

Asia Emerging Robotics

Humanoid Robotics: U.S.-China Decoupling



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We view the recent U.S. ban ([here](#)) on new foreign-made mobile robots (including humanoids and quadrupeds) as the formal beginning of U.S.-China decoupling in robotics. In this note, we assess the policy tools available to both sides, potential escalation scenarios, and the implications for key players along the value chain (Exhibit 1).

The U.S. to lead further escalation. Unlike sectors such as automobiles, telecoms, and drones, where U.S. market-access restrictions were introduced only after a series of other measures (Exhibit 4 to Exhibit 6), the FCC moved directly to restrict the entry of new Chinese robot models into the U.S. market. This underscores both the strategic importance of robotics and the potential for further U.S.-led escalation. We believe the U.S. could escalate its measures beyond market-access restrictions to include measures aimed at leading Chinese players (as seen in the cases of Huawei, Hikvision, and DJI, Exhibit 7), e.g. Entity List designations and investment restrictions. Currently, China's robotics industry remains reliant on **U.S. AI chips and simulation platforms** (Exhibit 10 to Exhibit 12), leaving these areas exposed to potential future U.S. policy actions.

China's potential response: lifecycle data as the base case, rare-earth magnets as the escalation lever. Data scarcity is widely recognized as a key bottleneck in humanoid robotics. In response, Chinese players have been moving faster in scaling training datasets and acquiring high-value data (Exhibit 13). For example, Chinese leader Galbot plans to expand its high-quality data volume by 10x within two years (Exhibit 14). The strength is enhanced by China's multiple times humanoid market size vs. RoW currently. China has recognized the importance of data and tightened controls on important data exports across industries. Following the precedent set by China's automotive industry (Exhibit 15, Exhibit 16), where data controls span the entire lifecycle from R&D and model development to manufacturing, operation and maintenance, we expect a similar framework to emerge in robotics, with **lifecycle data controls serving as China's base-case policy response**. Moreover, rare-earth magnets may represent China's strongest policy lever. Rare-earth magnets are critical to modern humanoid robots (Exhibit 17) and, as discussed earlier in our report ([here](#)), China dominates the entire value chain (Exhibit 18) and has sharpened its policy toolkit (Exhibit 19). While China has remained restrained, **tighter rare-earth magnet controls could emerge as the key escalation lever** in response to further U.S. escalation.

Implications. U.S.-China decoupling could create distinct beneficiaries across the value chain: (1) In the U.S., policy barriers shield the domestic market, which should benefit local humanoid OEMs (e.g. **Tesla, Figure, Agility**). (2) Backed by China's ability to impose meaningful countermeasures, we think leading Chinese humanoid OEMs can continue expanding in non-U.S. markets, as Hikvision demonstrated (Exhibit 8). (3) Leading Chinese component suppliers with overseas capacities (e.g. **Shuanghuan, Tuopu, Hesai, Orbbec**) may benefit from growth in both the Chinese and U.S. robotics industries. (4) Non-Chinese component suppliers (e.g. **Schaeffler, Harmonic Drive**) may gain additional opportunities with U.S. humanoid customers seeking to diversify supply chains. (5) Escalating U.S. technology restrictions may accelerate the localization of AI chips and simulation platforms in China. **Horizon Robotics** and **Black Sesame** both are working on chips for robotics leveraging their expertise in smart driving chips, and if any decouple on the chip side happens both companies would benefit.

DETAILS

EXHIBIT 1: U.S.-China decoupling in robotics: Policy toolkit and potential impact

U.S. Toolkit		Impact on Non-Chinese players		Impact on Chinese players			
Measures	Intended Effect	US humanoid robot OEMs	Non-Chinese components suppliers	Chinese humanoid robot OEMs	Chinese components suppliers		
					Players serving U.S. humanoid OEMs	Players serving Chinese humanoid OEMs	
Base case ↓	Denial of FCC Equipment Authorization	Block foreign robots from entering the U.S. market (may cover legacy models)	↑	↑	↓	↑	↓
	U.S. Tech & Product Export Controls (e.g., EntityList, FDPR)	Constrain the targeted entities' technological advancement and production capabilities	→	→	↓	→	↓
	Investment Restrictions (e.g., NS-CMIC List)	Restrict capital investment in targeted entities	→	→	↓	→	→
	Diplomatic Pressure on Allied Countries	Limit market access in U.S.-aligned countries	↑	↑	↓	↑	↓
	Specialty Designated Nationals (SDN) List	Impose global financial and commercial isolation on targeted entities	↑	↑	↓	↑	↓
Escalation							

China's Toolkit		Impact on Non-Chinese players		Impact on Chinese players			
Measures	Intended Effect	US humanoid robot OEMs	Non-Chinese components suppliers	Chinese humanoid robot OEMs	Chinese components suppliers		
					Players serving U.S. humanoid OEMs	Players serving Chinese humanoid OEMs	
Base case ↓	Data Export Controls	Control targeted entities from accessing important data (training, algorithms, designs, etc.)	↓	↓	→	↓	→
	Unreliable Entity List	Restrict targeted entities' trade with China	↓	↑ (Alternative to Chinese suppliers)	↑	↑ (If they have overseas capacity)	↑
	Countermeasure List / Malicious Entity List	Restrict targeted entities' trade, data flows, and technology cooperation with Chinese entities and individuals	↓	↑	↑	↓	↑
	Rare-Earth Permanent Magnet Controls (Export controls + "Long-arm jurisdiction")	Restrict targeted entities' access to critical materials	↓	↓ (Increasing uncertainty)	↑	↑ (Greater supply chain security)	↑
Escalation							

↑

 Positive impact

→

 Neutral

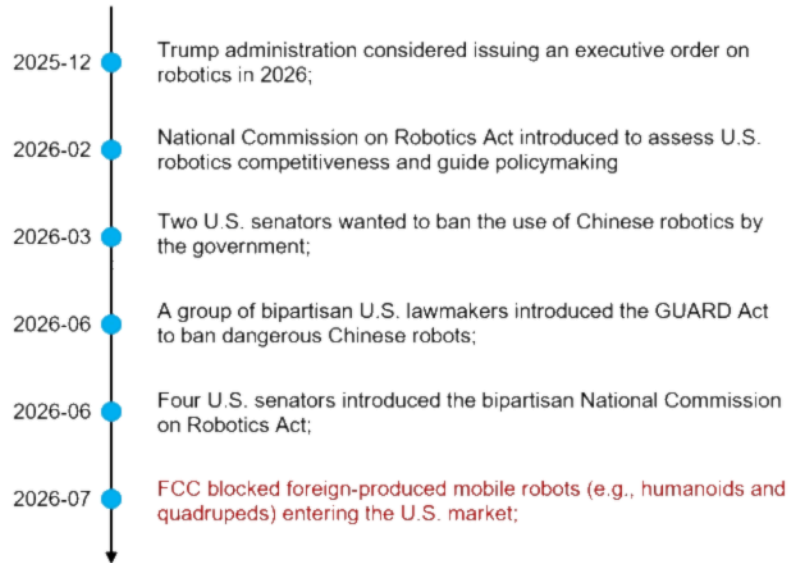
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 Negative impact

Note: 1) We assume that the measures target humanoid robot OEMs, while component suppliers are impacted secondarily through their exposure to the OEMs.

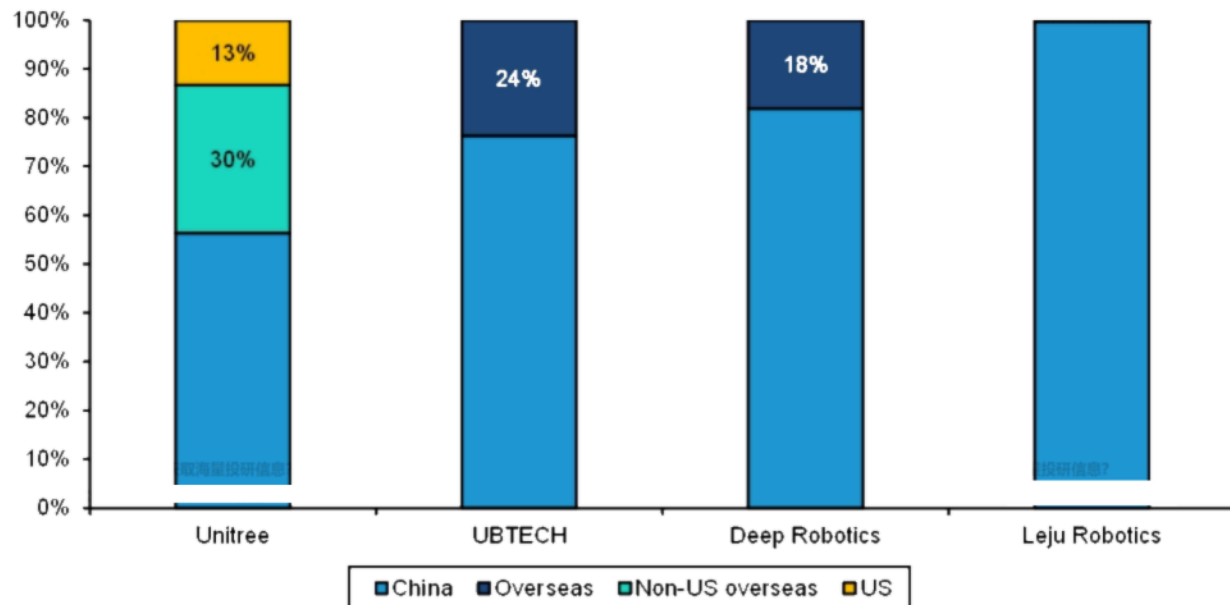
2) We focus on the implications for the local industry as a whole, rather than the impact on any individual company or its specific supply chain. 3) FCC - Federal Communications Commission; FDPR - Foreign Direct Product Rule; NS-CMIC - Non-SDN Chinese Military-Industrial Complex Companies List;

Source: FCC, BIS, OFAC, U.S. Department of State, State Council, CAC, MIIT, NDA, MOFCOM, GACC, Bernstein analysis and estimates

EXHIBIT 2: **Increasing U.S. attention to the robotics industry since late 2025****Timeline of U.S. Actions on Robotics**

Note: GUARD - Guarding the U.S. Against Adversarial Robotics Dominance; FCC - Federal Communications Commission.

Source: POLITICO, Office of Congresswoman Jennifer McClellan, Mashable, U.S. House of Representatives Select Committee on China, Office of U.S. Senator Dave McCormick, U.S. Federal Communications Commission, Bernstein analysis

EXHIBIT 3: **U.S. policy may have limited impact on Chinese humanoid robot players at present****Chinese humanoid robot companies: Revenue breakdown by region**

Source: Company annual reports, company IPO prospectus, Bernstein analysis

EXHIBIT 4: Escalating U.S. restrictions on China's automotive industry

Period	Policy Direction	Key Measures	Actual Impact
2018	Imposition of 10%-25% tariffs	Section 301 tariffs imposed on Chinese-imported autos and auto parts	Raised retail prices for Chinese vehicles in U.S.
2022-2023	Subsidy Restrictions	Subsidy eligibility tied to North American assembly and sourcing of critical minerals/battery components	Vehicles made in China or containing Chinese battery components lost U.S. subsidies
2024	Tariff Escalation	- Chinese EV tariffs raised from 25% to 100%. - Tariffs on Li-ion batteries, battery components, and critical minerals raised to 25%. - Tariffs on natural graphite and permanent magnets scheduled to rise to 25% in 2026.	Weakened competitiveness of Chinese EVs in U.S.
2025-2026	Restrictions on Chinese VCS & ADS	- Restrictions placed on connected passenger vehicles with Chinese VCS hardware, VCS software, and ADS software - VCS & ADS software-related restrictions effective Model Year 2027 - VCS hardware-related restrictions effective Model Year 2030	Restricted entry of Chinese VCS, ADS and passenger vehicles containing VCS or ADS into U.S.

Note: EV - Electric Vehicle; VCS - Vehicle Connectivity System; ADS - Automated Driving System.

Source: United States Trade Representative, U.S. Internal Revenue Service, U.S. Bureau of Industry and Security, Bernstein analysis

EXHIBIT 5: Escalating U.S. restrictions on China's telecommunications industry

Period	Policy Direction	Key Measures	Actual Impact
2018	Denial Order against ZTE	Prohibited export of U.S. controlled goods, software, and technology to ZTE	ZTE nearly ceased operations before settlement
2018-2019	Procurement Bans & Entity List	- Banned federal agencies from buying or using Chinese telecom or surveillance equipment (Huawei, Hikvision, etc.) - Created ICTS national security review framework - Blocked Entity List firms from accessing U.S.-origin technologies	- Federal procurement bans imposed - Entity List firms lost U.S. technology access
2020	Implementation of the Secure Networks Act	- Required the FCC to publish and maintain a list of communications equipment and services that pose national security risks - Funding support to help small telecom providers for equipment removal & replacement - Huawei and ZTE were added to covered companies	- FCC pulished Covered List, which became the foundation for future bans - Universal Service Fund subsidies barred for Huawei/ZTE
2021-2024	Covered List Enforcement	FCC halted equipment authorization for new products from Covered List companies	New Huawei, ZTE, Hytera, and Hikvision equipment banned in the U.S.
2025	Anti-Circumvention	Investigated market entry via subsidiaries or rebranding	Anti-circumvention enforcement phase
2026	Ban on Certain Authorized Products	Banned certain covered equipment, even if previously FCC-authorized	Restrictions extended to certain legacy models

Note: ICTS - Information and Communications Technology and Services; FCC - Federal Communications Commission.

Source: U.S. Bureau of Industry and Security, U.S. Public Law No: 115-232, U.S. Executive Order 13873, Public Law No: 117-55, FCC, Bernstein analysis

EXHIBIT 6: Escalating U.S. restrictions on China's drone industry

Period	Policy Direction	Key Measures	Actual Impact
2017-2021	Procurement & Investment Limits	- Restricted federal agencies from buying/using DJI and other Chinese drones - Treasury Department identified DJI as the Chinese Military-Industrial Complex	- Commercial sales remained but government market shrank - U.S. persons prohibited from investing in DJI
2022-2024	Customs Detention & Federal Bans	- U.S. Customs detained and investigated DJI products entering the U.S. market. - American Security Drone Act banned federal procurement/operation of Chinese drones	- DJI shipments faced Customs detention risks - Chinese drones largely excluded from federal projects
2025	New Model Ban	FCC updated the Covered List to include foreign-produced drone and critical drone components	- New models from DJI, Autel, and others blocked from U.S. market entry - Previously approved and deployed legacy models unaffected

Note: FCC - Federal Communications Commission.

Source: U.S. Executive Order 13981, U.S. Department of the Treasury, DJI, U.S. Public Law No: 118-31, U.S. Public Law No: 118-159, Bernstein analysis

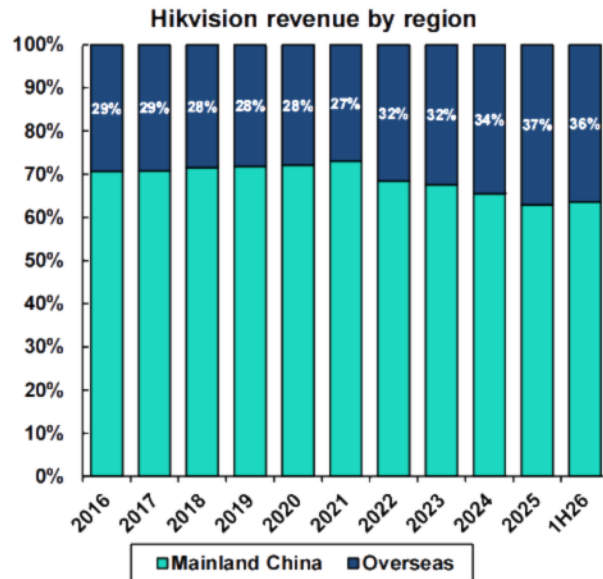
EXHIBIT 7: U.S. policy measures on Huawei, Hikvision, and DJI

U.S. Toolkit		Chinese companies impacted by the measures		
Measures	Intended Effect	Huawei	Hikvision	DJI
Denial of FCC Equipment Authorization	Restrict access to the U.S. market	∩ Year 2021	∩ Year 2021	∩ Year 2025
U.S. Tech & Product Export Controls (e.g., Entity List, FDP)	Constrain the targeted entities' technological advancement and production capabilities	∩ Year 2019	∩ Year 2019	∩ Year 2020
Investment Restrictions (e.g., NS-CMIC List)	Restrict capital investment in targeted entities	∩ Year 2021	∩ Year 2021	∩ Year 2021
Diplomatic Pressure on Allied Countries	Limit market access in US-aligned countries	∩ Year 2018		
Specially Designated Nationals (SDN) List	Impose global financial and commercial isolation on targeted entities			

Note: FCC - Federal Communications Commission; FDP - Foreign Direct Product Rule; NS-CMIC List - Non-SDN Chinese Military-Industrial Complex Companies List.

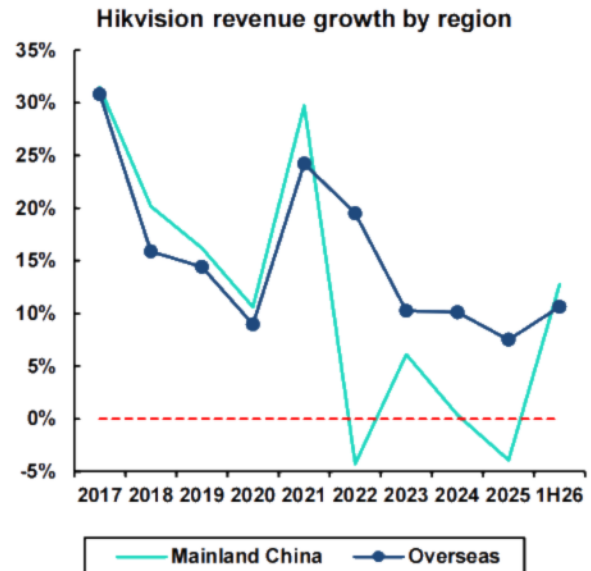
Source: U.S. Public Law No: 117-55, Viewpoints, U.S. Bureau of Industry and Security, U.S. Department of the Treasury, CNBC, Bernstein analysis

EXHIBIT 8: Hikvision's overseas business continued to expand after 2021, despite policy restrictions from the U.S.



Source: Hikvision, Bernstein analysis

EXHIBIT 9: Hikvision maintained robust growth outside China, despite policy restrictions from the U.S.



Source: Hikvision, Bernstein analysis

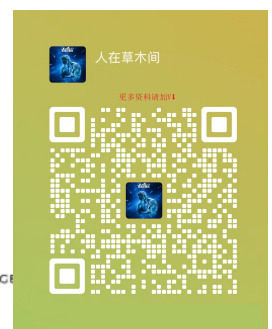
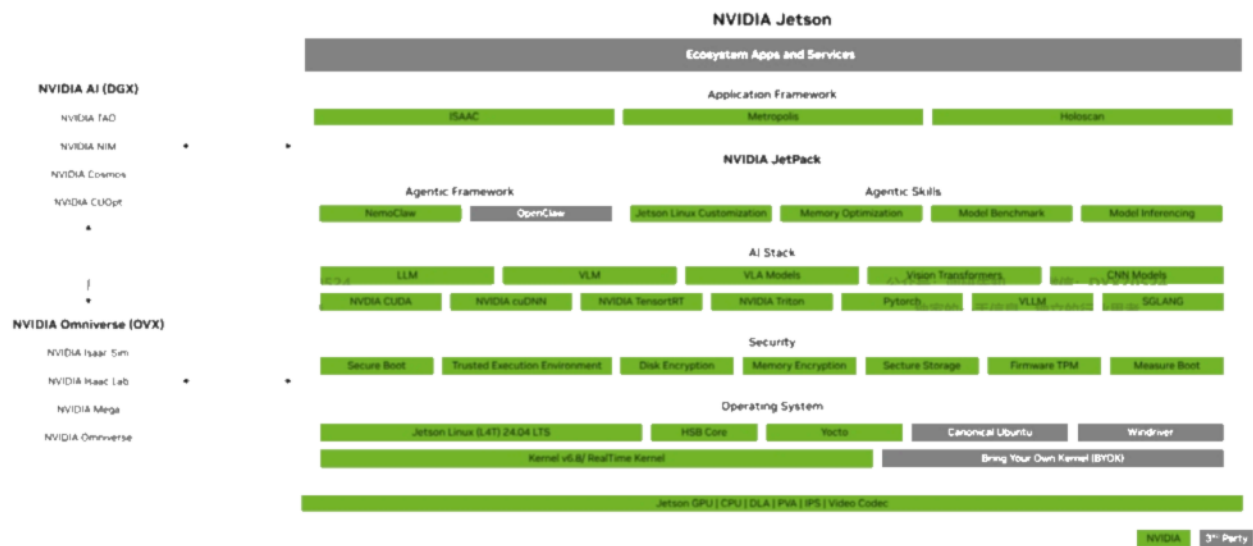
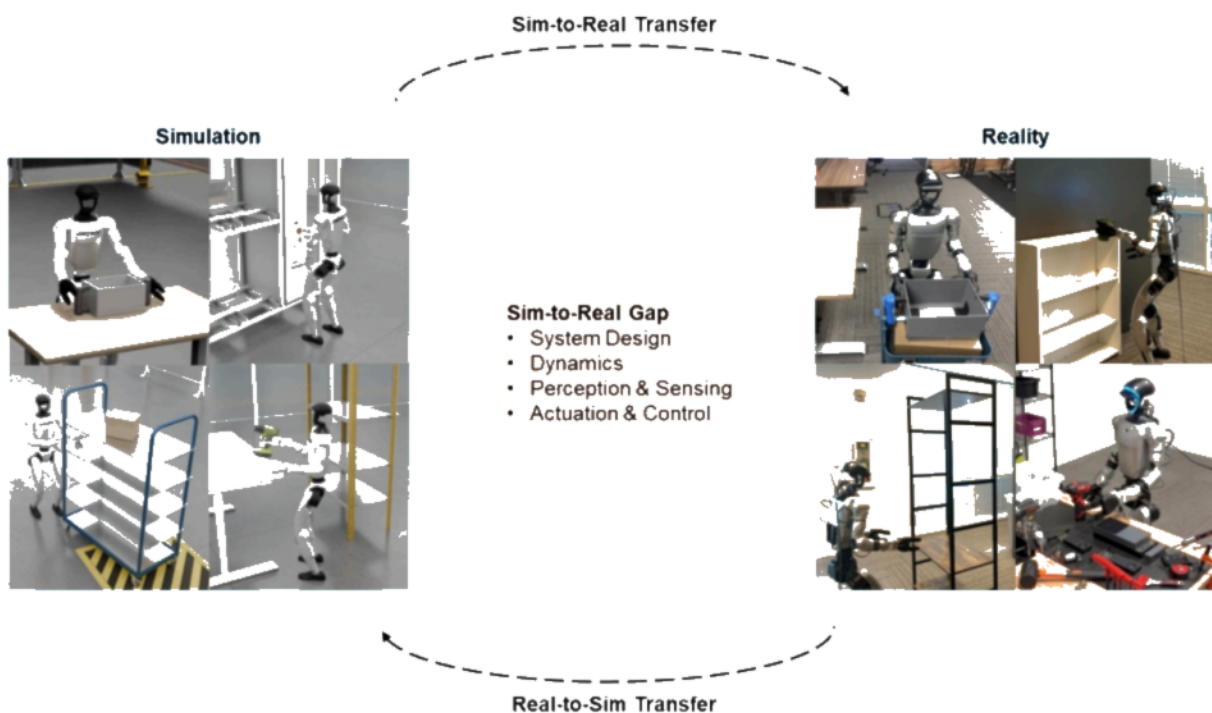


EXHIBIT 10: NVIDIA offers full-stack hardware and software solutions, with ecosystem spanning training, models, simulation and on-robot inference



Source: NVIDIA, Bernstein analysis

EXHIBIT 11: Simulation platform is critical for robotic training

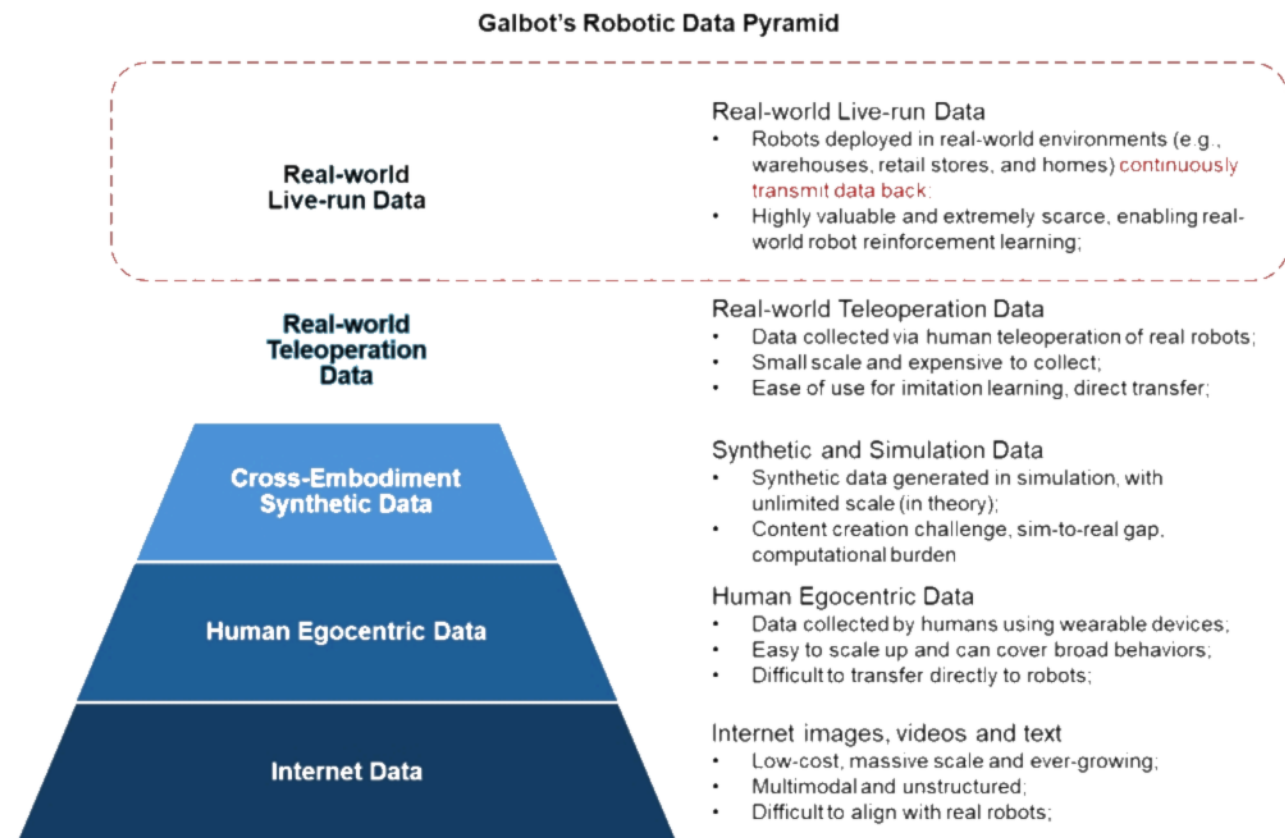


Source: "HumanoidMimicGen: Data Generation for Loco-Manipulation via Whole-Body Planning", Bernstein analysis

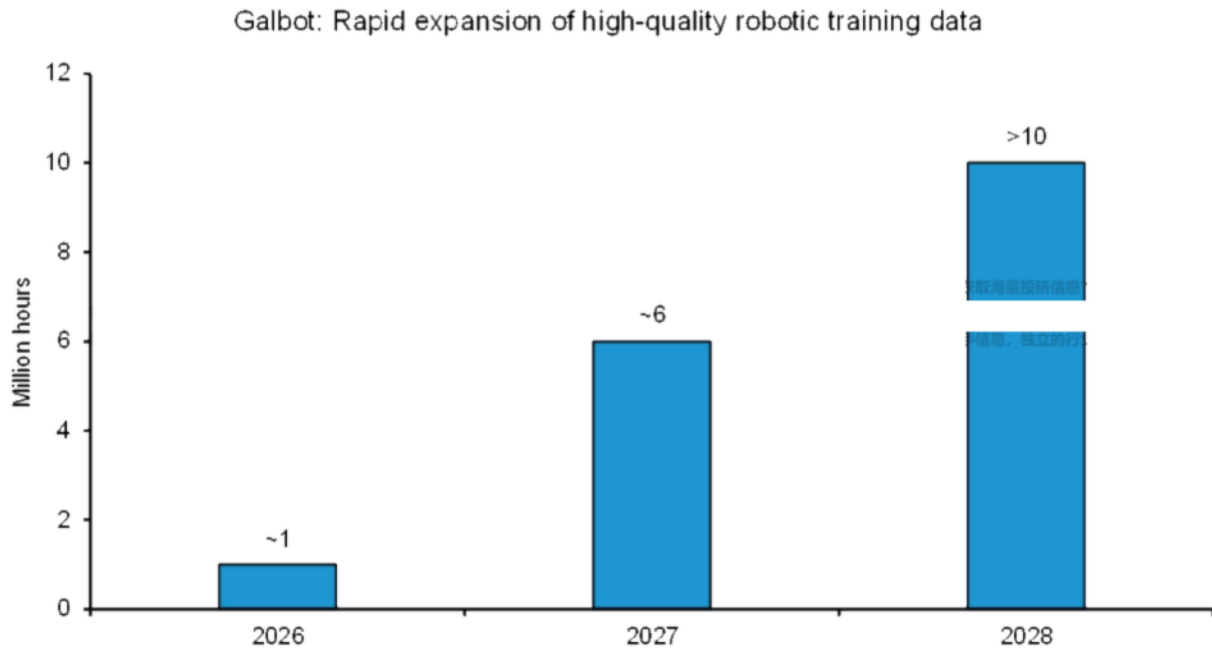
EXHIBIT 12: **Major suppliers of robotic simulators**

Company	Region	Simulation environment	Physics engines	GPU-accelerated simulation?	Open source?
NVIDIA	USA	NVIDIA Isaac Sim	PhysX; Newton;	✓	X
Google DeepMind	USA	MuJoCo (Acquired by DeepMind in 2021)	MuJoCo	✓	✓
Gazebo	USA	Gazebo	Bullet; ODE; DART; Simbody	X	✓
Coppelia Robotics	Switzerland	CoppeliaSim	MuJoCo; Bullet; ODE; Newton; Vortex	X	✓
Bullet Physics	USA	PyBullet	Bullet	X	✓

Note: NVIDIA is covered by Bernstein U.S. Semiconductors team. Google is covered by Bernstein U.S. Internet. Others are not listed or covered by Bernstein.
Source: Simulately, SimBenchmark, company websites, Bernstein analysis

EXHIBIT 13: **Robotic data pyramid: Robotic training requires large volumes of data and high-value data**

Source: Galbot, Bernstein analysis

EXHIBIT 14: **Galbot plans to expand its high-quality data volume by 10x within two years**

Source: Galbot, Bernstein analysis

EXHIBIT 15: Important data in China's automotive industry: R&D, testing, and manufacturing

Important data in product development

No.	Data Category	Data Item	Identification Criteria
1	Bill of Materials	Design Bill of Materials	<u>Meeting any of the following criteria:</u> 1 Supported by a National Major Project or the National Key R&D Program.
2	R&D Documents	R&D Documents	2 Covered by the Catalogue of Technologies Prohibited or Restricted from Export by China.
3	Development Source Code	Product Technology Development Source Code	3 Involving items included in the Export Control List of Dual-Use Items .

Important data in product testing

No.	Data Category	Data Item	Identification Criteria
1	Labeling Data	Image Labeling	<u>Meeting any of the following criteria:</u>
2		Point-Cloud Labeling	1 Covering sensitive areas such as military zones, defense entities, and government facilities.
3		Multimodal Labeling	2 Allowing the inference of sensitive geographic information data.
4		Video Labeling	3 Traffic, pedestrian, or logistics data reflecting prefecture-level economic operations accumulated for ≥ 30 days.
5	Simulation Data	Road-Network Simulation Files	4 Covering event security, emergency scenes, or public security law enforcement operations.
6		Environment Simulation Files	5 Containing human faces outside the vehicle with a bounding-box minimum side length of at least 32 pixels.
7		Traffic-Flow Simulation Files	6 Containing vehicle license plates outside the vehicle with a bounding-box minimum side length of at least 16 pixels.
8		Synthetic Simulation Files	7 Collected from 100,000 or more vehicles operating within China.
9		Replay Simulation Files	8 Collecting more than 2,000 hours of raw real-world video footage, or data derived from such footage.
10	Testing Data	Testing Files	9 Containing over 10 million raw images , or data derived from such images.

Important data in product manufacturing

No.	Data Category	Data Item	Identification Criteria
1	Bill of Materials	Process Bill of Materials	<u>Meeting any of the following criteria:</u> 1 Supported by a National Major Project or the National Key R&D Program.
2	Production-Control Program Source Code	CNC Machine Tool Program Source Code	2 Covered by the Catalogue of Technologies Prohibited or Restricted from Export by China.
3		Industrial Robot Program Source Code	3 Covering items included in the Export Control List of Dual-Use Items .

Note: CNC - Computer Numerical Control

Source: MIIT, CAC, NDRC, NDA, MPS, MNR, MOT, SAMR, Bernstein analysis

EXHIBIT 16: Important data in China's automotive industry: Autonomous driving

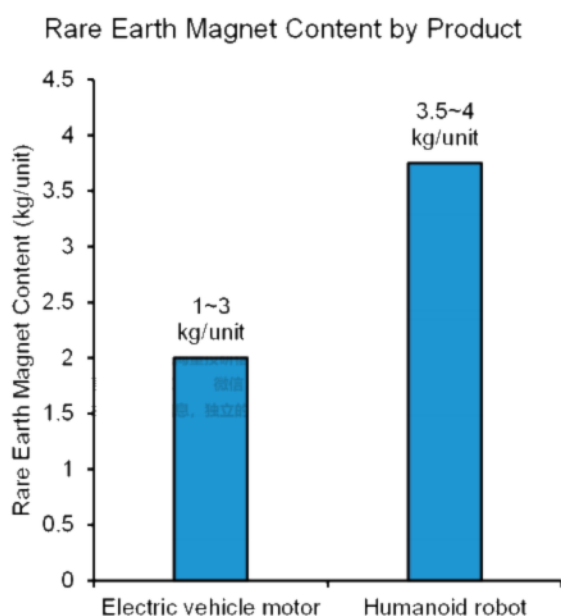
Important data for autonomous driving

No.	Data Category	Data Item	Identification Criteria
1	Automated-Driving Algorithm Data	Automated-Driving Algorithm Files	<u>Meeting any of the following criteria:</u> 1 Supported by a National Major Project or the National Key R&D Program.
2		Automated-Driving Algorithm Source Code	2 Relating to award-winning achievements in connected-vehicle cybersecurity, data security, or autonomous driving technologies at the provincial level or above.
3		Automated-Driving Algorithm Parameters	3 Potentially affecting national technological security and industry competitiveness
4	Automated-Driving Algorithm Training Data	Drivers' Decision-Making Dataset	<u>Meeting any of the criteria when fused with real-world imagery and radar data:</u> 1 Enabling the identification of sensitive areas such as military zones, defense entities, and government facilities.
5		Datasets for ADAS/Autonomous Driving Decision-Making, Prediction, and Planning	2 Enabling the inference of sensitive geospatial data. 3 Reflecting regional economic activity through vehicle, pedestrian, logistics, or related data collected over 30 days or more.
6		Vehicle Operation Dataset	4 Capable of revealing security operations for major events, emergency-response activities, or law-enforcement activities and personnel. 5 Collected from 100,000 or more vehicles operating within China.
7	Automated-Driving Algorithm Feature Data	Training Dataset	<u>Meeting any of the following criteria:</u> 1 Supported by a National Major Project or the National Key R&D Program. 2 Relating to provincial-level or higher achievements in connected-vehicle network and data security or automated driving.
8		Image Feature Data	3 Enabling the identification of sensitive areas such as military zones, defense entities, and government facilities. 4 Enabling the inference of sensitive geographic information data. 5 Reflecting regional economic activity through vehicle, pedestrian, logistics, or related data collected over 30 days or more.
9		Point-Cloud Feature Data	6 Capable of revealing security operations for major events, emergency-response activities, or law-enforcement activities and personnel. 7 Collected from 100,000 or more vehicles operating within China. 8 Collecting more than 2,000 hours of raw real-world video footage, or data derived from such footage. 9 Containing over 10 million raw images , or data derived from such images.

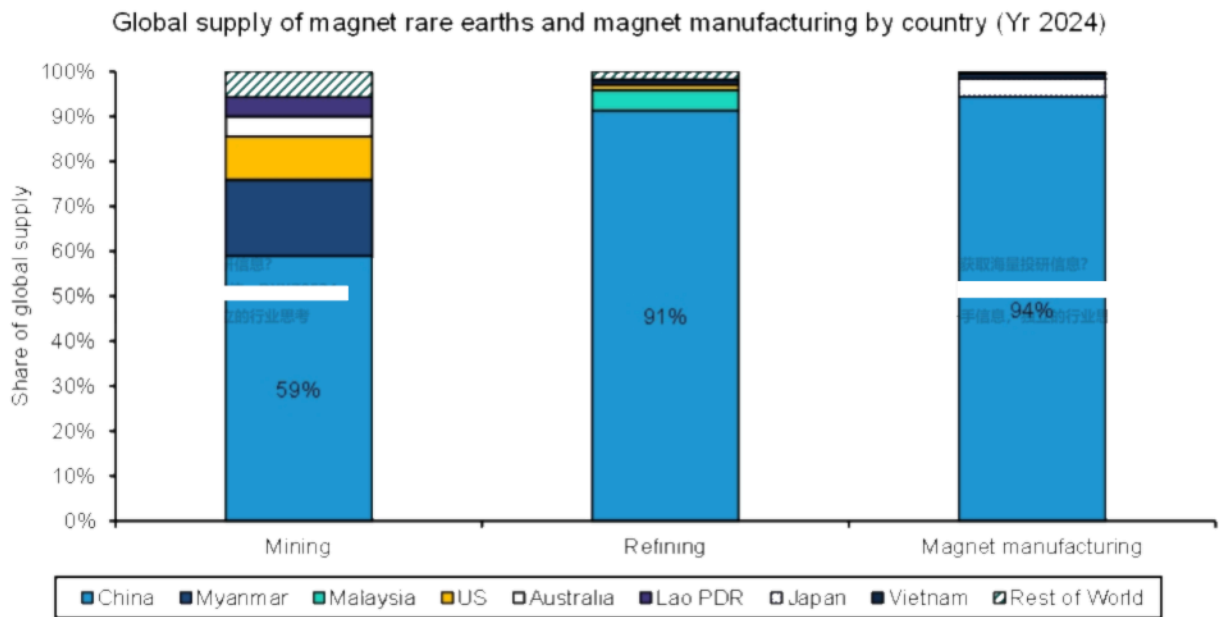
Note: ADAS - Advanced Driver Assistance Systems

Source: MIIT, CAC, NDRC, NDA, MPS, MNR, MOT, SAMR, Bernstein analysis

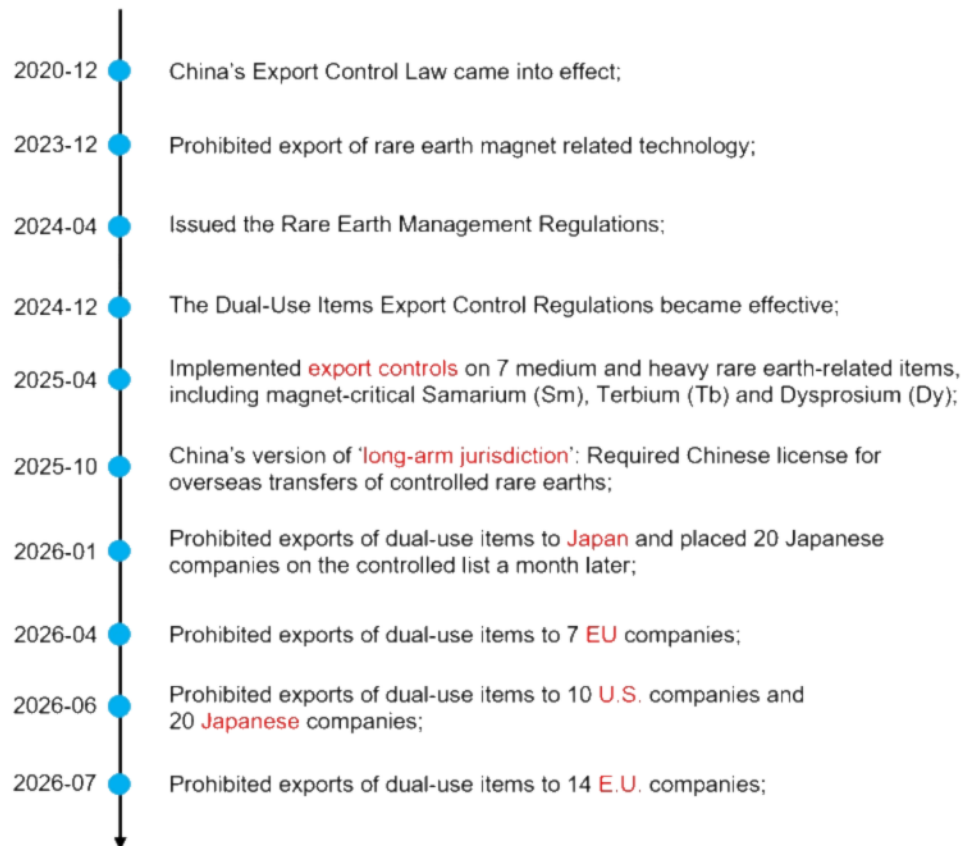
EXHIBIT 17: Rare earth magnet content per EV motor and humanoid robot



Source: Rare Earth Exchanges, IEA, China Northern Rare Earth, Bernstein analysis

EXHIBIT 18: **China dominates the value chain of rare-earth magnet**

Source: IEA, Bernstein analysis

EXHIBIT 19: **China has been strengthening controls across the rare earth supply chain****Timeline of China's Rare Earth Restriction**

Source: IEA, MDPI, The Royal United Services Institute, China's Ministry of Commerce, Bernstein analysis

INVESTMENT IMPLICATIONS

We rate Shuanghuan, Hesai, Tuopu, Inovance, Harmonic Drive, Hikvision, BYD and Xiaomi Outperform, Sanhua, XPeng and Estun Market-Perform and Leader Drive Underperform.

Horizon Robotics: **Outperform**, PT 10 HKD

Black Sesame: **Underperform**, PT 16 HKD

BERNSTEIN TICKER TABLE

Ticker	Rating	Cur	13 Aug 2026	Price Target	TTM	Cur	Reported EPS			Reported P/E (x)		
			Closing		Rel. Pert.		2025A	2026E	2027E	2025A	2026E	2027E
HSAL.US (Hesai)	O	USD	19.29	30.00	(48.6)%	CNY	2.92	3.31	5.27	44.6	39.3	24.7
2525.HK (Hesai)	O	HKD	18.41	30.00	NA	CNY	2.92	3.31	5.27	5.4	4.8	3.0
688017.CH (Leader Drive)	U	CNY	349.93	115.00	122.9%	CNY	0.69	0.83	0.96	505.4	419.5	363.9
601689.CH (Tuopu)	O	CNY	49.51	75.00	(25.6)%	CNY	1.61	1.81	2.36	30.8	27.4	21.0
2050.HK (Sanhua)	M	HKD	26.14	27.00	(34.9)%	CNY	1.03	0.97	1.11	21.8	23.1	20.3
002050.CH (Sanhua)	M	CNY	38.30	39.00	9.6%	CNY	1.03	0.97	1.11	37.2	39.4	34.6
002472.CH (Shuanghuan)	O	CNY	37.89	60.00	(25.8)%	CNY	1.50	1.70	2.00	25.3	22.3	19.0
9660.HK (Horizon Robotics)	O	HKD	5.01	10.00	(65.1)%	RMB	(0.81)	(0.25)	(0.11)	13.0	8.3	5.0
2533.HK (Black Sesame)	U	HKD	11.47	16.00	(67.4)%	RMB	(2.37)	(2.03)	(1.85)	7.6	4.4	3.1
1211.HK (BYD)	O	HKD	88.25	130.00	(53.8)%	CNY	3.58	4.15	5.57	21.2	18.3	13.6
002594.CH (BYD)	O	CNY	88.90	114.00	(47.8)%	CNY	3.58	4.15	5.57	24.8	21.4	15.9
1810.HK (Xiaomi)	O	HKD	25.62	38.00	(72.2)%	CNY	1.62	0.93	1.41	13.6	23.8	15.7
XPEV (XPeng)	M	USD	11.78	20.00	(59.6)%	CNY	(1.20)	(2.03)	0.45	(66.4)	(39.1)	175.9
9868.HK (XPeng)	M	HKD	45.52	78.00	(72.7)%	CNY	(0.60)	(1.02)	0.23	(65.4)	(38.5)	173.2
6324.JP (HDSI)	O	JPY	6,510.00	7,800.00	116.3%	JPY	16.99	57.37	79.51	383.2	113.5	81.9
300124.CH (Inovance)	O	CNY	61.20	82.00	(39.4)%	CNY	1.87	2.19	2.65	32.7	27.9	23.1
002415.CH (Hikvision)	O	CNY	34.88	45.00	(11.8)%	CNY	1.55	2.08	2.14	22.6	16.8	16.3
002747.CH (Estun)	M	CNY	34.75	26.00	14.5%	CNY	0.05	0.31	0.32	695.0	113.0	107.4
2715.HK (Estun)	M	HKD	18.22	17.26	NA	CNY	0.05	0.31	0.32	364.4	59.3	56.3
ASIA			1,960.56									
SPX			7,785.76									
JPL			2,732.89									

O - Outperform, M - Market-Perform, U - Underperform, NR - Not Rated, CS - Coverage Suspended

9660.HK, 2533.HK valuation is EV/Sales (x);

Source: Bloomberg, Bernstein estimates and analysis.