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China’s Self-Reliance Goal: How Much Progress?

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Context

1. **Chinese Industrial Policy Focus on Security and Self-Reliance**
   - ➢ Three phases of Industrial Policy
   - ➢ Shift in Objectives Requires new evaluation criteria
2. **New Instruments (such as Innovation Consortia):** Designed to achieve More effective **Micro** Interventions
3. **Evaluate Progress in Reducing Import Dependence (Self-Reliance)**

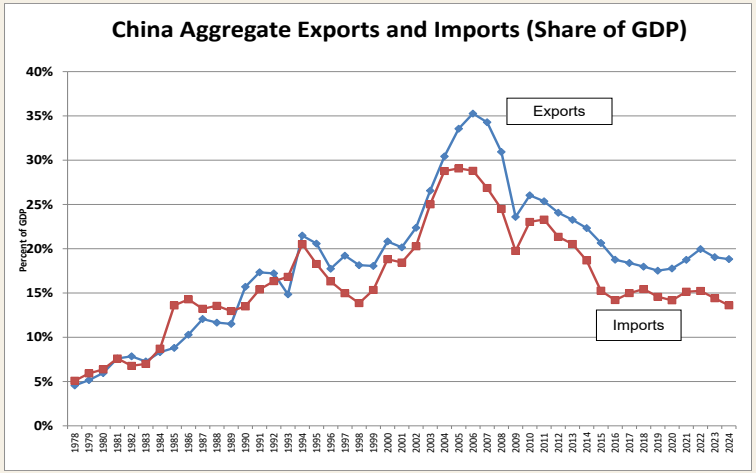
➢ Both macro and micro (specific commodities)

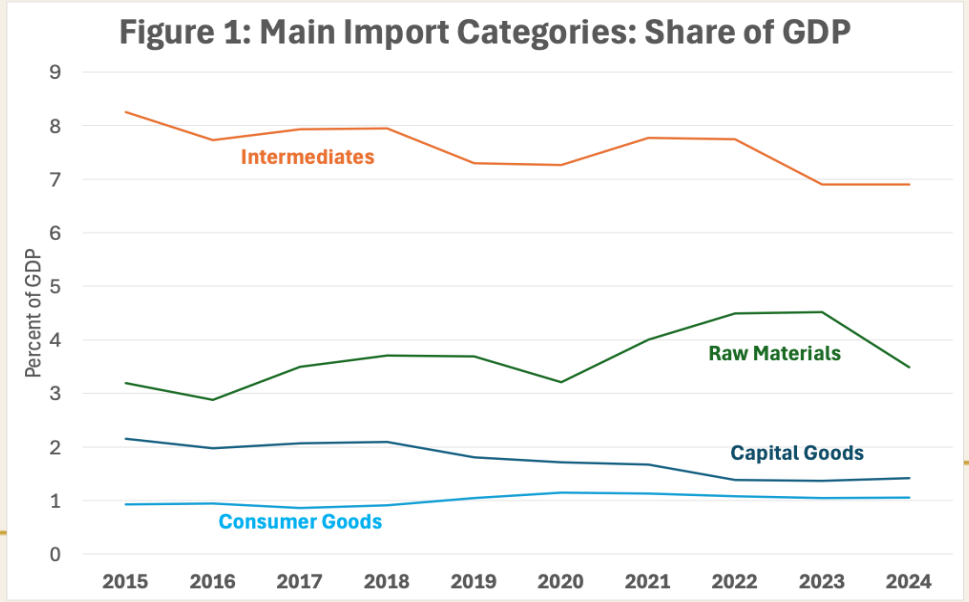
Three Phases of Chinese Industrial Policy

	Objective	Strategy	Additional Instruments
2006-2012	Economic Growth	Target Sectors, Opportunistically; Build Domestic Capacity	Traditional: Tax breaks; cheap credit;
2013-2019	Growth & Holistic Security	"Innovation-driven" New Technological Revolution	Government Guidance Funds; Gov't Research
2020-Present	Security & Self-Reliance	S&T Self-Reliance; Reduce Dependency	Innovation Consortia National S&T Forces "Modernized Industrial System"

Macro Trends

- Moderate reduction in “Big Economic Categories” (BEC), i.e., total imports of capital goods and Intermediates (scaled to GDP).
  - ➢ The two categories most likely to embody advanced technology.
- Moderate in the context of China’s relatively lower engagement in foreign trade.



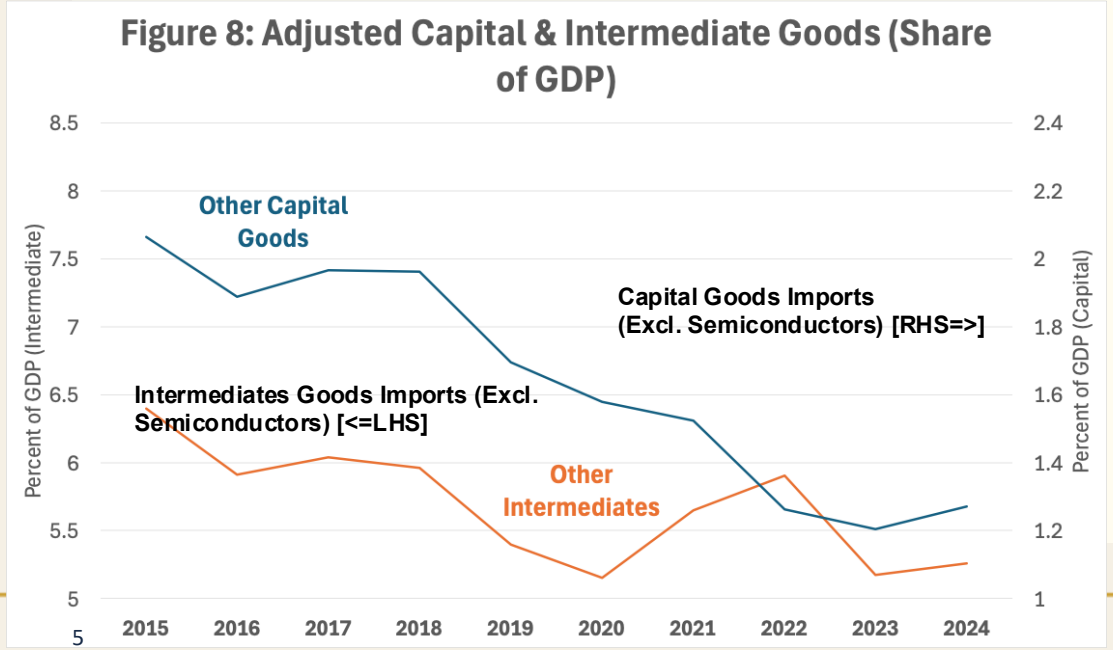


Preview of Procedures: Micro

1. Selected 16 groups of commodities based on 2018 Chinese evaluation of “bottleneck” technologies:
   - Partitioned by growth and volatility of imports (2 by 2 matrix).
   - Then divide into three policy-relevant groups.
   - Semiconductors and Semiconductor Capital Goods are different
2. Substantial Variation Among Groups
   1) Identified a substantial group of successful import-substitution commodities.
   2) Identified a group with “no discernable impact” of technology self-reliance.
   3) Identified a large group of policy-impacted groups, displaying high volatility along with continued rapid growth.
      - Includes all semiconductor-related categories
      - Not yet achieved import substitution, but picture is complex
3. Validated this approach with two additional “batches” from 2023 and 2025.
4. Used this information to return to the Aggregated Data (subtracting semiconductor-related groups): China Customs data is timely and rich, but difficult to use.

Preview of Results: How Effectively Has China Substituted for Imports? (Excluding Semiconductors)

- Imported capital goods (adjusted) declined significantly as a share of GDP; from 2.06% of GDP in 2015 to 1.27% of GDP in 2024. Almost 40%!
- Imported intermediates (adjusted) declined from 6.40% of GDP in 2015 to 5.26% of GDP in 2024. Reduction of 18%.



After a small uptick in 2024,
These two big categories together
(Excluding Semiconductors)
Declined from 8.46% of GDP to 6.53% of GDP.
Almost 2 full percentage points Of GDP.
This is a large and economically Significant number.

NOT the focus of much of the "Tech War" Commentary on China's Trade

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What We Have Done

1. **Looking at Commodity-Level and Aggregate Categories**

   Consistent and More Accurate Takeaways

2. Trends in **Technology Import Substitution**

   Both at the individual commodity level and in the aggregated data, we observe consistent signs of import substitution - partial but significant

3. **Externally validated** our bottleneck commodities as the self-reliance focus

   Utilized different batches of the sensitive technology product lists for cross-validation:

   - Batch 1: Technological Vulnerabilities from Technology Daily 2018
   - Batch 2: Advanced Manufacturing Roadmap from 2023
   - Batch 3: Custom Tariff Exemption Products from 2025

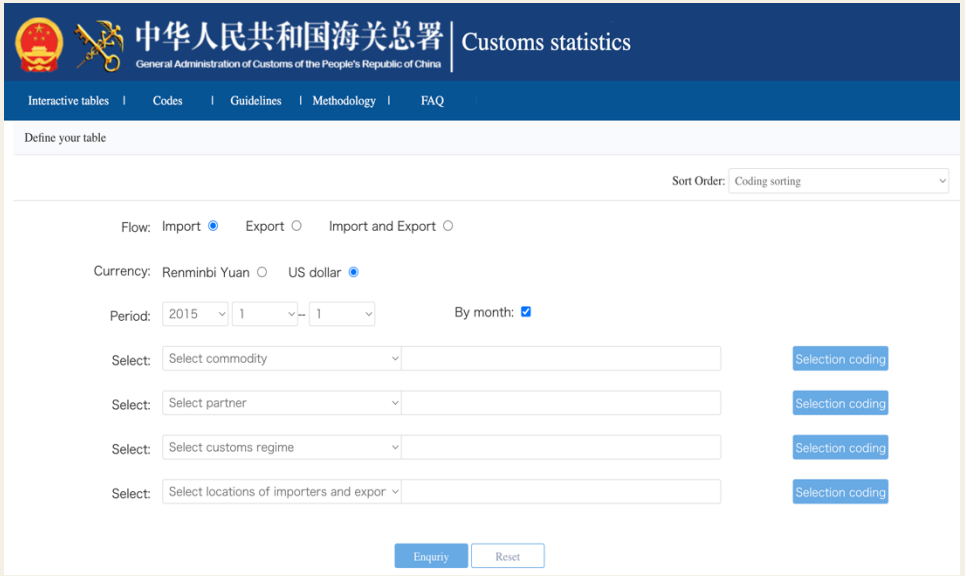
4. **Adjusted** Trends Considering **Stockpiling** Distortion

   Commodity-based patterns → ruling out precautionary stockpiling effects

Technology Groups

Unit of Analysis & Data

- Granularity
  - Chinese Harmonized System Code on 8-digit **(Commodity HS8 Code)**
- Data
  - Monthly trade volume by Commodity HS8 Code from **China National Custom**



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How We Define Technology Groups

Identifying Bottleneck Technologies

- **35 Technologies** from Science and Technology Daily (2018):
  - High Foreign Dependency
  - Lack of Substitutes
  - Strategic Importance
  - Vulnerability to Trade Restrictions
- **35 Technologies → 85 Commodity HS8 Code**

35 项中国被“卡脖子”的关键技术			
1	光刻机	19	高压柱塞泵
2	芯片	20	航空设计软件
3	操作系统	21	光刻胶
4	触觉传感器	22	高压共轨系统
5	真空蒸镀机	23	透射式电镜
6	手机射频器件	24	掘进机主轴承
7	航空发动机短舱	25	微球
8	iCLIP 技术	26	水下连接器
9	重型燃气轮机	27	高端焊接电源
10	激光雷达	28	钾电池隔膜
11	适航标准	29	燃料电池关键材料
12	高端电容电阻	30	医学影像设备元器件
13	核心工业软件	31	数据库管理系统
14	ITO 靶材	32	环氧树脂
15	核心算法	33	超精密抛光工艺
16	航空钢材	34	高强度不锈钢
17	铣刀	35	扫描电镜
18	高端轴承钢		

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How We Define Technology Groups

Identifying Bottleneck Technologies

- **85 Commodity HS8 Code → 16 Bottleneck Technology Groups**
- **16 Groups → 4 Technology Commodity Categories (common sense)**:
  - Semiconductor intermediates (semiconductor intermediate)
  - Semiconductor-related capital goods (semiconductor capital)
  - All other intermediates embodying bottleneck technologies (other intermediate)
  - All other capital goods embodying bottleneck technologies (other capital)
- **16 Groups → 17 Groups** (Medicaments added in the external validation process, as one of the top import commodities being exempted from tariffs)

How We Define Technology Groups

Table 1: Technology Groups

Sector	Category	Semiconductor-related?
1 Passive Component	Capital Goods	Semi
2 Integrated Circuits (ICs)	Intermediate	Semi
3 Silicon Processing	Capital Goods	Semi
4 Energy Equipment	Capital Goods	Other
5 Laser or Optical Measurement Devices	Capital Goods	Other
6 Lithography for Electronics	Capital Goods	Semi
7 Telecommunication Equipment	Capital Goods	Other
8 Cleanroom Process Equipment	Capital Goods	Semi
9 Fluid Control Equipment	Capital Goods	Other
10 Bearings and Alloy Steel	Intermediate	Other
11 Hot or Cold Process Equipment	Capital Goods	Semi
12 Polymers	Intermediate	Other
13 Batteries and Components	Intermediate	Other
14 Automotive and Power Systems	Intermediate	Other
15 Medical and Bio Precision Equipment	Capital Goods	Other
16 Aviation & Aerospace	Capital Goods	Other
17 Medicaments	Consumption Goods	Other

Sixteen Groups from 2018 Bottleneck List Plus Medicaments From 2025.

Aggregate Trends

Semiconductor Tech Group Displays Distinct Patterns:

(Regression-based Validation in Paper)

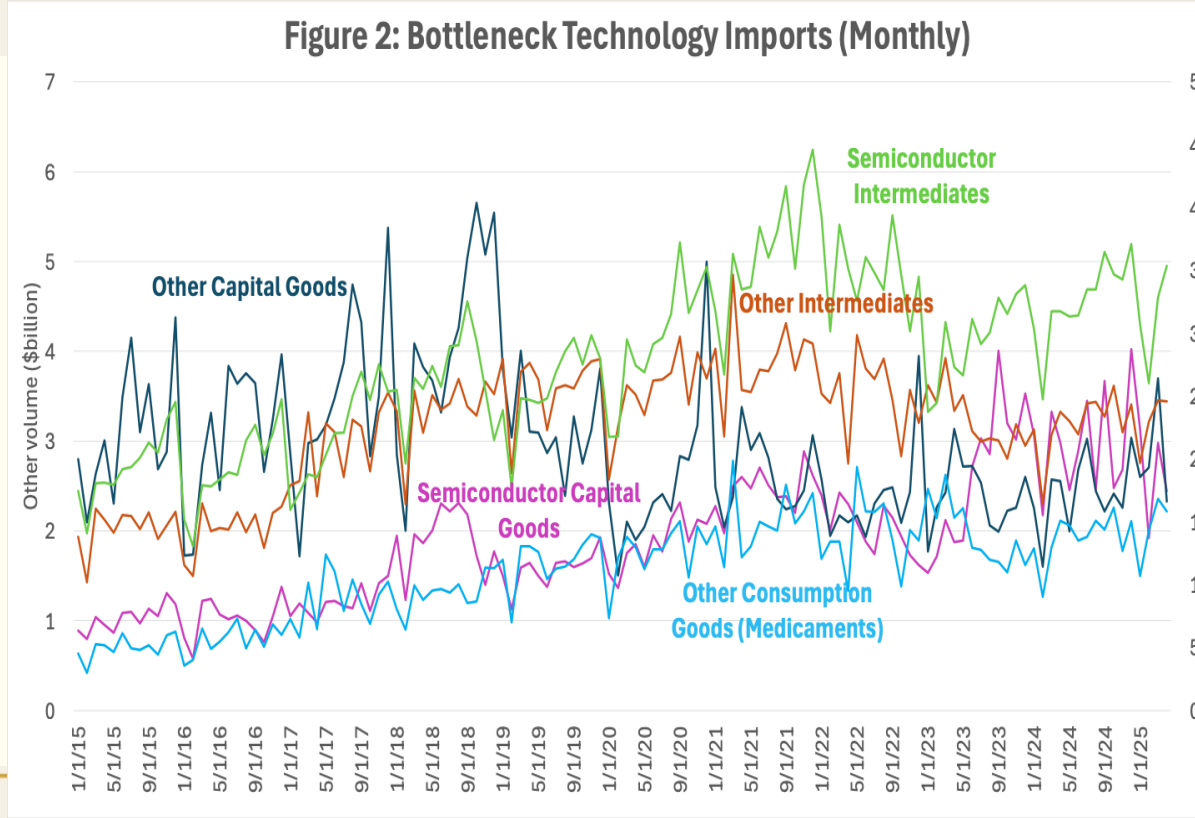
Increase in semiconductor-related technology-embodying imports:

Semiconductor Capital Goods:
- 0.09% → 0.16% of GDP
- 1 $billion → > 4 $billion

Semiconductor Intermediate Goods:
- 1.85% → 2.12% → 1.64% of GDP
- 15 $billion → >30 $billion

The Rest of Total Capital Goods:
- 2% → ~1.2% of GDP

The Rest of Total Intermediate Goods:
- 6.5% → ~5% of GDP



How We Partition Trade Patterns by Tech Groups

Calculation of Volatility Index & Growth Index

- **Volatility Index - Capturing Degree of Import Fluctuations**

Calculated using the coefficient of variation: $Volatility\ Index_i(COV) = \frac{SD(X_i)}{Mean(X_i)}$

- High values → erratic fluctuations
- Medium/low values → stable imports

- **Growth Index - Measuring Growth in Import**

Reflect the direction and magnitude of long-term trends, with recent data weighted more heavily :

$Growth\ Index_i = \frac{\sum_{t=1}^{T} w_t \cdot X'_{it}}{\sum_{t=1}^{T} w_t}, where\ X'_{it} = index(X_{it}) = \frac{x_{i,t} - x_{i,1}}{x_{i,1}}, \mathrm{t} = 1,2, \ldots \mathrm{T}$

- High values → high growth in imports
- Low values → low growth in imports

How We Partition Trade Patterns by Tech Groups

Three Key Trade Patterns Partitioned:

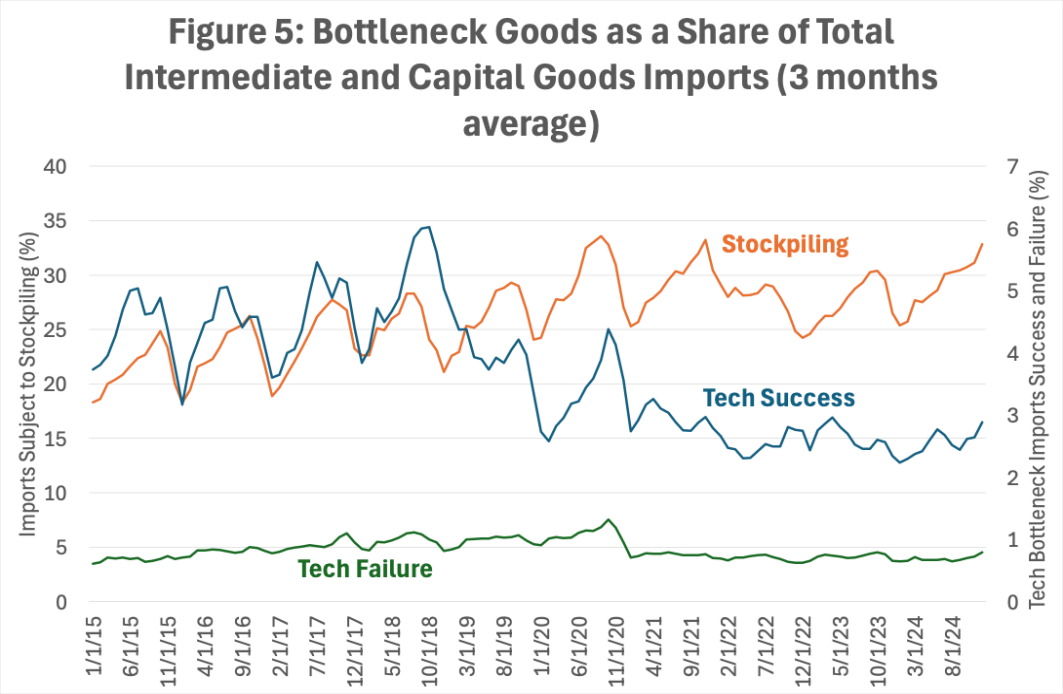
- **Stockpiling or Other Policy Disturbance** → *High growth (Growth Index > 0.5) & High volatility (Volatility Index > 0.3)*
- **No Discernable Effect** → *High growth (Growth Index > 0.5) & Medium/low volatility (Volatility Index < 0.3)*
- **Successful Import Substitution** → *Low growth (Change Index <0.5)*

Matrix: Seventeen Technology Groups

	High Growth (G > 0.5)	Low Growth (G < 0.5)
High Volatility (V > 0.3)	Cleanroom Process Equipment Energy Equipment Hot or Cold Process Equipment Lithography Equipment Medicines Silicon Processing Tools	Aviation & Aerospace
Medium Volatility (0.24 ≤ V < 0.3)	Integrated Circuits (ICs) Laser/Optical Devices Medical/Biotech Equipment	Passive Components Telecom Equipment
Low Volatility (V ≤ 0.23)	Fluid Control Equipment	Automotive / Power Systems Batteries and Components Bearings and Alloy Steel Polymers

Overview of Trade Patterns

Stockpiling vs No Discernable Effect vs Substitution



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Stockpiling Behavior - The Semiconductor Rush

Evidence of precautionary purchases rather than technological in/dependence

- Import surges driven by stockpiling or other policy disturbance
- Key groups:
  - **Integrated Circuits (ICs)**
  - **Lithography Equipment**
  - **Silicon Processing Tools**
  - **Cleanroom Process Equipment**
  - **Energy Equipment**
  - **Hot or Cold Process Equipment**
  - **Medicaments**
- Perhaps evidence of a policy cycle that allows or encourages imports early in the implement phase for that industry. Might serve to establish a market for the commodity and give domestic producers the chance to reverse engineer and incrementally innovate.

Sectors with Persistent Foreign Dependence

Slow progress of self-reliance, indicating no discernable effect from industrial policy

- Continuously increasing import volumes = lack of viable domestic alternatives
- Key groups:
  - **Medical/Biotech Precision Equipment**
  - **Laser/Optical Devices**
  - **Fluid Control Equipment**

Sectors Showing Self-Reliance Success

Consistent decline signaling domestic import substitution

- Key groups:
  - **Passive Components**
  - **Telecommunication Equipment**
  - **Automotive and Power Systems**
  - **Batteries and Components**
  - **Polymers**
  - **Aviation and Aerospace**
  - **Bearings and Alloy Steel**

Updating the Analysis with More Recent "Bottleneck" Commodities (Validation)

- Batch 1: HS8 commodities identified from *2018 Science and Technology Daily Chokepoint Tech List*

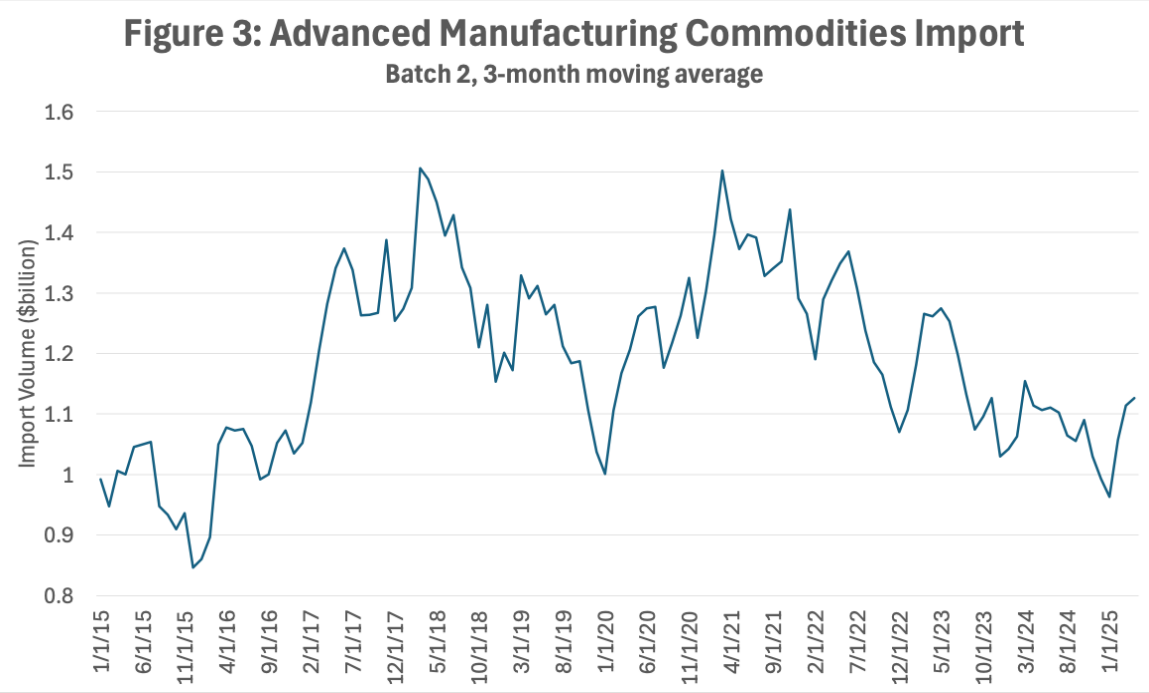
- Batch 3: HS8 commodities extracted from *2025 Custom Tariff Exemption Product List*

- Batch 2: HS8 commodities extracted from *2023 China Advanced Manufacturing Greenbook*

Advanced Manufacturing 2023	
HS8 Code	**Brief Label**
84561100 (84561000 pre-2022)	Machine-tools operated by laser process
84799010	Assembly equipment for aerospace manufacturing
84798999	Manufacturing equipment for ships and marine engineering
84679910	High-speed, high-power electric spindles
84669390	Milling heads with direct-drive mechanisms
90262090	Pressure sensors for ultra-high-pressure applications
85158090	Welding heads for alloy friction stir applications
84775900 (84775990 pre-2022)	Heads for weaving, filament, and tape placement
84775910	3D printers
85158010	Heads for intelligent laser welding
84141000	Vacuum systems for industrial processes
84821010	Spindle bearings for high-performance machine tools
84821020	Bearings for screw pairs
84821030	Bearings for turntables
84662000	Precision guide rails and screws
85159000	Generators for high-power lasers
84669400	Molds with ultra-precision specifications
90319000	Encoders for high-precision measurements
90271000	Sensors for high-temperature zirconia oxygen measurement

Other types of Import Dependency

- Batch 2 import trend shows a pattern related to the industrial policy cycle



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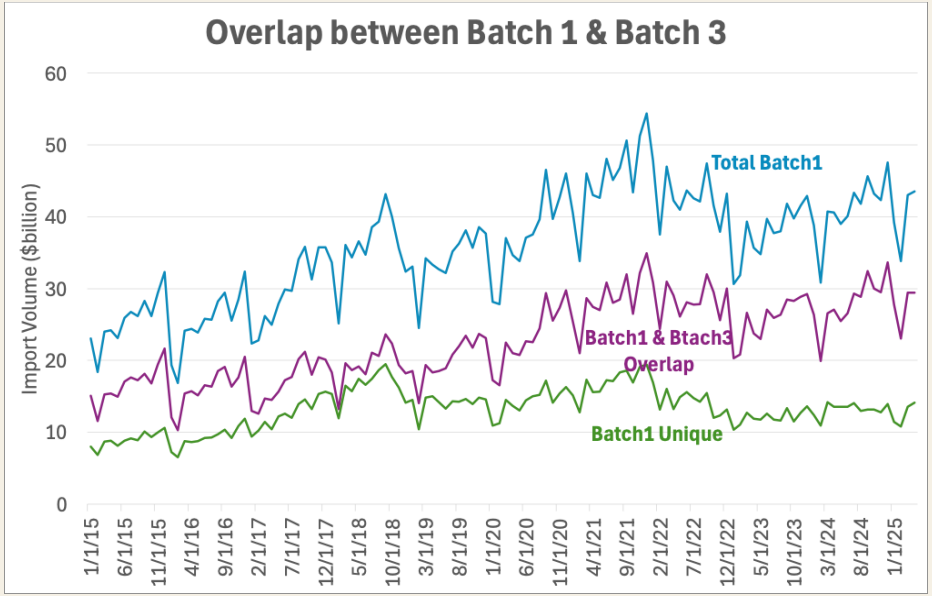
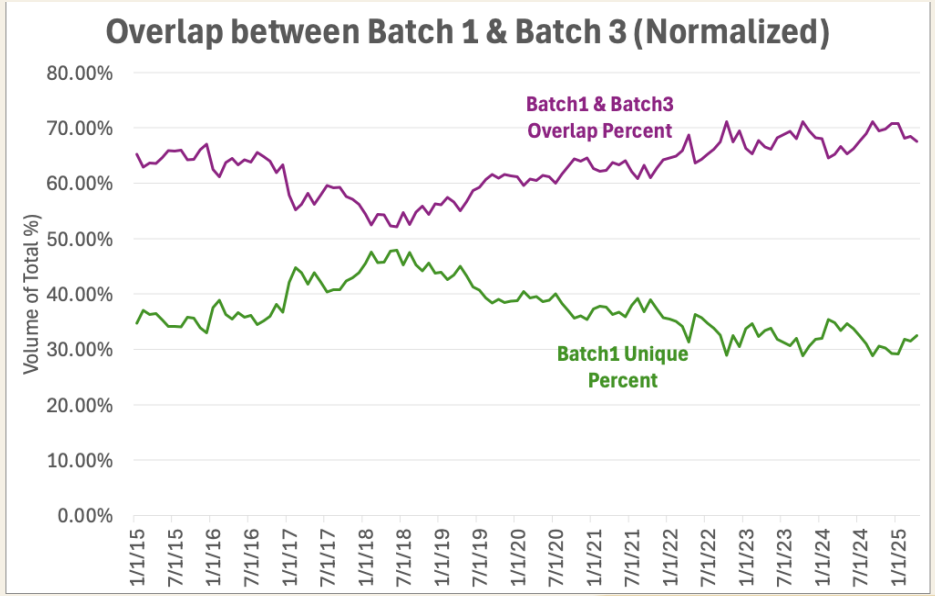
Other types of Import Dependency

- Batch 1 & Batch 3 comparison shows a reasonably high degree of persistence of crucial bottleneck areas





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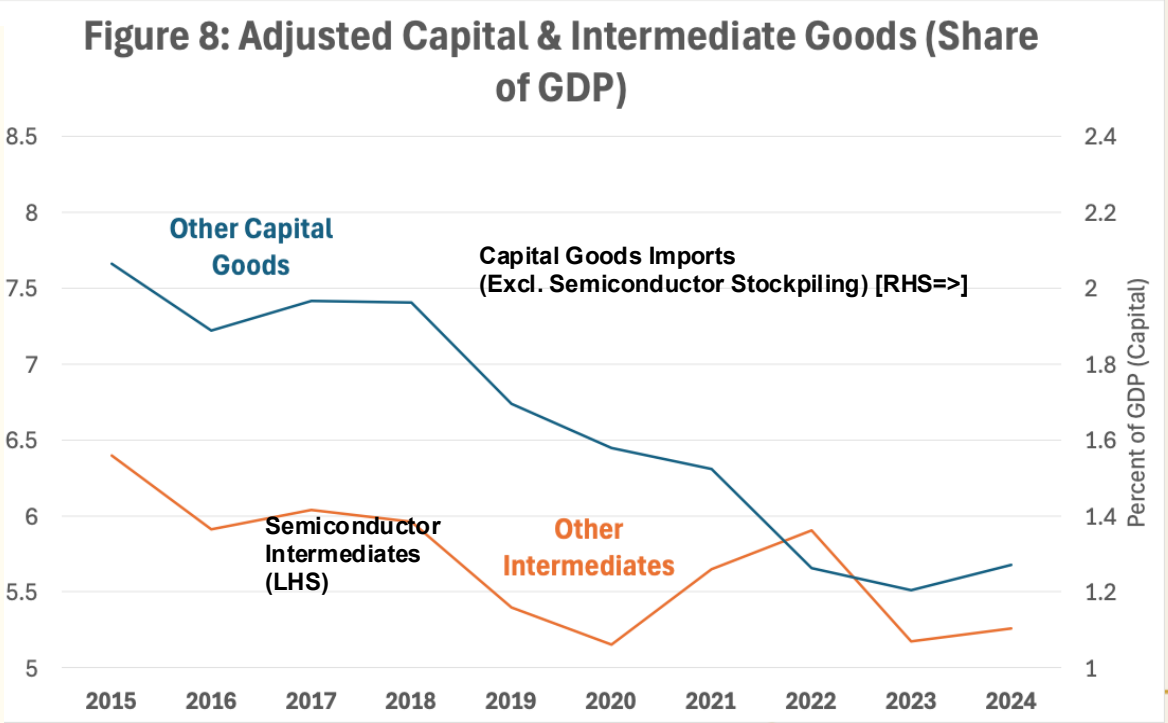
How Effectively Has China Substituted Technology Imports?

(Returning to Our Preview)

- Semiconductor-related imports must be handled separately due to stockpiling.
- Seven out of seventeen non-semiconductor-related “bottleneck” groups' imports display significant domestic technology substitution.
- Imported capital goods (adjusted) declined significantly as a share of GDP; from 2.06% of GDP in 2015 to 1.27% of GDP in 2024.
- With Intermediates, total decline from 8.5% to 6.5% of GDP.



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Conclusions

- China is making progress overall in **reducing technology import dependence**
- Strategic **stockpiling** distorts the true picture of self-reliance
- Planners have probably succeeded in **narrowing dependencies** rather than **eliminating** them
- Import reliance is increasingly limited to a few **high-tech capital goods sectors**
- In the **less glamorous, not-bleeding-edge** industrial technologies, China has made very substantial progress in import substitution.
- **Trade imbalances** are deepening - export growth (5.9%) outpaced import growth (1.1%) in 2024

Extended Implications

1. This aspect of China's industrial policy is likely to be extremely costly.
   - The goals are non-economic; security at any price.
   - Investments go into products where China has a demonstrated lack of comparative advantage, by definition.
   - Costs are diffused throughout the economy.
2. Perhaps recognizing this, Chinese policymakers have built flexibility into their industrial policy instruments.
   - "Sustained pressure" to substitute for foreign inputs, rather than "commands."
   - Many micro-initiatives, so failure can be tolerated.
3. China restricts imports while promoting exports.
   - Not so evident from the US perspectives, since both sides are trying to decouple (reducing both supply and market dependence).
   - Very evident from a third-party perspective, as Chinese trade surpluses, especially in manufactured goods, are set to sustain and increase for the foreseeable future.
   - Large economic cost and huge geopolitical headache for China.

Thanks!