

A Bug in the System and the Weakest Link Mantra; Lessons from COVID-19 for Resilient Global Supply Chain

Omole, Timilehin Michael¹, Ehimen, Osezefe Isaac², Omole, Miriam Lami³

¹University of Roehampton Business School

²Ducit Blue Solutions

³First Bank of Nigeria

Abstract: Building a resilient global supply chain is a prominent theme in the recommended strategies for managing disruptions of the scale brought by the COVID-19 Pandemic. This work is a systematic review of the history of pandemics in the past 100 years and their relation with the global supply chain and the economy at the time. It queries the weak link in the global supply chain during the COVID-19 pandemic and identifies lessons to shape the design of future global supply chains. In the review, the causes of the pandemics and impacts via trade routes and other economic factors were compared. We also compared the pandemic severities and economic impacts on most affected countries. Tracking the global supply chains route and travel routes is a key lesson for countries trying to contain and mitigate future pandemics. The COVID-19 challenge has begun to reengineer global supply chains and we concluded with a recommendation of re-identifying the weakest links, consider distributed or decentralized supply chain networks and consider Africa and the global south as an alternative for resilient global supply chain post-COVID-19.

Keywords: COVID-19, Global Supply Chain, Pandemic, Resilience and Strategy

I. INTRODUCTION

As China makes progress in curbing the spread of the COVID-19, it is important to begin to track the lessons as the world continues in the fight against the virus. The impact of the COVID-19 pandemic on the global supply chain, economics and businesses has been heralded as huge, unprecedented and still unveiling (Betti & Ni, 2020, Simchi-Levi, 2020 and Choi, Rogers & Vakil, 2020). China as the dominant world's factory receiving the hit of disruption by COVID-19 confers a significant downturn to the global supply chain and of course business and the economy (Kilpatrick, 2020).

Supply value chain as part of the strategies for managing this kind of disruptions as prescribed by the World Economic Forum (WEF) would happen over time (Betti & Ni, 2020). The important thing here in this discourse, however, is what should be considered or go into this new kind of strategy. In our thought we are questioning the weakest link mantra - a system is as strong as its weakest link. This would be a serious consideration in restructuring the global supply chain during and post-COVID-19 pandemic.

The WEF and Deloitte have alluded that the COVID-19 pandemic has reminded corporate decision-makers that there is a need to develop new business strategies in their future supply chain designs (Betti & Ni, 2020 and Kilpatrick, 2020). In their submission, new performance measures would include resilience, responsiveness, and reconfigurability - otherwise known as the 3R's (WEF, 2020).

With the COVID-19 pandemic, some things are clear. First, the pandemic has hugely affected the global supply chain and the global economy (Scott, 2020). It also highlights the fact that the global supply of goods depends heavily on China and as such makes the global economy vulnerable with any China-related disruption in the supply chain (Betti & Ni, 2020). Lastly, for supply chain and economic recovery after COVID-19, a restructuring or reengineering is inevitable for building a resilient global supply chain and economy.

In the consideration of the last point above, we examine the age-long weakest link mantra. In this review, we delve into the understanding of the weakest link and how China has become the weakest -link in the space of COVID-19 Pandemic.

II. METHODOLOGY

This work is a review article. It captures and uses secondary and reported data only. We use the work from the Center for Disease Control (CDC) on the past pandemics to backtrack 4 major pandemics in the past century and compared with the current COVID-19.

To properly put the economic disruption of the current COVID-19 pandemic and its global impact into perspective, we review 4 major pandemics in the last 100 years as we track the current 5th, the COVID-19. As documented by the NCIRD of CDC (2018), the four major pandemics in the last century are:

1. 1918 Pandemic (H1N1 virus)
2. 1957-1958 Pandemic (H2N2 virus)
3. 1968 Pandemic (H3N2 virus)
4. 2009 H1N1 Pandemic (H1N1pdm09 virus)
5. 2019 COVID-19 Pandemic

To articulate our findings and provide a basis for comparison we created a list of common features and factors common to most of the pandemics. In this view the factors and features we considered as markers for comparison are; the Pandemic epicentre, the world economic nerve centre/supply chain hub as of the time, the documented economic impact of the pandemics, Pandemic Severity Index, PSI (CDC) and death, spread track, Supply Chain Structure

We, therefore, provided a comparative analysis of the economic impacts of the different pandemics and ultimately adjudged what makes the COVID-19 different. From our analysis, we highlighted the trends and from that, we made some projections, recommendations and conclusions.

III. REVIEWS

1. 1918 Pandemic (H1N1 virus)

The highly fatal influenza pandemic of 1918 - 1920 commonly referred to as “the Spanish flu” spread throughout the world infecting about a third of the world’s population and killing over 50 million people (CDC, 2018). Although researchers have differed on the actual origin of the virus responsible for the disease, its spread is also attributed to the timing around the end of the 1st world war. As allied soldiers returned to their countries of origin, they spread the outbreak along major transportation routes (Colvin & McLaughlin, 2020) from the USA through Western Europe to Eastern Europe, Asia and Africa.

Britain was a major economic and financial centre of world capitalism at the time (Cunningham, 2014) accounting for 14% of global exports (Gerd Hardach, 1981) followed closely by the United States of America, Germany and France. Global supply chain routes were not as specialised and interdependent in 1918 as they are today, and not much was documented as economic effects of the Spanish flu, probably due to the immediate global focus on World War 1 which ended in 1918. The pandemic swept across the United States of America following the track of the founding fathers and then the rail tracks, then the coasts and followed by the inlands (Garrett, 2007). These were the major paths of transportation and supply chain of goods and human resources at the time. This pattern of spread suggests a correlation in the supply chain track at the time. Then, the question is ‘*does the current spread of COVID-19 follow any similar path in the global supply chain?*’

An analysis of global trade data from the United Nations (UN, 1962) showed that the major economic centres of the world at the time had a steady growth in trade and exports until the global economic meltdown of the 1930s. Economist, Thomas Garrett (2007) noted that although the 1918 flu pandemic had a ‘short-lived’ effect on the global economy, the occurrence of a pandemic of similar scale today may have a more severe impact due to the highly mobile and connected nature of society today.

2. 1957-1958 Pandemic (H2N2 virus)

Early in 1957, cases of infections with the H2N2 influenza virus that would escalate to a pandemic were first reported in Singapore (CDC, 2018). It subsequently spread through China to all of Asia and then to the West and parts of the United Kingdom by the end of 1957 and recorded about 1.1 million deaths (CDC, 2018).

The global supply chain was still centred on America and Europe around this time with the United States leading the global exports chart in 1957 accounted for 18.6% of global exports (UN, 1962). Global trade data (UN, 1962) showed steady growth of total global exports in the years leading to 1957, with a temporary dip in 1958 before bouncing back in 1959 and 1960.

No significant economic impact is attributed to the H2N2 flu pandemic in (Henderson et al, 2009). We, however, note that global transmission occurred via land and sea routes to Europe and the USA (Pyle, 1986, Payne, 1958, Langmuir, 1961).

3. 1968 Pandemic (H3N2 virus)

The H3N2 virus was first reported in Hong Kong and went on to infect over 500,000 Hong Kong citizens (Starling, 2006). It ravaged the world spreading from Asia to the United States of America by soldiers during the Vietnam war, Australia, Europe and Africa (Rogers, 2020), and killing 1 million people worldwide (CDC, 2020). By 1969, the pandemic had ended, but this H3N2 virus resurfaces every year causing as much as 60,000 deaths yearly in the US in what has become known as the influenza season (CDC, 2018).

It was the end of the second industrial revolution and beginning of the third industrial revolution, and government investments helped US industries to remain a key global player, cementing the US’s position as the economic nerve centre of the world. Asian territories of Japan, China, Taiwan were also beginning to ramp up manufacturing sectors and were attractive due to the cheaper labour costs when compared to Europe and USA.

Post-World War 2, world leaders came together to begin the task of building a more united and prosperous world. Several trade agreements and treaties began to come in place around the world setting the stage of the more dynamic and sophisticated global supply chain system as we have it today.

4. 2009 H1N1 Pandemic (H1N1pdm09 virus)

The 2009 pandemic was caused by a new strain of the H1N1 influenza virus (Trifonov et al, 2009) that devastated the world in the 1918 pandemic. It was first identified in Mexico (Trifonov et al, 2009) and quickly spread to the United States of America and Canada, making North America the epicentre of the pandemic (Rio & Guarner, 2010). Verikios et al, 2011 notes that high volumes of international air traffic accelerated the rate of spread of this pandemic far more than previous ones, infecting 74 different countries in all six continents within five weeks.

Looking at trade exports and financial services as key components of economic nerve centres in the global supply chain. By 2009, China dominated global trade volumes (WITS, 2009), accounting for about 9% of global exports, closely followed by the United States of America which had established itself as the financial nerve centre of the world. WITS data shows a 21.7% decline in the value of global exports in 2009 compared with 2008. The top 2 export countries (China and the US) reflected a similar reduction in the dollar value of exports in the same year (WITS, 2009). At the time of the 2009 pandemic, the world was still grappling with a global economic crisis which began in 2007 (ECB, 2009).

Pandemics impact trade in affected areas and regions, in lower productivity of infected workers. Travel to and from pandemic-hit regions is also affected directly hindering trade, with indirect effects on leisure, tourism and entertainment businesses in these regions. Indeed, the much more economic impact of pandemics is seen in behavioral change as people seek to avoid infection than from mortality itself (Burns et al., 2008).

5. 2019 COVID-19 Pandemic

The first cases of the novel coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) were reported in Wuhan district of China in December 2019 (WHO, 2020). China was initially the COVID-19 pandemic epicentre for a first infection wave with 79,400 confirmed cases by the end of February 2020 (JHU, 2020). As at 2nd April 2020, over 1 million cases have been confirmed across 6 continents (JHU, 2020), and the United States of America has become the pandemic’s epicentre (Live Science, 2020).

Both China and the US have grown their share of global exports by at least 1 trillion dollars in the 10 years from 2008 - 2018 (WITS, 2020) to increase their share of global trade and relevance in the global supply chain. The COVID-19

pandemic has greatly impacted the global supply chain and trade negatively. Wuhan where the virus was first discovered, is a nerve centre in the global supply chain (Reuters, 2020) hosting manufacturing and assembly plants for major global producers. The 1st quarter of 2020 is expected by economists to record the slowest growth rate for China since the 2008 economic meltdown.

Today’s global supply chains are more dynamic because of advanced technology and globalization (Johnson, 2006, Totonchi & Manshady, 2012 and Hu & Haddud, 2017). These deeper global supply chains today translates to greater pandemic risks (Matthew, 2020). Infectious diseases today have increased economic impacts due to greater human and economic connectedness, as ‘transnational supply chains, increased travel, or ubiquitous access to communication technologies and media fuel contagion, both of the virus itself and of fear’. Countries and regions with greater economic integration to the world economy (via international trade) tend to be more greatly affected by the pandemic events. (Verikios et al, 2011). In a preliminary assessment, the World Bank had estimated a 2% decline in the world’s GDP but acknowledged this is not final as the case is still developing (Maliszewska, 2020).

Disruptions to supply chains during this pandemic will also have huge effects on nations that consume essential health commodities like medicines, APIs, medical consumables, PPEs. India’s Pharmaceuticals Export Promotion Council announced restriction of export of 26 finished pharmaceutical products and active pharmaceutical ingredients including paracetamol (Thomas, 2020). Such restrictions will have grave implications on countries who rely on them for the needed medicines.

IV. DISCUSSIONS

From the review above, we extracted some trends and patterns as markers to compare the pandemics as shown in the table below:

Trend Tracking in the Pandemics of the last 100 years and COVID-19					
Trend Markers/Pandemics	1918 Pandemic	1958 Pandemic	1968 Pandemic	2009 Pandemic	COVID-19
Pandemic Epicentre	Unclear (USA)	Singapore, China (Asia)	Hong Kong	Mexico/USA/Canada	China/USA/Italy
Economic/Supply Chain Hub	Britain	USA/Britain	USA	USA/China	China/USA
Economic/Growth Impact	~ 6% GDP (transient)	~ Insignificant direct Impact	~ Insignificant direct Impact	USA/China Growth Dip	Significant Dip 15% GDP*Forecast
Spread Track	Rail, Coast Inland (Supply Chain Track)	Unclear	War and Soldiers	International Air Travels	Supply Chain Globalization Int'l air travel
PSI*	Category 5	Category 2		Category 1	Category 5 (developing)
Supply Chain Structure	Linear Supply Chain	Linear Supply Chain	Linear/Dispersed/Distributed	Connected	Complex, Digital Networked
Death	50 million	1.1 million death	1million death		126,000 death (April 15, 2020)
*PSI=Pandemic Severity Index, a death per case index by CDC					

It is clear that the pandemics share similar epidemiologic features but with varying impacts. Pandemics could also result in acute, short-term fiscal shocks as well as longer-term damage to economic growth (Madhav et al, 2017). Our understanding from our review likewise is that pandemics impact regional and international economies by causing a drop in trade volume and discretionary spending. This ultimately impacts the national gross domestic product (GDP). Historically, these effects, however, are seen to only last for the duration of the pandemic in a form of shocks. As soon as infection rates drop due to herd immunity or the discovery of a vaccine or cure; trade and economic activity return to normal and trade volumes are relatively restored.

For example, the global GDP data (Maddison, 2010; World Bank, 2020) during the years of previous epidemics show no reduction in the world's total output in those years. In 1968 and 1969, during the years of the Hong Kong pandemic, annual global GDP grew at 6.3% and 6.1%, above the average growth rate (5.37%) for that decade (World Bank, 2020). GDP data is unreliable for 2009 Avian flu. The 1968 pandemic started in Hong Kong and world bank data shows a GDP growth of 3.398% from 1967 when Hong Kong experienced its slowest growth during that decade, and 11.343% annual GDP growth in 1969 (World Bank, 2020).

In terms of pandemic severity, analysis of available reports so far has shown that the ongoing COVID-19 pandemic is one with very high clinical severity and transmissibility, analogous to the 1918 Spanish flu pandemic (Freitas et al, 2020). In 1918, soldiers participating in World War 1 were primarily responsible for the high transmission rates of the Spanish flu across countries and continents. The spread followed major rail transportation routes to spread in the USA, and sea transportation routes mapped the spread to Africa.

The high transmissibility being witnessed with COVID-19 can be attributed to globalisation, made easier by air travel. The index cases of COVID-19 in Italy and the USA were recent air travellers for tourism and family vacation respectively (Severgnini, 2020; Holshue et al, 2020). Just about two weeks after the WHO confirmed the presence of human to human transmission (WHO, 2020), cases of COVID-19 were being reported in 19 countries (WHO, 2020).

China's position as the number one export country worldwide may have also contributed to the spread of COVID-19. A look at the top 5 export destinations from China (OEC, 2020) show all five countries announced their first cases of COVID-19 within January 2020, and the index patients had a recent history with China.

China's central position in the global trade supply chain today has become a sort of an albatross by accelerating the spread of COVID-19 disease to pandemic status. The economic implications of this pandemic can only be underestimated. Global demand for goods and services has declined across various sectors, even as supply has been disrupted due to the

virus. Global oil demand for 2020 is expected to fall by 9.3mbpd (IEA, 2020), driven largely by low air travel and economic activity in countries affected by the virus. This will be the largest decline in oil demand in the 21st century, thus putting huge strains on oil-dependent nations, like Nigeria. The impact of COVID-19 on Nigeria and other developing countries will extend beyond health to serious socioeconomic implications. The UNDP estimates income losses to exceed 220 million dollars in developing countries (UNDP, 2020).

A world bank report predicts that the world's GDP will decline by 2.1-3.86% (Maliszewska et al, 2020). Firms globally are expected to post lower first-quarter earnings. In the USA, blended quarterly earnings declined by 14.5% year-on-year for the first quarter of 2020 (Renicke, 2020).

As other nations and regions express displeasure with China over their role in the global supply chain and subsequently the COVID-19 pandemic, there are indications that the global supply chain will be increasingly decentralized. This presents an opportunity for Africa to increase its role and play dominant positions in the global supply of goods and services. Africa has a young and energetic population with low labour costs both for skilled and unskilled labour.

From our review, we also noticed an interesting pattern. The impact of COVID-19 in terms of death as compared to those of the early pandemics is relatively lower as of the count at the moment (~1 to 10 ratio). However, we noticed an inverse proportionality when we compared the same in terms of economic impact. A comparative dip of GDP to about 15% already twice the effect of the most turbulent pandemic of 1918 at 6%. We can attribute this pattern to China and the USA being both economic/global supply chain hubs and being the pandemic epicentre at the same time. This is rather peculiar to COVID-19 and was not the case in the previous pandemic. It also means a pandemic attack or any attack on the supply chain nerve-centre means potential heavy damage to the global economy and that by all means such should be prevented.

The Lessons and Recommendations

The Paradox in the Weakest Link Mantra: The old saying goes: 'a chain is as strong as its weakest link'. Same has been implied in several other situations, in strategy, supply chain, production, environment and economics (Jones, 2007, Tol & Yohe, 2007 and Hirshleifer, 1983). So, we generally here that a supply chain, system, network is only as strong as its weakest links because of general interdependencies and connectedness (James, 2011, Harvard, 2008, Reuben et al, 2007).

Following the track of pandemics in this walk, we also check to see what the weakest link mantra means in the face of the current crisis. We, therefore, asked some questions as follows. Does the mantra hold in the current COVID-19 pandemic? Could there be a meeting point to generate an abridged

theory? Could the level of invalidity in the theory mean an opportunity for the world and the global south?

Supply chain clustering, outsourcing, technology, labour and globalization has significantly evolved China as the global supply chain nerve centre as highlighted in our review (He, 2016, Miguel, 2014. According to David Lipton in his 2018 remark, China has since become the global supply chain hub with partnerships accounting for 80% of global GDP (IMF, 2018). With her partnership with over 100 countries and 80% of the share of global GDP, we could favour China as the global supply chain strongest link.

So while everything was right and the global supply chain has not been hit by a disaster, the weakest link remains an issue. However, with COVID-19 hit on China (the strongest link), the world economy has shaken in a matter of weeks and months. This means that a hit in China implies a hit on the global economy.

The lesson we are tracking, therefore, is that

1. While the weakest link mantra might remain valid, the actual determinants of the weakest link may be revisited to properly build a resilient global supply chain.
2. Clustering and Concentration of supply chain activities with all their advantages may need to be reconsidered. A distributed supply chain may be favoured in the future and a more resilient supply chain (Shamsuzzoha & Helo, 2013).
3. Good knowledge and monitoring of trade, travel routes and supply chain activities will also be of huge advantage to public health and development interventions working in pandemic preparedness and response. Since the spread of such pandemics has a strong correlation with these routes, increasing epidemiologic surveillance and controls in the global supply chain would be a way to stop or at least slow down future epidemics.

V. LIMITATION

This study only looks at the weak link in the global supply chain as China is the world's factory today and reflects on a more decentralized global supply chain in the future in which Africa can play a more robust role.

VI. CONCLUSION

The mantra that a chain is as strong as its weakest link has proven applicable in every facet of human endeavour. Centralised global supply chains have been instrumental in globalisation and China has established itself as the 'strongest link' in the chain and centre of global supply. Any disruptions in manufacturing in China will have many-fold ripple effects on other nations. The recurrent threat posed by highly infectious diseases and pandemics necessitates a restructuring of supply chains to limit the effects of a "weak link" in the global supply of goods and services. The ability of trade and

travel routes to accelerate the spread of infectious diseases to global pandemic status is established.

Countries and businesses must incorporate these lessons as they begin the arduous task of re-engineering a distributed global supply chain that is resilient.

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