Supply Chain and Trade War Analysis

MSBA Capstone Project 2019

2019.6.14

HSBC | HexaNet

AGENDA

01 **Background and Data**

02 **Challenge 1**

How To Identify Potential Customers?

03 **Challenge 2**

How To Discover Trade War Effect?

04 **Summary**

01

Background and Data

HSBC Is The Market Leader In Commercial Banking

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Services:

- Forfaiting
- Credit and lending
- Clearing and foreign currency payments
- Global payables and receivables
- Liquidity, liability and investments

No.1 in global trade finance

USD 333bn

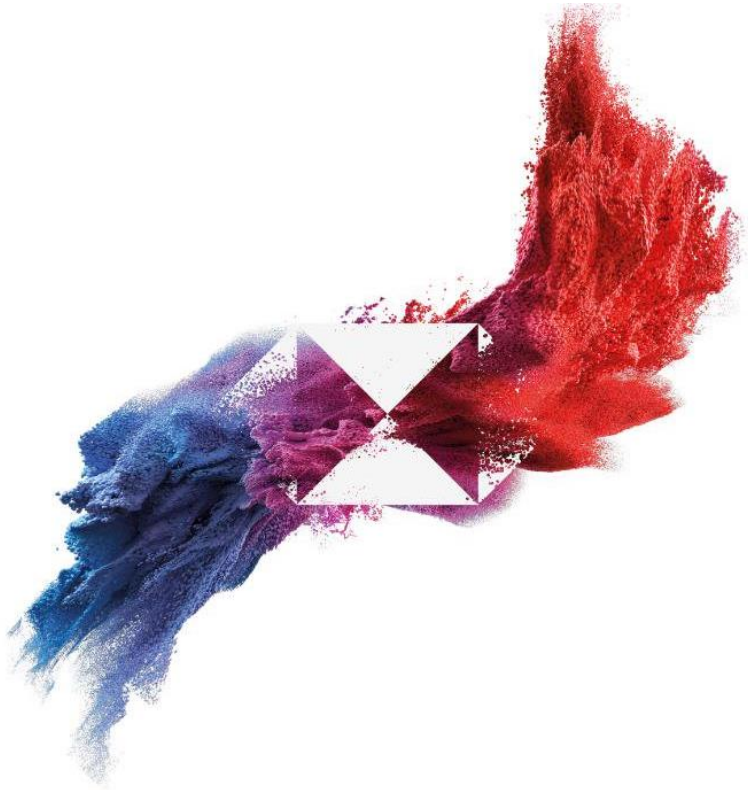
of loans to businesses at the end of 2018

USD 740bn

of trade facilitated annually

Reference:
HSBC Official Website https://www.business.hsbc.com.hk/en-gb/corporate?DCSext.nav=foot-mat

Facing Two Challenges



01 **Identify Potential Customers**

02 **Discover The Effect Of US-China Trade War**

Take Automobile Industry As Starting Point

Plenty of Suppliers

5,000+

High Proportion in GDP

3.5% - 10%

International Trade

40,000+ international relationships

Reference:

1. Vernon, R. (1979). The product cycle hypothesis in a new international environment. *Oxford bulletin of economics and statistics*, *41*(4), 255-267.
2. Hill, K., Menk, D., & Cooper, A. (2010). Contribution of the automotive industry to the economies of all fifty states and the United States. *Center for Automotive Research*, *42*.

Use Bloomberg As Data Source

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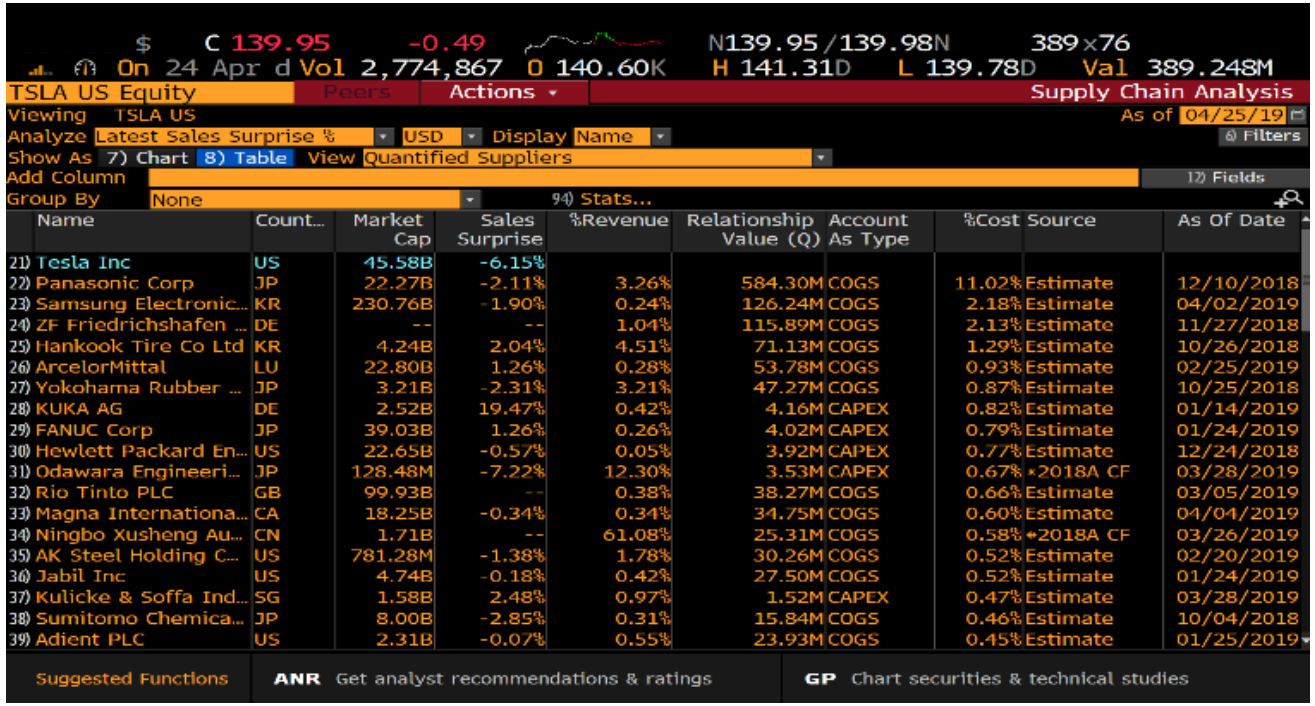
Bloomberg

- The most complete data
(Supply chain data & Financial data)
- Provides quantified relationships



Other Sources

Eikon

- Relationships are not quantified
- Data not complete

Cninfo/WRDS

- Only US/China data
- No supply chain information

Two Datasets From Bloomberg

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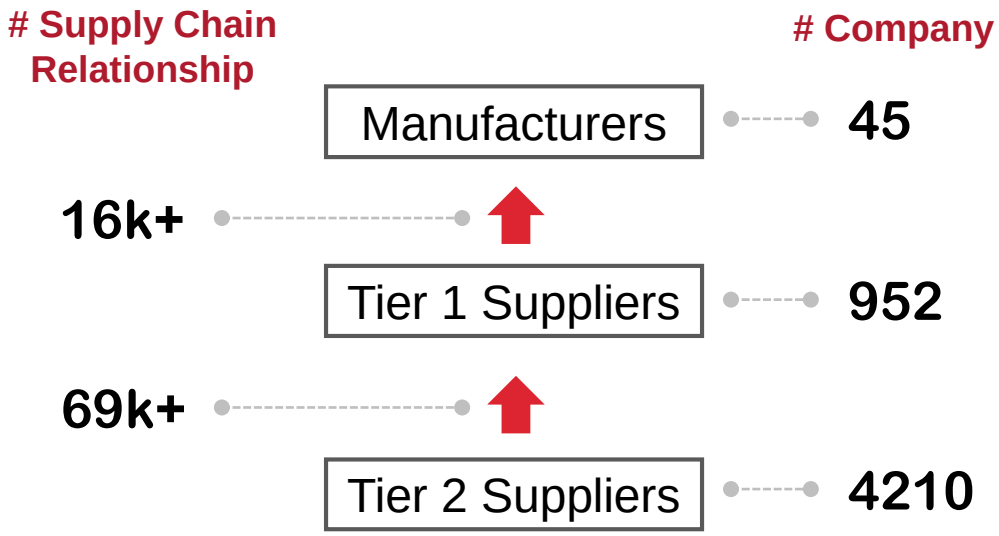
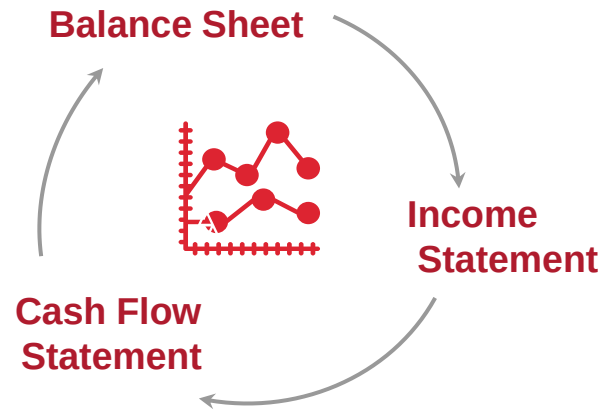
Supply Chain Data

2017 Q4 – 2019 Q1



Financial Data

2014 Q1 – 2019 Q1



30 Variables

- Cash
- Inventories
- COGS
- Total Equity
- Total Liabilities
- And more……

Methodology

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Analysis

- ❑ Network Analysis
  - Centrality Ranking
  - HITS Algorithm
- ❑ Trade War Study
  - Three-factor Model
  - HexaNet Scoring System

Visualization

- ❑ D3.js JavaScript Lib
- ❑ Plotly.js JavaScript Lib
- ❑ Bootstrap Front-end Lib
- ❑ Tableau Public

02

How To Identify Potential Customers?

Challenge 1 - Identify Potential Customers

How to target the market?

How to know more about the companies?

How to measure the potential of a company?

How to search a specific company?

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Solution 1 - Identify Potential Customers

01. How to target the market?

- Filter on the companies and relationships
- Group companies by region

02. How to know more about the companies?

- Differentiate companies by color and size
- Zoom in/out on the network
- Choose a company on the network, or search it

03. How to measure the potential of a company?

- Denote company importance by color
- Rank the companies by centrality scores

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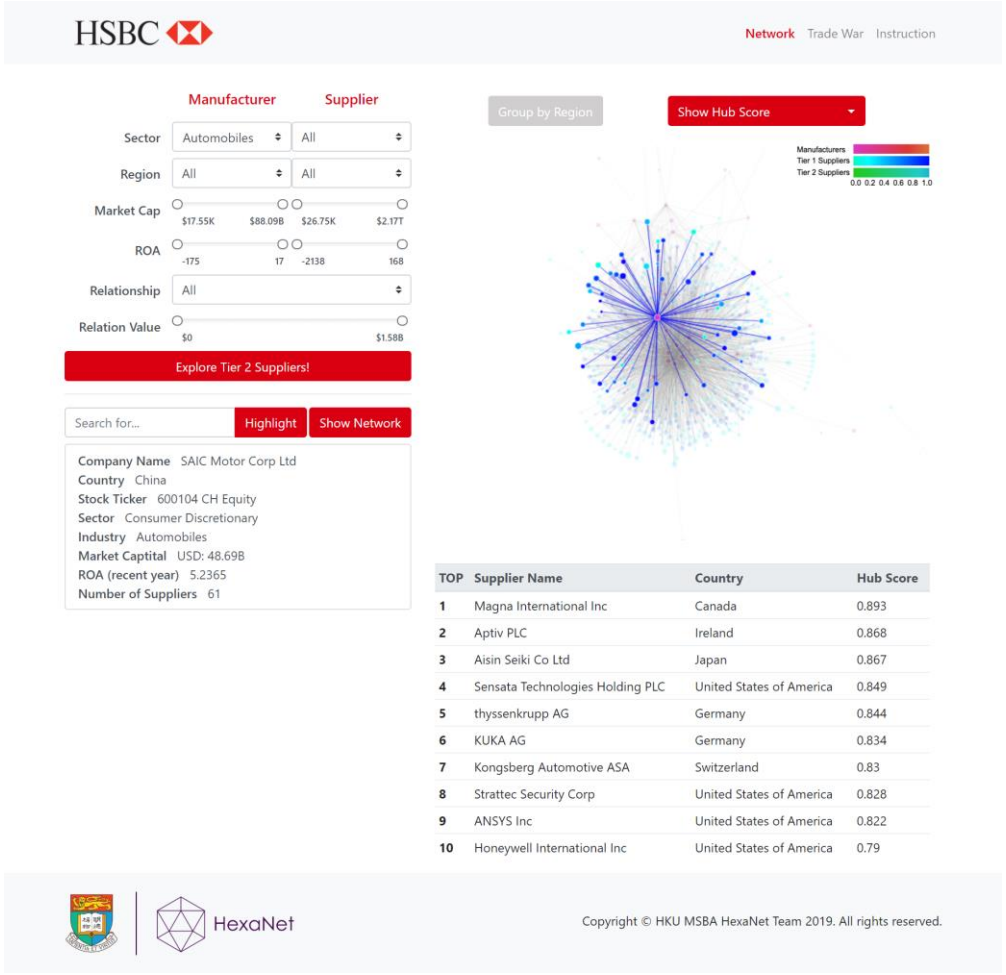

Centrality:
The Importance of Vertices Within A Graph

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Degree Centrality defines the number of links incident upon a node.

Closeness Centrality measures how short the shortest paths are from node i to all nodes.

Betweenness Centrality defines the shortest path between one and another.

Hubs and Authorities

Hubs: importance of suppliers

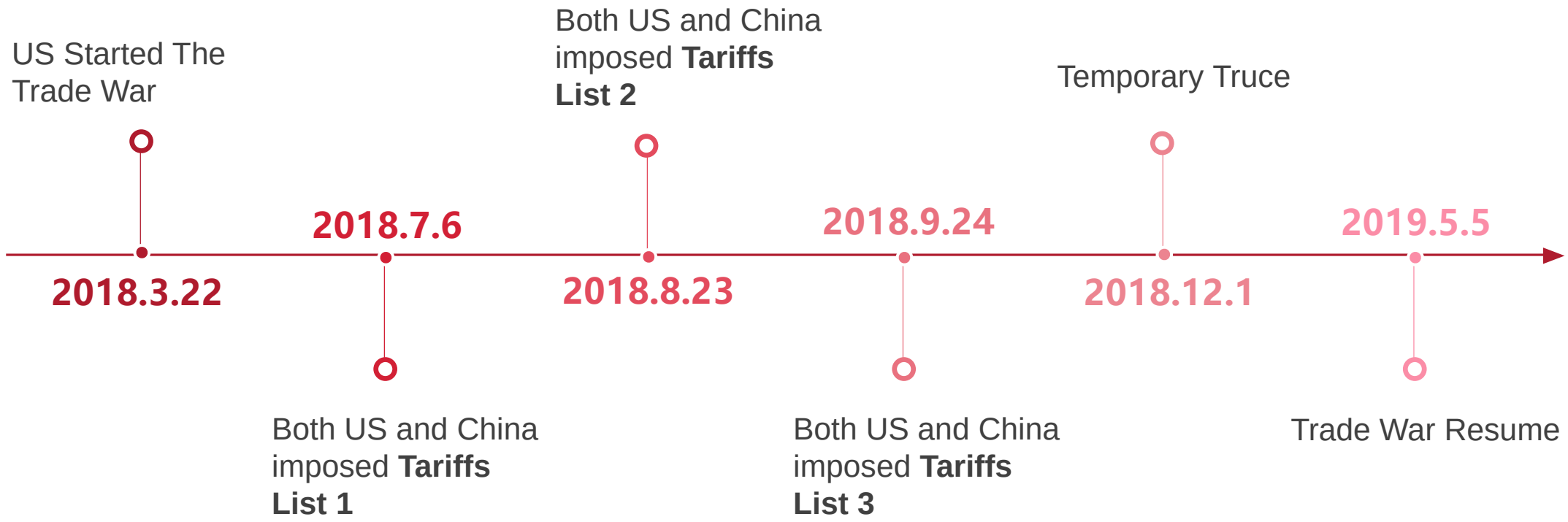
Authorities: importance of manufacturers

Reference:
Manning, Christopher and Raghavan, Prabhakar and Schütze, Hinrich (2010) Introduction to Information Retrieval. Natural Language Engineering, 16 (1). 100–103.

03

How To Discover Trade War Effect?

Trade War Started At 2018 Q1

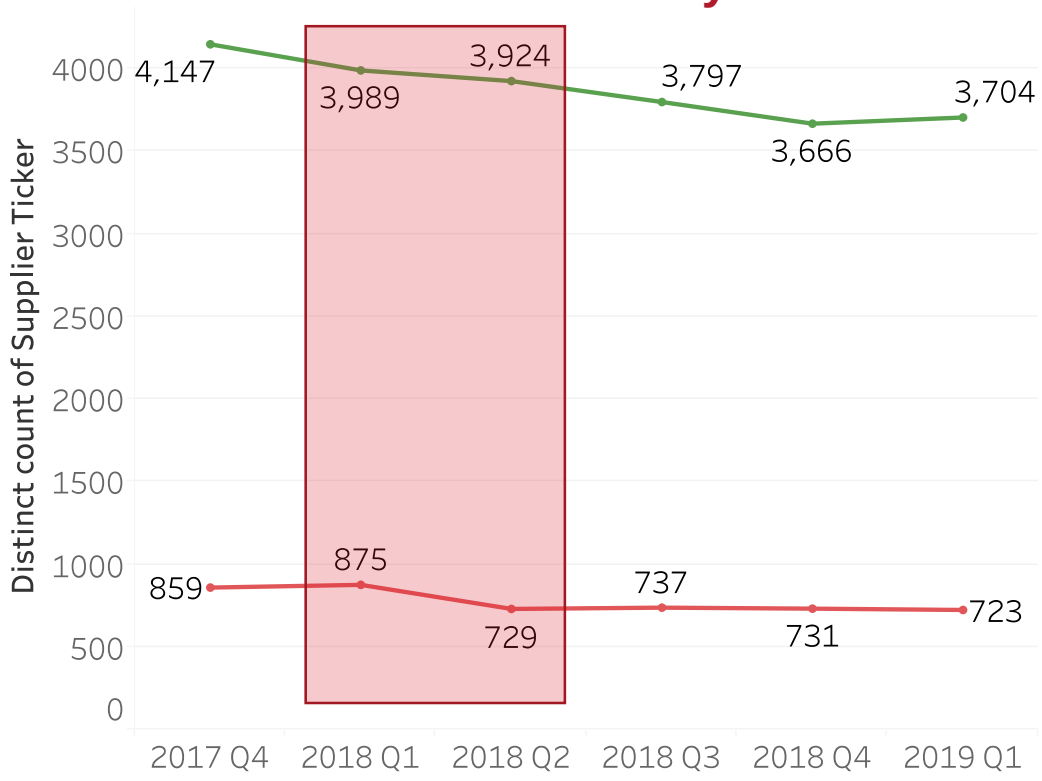


Reference:

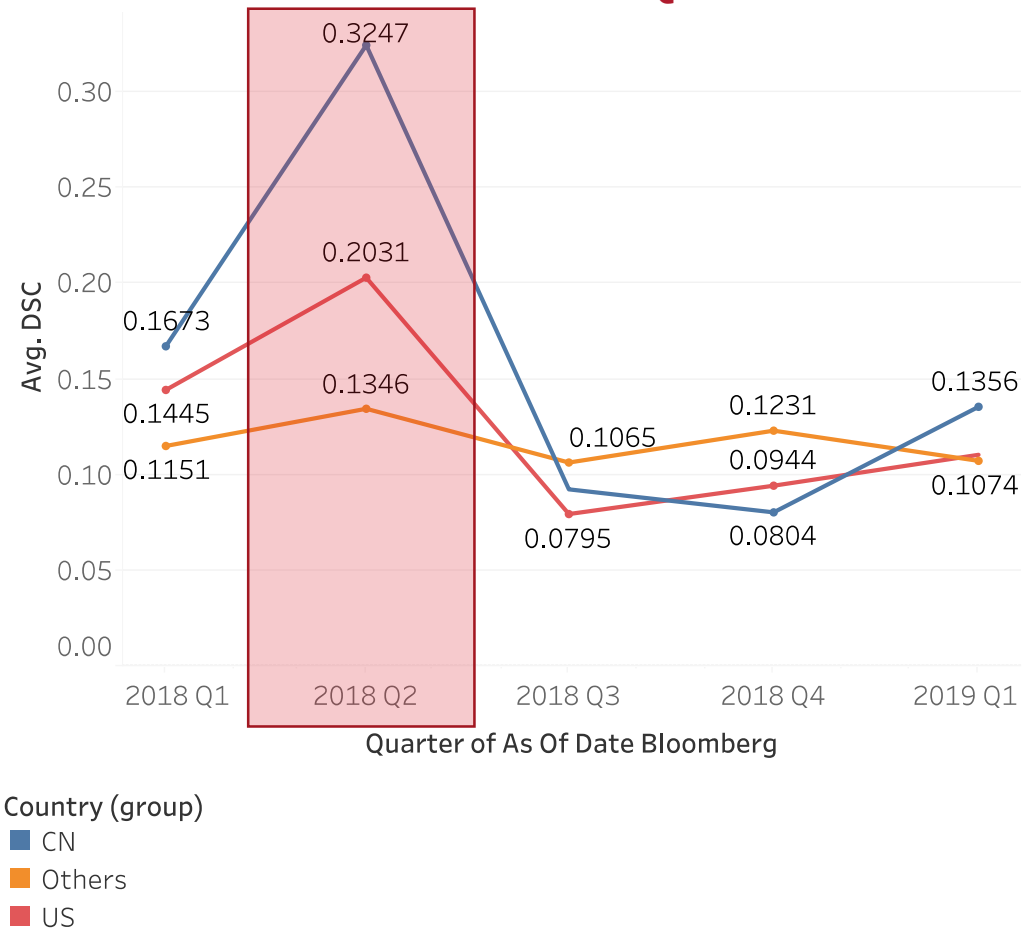
- What's at stake in US-China trade war (July 19, 2018), from https://ig.ft.com/us-china-tariffs
- Trump said trade wars are 'easy to win.' A year later, here's a timeline of what's happened with China (March 2, 2019), from https://www.cnbc.com/2019/03/01/the-timeline-of-trump-china-tariffs-and-trade-war.html
- The US-China Trade War: A Timeline (April 12, 2019), fromhttps://www.china-briefing.com/news/the-us-china-trade-war-a-timeline/

Choices of Supplier Network Changed In 2018Q2

Number of Suppliers drop in 2018Q2 in the overall industry



DSC reviewed that big changes of supplier network in 2018Q2



US Firms Decreasing Its Exposure In China And Number Of Suppliers

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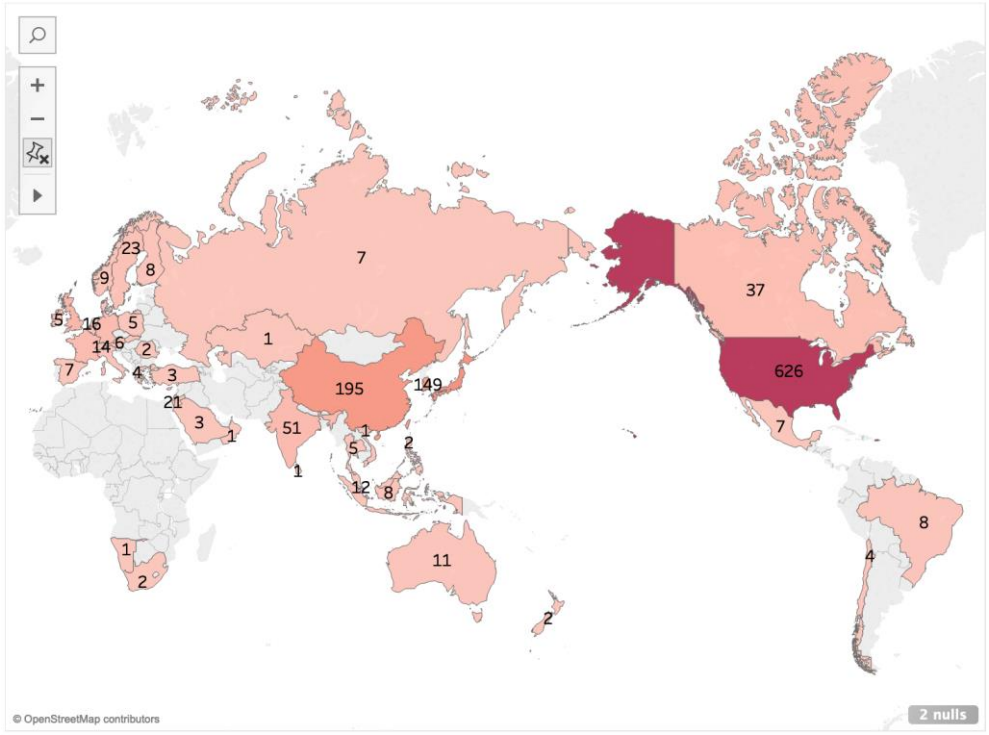
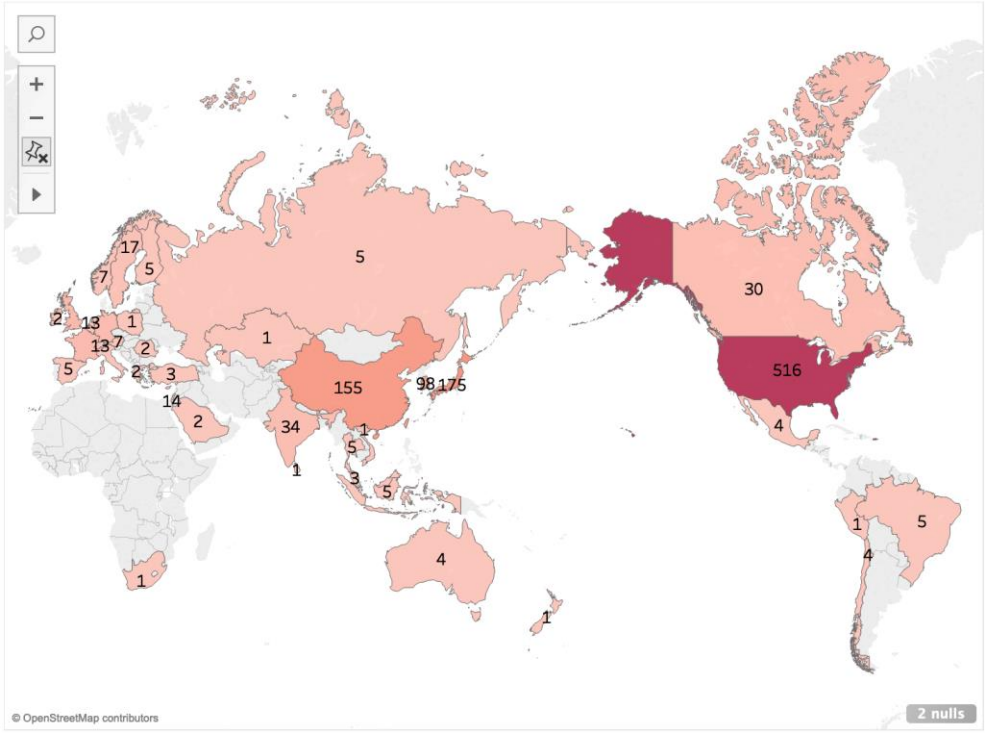
Suppliers COO as of 2017/12/31



US	626(34.26%)
JP	217(11.88%)
CN	195(10.67%)
TW	160(8.76%)
KR	149(8.16%)

Suppliers COO as of 2019/03/31



US	516(36.03%)
JP	175(12.22%)
CN	155(10.82%)
TW	126(8.80%)
KR	98(6.84%)

Chinese Firms Are Indifferent With Trade War

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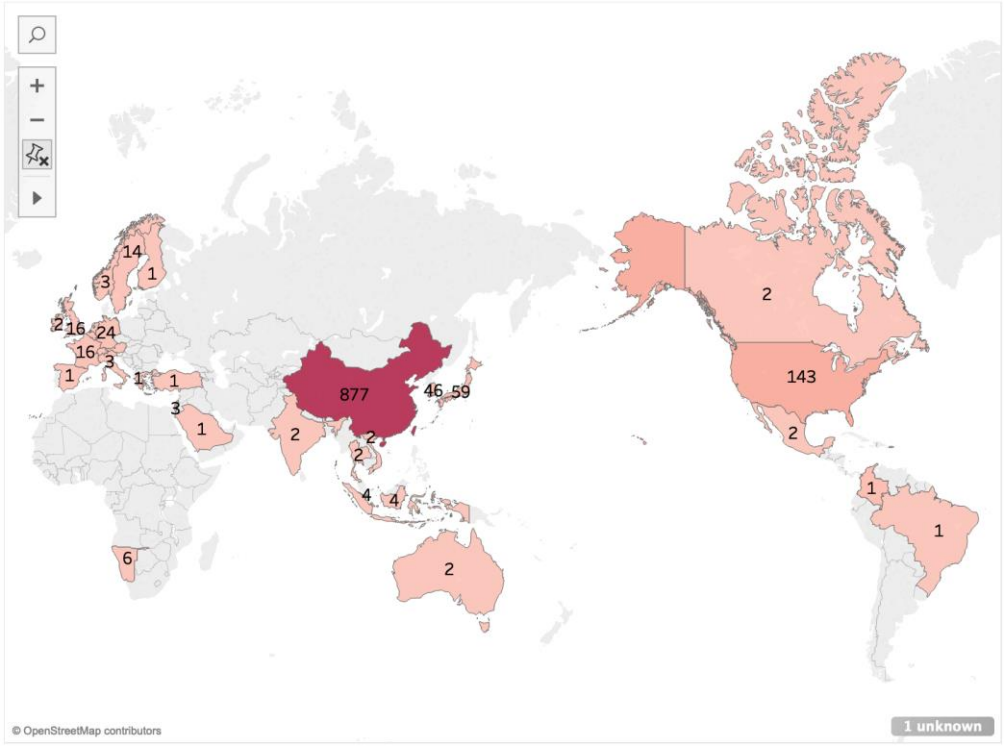
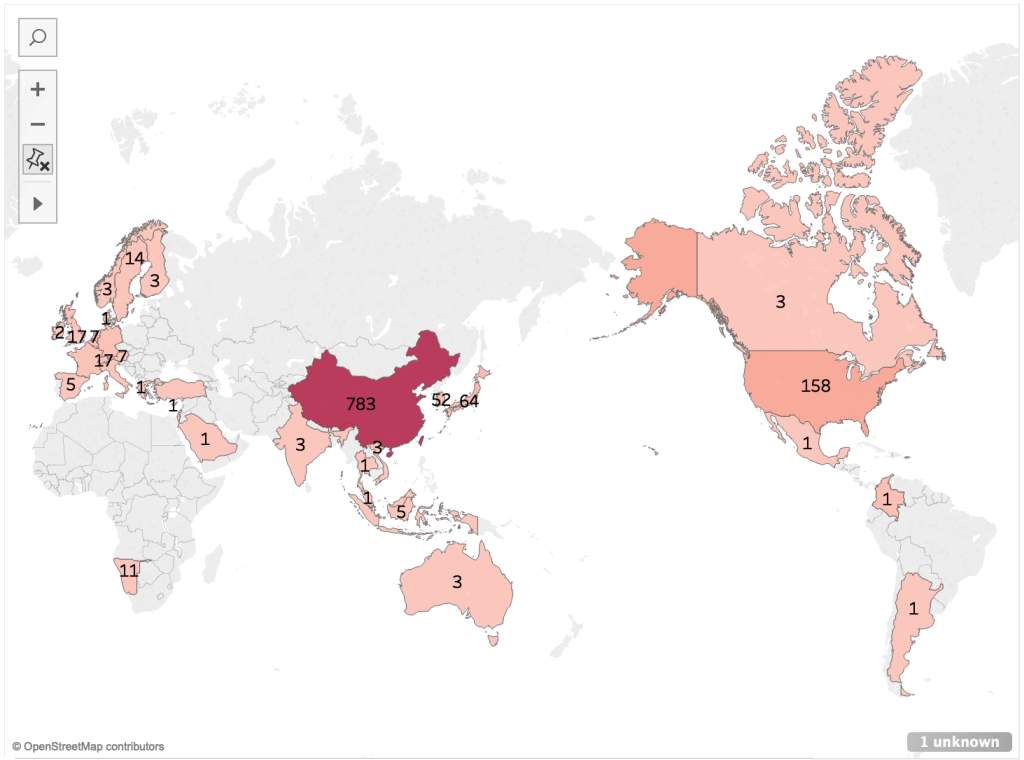
Suppliers COO as of 2017/12/31



CN	877(66.04%)	
US	143(10.77%)	
JP	59(4.44%)	
KR	46(3.46%)	
TW	44(3.31%)	

Suppliers COO as of 2019/03/31

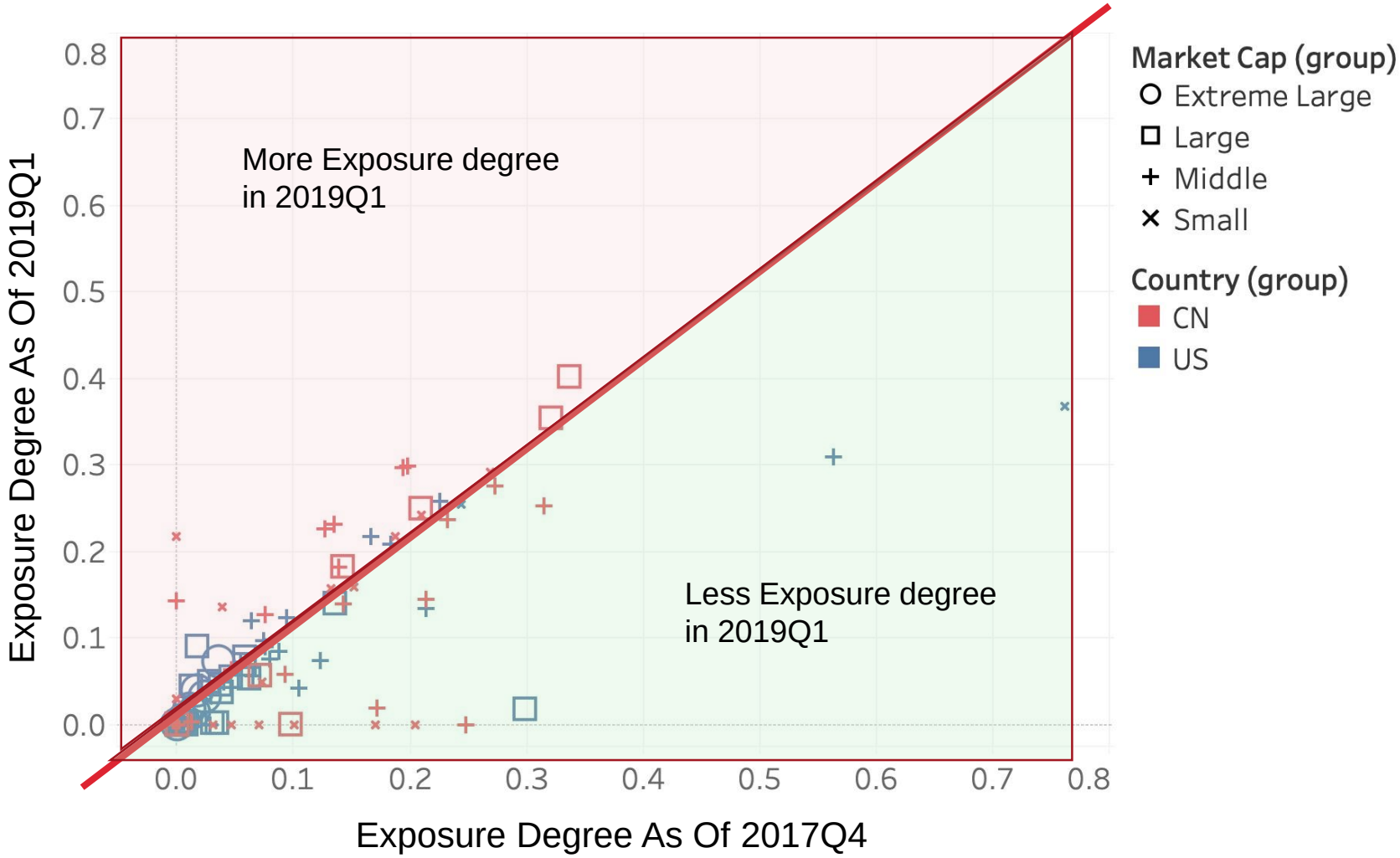


CN	783(59.45%)	
US	158(12.00%)	
JP	64(4.86%)	
KR	52(3.95%)	
TW	50(3.80%)	

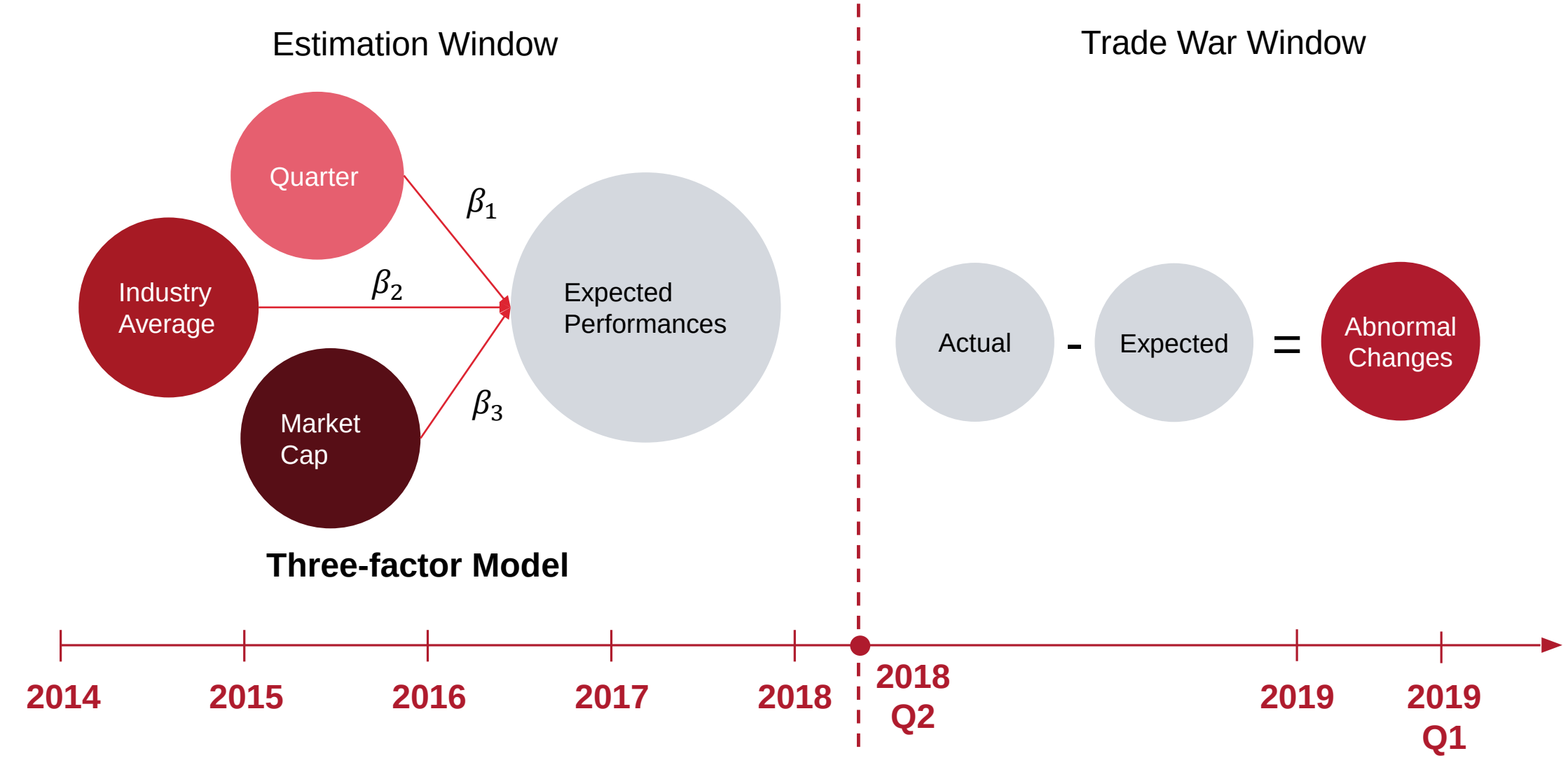
Large Companies Have Less Exposure To Trade War

Exposure Degree:
Measure the portion of US/CN suppliers and customers

Company Size	Exposure Degree
Extreme Large	0.03076
Large	0.081
Middle	0.1022
Small	0.074



Study Abnormal Changes Of Financial Metrics Of Each Firm During Trade War



Reference:
Kothari, S.P. & B. Warner, Jerold. (2004). The Econometrics of Event Studies.

Take Ford Motor As A Numerical Example

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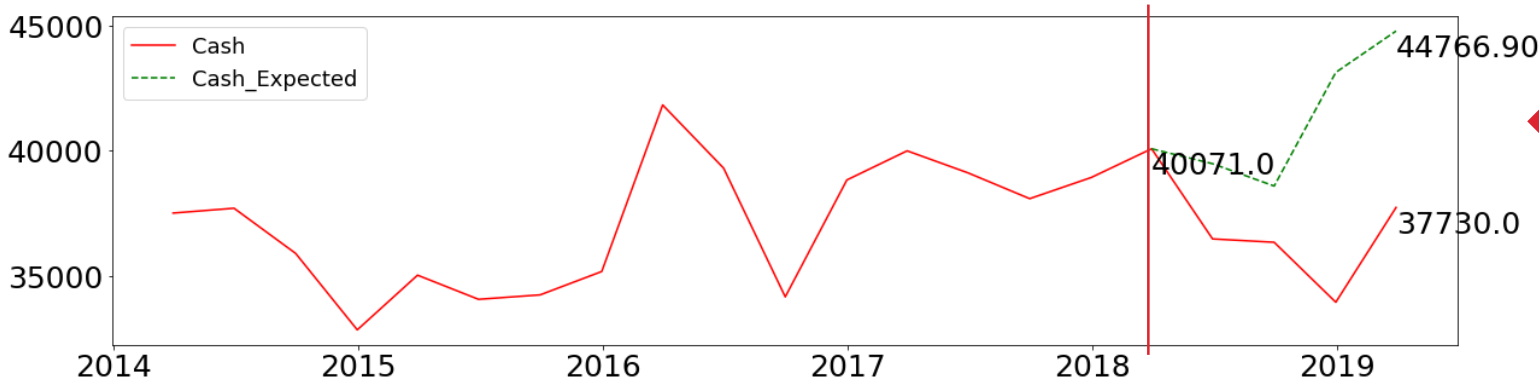
Econometrics

Financial Metrics: Cash



Inspect the abnormal changes during the Trade War Period

Three-Factor Model

$$Expected = c + \beta_1 * Quarter + \beta_2 * Industry\ average + \beta_3 * Market\ cap$$

$$constant = 25960.98$$

$$\beta_{Q2} = -1505.99; \beta_{Q3} = -3979.66; \beta_{Q4} = -2663.73$$

$$\beta_{Inudstry\_avg} = 3.27$$

$$\beta_{Market\_Cap} = -0.127$$

Abnormal Changes

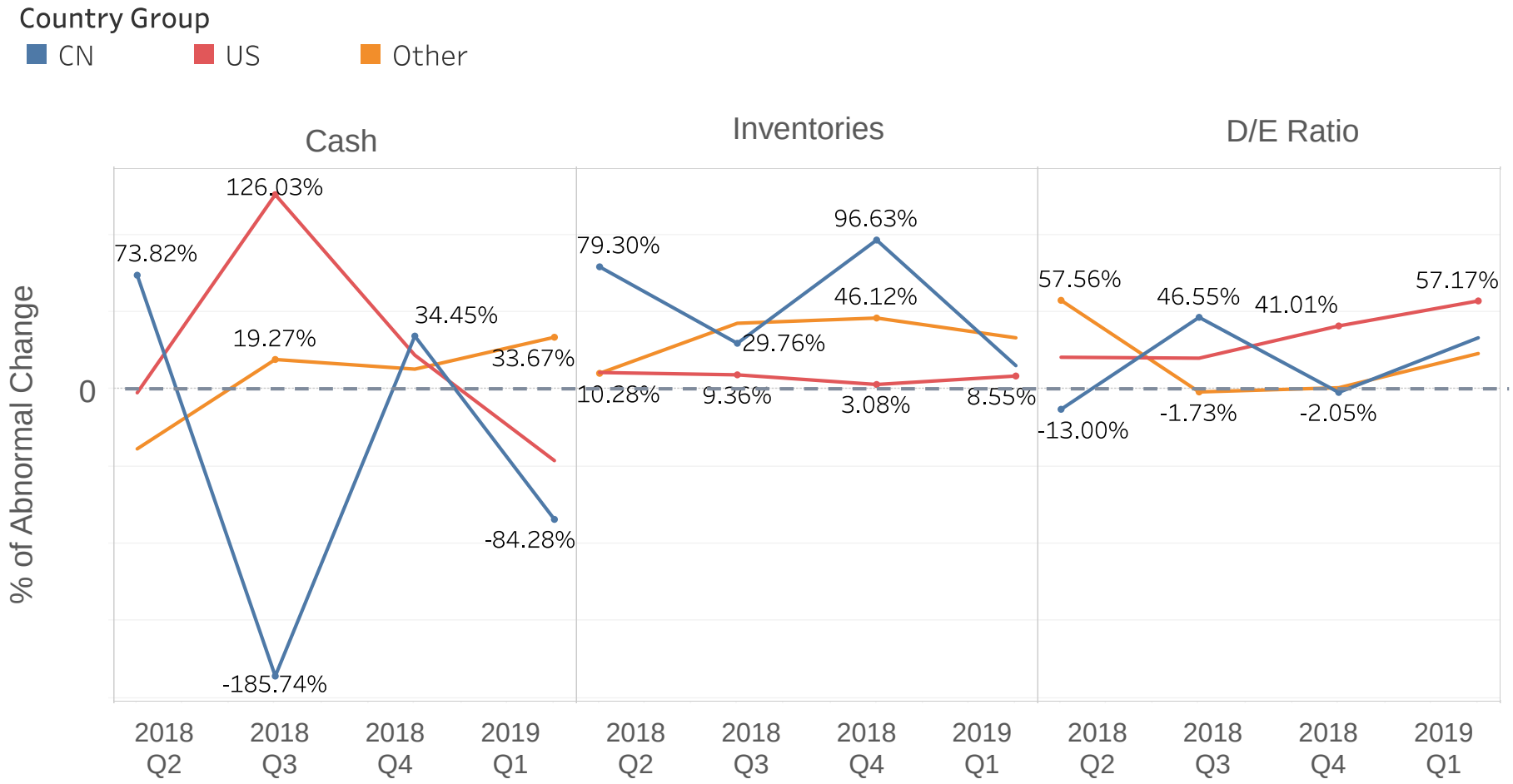
2019Q1: Industry average: 7110.36 Market Cap: 35028.213

$$Expected\ Cash = 44{,}766.9$$

$$Actual\ Cash = 37{,}730.0$$

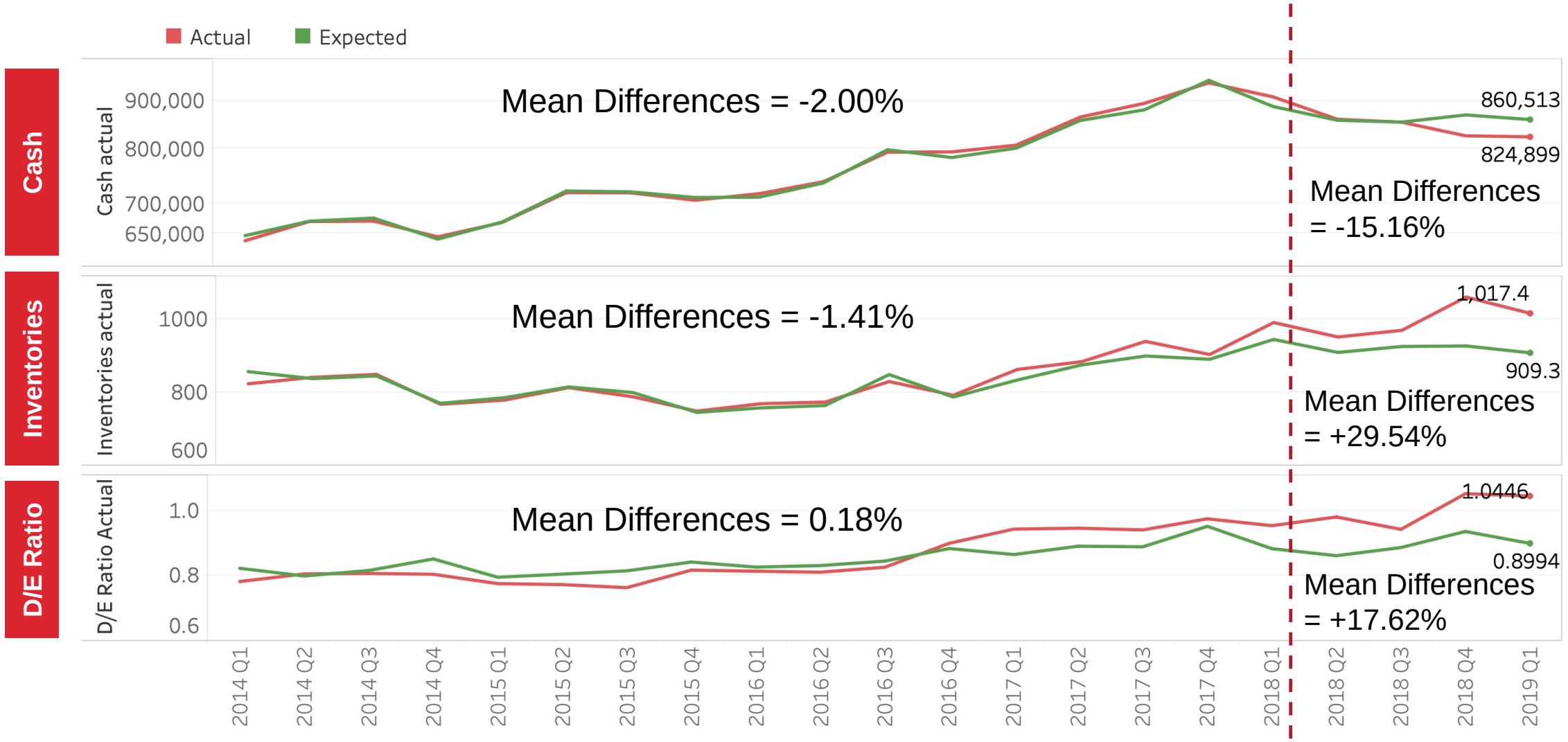
$$Abnormal\ Changes = \frac{37{,}730}{44{,}766.9} - 1 = -15.72\%$$

Abnormal Changes Of Financial Metrics During Trade War



❑ Decreasing Cash ❑ Increasing Inventories ❑ Increasing D/E Ratio

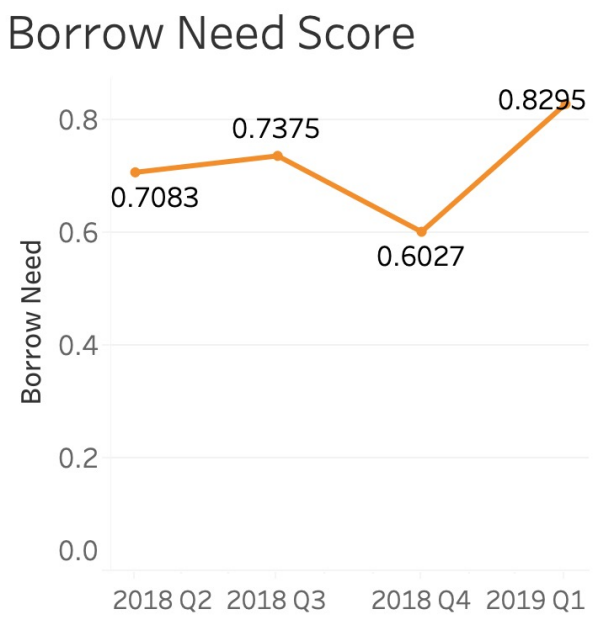
Cash, Inventory And D/E Varies From Expectations

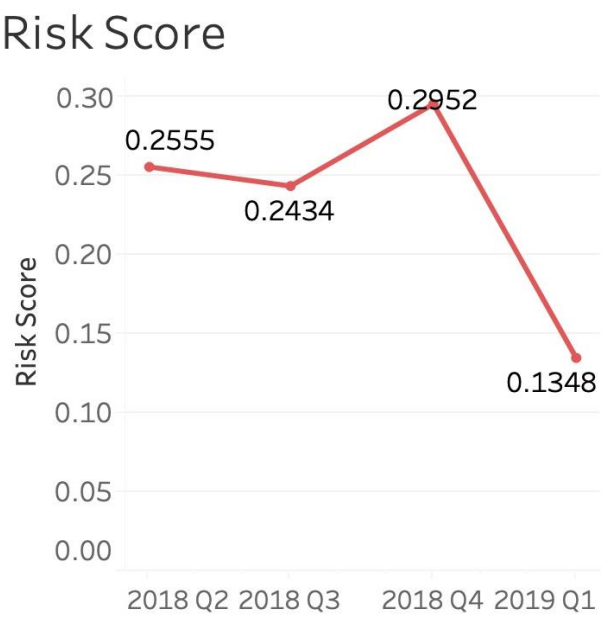


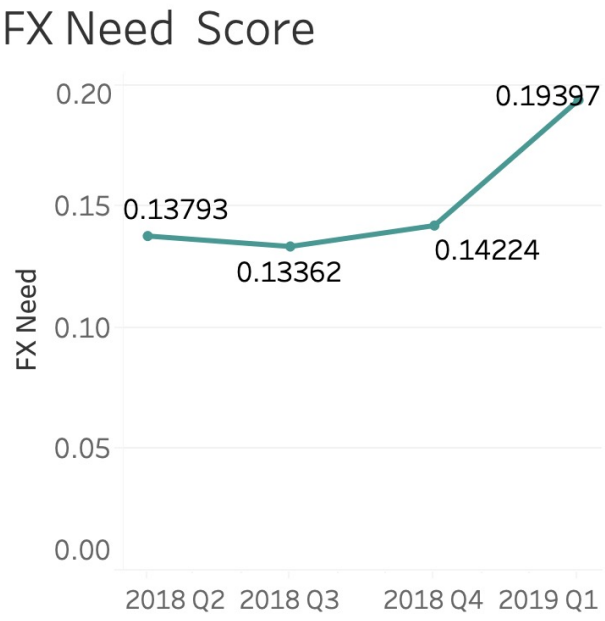
HexaNet Scoring System

Scores	Calculations	Rationales
Borrow Need Score	abnormal change of Inventories – abnormal change of cash	Inventories ↑, Cash ↓ → Operation Efficiency ↓
Risk Score	abnormal change of D/E ratio	D/E ratio ↑ → Financial Flexibility ↓
FX Need Score	number of foreign suppliers	Foreign Suppliers ↑ → FX Opportunities ↑
HexaNet Score	$\sqrt{(Borrow\ Need\ )^2 + (FX\ Need)^2 + (1 - Risk)^2}$	Aggregated score using Euclidean metric

Take Tesla As An Example







2019 February news - “Tesla reached an agreement with a group of Chinese banks to secure over $500 million in loans”[1]

Tesla bond price rose from $95 in March 2018 to $110 in January 2019[2]

2019 February news -“Tesla plans to build its first overseas Gigafactory in Shanghai, China.”[1]

Reference:
1. Business Insider, Tesla Tesla reached an agreement with a group of Chinese banks to secure over $500 million in loans for its new Gigafactory in Shanghai https://www.businessinsider.my/tesla-enters-loan-agreement-chinese-banks-to-fund-new-gigafactory-2019-3/
2. Markets Insider, tesla inc bond 2021 Historical Price https://markets.businessinsider.com/bond/historical/tesla_inc-bond-2021-us88160rac51/ber/31.3.2018_1.4.2019

Challenge 2 - Discover Trade War Effect

How to visualize the trade war effect on individual company?

How to prioritize the companies to target under the trade war?

🎯 http://hexanet.live

Solution 2 - Discover Trade War Effect

01. How to visualize the trade war effect on individual company?

- Show network evolvement through timeline
- Plot HexaNet scores over time
- Plot company financial performance

02. How to prioritize the companies to target under the trade war?

- Locate companies in HexaNet scoring system through 3D scatter plot
- Rank the companies by HexaNet scores

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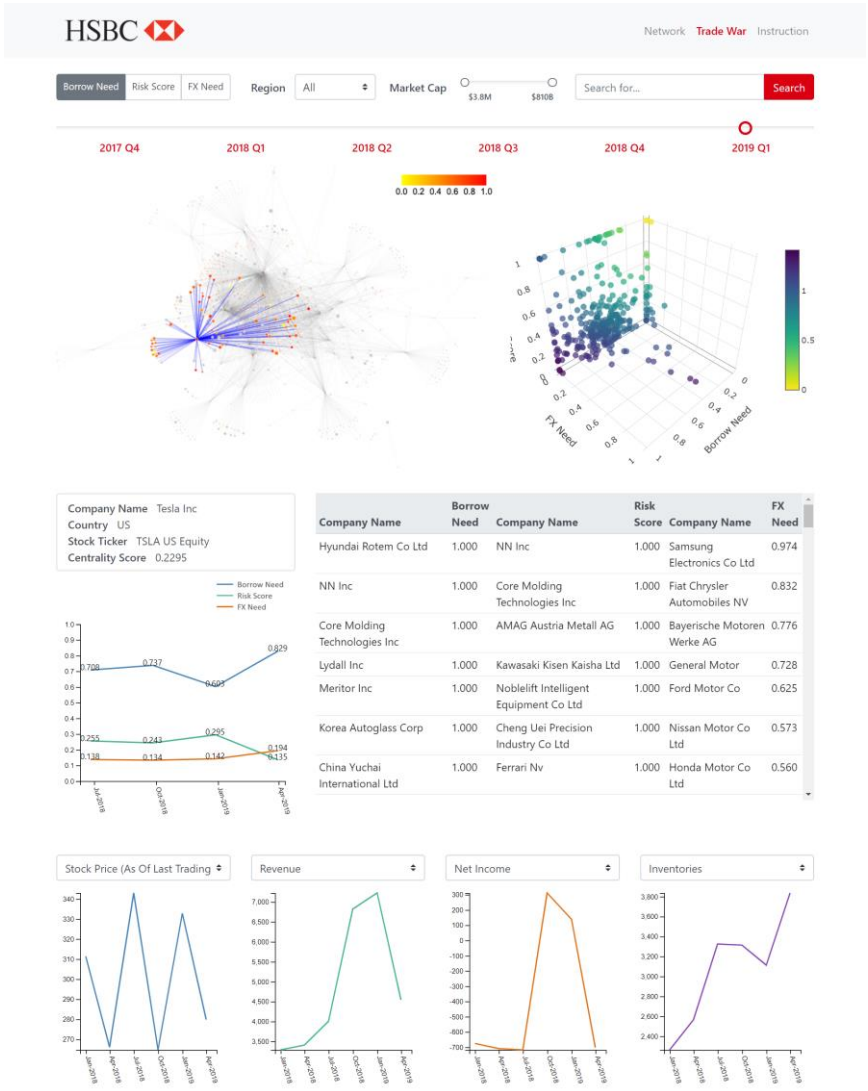

04

Summary

Solutions Summary

Challenges	Solutions
01 Identify Potential Customers	❑ Visualize The Supply Chain Network ❑ Rank Companies By Centrality Scores
02 Discover The Effect Of Trade War	❑ Three-factor Model ❑ HexaNet Scoring System ❑ Visualize The Changes Of Supply Chain ❑ Visualize The Financial Performance

Acknowledgement

Professors: Dr. Hailiang Chen, Dr. Eric Park

Client: HSBC ASP CMB Business Analytics team

Supporting: Ziyun W, Dongyu Z, Jane M, Hoyin S, Ethan W, Happy L, Mei W, Anson M, Horace L, Charisse W

Thank you!

HexaNet

2019.6.14

Appendix I -
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Appendix II - 4 Ways to Identify Business Opportunity Using Centrality

Centrality: the most important vertices within a graph[1]

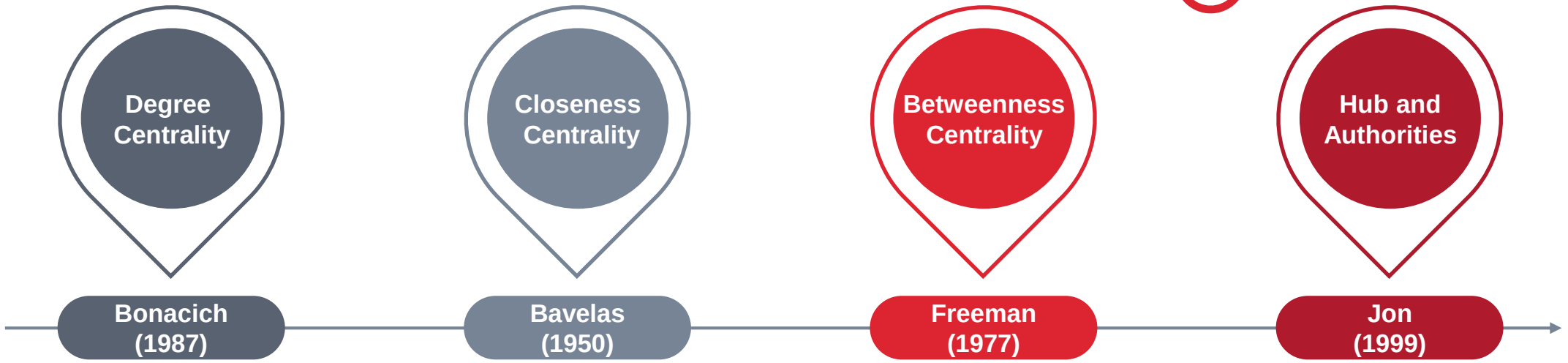
Social Network

the most influential persons[1]

Supply Chain Network

the most important companies

Method we recommend



The use of the number of connected nodes*

$$C_{deg}(v) = \frac{d_v}{|N|-1}$$

Nodes have shortest distance to the others are more important.*

$$C_{close}(v) = \frac{|N|-1}{\sum_{u \in N \setminus \{v\}} d(v,u)}$$

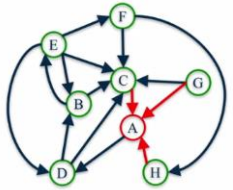
# of times of a node exists in other shortest path.*

$$C_{btw}(v) = \Sigma_{s,t \in N} \frac{\sigma_{s,t}(v)}{\sigma_{s,t}}$$

Link analysis algorithm that rates Web Page originally.

Reference:
1. Wikipedia, 2019, https://en.wikipedia.org/wiki/Centrality
2. Coursera, 2019, Applied Social Network Analysis in Python. https://www.coursera.org/learn/python-social-network-analysis/home/week/1

Appendix III - HITS Algorithm, Or Hubs And Authorities



Step 1

Assign each node an authority and hub score of 1.

Nodes	Auth	Hub
A	1	1
B	1	1
C	1	1
D	1	1
E	1	1
F	1	1
G	1	1
H	1	1

Step 2

Apply the Authority Update Rule: each node's authority score is the sum of hub scores of each node that points to it.

Nodes	New Auth	New Hub
A	3	
B	2	
C	5	
D	2	
E	1	
F	1	
G	0	
H	1	

Step 3

Apply the Hub Update Rule: each node's hub score is the sum of authority scores of each node that it points to

Nodes	New Auth	New Hub
A	3	1
B	2	2
C	5	1
D	2	2
E	1	4
F	1	2
G	0	2
H	1	1

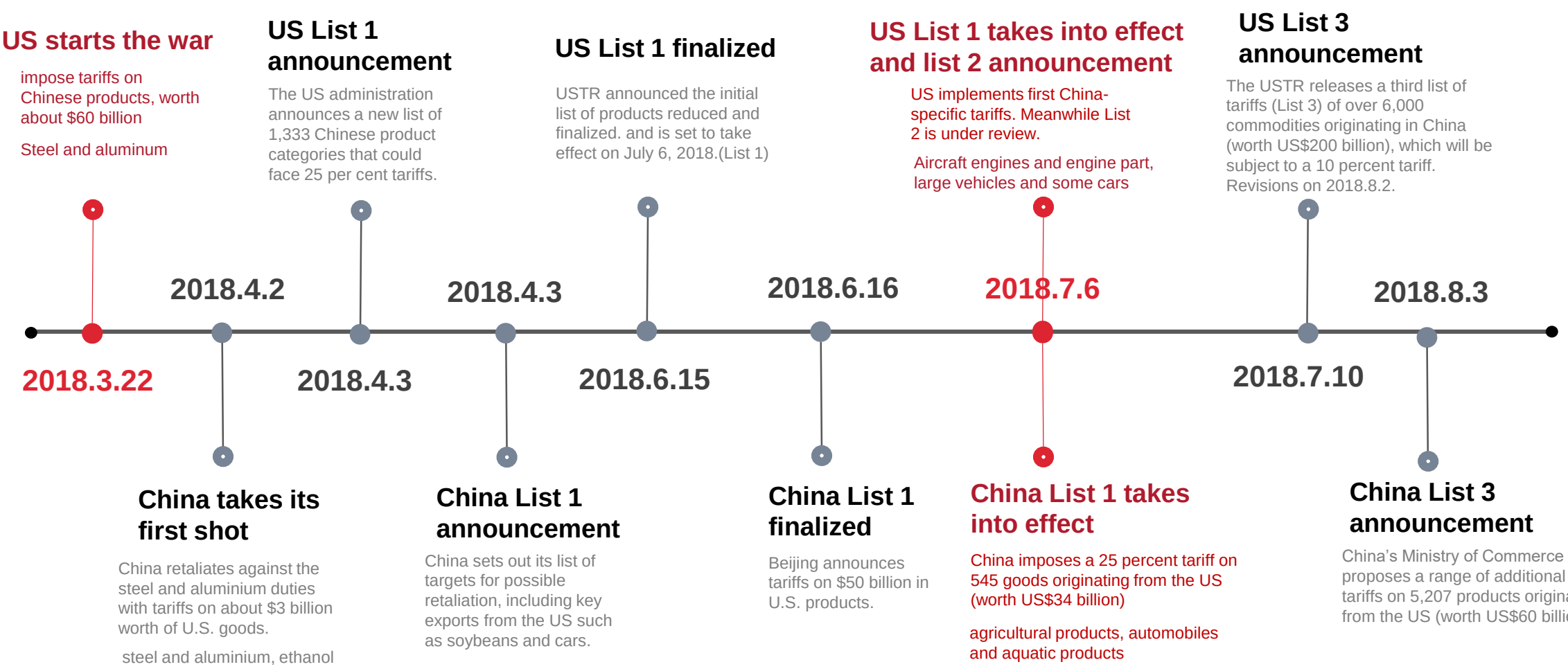
Step 4

Normalize Authority and Hub scores: $auth(j) = \frac{auth(j)}{\Sigma_{i \epsilon N} auth(j)}$

Nodes	Auth	Hub
A	3/15	1/15
B	2/15	2/15
C	5/15	1/15
D	2/15	2/15
E	1/15	4/15
F	1/15	2/15
G	0/15	2/15
H	1/15	1/15

Computing k iterations of the HITS algorithm to achieve the optimal solutions.

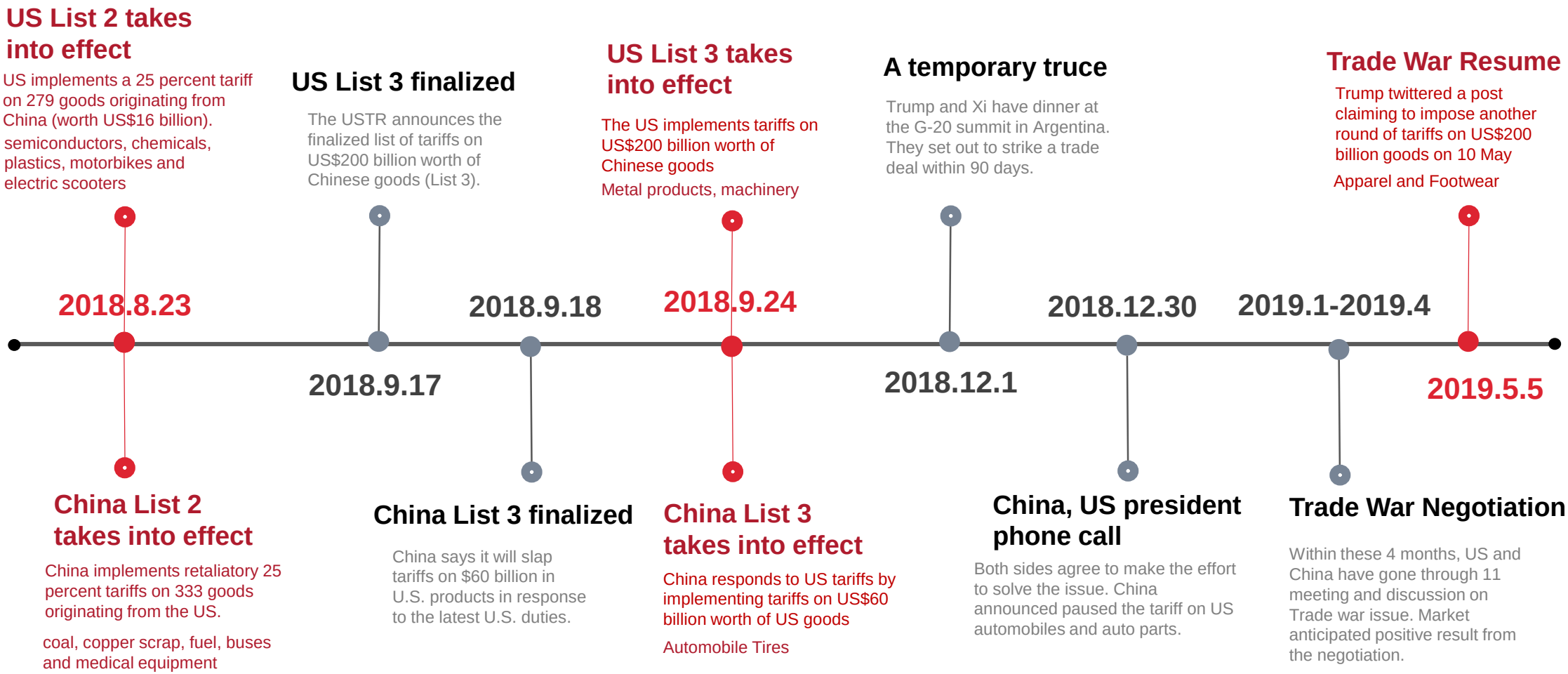
Appendix IV - Trade War Timeline (1/2)



Reference:

- What's at stake in US-China trade war (July 19, 2018), from https://ig.ft.com/us-china-tariffs
- Trump said trade wars are 'easy to win.' A year later, here's a timeline of what's happened with China (March 2, 2019), from https://www.cnbc.com/2019/03/01/the-timeline-of-trump-china-tariffs-and-trade-war.html
- The US-China Trade War: A Timeline (April 12, 2019), fromhttps://www.china-briefing.com/news/the-us-china-trade-war-a-timeline/

Appendix V - Trade War Timeline (2/2)



Reference:

- What's at stake in US-China trade war (July 19, 2018), from https://ig.ft.com/us-china-tariffs
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- The US-China Trade War: A Timeline (April 12, 2019), fromhttps://www.china-briefing.com/news/the-us-china-trade-war-a-timeline/

Appendix VI - Definition of DSC (Degree of Supplier Change)

Degree of supplier changes (DSC) indicates how a company supplier relationship value changed.

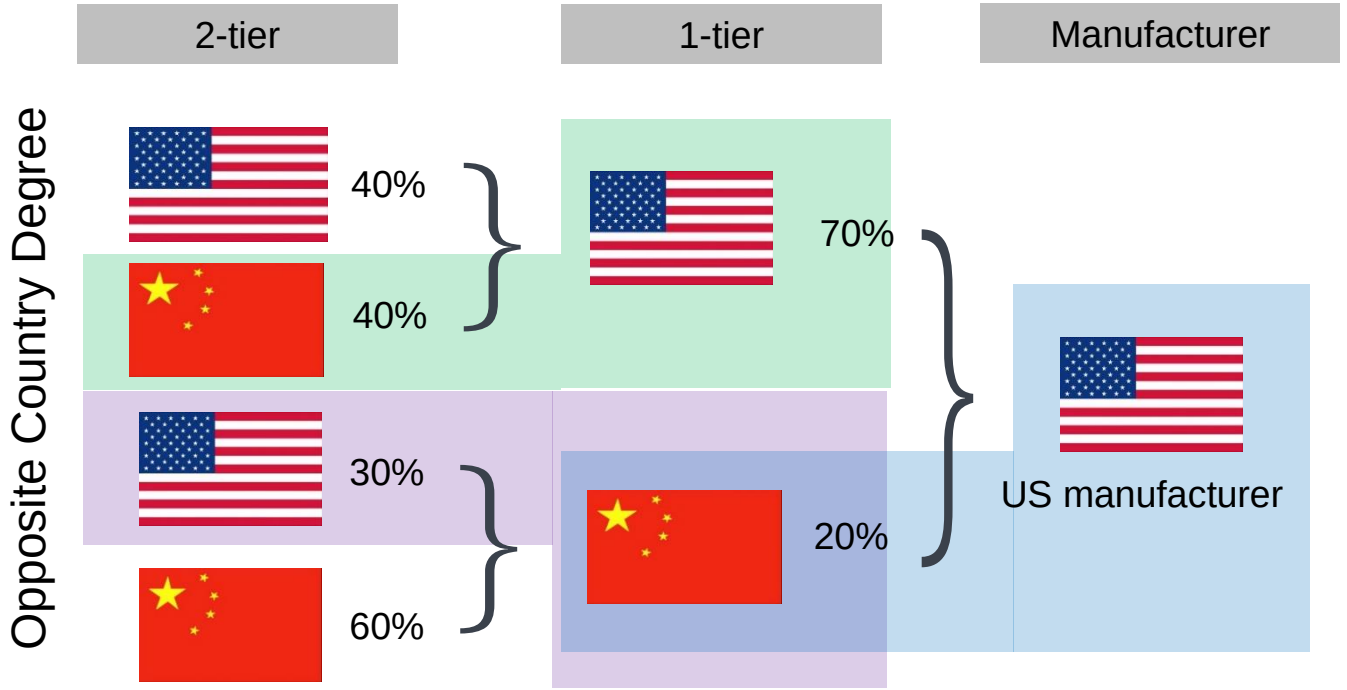
$$DSC = \frac{\sum Abs(Change\ of\ proportion\ count\ of\ supplier)}{Sum\ of\ Before\ Period\ and\ After\ Period\ proportion}$$

Example:

Company ABC's Suppliers	2017 Count of suppliers	2019 count of suppliers	Absolute Change
A	1 (0.5)	0	0.5
B	1 (0.5)	1 (0.5)	0
C	0	1 (0.5)	0.5
Total	2 (1)	2 (1)	1

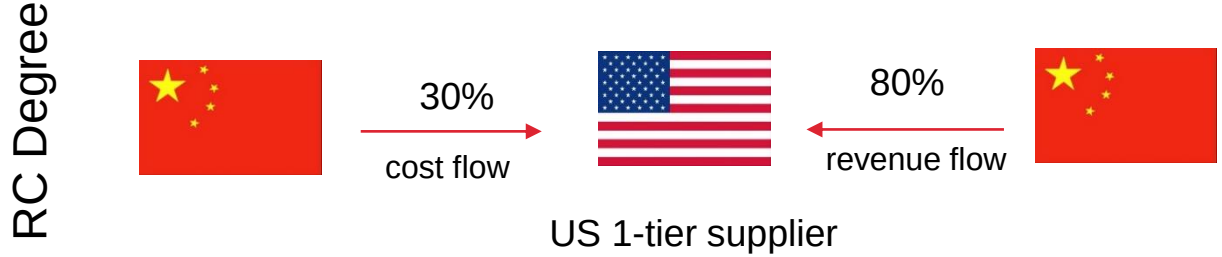
DSC = 0.5

Appendix VII - Trade War Exposure Score



Opposite country degree =

0.2 + 0.2*0.3 +0.7 *0.4 = 0.54



RC(Revenue-Cost) degree =

$$0.3 * \left(\frac{COGS}{revenue}\right) + 0.8 * (1 - \frac{COGS}{Revenue})$$

Appendix VIII –
Top 10 Automobile Companies By HexaNet Scores

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Borrow Need Score
Rank Top 10

Company name	Score
FAW CAR Co Ltd	1
Guangzhou Auto-H	0.987394797
Tesla Inc	0.829461388
Suzuki Motor Corp	0.665430078
Nissan Shatai Co Ltd	0.609984358
Volkswagen AG	0.574148521
Daimler AG	0.570870208
SAIC Motor	0.559980369
Ford Motor Co	0.550327562
Honda Motor Co Ltd	0.538442819

FX Need Score
Rank Top 10

Company name	Score
Fiat Chrysler Automobiles NV	0.8319
Bayerische Motoren Werke AG	0.77586
General Motor	0.72845
Ford Motor Co	0.625
Nissan Motor Co Ltd	0.57328
Honda Motor Co Ltd	0.56034
SAIC Motor	0.2069
Tesla Inc	0.19397
Great Wall Motor Co Ltd	0.15517
BYD Co Ltd	0.13793

Risk Score
Rank Top 10

Company name	Score
Ferrari Nv	1
DongFeng Automobile Co Ltd	1
Haima Automobi-A	1
Zap Motors	1
Tianjin Faw Xiali Automobile Co Ltd	1
Beiqi Foton Motor Co Ltd	0.699637
Great Wall Motor Co Ltd	0.482817
General Motor	0.327498
SAIC Motor	0.312815
Nissan Shatai Co Ltd	0.296606