



## The Concentration of Suppliers Caused the Correlation Risks and Aggravated Disruptions in the Supply Chain Network

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The coronavirus (COVID-19) pandemic as a public health event disrupted the pattern of just in time (JIT) system in the global supply chain. One significant challenge is a crippling shortage of medical suppliers, such as masks, disposable protective coverall suits, and ventilators. The article studies the centralized supply chain of U.S. medical equipment listed companies as single buyers and multiple suppliers. According to Bloomberg Supply Chain Database, in April 2020, there are 478 medical equipment list companies in the United States (US), and 36 companies accounted for 80% market share. The coincidence rate of suppliers in the first tier occupies 36.84 %, and in the second-tier supplier accounts for 83.65% (Figure 1).

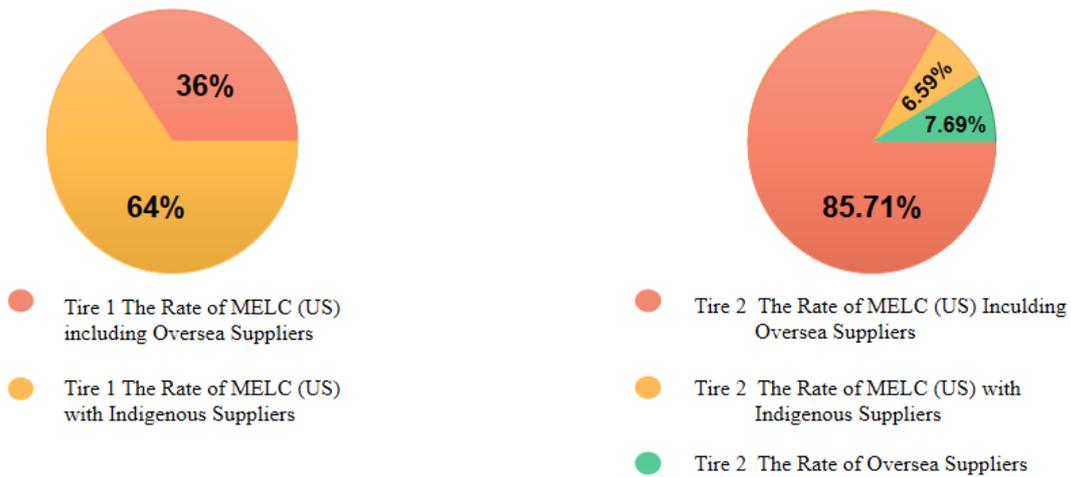
**Figure 1** The Rate of Coincident Suppliers and Isolated Suppliers in Tire 1 &2 of Supply Chain Network in Medical Equipment List Companies US



Source: Bloomberg Supply Chain Database

A high rate of coincidence aggravates the correlation risks (co-risks) in the global supply chain network. Also, 36 % of suppliers in Tire 1 of the supply chain network come from overseas, and 64 % are indigenous. In Tire 2, however, 85.71 % of suppliers come from overseas, 6.59 % are indigenous and 7.69 % are indigenous (Figure 2).

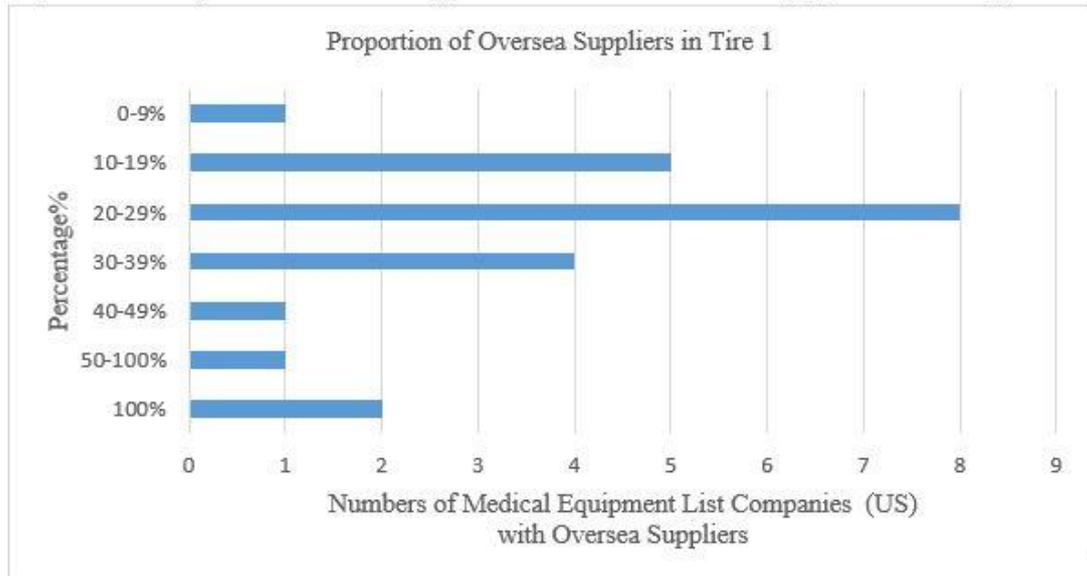
**Figure 2** The Proportion of Indigenous Suppliers and Oversea Suppliers in Medical Equipment List Companies (MELC) US



Source: Bloomberg Supply Chain Database

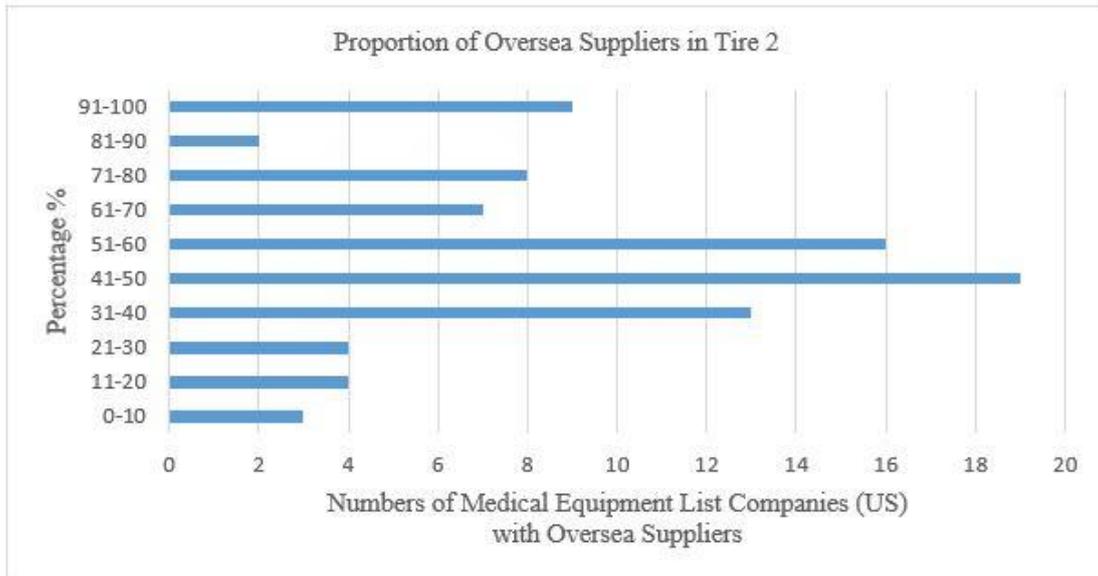
The largest share of overseas suppliers in the first tire is 20-29%, and the second level of offshore suppliers concentrated in 41-50% (Figure 3&4).

**Figure 3** The Proportion of Oversea Suppliers in Tire 1 of 36 Medical Equipment List Companies US



Source: Bloomberg Supply Chain Database

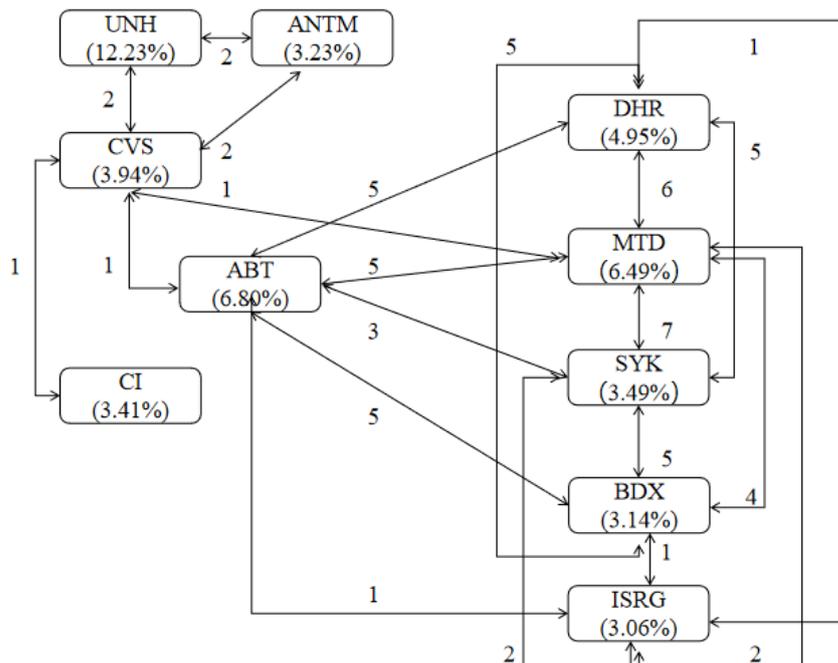
**Figure 4** The Proportion of Oversea Suppliers in Tire 2



Source: Bloomberg Supply Chain Database

Two sets of data show the proportion of secondary overseas suppliers is 2.5 times as many as that of primary overseas suppliers. As a result, sales and inventories are subject to increased transport risk. The coincidence rate of suppliers in two tires reflects the correlation coefficient of risk of enterprises. In the top 10 medical equipment list companies (US), which account for a 50% market share, Medtronic Plc is riskiest that the cumulative co-risk is 25, and Cigna Corp is safe that the minimum value at co-risk is 1. (Figure 5)

**Figure 5** A Diagrammatic Depletes of Co-Risk in 10 Health Equipment List Companies in US (Market Share 50%)



Code	Name	Market Share(%)	Degree of Co-Risk (Cumulative)
UNH	UNITEDHEALTH GROUP INC	12.23%	4
ABT	ABBOTT LABORATORIES	6.80%	20
MDT	MEDTRONIC PLC	6.49%	25
DHR	DANAHER CORP	4.95%	22
CVS	CVS HEALTH CORP	3.94%	5
SYK	STRYKER CORP	3.49%	22
CI	CIGNA CORP	3.41%	1
ANTM	ANTHEM INC	3.23%	4
BDX	BECTON DICKINSON AND CO	3.14%	20
ISRG	INTUITIVE SURGICAL INC	3.06%	7

Source: Bloomberg Supply Chain Database

The stuck of production and transportation upended the global network. Even if the supply chain information system reflects the logistics situation in real-time, the congestions are in the whole network. So what causes congestion in the supply chain network? Because of the high concentration of suppliers in levels 1 and 2. The coincidence rate in the second level is higher than the first. The overlapping rate of suppliers in the same region is high. The cross-regional suppliers cannot meet the market demand due to labor, transportation, raw materials, and other factors, which leads to the rupture of the global supply chain. In a short period, because the enterprises (buyers) choose the same suppliers, there is no alternative, resulting in the interruption of supply and purchase restrictions. The stock market directly reflects the further market panic.

At the beginning of the COVID-19 pandemic (Jan 22nd-March 25th, 2020), the global supply chain disruption has triggered a butterfly effect in financial markets, transportation systems, healthcare systems, labor markets, and political security. Meanwhile, the large-scale reduction of economic activities and pessimism reflect the growing economic uncertainty. On March 16th, 2020, Dow dropped nearly three thousand points one day, which is the most significant single-day drop in Dow history. This article collected four sets of data from the World Health Organization (WHO), U.S. stock market, Bloomberg Supply Chain Database System, which are confirmed coronavirus cases in the U.S. and worldwide between January 22nd and March 25th; stock prices of publicly medical equipment list companies; the rate of COGS from top five suppliers in Tire 1 and 2; the rate of COGS from the indigenous and offshore suppliers in Tire1 and 2. According to the analysis of four sets of data, the empirical results are as follow:

(1) the negative correlation between the stock price variation and percentage of COGS in the top five suppliers in medical equipment list companies; In other words, the stock price variation decreases as the percentage of COGS increases. The result means the centralized rate of suppliers has increased as well. Then the co-risk of the supply chain network fell into a vicious circle.

(2) the positive correlation between the COGS percentage of the top five suppliers and the first two-tier overseas suppliers. The cost of overseas suppliers and the top five suppliers in the first tier increased.

(3) the negative correlation between the stock price and the number of COVID-19 confirmed cases in the US; the stock prices of medical equipment list companies decrease as well as the number of COVID-19 confirmed cases in the US and worldwide increase.