

Pricing the Global Trade Vulnerability

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Motivation: The Emergence of Trade Vulnerability as a New Risk Factor

- Since 2018, global trade has shifted from a period of steady growth and efficiency gains into an era of fragmentation, with increased risks and uncertainty.
- Trade vulnerability caused by overreliance on a small number of suppliers from a single geographical region has long been a concern for executives of multinational firms (McGee 2025, *Apple in China*).
- But it was not until Trump's 2018 Trade War against China, when geopolitics began to disrupt and reshape the previously efficiency-driven global supply chains:
 - ▶ Trump 1.0: targeting primarily imported goods from China.
 - ▶ Covid-19: underscored the fragility of the global international trade.
 - ▶ Trump 2.0: a broad-based blow to all international trade.

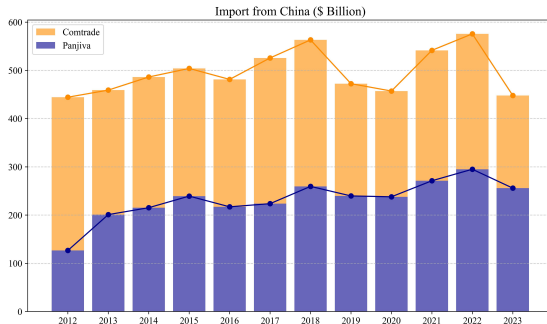
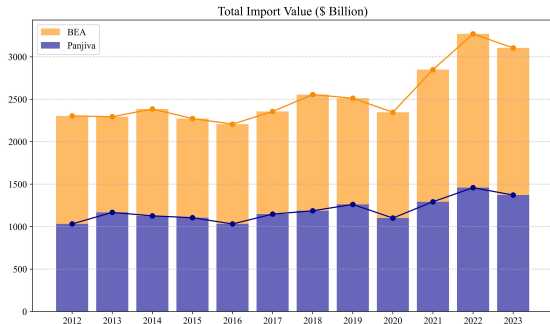
This Paper: Pricing the Global Trade Vulnerability

- As trade uncertainty becomes a central force shaping corporate decisions and driving asset allocation, we look into financial markets to uncover the emerging risk factors on global trade, and importantly, to estimate the market price of trade uncertainty.
- Central to our paper is the concept of trade vulnerability:
 - ▶ Measured from the ground up using firm-level import data from S&P Panjiva.
 - ▶ Firms with more concentrated trade exposure to a small number of countries are more vulnerable to disruptions in global trade.
- Our main hypothesis:
 - ▶ Trade vulnerability elevates from a firm-level concern to a system-wide risk.
 - ▶ Firms with higher exposure to trade risk are expected to earn a higher risk premium, giving rise to a priced risk factor on global trade.

- Asset Pricing under Trade/Geopolitical Uncertainty
 - ▶ Choke-points: [Dyakov & Jiang 2025](#).
 - ▶ Policy uncertainty measures: [Baker et al. 2016](#).
 - ▶ Geopolitical risk: [Sheng et al. 2025](#) and [Clayton et al. 2025](#).
- Supply-Chain Disruptions
 - ▶ Firm-level sourcing decisions: [Grossman et al. 2023](#) and [Ersahin et al. 2024](#).
 - ▶ Economic losses due to concentrated sourcing: [Ahn & Tan 2025](#).
 - ▶ On China dependence: [Aral et al. 2025](#) and [Alfaro & Chor 2023](#).
 - ▶ Macro implications: [Carvalho et al. 2021](#) and [Acemoglu and Tahbaz-Salehi 2025](#).
 - ▶ Mitigating disruptions via political connection [Cen et al. 2024](#) and via M&A [Cen et al. 2025](#).

- S&P Panjiva Bill of Lading Data
 - ▶ The Panjiva dataset is compiled from U.S. Customs, shipping companies, and digitized paper bills of lading collected by S&P Global.
 - ▶ This highly granular dataset includes both private and public U.S. firms, containing detailed shipment-level information (e.g., shipment value, supplier, cargo description, TEU, and date).
- Public Firms Sample
 - ▶ We extract Panjiva import shipment records from 2012–2023 and merge U.S. consignees with Compustat public firms using S&P Global Company IDs.
 - ▶ The final sample includes 1,840 unique firms, with a cumulative shipment value of \$469.9 billion.
 - ▶ The average annual import value is approximately \$44 million per firm.

Total Import Value: Panjiva vs BEA



Summary Statistics

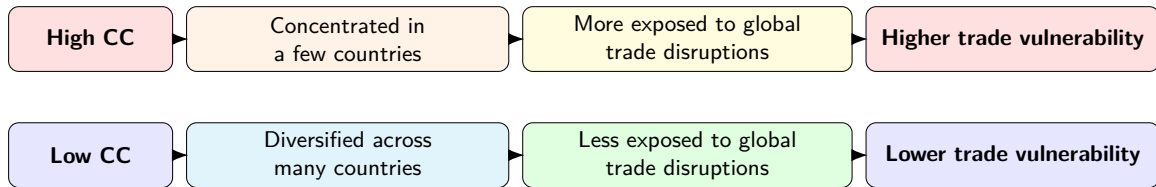
	Mean	Std	P1	P25	Median	P75	P99
Import amount							
Import value (\$ thousand)	44,389	247,909	0.85	151	1,567	11,976	723,289
Import/revenue ratio (%)	2.25	14.41	0.00	0.01	0.11	0.81	34.68
Import from number of							
Countries	5.62	6.86	1.00	1.15	3.00	6.92	35.33
Suppliers	19.94	60.91	1.00	1.92	4.92	15.71	229.80
HS2 Goods	5.94	7.20	1.00	1.25	3.17	7.42	35.40
Import ratio (%)							
Asia	75.05	34.26	0.20	55.06	95.89	100	100
China	42.03	36.84	0.03	7.11	31.44	78.17	100
Europe	43.58	40.07	0.02	4.44	30.66	90.52	100
North America	22.88	34.49	0.00	0.40	3.33	31.42	100
South America	17.42	29.35	0.00	0.32	2.63	18.98	100
Africa	12.20	25.30	0.00	0.20	1.30	8.12	97.81
Oceania	14.18	28.61	0.00	0.10	0.95	8.56	100

Part II: Measure of Trade Vulnerability

- Central to our analysis is **Country Concentration (CC)**.
- For firm i in year t , CC_{it} is the Herfindahl index of country-level import shares:

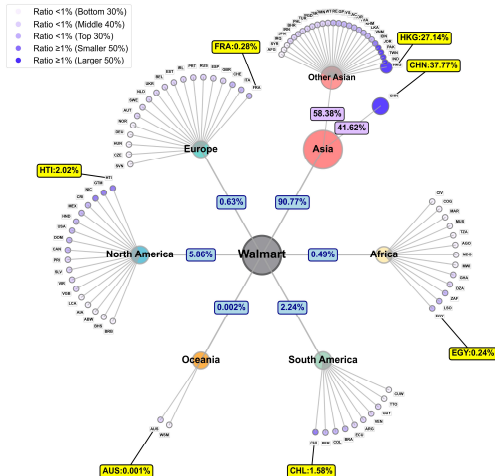
$$CC_{it} = \sum_c \left(\frac{\text{Import Value}_{itc}}{\sum_c \text{Import Value}_{itc}} \right)^2$$

- $CC_{it} = 1$ when a firm sources from only one country; the lower bound is the inverse of the number of sourcing countries.



Walmart's Import Network and Top 20 Suppliers

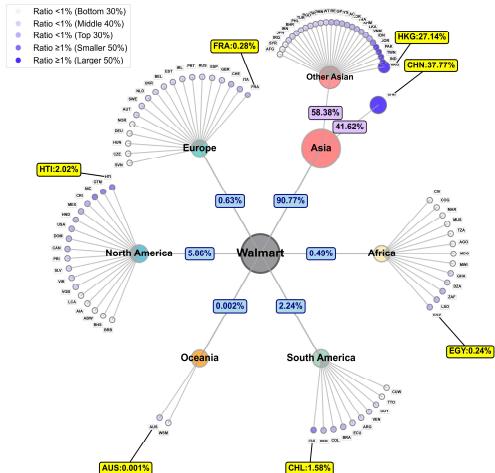
The Average CC of Walmart is 0.22



S&P Panjiva (2012-2023)

Walmart's Import Network and Top 20 Suppliers

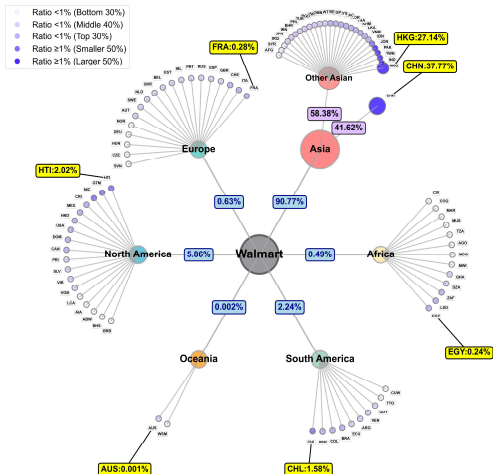
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S&P Panjiva (2012-2023)

Walmart's Import Network and Top 20 Suppliers

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S&P Panjiva (2012-2023)

Walmart: Top Suppliers by Ranking

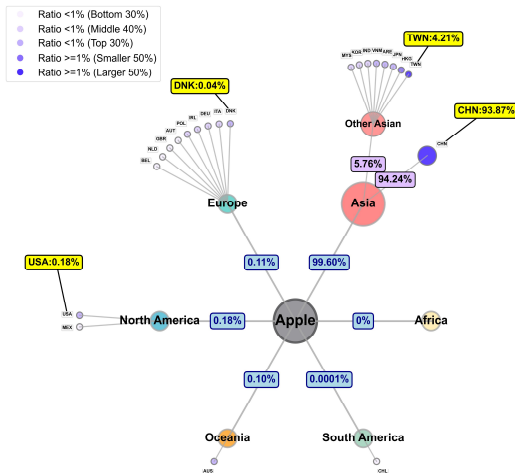
Rank	Supplier	Country	%Cost
1	MCK	US	7.73%
2	PG	US	2.62%
3	PEP	US	2.46%
4	TSN	US	1.93%
5	Nestle	Switzerland	1.53%
6	BRK/A	US	1.64%
7	Kraft Heinz	US	0.99%
8	ULVR	UK	0.95%
9	GIS	US	0.83%
10	CAG	US	0.65%
11	Grupo Bimbo	Mexico	0.63%
12	SJM	US	0.56%
13	KDP	US	0.50%
14	KMB	US	0.49%
15	KO	US	0.48%
16	Smithfield	US	0.44%
17	AB InBev	Belgium	0.40%
18	CL	US	0.42%
19	Arca Continental	Mexico	0.41%
20	CPB	US	0.41%

China Total 0.00%

Bloomberg SPLC (2024-25)

Apple's Import Network and Top 20 Suppliers

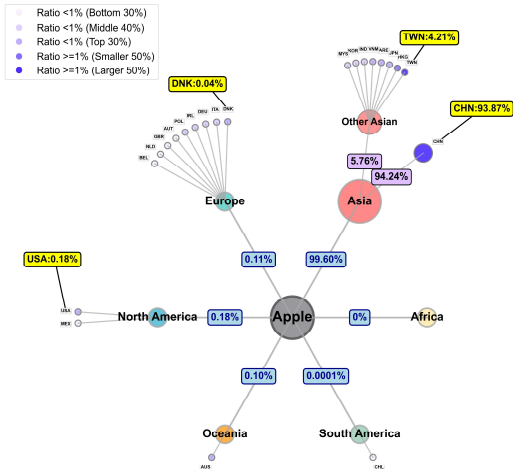
The Average CC of Apple is 0.88



S&P Panjiva (2012-2023)

Apple's Import Network and Top 20 Suppliers

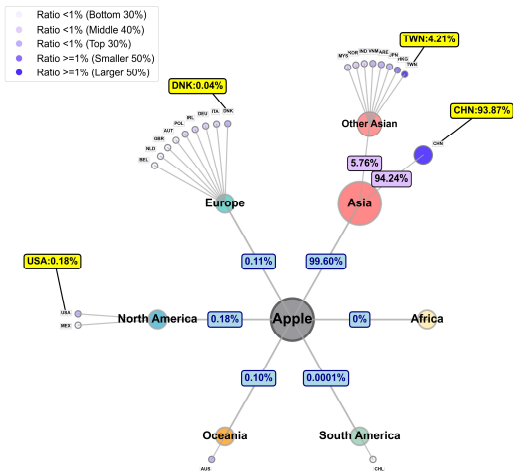
The Average CC of Apple is 0.88



S&P Panjiva (2012-2023)

Apple's Import Network and Top 20 Suppliers

The Average CC of Apple is 0.88



S&P Panjiva (2012-2023)

Apple: Top Suppliers by Ranking

Rank	Supplier	Country	%Cost
1	Hon Hai	China	31.75%
2	Luxshare	China	12.19%
3	TSMC	Taiwan, China	7.70%
4	Quanta	China	7.42%
5	LG Innotek	South Korea	5.72%
6	Samsung	South Korea	6.13%
7	QCOM	US	4.38%
8	LG Display	South Korea	4.00%
9	Pegatron	China	3.45%
10	SK hynix	South Korea	1.88%
11	Lens	China	2.41%
12	ASE	Taiwan, China	2.58%
13	GoerTek	China	2.40%
14	Wistron	Taiwan, China	1.59%
15	BOE	China	2.08%
16	Zhen Ding	China	1.86%
17	AVGO	US	1.72%
18	Dongshan	China	1.35%
19	SWKS	US	1.24%
20	MU	US	0.79%

China Total 64.91%

Bloomberg SPLC (2024-25)

Concentrated Exposure to China



Trump-Xi Summit in May 2026

Concentrated Exposure to China



Trump-Xi Summit in May 2026

Concentrated Exposure to China



Trump-Xi Summit in May 2026

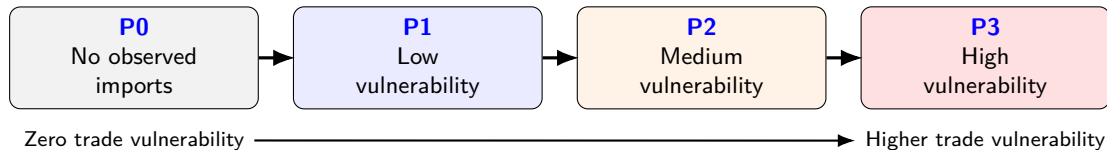
Lens Technology Co Ltd: Top Customers by Ranking

Rank	Customer	Country
1	AAPL	US
2	Xiaomi	China
3	TSLA	US
4	Huawei	China
5	Samsung	South Korea
6	VOW	Germany
7	GOOGL	US
8	BMW	Germany
9	MBG	Germany
10	Lenovo	China
11	BYD	China
12	AMZN	US
13	Huaqiang	China
14	Contemporary Amperex	China
15	LI	China
16	NIO	China
17	META	US
18	Sinocera	China

Bloomberg SPLC (2024–25)

Part III: Pricing the Global Trade Vulnerability

Following the standard procedure in empirical asset pricing, we sort firms by lagged, industry-adjusted country concentration into three CC-sorted portfolios and one portfolio with zero observed imports.



Country-Concentration Trade Factor

$$R_t^{\text{CCTF}} = R_t^{P3} - R_t^{P0}$$

Long high-vulnerability firms; short firms with no observed direct import exposure.

Market price of trade vulnerability: CCTF risk premium, controlling for existing risk factors.

Summary Statistics of the CC-Sorted Portfolios

	Mean			
	P1	P2	P3	P0
Country Concentration (industry demeaned)	-0.31	-0.05	0.28	
Country Concentration	0.31	0.55	0.91	
Supplier Concentration	0.22	0.41	0.78	
HS2 Goods Concentration	0.51	0.64	0.83	
Number of Countries	12.20	7.11	2.99	
Number of Suppliers	49.08	28.25	7.54	
Number of HS2 Goods	11.53	7.70	3.80	
Import Value (\$ million)	102	71	28	
Import/Revenue Ratio (%)	1.65	2.00	1.79	
China Value (\$ million)	17	19	9	
China Ratio (%)	19.98	26.73	29.97	
Number of Firms	175	195	229	2190
Market Cap (\$ million)	23,608	23,142	18,333	6,519
Revenue (\$ million)	13,928	9,184	6,711	3,881

Empirical Performance of the CC-Sorted Portfolios

$$R_t^i - r_f = \alpha^{\text{FF5}} + \beta^{\text{MKT}} (R_t^{\text{MKT}} - r_f) + \beta^{\text{SMB}} R_t^{\text{SMB}} + \beta^{\text{HML}} R_t^{\text{HML}} + \beta^{\text{RMW}} R_t^{\text{RMW}} + \beta^{\text{CMA}} R_t^{\text{CMA}} + \epsilon_t^i$$

	No Trade P0	CC-Sorted Portfolios			CCTF Factors	
	P0	P1	P2	P3	P3 - P0	P3 - P1
Excess ret (%)	0.84 [2.78]	0.80 [3.05]	1.03 [2.82]	1.71 [4.50]	0.86 [3.74]	0.90 [3.46]
FF5 alpha (%)	-0.03 [-0.46]	-0.11 [-1.08]	-0.00 [-0.01]	0.52 [3.22]	0.54 [2.86]	0.63 [2.84]
MKT beta	0.98 [88.62]	0.90 [32.46]	1.03 [24.74]	1.09 [28.27]	0.11 [2.44]	0.19 [3.66]
SMB beta	0.08 [3.13]	-0.03 [-0.81]	-0.06 [-1.05]	-0.03 [-0.46]	-0.11 [-1.38]	-0.00 [-0.04]
HML beta	0.12 [4.46]	0.09 [1.84]	-0.22 [-3.60]	-0.19 [-2.42]	-0.31 [-3.50]	-0.28 [-2.38]
RMW beta	-0.14 [-3.99]	0.22 [3.28]	-0.04 [-0.57]	0.26 [2.74]	0.40 [3.38]	0.05 [0.34]
CMA beta	-0.09 [-1.88]	0.15 [1.68]	0.01 [0.08]	-0.16 [-1.13]	-0.07 [-0.38]	-0.32 [-1.53]

The Emergence of a Trade Risk Factor



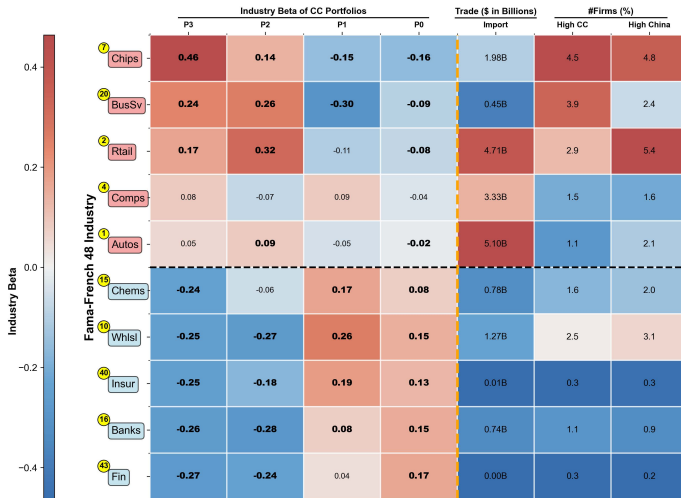
Part IV: What Drives the Trade Risk Factor?

- In the era of *efficiency-driven globalization*:
 - ▶ U.S. firms have long been deeply integrated into global supply chains.
 - ▶ The most innovative U.S. industries thrive and rely on global supply chains.
 - ▶ China offers a unique supply-chain ecosystem, particularly in the tech sector.
- Short term, this equilibrium is difficult to dismantle as China not easily replaceable.
- Geopolitics, however, forces globalization into the *fragmentation era*:
 - ▶ Since 2018, sudden disruptions in global trade have become a reality and trade vulnerability emerges as a systematic, undiversifiable risk.
 - ▶ Consistently, we find that an important driver of our trade risk premium is concentrated exposure to China.
 - ▶ Further exploring the industry exposures of our trade risk factor, we document a close connection to the tech sector.

Concentrated China Exposure as a Key Driver

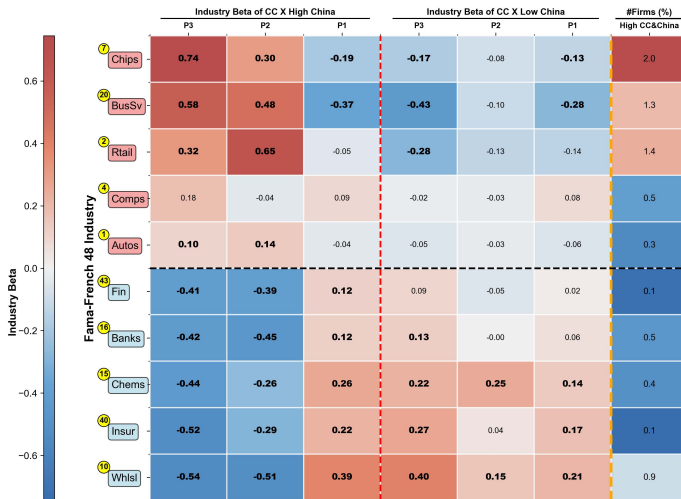
	Country Concentration					
	P1 (low)		P2		P3 (high)	
	High CHN	Low CHN	High CHN	Low CHN	High CHN	Low CHN
Ex Ret (%)	0.84 [2.99]	0.81 [3.05]	1.28 [2.81]	0.74 [2.29]	2.03 [4.40]	0.93 [3.44]
alpha (%)	-0.14 [-0.94]	-0.08 [-0.76]	0.06 [0.31]	-0.08 [-0.42]	0.68 [2.90]	0.18 [0.83]
MKT beta	0.99 [25.56]	0.85 [29.45]	1.18 [18.43]	0.86 [25.38]	1.17 [18.48]	0.84 [16.17]
SMB beta	0.05 [0.76]	-0.06 [-1.45]	-0.15 [-1.49]	0.05 [0.77]	-0.14 [-1.23]	0.27 [3.61]
HML beta	0.10 [1.42]	0.10 [1.96]	-0.41 [-4.44]	0.08 [1.11]	-0.35 [-2.91]	0.13 [1.19]
RMW beta	0.19 [1.94]	0.24 [3.52]	-0.09 [-0.70]	0.06 [0.94]	0.34 [2.46]	0.09 [0.94]
CMA beta	0.12 [1.29]	0.16 [1.70]	0.02 [0.10]	0.02 [0.13]	-0.18 [-0.87]	0.04 [0.28]

Industry Exposures of the CC-Sorted Portfolios



$$R_t^i - r_f = \alpha + \beta_i^{\text{MKT}} (R_t^{\text{MKT}} - r_f) + \beta_i^{\text{IND}} (R_t^{\text{IND}} - r_f) + \epsilon_t^i$$

Industry Exposures of CC×China-Sorted Portfolios



$$R_t^{i,j} - r_f = \alpha + \beta_{i,j}^{\text{MKT}} (R_t^{\text{MKT}} - r_f) + \beta_{i,j}^{\text{IND}} (R_t^{\text{IND}} - r_f) + \epsilon_t^i$$

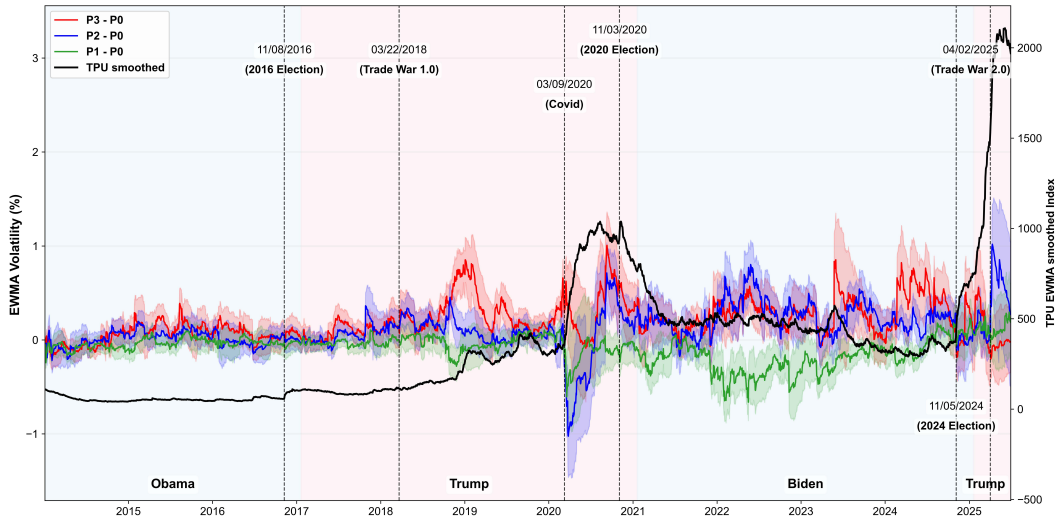
Can Tech Performance Explain the CCTF Risk Premium

	With Industry Control						Without Industry Control					
	CC-Sorted Portfolios				Risk Factors		CC-Sorted Portfolios				Risk Factors	
	P0	P1	P2	P3	P3 - P0	P3 - P1	P0	P1	P2	P3	P3 - P0	P3 - P1
alpha	-0.12 [-1.92]	-0.01 [-0.17]	0.07 [0.56]	0.28 [3.01]	0.44 [3.72]	0.30 [2.45]	-0.08 [-1.11]	0.06 [0.77]	-0.05 [-0.34]	0.52 [2.98]	0.60 [2.80]	0.46 [2.41]
MKT beta	1.04 [66.06]	1 [30.46]	1.02 [44.94]	1.01 [30.38]	-0.05 [-1.50]	0.01 [0.27]	1.01 [75.67]	0.87 [37.59]	1.02 [30.71]	1.10 [31.06]	0.09 [2.07]	0.23 [4.92]
NASDAQ[⊥] beta	-0.18 [-3.10]	-0.54 [-7.29]	-0.11 [-1.18]	-0.02 [-0.29]	0.10 [1.10]	0.52 [4.64]	-0.27 [-3.93]	-0.59 [-5.78]	0.57 [4.16]	0.76 [6.68]	1.03 [6.74]	1.35 [8.08]
alpha	-0.08 [-1.25]	0.04 [0.60]	0.1 [0.75]	0.3 [3.34]	0.42 [3.52]	0.27 [2.25]	-0.03 [-0.49]	0.1 [1.08]	-0.12 [-0.89]	0.42 [2.60]	0.46 [2.34]	0.33 [1.91]
MKT beta	1.04 [76.40]	1 [28.84]	1.02 [46.91]	1.01 [31.57]	-0.05 [-1.46]	0.01 [0.26]	1.01 [93.12]	0.87 [35.68]	1.02 [31.76]	1.10 [32.91]	0.09 [2.30]	0.23 [4.92]
QQQ[⊥] beta	-0.2 [-5.70]	-0.39 [-6.23]	-0.13 [-1.66]	-0.06 [-1.19]	0.1 [1.85]	0.33 [3.85]	-0.25 [-5.72]	-0.37 [-4.73]	0.47 [4.75]	0.61 [6.70]	0.86 [7.67]	0.97 [7.29]
alpha	-0.05 [-0.96]	0 [0.01]	0.13 [0.95]	0.24 [2.43]	0.33 [2.98]	0.24 [2.14]	0.00 [-0.01]	0.08 [0.75]	-0.06 [-0.35]	0.28 [2.25]	0.28 [2.26]	0.20 [1.17]
MKT beta	1.04 [77.91]	1 [30.65]	1.02 [45.36]	1.01 [28.82]	-0.05 [-1.44]	0.01 [0.27]	1.01 [94.96]	0.87 [37.31]	1.02 [25.30]	1.10 [38.96]	0.09 [2.79]	0.23 [5.66]
Chips[⊥] beta	-0.12 [-5.17]	-0.13 [-3.96]	-0.09 [-2.55]	0.05 [2.43]	0.16 [5.80]	0.19 [4.68]	-0.16 [-5.66]	-0.15 [-3.77]	0.14 [2.74]	0.46 [14.52]	0.62 [14.08]	0.62 [9.94]

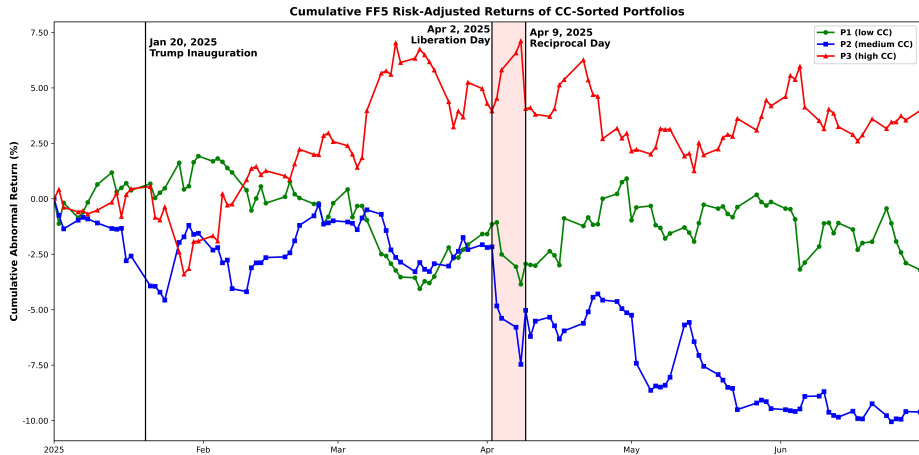
Can CCTF Explain the Tech Performance?

	NASDAQ	QQQ	SP500TECH	Comps	Chips	BusSv	Rtail	Autos
CAPM: $R_t^i - r_f = \alpha + \beta^{\text{MKT}} (R_t^{\text{MKT}} - r_f) + \epsilon_t^i$								
alpha (%)	0.17 [1.06]	0.37 [1.76]	0.51 [2.52]	0.11 [0.56]	0.80 [2.76]	0.32 [1.38]	0.16 [0.64]	-0.02 [-0.04]
MKT beta	1.10 [30.53]	1.07 [20.78]	1.10 [20.59]	1.04 [14.77]	1.22 [16.77]	1.05 [26.94]	1.01 [16.99]	1.80 [8.75]
Add CCTF: $R_t^i - r_f = \alpha + \beta^{\text{MKT}} (R_t^{\text{MKT}} - r_f) + \beta^{\text{CCTF}} R_t^{\text{CCTF}} + \epsilon_t^i$								
alpha (%)	-0.09 [-0.63]	0.01 [0.07]	-0.02 [-0.13]	0.01 [0.08]	-0.04 [-0.29]	0.14 [0.67]	-0.01 [-0.02]	-0.52 [-0.90]
MKT beta	1.07 [37.95]	1.03 [27.08]	1.04 [34.93]	1.02 [15.21]	1.12 [25.96]	1.02 [25.81]	0.99 [16.90]	1.74 [8.51]
CCTF beta	0.33 [6.88]	0.46 [6.91]	0.68 [13.19]	0.12 [1.18]	1.08 [12.79]	0.23 [3.17]	0.21 [2.38]	0.64 [1.76]
Add Industry-Controlled CCTF: $R_t^i - r_f = \alpha + \beta^{\text{MKT}} (R_t^{\text{MKT}} - r_f) + \beta^{\text{CCTF}} R_t^{\text{CCTF}} + \epsilon_t^i$								
alpha (%)	0.12 [0.68]	0.27 [1.22]	0.25 [1.11]	0.14 [0.79]	0.31 [1.08]	0.33 [1.51]	0.13 [0.46]	-0.47 [-0.81]
MKT beta	1.1 [29.40]	1.08 [19.90]	1.12 [19.51]	1.03 [14.39]	1.27 [16.24]	1.04 [27.04]	1.01 [17.09]	1.84 [8.16]
CCTF beta	0.12 [1.07]	0.21 [1.81]	0.58 [5.41]	-0.07 [-0.37]	1.06 [5.67]	-0.04 [-0.35]	0.05 [0.39]	0.98 [1.23]

When is the High-CC Portfolios More Volatile?



The Evolving Nature of Trade Vulnerability



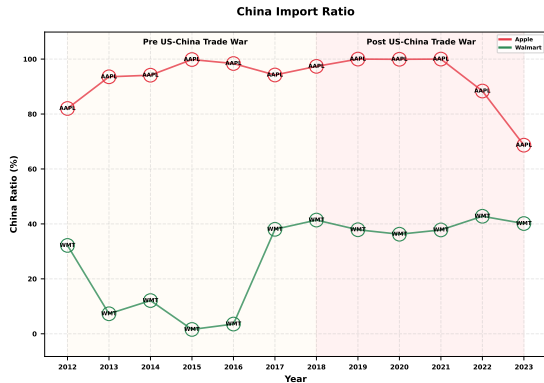
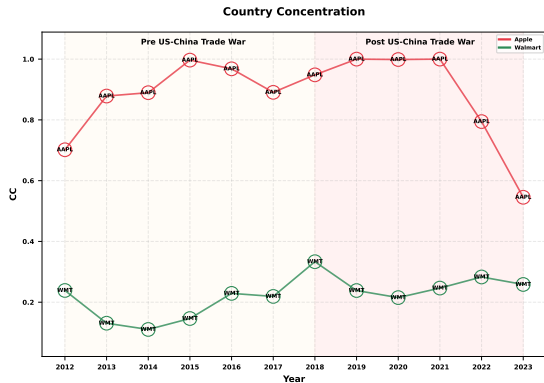
- Alternative vulnerability measures: supplier concentration, goods concentration, number of countries, suppliers, goods, import volume, and China ratio.
- Country concentration remains the most robust predictor of the trade-vulnerability premium.
- Industry-controlled CC portfolios further balance industry exposure across vulnerability portfolios.
- Leave-one-FF12-industry-out tests show that the P3–P0 premium is not driven by any single major industry.

Conclusions

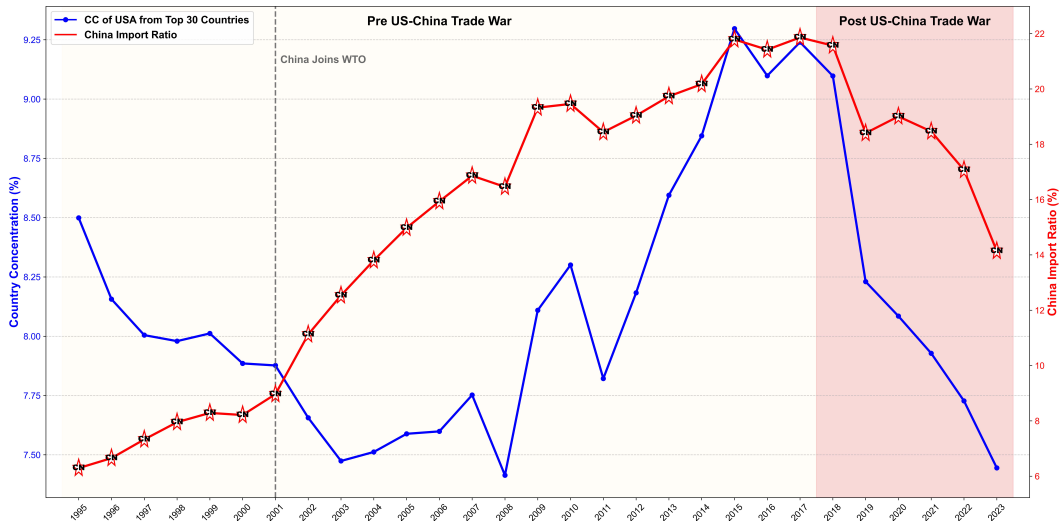
- We document the emergence of a priced global trade risk factor
 - ▶ Central to our estimation is the concept of trade vulnerability, measured by the firm-level country concentration using granular bill-of-lading data.
 - ▶ High-concentration firms, more vulnerable to disruptions in global trade, demand a significantly higher risk premium.
- Triggered by the 2018 US-China tariff war and exacerbated by Covid-19 supply chain disruptions, concentrated exposure to China is a key driver to the estimated risk premium.
- Pushing beyond China, the broad-based Liberation Day tariffs hit the pricing of medium-concentration firms the hardest, reflecting the evolving nature of trade vulnerability.

Appendix

Apple vs Walmart on CC and China Ratio



USA's Country Concentration and China Exposure



Alternative Measures of Trade Vulnerability

Alternative Measures	Fama-French 5-Factor Alpha (%)					
	No Trade	Sorted Portfolios			Long/Short	
	P0	P1	P2	P3	P3 - P0	P3 - P1
Supplier Concentration (SC)	-0.03 [-0.46]	0.05 [0.56]	-0.10 [-0.65]	0.42 [2.31]	0.44 [2.08]	0.36 [1.82]
HS2 Goods Concentration (GC)	-0.03 [-0.46]	0.08 [0.79]	-0.02 [-0.11]	0.31 [1.93]	0.34 [1.90]	0.24 [1.34]
1/Number of Countries (1/NC)	-0.03 [-0.46]	0.19 [1.89]	-0.32 [-2.05]	0.54 [2.18]	0.57 [2.13]	0.36 [1.26]
1/Number of Suppliers (1/NS)	-0.03 [-0.46]	0.25 [2.34]	-0.33 [-3.10]	0.42 [1.83]	0.45 [1.83]	0.18 [0.64]
1/Number of HS2 Goods (1/NG)	-0.03 [-0.46]	0.19 [2.18]	-0.23 [-1.50]	0.21 [0.91]	0.24 [0.94]	0.03 [0.10]
Import/Revenue (Import)	-0.03 [-0.46]	0.24 [1.44]	0.13 [1.29]	-0.14 [-1.01]	-0.12 [-0.71]	-0.38 [-1.50]
China Ratio (China)	-0.03 [-0.46]	0.11 [0.52]	-0.07 [-0.60]	0.22 [1.54]	0.25 [1.40]	0.11 [0.40]

A Two-Factor Model with Country Concentration Trade Factor (CCTF)

- We construct the country concentration trade factor (CCTF) via

$$R_t^{\text{CCTF}} = R_t^{\text{P3}} - R_t^{\text{P0}},$$

where P3 is the high-CC portfolio and P0 is the portfolio with no trade exposure.

- Our two-factor model:

$$R_t^i - r_f = \alpha + \beta^{\text{MKT}} (R_t^{\text{MKT}} - r_f) + \beta^{\text{CCTF}} R_t^{\text{CCTF}} + \epsilon_t^i.$$

- Applied to the long/short portfolios constructed from the alternative measures:

Alternative Measures	SC	GC	1/NC	1/NS	1/NG	Import	China
alpha (%)	0.00 [0.02]	0.13 [1.04]	0.08 [0.56]	0.02 [0.13]	-0.14 [-0.72]	-0.11 [-0.65]	-0.09 [-0.58]
MKT beta	-0.01 [-0.15]	-0.04 [-1.06]	0.05 [1.03]	0.11 [2.09]	0.12 [2.22]	-0.11 [-2.84]	-0.01 [-0.23]
CCTF beta	0.69 [6.41]	0.36 [3.11]	0.94 [9.84]	0.72 [5.52]	0.71 [5.94]	0.17 [2.20]	0.78 [7.71]