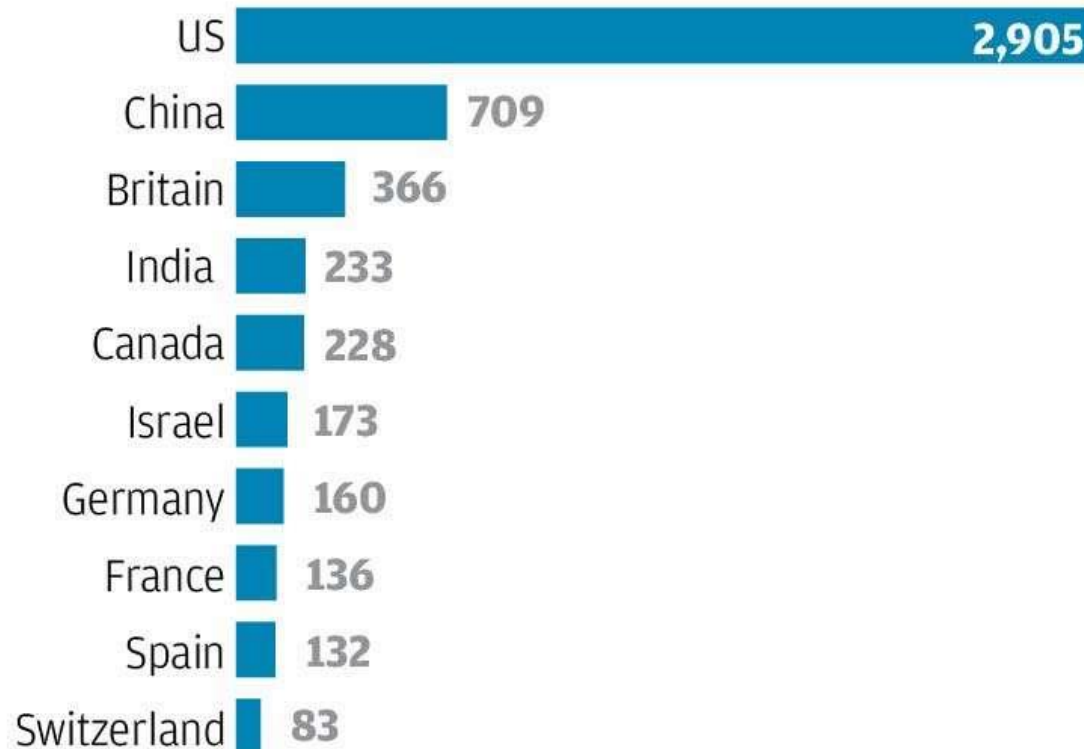


Source: Technode



# Investment – Number of AI companies

## Total number of artificial intelligence companies

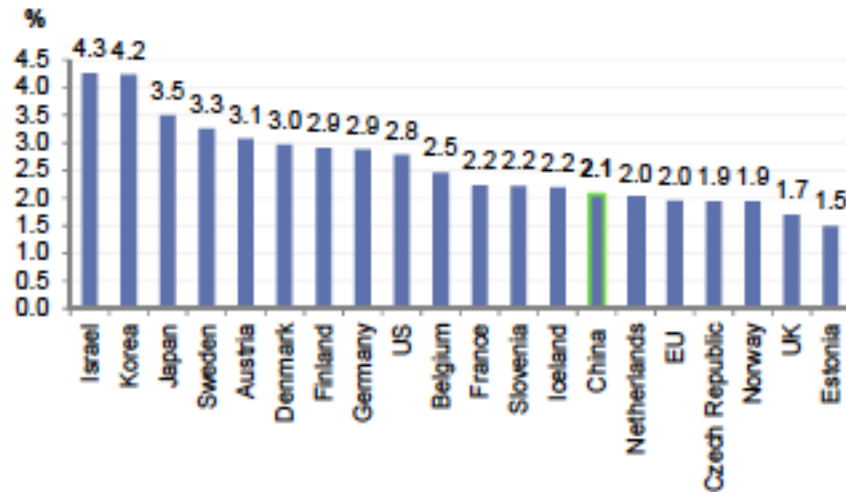


Source: Wuzhen Institute

SCMP

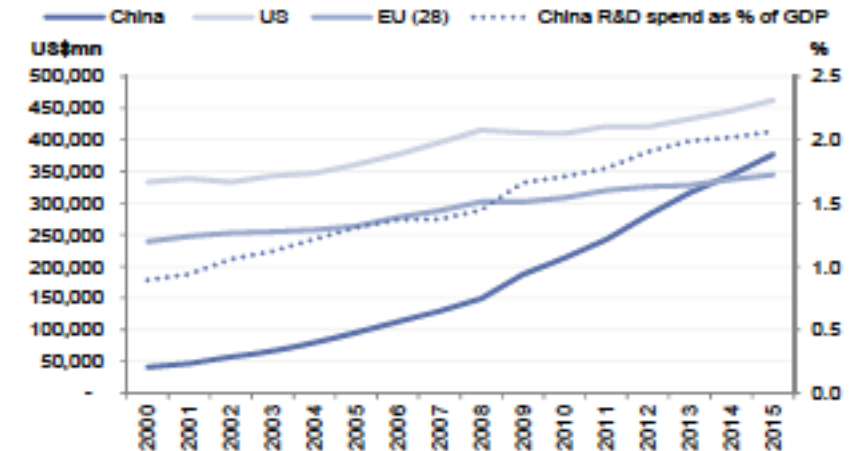
# Investment – R&D Spending and Intensity (macro)

**Exhibit 52: China R&D intensity reached 2.1% in 2015, up from 1.1% a decade ago...**  
R&D expenditure as % of GDP in 2015



Source: OECD.

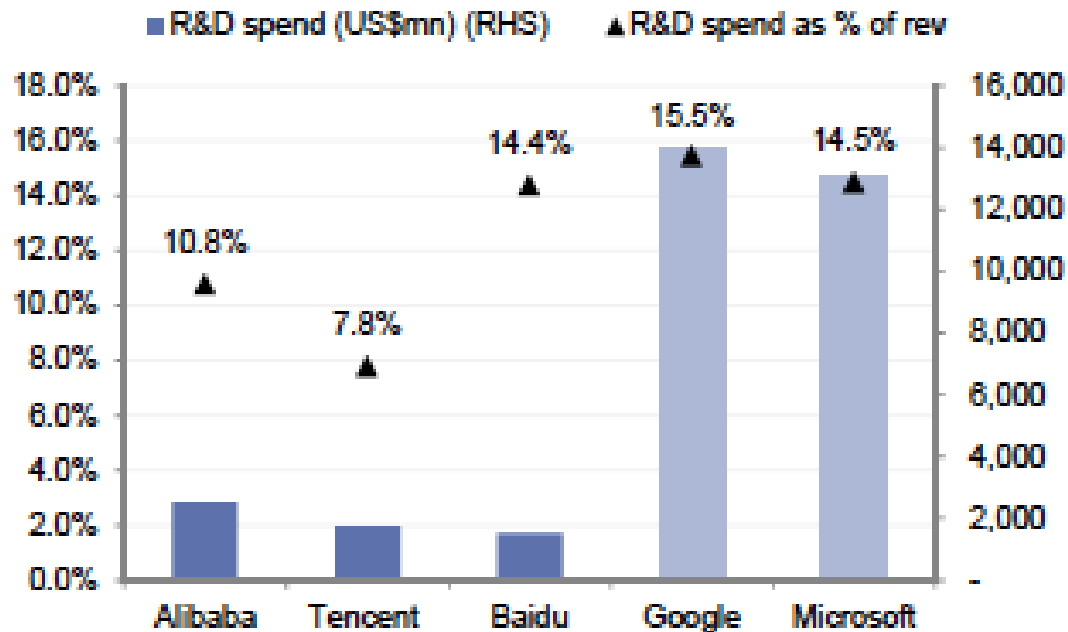
**Exhibit 53: ...with R&D expenditure surpassed that of EU in 2014, narrowing the gap vs. the US**  
R&D spend in US, China, and EU



Source: OECD.

# Investment – R&D Spending and Intensity (micro)

**Exhibit 7: BAT slightly underspent on R&D vs. Google/Microsoft...**  
R&D spend as percentage of revenue



Source: Company data.

Section 3.3

How is China doing  
in AI?

Infrastructure



# Infrastructure – Data availability

## Exhibit 11: BAT data assets

Detailed discussions of each company's data assets can be found in the company section of this report

	Alibaba	Tencent	Baidu
<b>Assets (data source)</b>	Ecommerce & O2O Tmall, Taobao, Ele.me	Social/ Media Weixin/WeChat, QQ Messenger, Qzone, QQ Music, Tencent Literature	Search Web search and mobile search
	Finance/ Payment AliPay, Ant Financial, Paytm, Mynt, Kakao Pay, Ascend Money, MyBank	Finance/ Payment Tenpay, Weixin Payment, WeBank	O2O Nuomi, Baidu Takeout Delivery
	Social Weibo (31.0%)	Online games Tencent Games Platform / WeGame	Locations Baidu Map
	Location & logistics Cainiao, YTO, BEST Logistics, Amap (by Autonavi)	Ecommerce & O2O JD (18.1%), 58.com (23.2%), Meituan (15%), WeChat Mini Programs	Finance Baidu Financial Services Group (FSG), incl. consumer finance, Baidu Wallet payment, online insurance, etc.
	Video and others Youku, UC browser, Shenma	Video and others Tencent Video, Tencent map	Video and others iQiyi
<b>Data type</b>	Transaction & logistics data Payment data Social networks data	Social networks data Payment data Transaction data	Search data Location data Transaction data
<b>Data usage</b>	Targeted marketing Personalized shopping experiences Credit score system Improved logistics efficiency Cloud solutions	Targeted marketing (in both social/gaming assets) Customized feeds recommendation	Targeted marketing Improved search results Baidu Brain Public opinion monitoring

Source: Company data, Sina news reports.

# Infrastructure - Supercomputers

Rank	System	Cores	Rmax (TFlop/s)	Rpeak (TFlop/s)	Power (kW)
1	<b>Sunway TaihuLight</b> - Sunway MPP, Sunway SW26010 260C 1.45GHz, Sunway , NRCPC National Supercomputing Center in Wuxi China	10,649,600	93,014.6	125,435.9	15,371
2	<b>Tianhe-2 (MilkyWay-2)</b> - TH-IVB-FEP Cluster, Intel Xeon E5-2692 12C 2.200GHz, TH Express-2, Intel Xeon Phi 31S1P , NUDT National Super Computer Center in Guangzhou China	3,120,000	33,862.7	54,902.4	17,808
3	<b>Piz Daint</b> - Cray XC50, Xeon E5-2690v3 12C 2.6GHz, Aries interconnect , NVIDIA Tesla P100 , Cray Inc. Swiss National Supercomputing Centre (CSCS) Switzerland	361,760	19,590.0	25,326.3	2,272
4	<b>Titan</b> - Cray XK7, Opteron 6274 16C 2.200GHz, Cray Gemini interconnect, NVIDIA K20x , Cray Inc. DOE/SC/Oak Ridge National Laboratory United States	560,640	17,590.0	27,112.5	8,209
5	<b>Sequoia</b> - BlueGene/Q, Power BQC 16C 1.60 GHz, Custom , IBM DOE/NNSA/LLNL United States	1,572,864	17,173.2	20,132.7	7,890

## Section 4

# AI in China and Globally



# The AI Index 2017 - Full

	Ranking	Human Capital Score	Investment Score	Infrastructure Score	Application Score	Total Score
<b>US</b>	1	39	40	36	30	145
<b>China</b>	2	25	36	38	23	122
<b>Japan</b>	3	24	14	30	30	98
<b>Germany</b>	4	21	20	26	23	90
<b>UK</b>	5	26	32	18	12	88
<b>India</b>	6	18	26	20	16	80
<b>France</b>	7	19	14	18	24	75
<b>South Korea</b>	8	12	8	12	34	66
<b>Canada</b>	9	21	26	6	12	65
<b>Italy</b>	10	18	8	18	18	62



# Human Capital

	Human Capital								
	Number of AI professionals	Score	Publications in AI research (2011-2015)	Score	Field-weighted citation impact	Score	Patents filed within 2016	Score	Human Capital Score
<b>US</b>	850,000	10	25,500	9	1.79	10	56,595	10	39
<b>UK</b>	140,000	8	10,100	7	1.63	7	5,496	4	26
<b>China</b>	50,000	6	41,000	10	0.86	1	43,168	8	25
<b>Japan</b>	<30,000	1	11,700	8	1.5	6	45,239	9	24
<b>Canada</b>	80,000	7	7,957	6	1.5	6	2,820	2	21
<b>Germany</b>	30,000	4	6,221	2	1.66	8	18,315	7	21
<b>France</b>	50,000	6	7,200	4	1.3	4	8,208	5	19
<b>India</b>	150,000	9	7,800	5	1.2	3	1,412	1	18
<b>Italy</b>	30,000	4	6,221	2	1.74	9	3,072	3	18
<b>South Korea</b>	<30,000	1	6,800	3	1.1	2	15,560	6	12

# Investment

	Investment				
	Total amount raised for AI projects (million USD)	Score	Number of AI Companies	Score	Investment Score
<b>US</b>	11010	20	2905	20	40
<b>China</b>	2762	18	709	18	36
<b>UK</b>	1251	16	366	16	32
<b>Canada</b>	695	14	228	12	26
<b>India</b>	437	12	233	14	26
<b>Germany</b>	370	10	160	10	20
<b>Japan</b>	300	8	>34	6	14
<b>France</b>	280	6	136	8	14
<b>Italy</b>	<210	4	>22	4	8
<b>South Korea</b>	<210	4	>23	4	8

# Infrastructure

	Infrastructure				
	Mobile cellular subscriptions	Score	Number of supercomputers ranked in the Top 500 list	Score	Infrastructure Score
<b>China</b>	1.36 billion	20	160	18	38
<b>US</b>	417 million	16	168	20	36
<b>Japan</b>	164 million	14	33	16	30
<b>Germany</b>	94 million	12	28	14	26
<b>India</b>	1.13 billion	18	4	2	20
<b>UK</b>	79 million	8	17	10	18
<b>Italy</b>	86 million	10	8	8	18
<b>France</b>	68 million	6	18	12	18
<b>South Korea</b>	61 million	4	8	8	12
<b>Canada</b>	30 million	2	6	4	6

# Application

	Application (Robots and Automation)								
	Number of industrial robots	Score	Robot density per 10,000 employees	Score	Automation per 10,000 employees	Score	Industrial robots in 2015-2016 (growth rate)	Score	Application Score
South Korea	41373	9	631	10	2154	10	8%	5	34
US	31400	7	189	7	1261	9	14%	7	30
Japan	38586	8	303	8	1240	8	10%	6	30
France	4232	3	127	4	1150	7	39%	10	24
China	87000	10	68	2	505	2	27%	9	23
Germany	20039	6	309	9	1131	6	0%	2	23
Italy	6465	4	160	6	1003	5	-3%	3	18
India	14300	5	2	1	58	1	27%	9	16
UK	1787	1	71	3	622	3	8%	5	12
Canada	2334	2	136	5	856	4	-34%	1	12

## Section 5

# Implications for foreign investors in China



# What will the Index look like in 2037?

- Human Capital:
  - An estimated 43% of world's trained AI scientists are in China already.
  - China's Thousand Talents Plan is concentrating on recruiting top overseas experts with better packages than the traditionally prestigious universities and companies.
- Investment:
  - Aggressive subsidies and private company investment in AI technology suggests number of AI companies will only increase, not decrease nor stagnate
- Infrastructure:
  - More data, better data
  - More powerful supercomputers
- Application:
  - The better and more pervasive the AI, the greater the rate of implementation across all industries
- Conclusion: Given currently conditions across the four metrics, AI in China will only get better, and it is a matter of time before it surpasses the US.

# Implication 1: Higher productivity

Chart 7: China's population pyramid: 1980

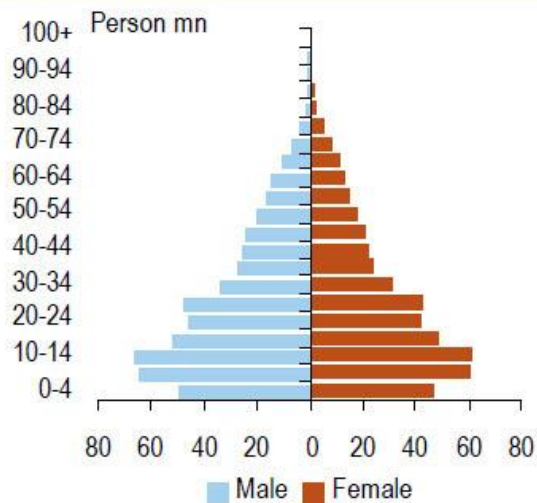


Chart 8: China's population pyramid: 2010

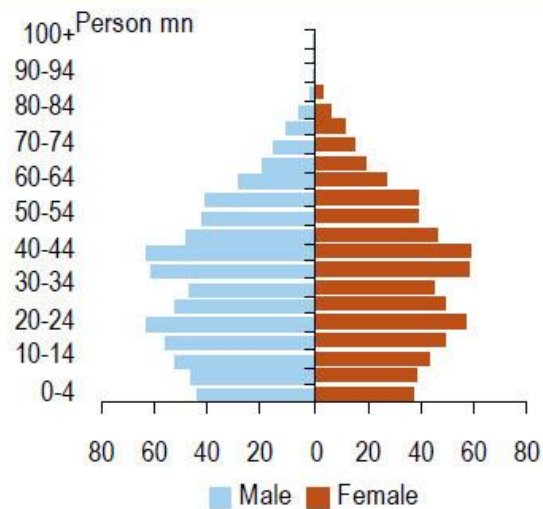
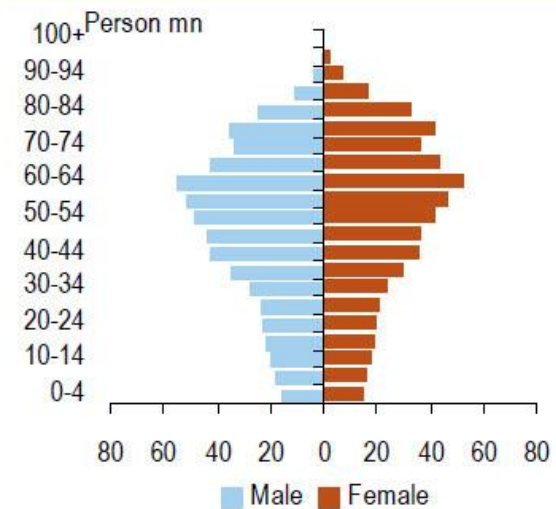


Chart 9: China's population pyramid: 2050F

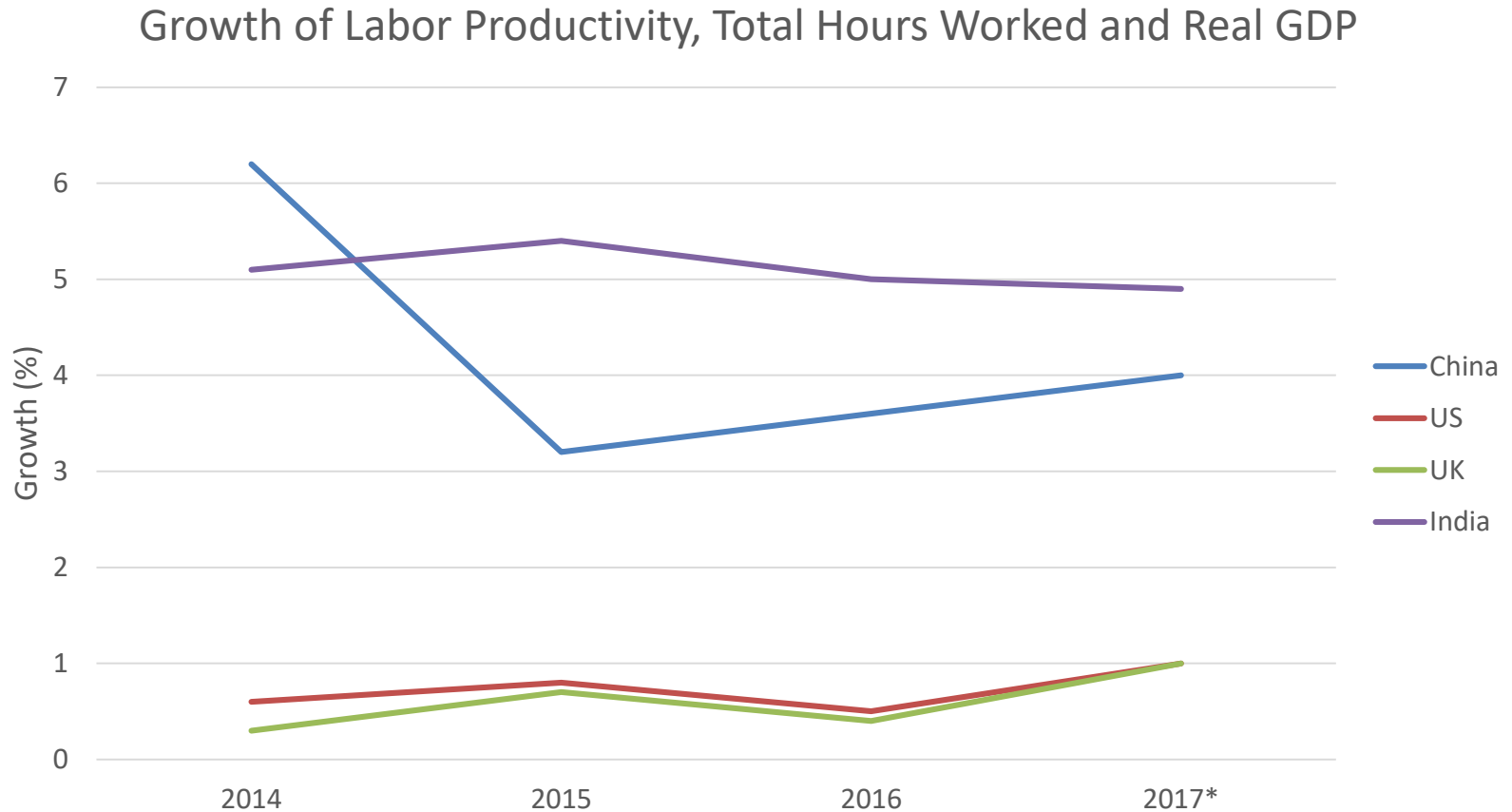


Source: BofA Merrill Lynch and UN World Population Prospects 2010  
Revision (Low variant used for China).

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Revision (Low variant used for China).

# Implication 1: Higher productivity





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# Implications 2: Local, local, local

## The Curious Case of Google –

- 2010: Leaves because of censorship
- Leaves certain operations open, like marketing
- Recently, starts cautiously creeping back in
- Their main goal?
- Grassroots approach to get AI developers hooked on TensorFlow
- Hiring spree in Beijing to build an AI team
- Investing in Chinese AI startups
  - Mobvoi (AI chatbot in cars, phones and other devices)

Facebook, too.

## Obstacles:

- Intense domestic competition (BAT)
- Government
  - Cybersecurity Law – data servers
  - Data is tricky topic

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# Industries to watch out for (a sampling)

1. Military and defense
  - Intelligent weaponry, i.e. AI guided missiles
  - Tracking of people through closed-circuit cameras
  - Internet censorship
  - Crime prediction
2. Finance – “fintech”
  - Automated trading programs
  - Compliance, i.e. anti-money laundering
  - Lending
3. Manufacturing
  - Robotic arms
  - Quality check cameras
4. Agriculture
  - Driverless tractors
  - Surveying drones
  - Milk bots
5. Medical care
  - Care bots
  - Robot-assisted surgeries



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