UNIVERSITÀ DEGLI STUDI DI PADOVA

DIPARTIMENTO DI SCIENZE POLITICHE, GIURIDICHE
E STUDI INTERNAZIONALI

Corso di laurea Magistrale in Relazioni Internazionali e Diplomazia

The impact of pandemic crisis on Globalization and Global Value Chains: The case study of Air transportation

Relatrice: Prof. LUCIA COPPOLARO

Laureanda: FEDERICA FANT

matricola N. 1203147

Table of contents

Introduction

March 2020 marks a watershed in the global economy which has led national economies and the global economic system to face new challenges arising from the current health emergency which in the last two years has shaken the ground of the world economy threatening the global stability in a manner which has never been experimented before.

It's not the first time that the world has had to cope with the spread of a deadly virus, but the current health emergency has different features from the previous ones. One of the main differences concerns undoubtedly the scale and the scope which are unprecedented.

The ongoing pandemic crisis reminded us that the world is highly interconnected, and economies are deeply interdependent, but above all proved that on one hand, this deeply fragmented and integrated economic system can be weak in the face of large-scale crisis, and on the other hand for many aspects resilient.

The spread of Coronavirus put in evidence that the close interconnection among the countries of the world can provoke a domino effect of, both contamination and the economic consequences.

Concerns about the infection rate of Covid19 led national and local governments around the world to enact restrictive public health measures to mitigate its spread and these public health measures affected both the supply and the demand sides of the economy.

According to many authors, the pandemic speeded the processes and trends of deglobalization, marking the onset of a new economic, social and political system, but there is also a portion of scholars who considers that the health crisis simply provoked a slowdown in the globalization's processes. In this latter case, the pandemic does not entail a real collapse of the integration of the markets. At the same time, the Coronavirus crisis has highlighted the importance to adopt new policies and new strategies for all firms and companies which are engaged in to tackle the recession caused by Covid 19. Thus, while Coronavirus ricocheted around the world, governments and firms debated on costs and benefits of globalization, emphasizing the risks and the instability associated with the international fragmentation of production.

In the context of globalization, the Global Value Chains (GVCs) play and important role since they are forms of organizing economic activities which are characterized by a functional integration of activities of independent yet interconnected companies worldwide. GVCs generate significant economic gains to both participating firms and countries that host GVC activities.

In other words, GVCs have emerged as a key feature of the global economy and when the global economy is threatened either by a financial crisis, as it happened in 2008, or by an external cause which spills over into the economy, as in the case of the global health crisis in 2020, the GVC are inevitably affected. Furthermore, another aspect which is important to underline concerning the functioning of the GVCs is that despite the GVCs entail many benefits for the local economies and in general for the global economy, they also facilitated the propagation of shocks, and Covid19 crisis is an emblematic case.

In this complex and highly interconnected framework, Covid-19, especially in the first phase, undermined globalization, hitting hard every element of it (free movement of people, capital and goods) and the pandemic exacerbated the fragility of the Global Value Chains (GVCs). In a world where production chains are increasingly fragmented, a shock in one industry (or a group of industries) in one country will affect other domestic industries as well as international trade, leading to impacts on production in other countries. This has led to a debate on alternative industrial policies that can reshape GVCs in the longer run, in particular re-shoring and diversification.

Therefore, it's generally accepted that GVCs increase productivity, by allowing producers to reap the gains from their individual comparative advantage, but there is an open discussion on the effects they have on macroeconomic volatility. In this sense, some argue that the GVCs can be deemed as a "double-edge sword".

The aim of this work is to carry out an analysis about how the pandemic changed and will potentially further change the global economic order. More precisely, the research question focuses on assessing the impact of pandemic crisis on the functioning of Global Value Chains, which are the core of the current globalization. The study and the assessment of the aftermath and the impact of pandemic crisis on Global Value Chains is instrumental and functional because it provides us a comprehensive view of the role of GVCs especially during shocks which can have serious repercussions on other economies.

The core of the research is to conduct an in-depth analysis of changes in Global Value Chains as a result of Covid19 both analyzing expected changes in the behavior of firms, and from a normative point of view assessing the different arguments for policy interventions by governments.

In the last two years, the pandemic has clearly slowed down the processes of globalization and especially of the Global Value Chains and this slowdown affected not only the global production processes but also pre-production and post-distributional ones, including design, marketing and distribution. The world economy is facing a number of structural shifts that may dramatically change the outlook of GVCs in the coming years.

The first chapter will deal with the process of globalization, taking into account the previous slowdown which has begun in 2008 with the financial crisis and then in 2018 with the tariff war between China and the US.

This chapter provides us a background, explaining the already existing situation and the condition of the world economy when the pandemic crisis broke out. The existing framework before 2020 is pivotal in this analysis to better understand how the pandemic has worsened the global economy, proving in some cases the fragility of the globalization since it increased the awareness that in a context of GVCs and of strong interdependence among the economies a shock, as the Coronavirus, can hit one of the links of the chain in order that the impact become systemic.

By the same token, the second chapter focuses on the role of the GVC in the global economy through a narration of its origins and its development, describing how they work and their impact on the global economy. Moreover, this chapter describes the different value chains, that is to say, the regional and global ones, referring to the United States and East Asian model.

Since the GVCs are a remarkable and central element of globalization, the focus on the GVCs contributes to the wide and comprehensive definition of the integrated economy. This chapter allows us to have a full understanding of the functioning of the GVCs and the benefits for both companies and countries, but also the challenges and the negative aspects. Indeed, in the Global Value Chains the different economic actors are engaged in bringing a product to market, involving not only a production processes but also pre-production and post-production processes. This implies several hardships and problems especially between developed countries and developing countries.

The analysis and the study of the functioning of the GVCs is the starting point in order to be able, in the second instance, to analyze and assess the impact of the pandemic on the Global Value Chains.

Instead, the third chapter will specifically deal with the impact of the pandemic crisis on the GVCs, carrying out a comparison with the financial crisis in 2008 and its impact on the GVCs.

Furthermore, in this chapter there will be a part regarding the new strategies adopted by companies after Covid19 with the aim to prove the change occurred within companies and countries. This chapter is functional because illustrates the different trade policies adopted by governments to address GVCs' issues.

Eventually, the fourth chapter will present a case study concerning the specific sector of air transportation since the outbreak of Covid-19 in order to give further evidence of the shifts occurred in the period since 2020 until now. This last part is aimed at showing how pandemic crisis affected one of the most pivotal sectors concerning the free movement of people, which in its turn is one of the three elements of the globalization.

In this way, it will be possible to reach a conclusion on the impact of Covid19 on GVCs, which will help us to understand whether pandemic crisis and its economic and political consequences determined a temporary shift in the global economy or a structural change which will determine the establishment of a new global economic order.

In order to develop this work, the sources upon which I unfold my thesis have different nature. In particular, I've utilized reports published by international bodies which go from the most important international organizations, such as the *World Central Bank*, the *Organization for economic cooperation and development* (OECD), and the *European Central Bank,* to papers of independent nonpartisan research institution devoted to studying the challenges facing the global economy, such as *Peterson Institute for International Economics* and *Science Direct,* which is a digital platform providing access to large bibliographic database of scientific publications.

Additionally, this work has been developed on the basis of many publications of news organizations and articles concerning the role played by Covid19 in the processes of globalization written by political scientists, journalists, economists and scholars who investigated and assessed the impact and the economic consequences of global health crisis on globalization and more specifically on GVCs.

Furthermore, many Italian institutions' websites have been helpful to gather information, data and news on GVCs especially for what has been happening since March 2020. Among these many Italian organizations and institutions, we can find *Confindustria* and *the Bank of Italy.*

At the end of the work and through the study and analysis of GVCs especially during the last 2 years, it will be possible to define whether the GVCs have proven their resilience during the pandemic crisis and thus, whether they can and should be considered also as a solution to the economic, social and political crisis brought about Coronavirus rather than a weakness.

GVCs were already slowing down even before the pandemic, partly as a natural adjustment. However, the recent pandemic has disrupted the GVCs, further worsening their "slow initial decline", but the open question is whether this disruption is temporary or entails a structural change.

CHAPTER I: GVCs and Globalization before Covid-19: Which events triggered regionalization and slowdown processes?

1.1 Globalization: a continuous challenge

The term globalization is used to describe the ongoing process of greater interdependence among countries and their citizens which is political, social, technological and cultural, as well as economic. Globalization is much more than an economic phenomenon because it also has social, human, cultural and political dimensions. It deals with "*cumulative processes of worldwide expansion of trade and production, of commodity and financial markets, of the media and computer programs, of news and communication networks, of transport systems and migratory flows, of the risks generated by technologies used on a large scale, from environmental damage and epidemics, as well as from organized crime and terrorism".*[1]

If we see globalization from the perspective of people's daily lives, we can state that globalization concerns the possibility to consume the products of another country, to invest in another country, talk on the telephone to people in other countries and to know that they are being affected by economic developments in other countries.[2]

It is a phenomenon which undergoes changes, faces continuous challenges due to the political, social, cultural and economic events which affect the processes of globalization and its smooth functioning. Indeed, the world has come to know different phases of globalization, and this was caused by the remarkable success of events which hit the world over the years. These multifaceted events range from wars, economic and financial crisis, to technological developments, cultural and political changes. In other words, events which may have different nature are able to determine the pace and trends of globalization which in turn may affect the patterns in GVCs.

In the face of these events, globalization can speed up or it can change direction. This aspect highlights the changeable nature of globalization, which means that globalization is not a permanent state, but rather a fluid one, whose pace can accelerate or decelerate.

[1] A. Giddens, Le conseguenze della modernità" Bologna, (Il Mulino, 1994)
[2] S. Fisher, "Globalization: Valid concerns? (International Monetary Fund, 2000)

The debate over globalization and its challenges, especially after the broke out of Covid-19, is lively and still open because of its structural changes. The versatility and dynamics of the world economic development require a systematic study of globalization processes in order to identify future challenges and changes. Nowadays, the main challenges come from health issues triggered by Covid 19, which has halted the dynamics of globalization and has hampered for about 2 years the production processes, as well as distribution and marketing ones. However, in the last two decades, globalization has encountered many challenges which have nothing to do with health crisis or diseases as in the case of Covid19. Indeed, one of the biggest challenges that the globalization and the world economy have never tackled is undoubtedly the economic and financial crisis, broke out in 2008 in US and then ricocheted around Europe.

While the Covid19 hit the whole world without exceptions, forcing every national economy in the world to cope with travel restrictions, closing of any economic activities and so on, the 2008 economic and financial crisis shook the backbone of large part of the world, which was essential for worldwide economy, that is to say the US and consequently Europe. Economy is a large component of globalization, hence, the crash of the US economy which had a trickle-down effect on European countries, broke one of the essential links of globalization, causing a setback to it.

Additionally, among these hard challenges, the nature and number of conflicts has had several consequences on globalization in the last years. This can be explained by the fact that globalization is based on continuous increase of interactions among states and among people in the field of economy, politics and culture as well as technology. Thus, if the states have divergent interests, by adopting contrasting policies, these will become the cause of future conflicts undermining relations among countries. In other words, good and "healthy" relations among states are the assumption of the smooth functioning of globalization.

In few words, globalization is a transformation in relations between states but at the same time it is a transformation of the nature of the state itself. The states 'successful development depends on the ability to respond adequately to constantly emerging challenges. Globalization requires better policies and better multilateral cooperation, especially in times of financial turbulence, economic uncertainty and political instability.

To sum up, regardless the nature of the crisis and the challenge that stems from it the question at stake is how to re-organize economic and political relationships in the throes of a conflicts or crisis since these relations are the basis of globalization and how to prevent in future a collapse of the global financial system or a deep global recession.

Shocks are the primary triggers of change, as in the case of the major global crises: the September 11 terrorist attack in 2001, the financial crisis in 2008 and oil price spike that peaked in the same year as well as the last recent, meaning the Russian invasion of Ukraine which has caused and is still causing GVCs disruptions.

The remarkable number of challenges and risks ensued by financial turmoil, political reforms, economic slump and so on leads to the conclusion that globalization requires the construction of a more resilient international order.

In fact, resilient systems can absorb disturbance and reorganize while undergoing change, so as to retain or enhance effective function, structure and identity. The emphasis of the globalization as a process focused on resilience, has strategic implications because it requires the governments 'commitment to work towards the creation of shared operating systems for managing global risks.

The challenges facing globalization can be compared to the ship in the throes of the storm. It's the sea and the wind that dictate the speed with which the ship moves. There is no opportunity to pause and reverse direction: it's the capacity to reorganize while undergoing change that determine the success of action and the journey's outcome. First and foremost, the challenge needs a collective response since the direction of the ship depends on the combined efforts of all those on board; they cannot control the wind, but they can steer the sails.

The resilience of globalization is similar. The risks themselves, such as shocks, financial slump and political crisis dictate the pace of transition. Yet governments will only succeed in if they are able to act jointly by taking common initiative. The outcomes will be determined by the governments' alliances, as well as their cooperation with non-state actors.

In the framework of a resilient globalization, every time that governments tackle global challenges, they have to make fundamental shifts in the paradigm and analysis that underpins government's approach to global issues.

In the last 2 decades, many political and economic events have created pressures on the international system which have increased demand for more effective management of global challenges.

Globalization itself presents a paradox: on one side it has spread prosperity and strengthened cooperation and coordination, but on the other hand simultaneously has increased risk because the nature of globalization itself is complex and deeply interconnected and when a link of these interconnections breaks, the globalization is forced to adjust and find a new balance.

Furthermore, the task of boosting the resilient globalization is focused on embedding a new doctrine for managing transnational risk which has the goal of creating a framework for international cooperation in order to cope with demands of the turmoil and hard times that are likely to lie ahead.

Over the past twenty years, the most remarkable crisis and shocks which have undermined international stability, financial and economic security can be seen both as a threat and as opportunity for globalization. These challenges contribute to deliver the "broader", more comprehensive concept of collective security, which ensures the prevention of the worst global risks. Shocks are the most important triggers for change, as it has been demonstrated by the four global emergencies.

The result is that globalization has cycles which are determined by crises and shocks.

A common feature of all these crisis (pandemic emergency, financial crisis of 2008, oil crisis,) is that they forced the global economy to modify the global supply chains, marking a turning point. In this framework, states cannot take for granted that the world will continue down the road of globalization because political, cultural, religious, and economic forces play a paramount role in shaping the future of globalization. Economic progress can be considered in large part as a result of successful adaptation and adjustments to changes.

1.2.The economic and financial crisis 2008: a setback to globalization?

One of the most dramatic pages in the history of the global economy was written in 2008, when the economic and financial crisis shattered many of the most pivotal national economies, including the US and Europe which are considered two of the most important engines of worldwide economic globalization. The 2008 economic and financial crisis,

which broke out in the US and then spread to the rest of Europe, is also known as the *subprime mortgage crisis*. It's unprecedented in the history of globalization and marks a watershed in the global economy due to its contagious domino effect which overwhelmed almost all countries in a synchronized and homogeneous way.

In the international politics, there is a Keynesian economists' mainstream according to which the financial history is studded with bubbles and crisis. A theory, known as "*the theory of the financial instability*" exposed by an American economist, Hyman Minsky, holds that in the economic cycle, financial markets yield endogenous bubbles of speculative investments.[3]

This financial turmoil has raised many questions, which are still open nowadays: Was the 2008 crisis the first global recession of the 21st century or has to be considered as a more structural breakdown of globalization? Will world trade, demand and production be the same as before or has the crisis entrenched fundamental shifts?

In order to better understand and analyze the impact and the effects of the 2008-2009 economic and financial crisis on globalization, we will take into account the functioning of the Global Value Chains (GVCs) during and after the crisis. Through the lens of GVCs, which can be deemed the core of the current globalization, it will be possible to assess how the crisis has changed globalization and its impact on the global economy and global dynamics.

As it has been stated in the introduction of this work, GVCs encompass the full range of activities that are necessary to bring a good or service from conception through the different phases of production, such as provision of raw materials, producer services, the input of various components, subassemblies to delivery to final consumers.[4]

The causes of financial crisis are complex. One of them was the excessive debt burden of Western, and especially US, households, in the last decade. The crisis was triggered by the proliferation of the mortgage loans, the so-called subprime loans granted to low-income household. The crisis had been brewing for months and on August 9, 2007, when the American Home Mortgage Investment Co. announced its incapacity to meet its financial obligations concerning funds guaranteed by subprime mortgages, and seven days later it declared bankruptcy.

[3] H.p. Minsky, The financial Instability Hypothesis, (Levy Economics Institute, 1992)
[4] O. Cattaneo, G,Gereffi, C. Staritz, Global Value Chains in a Postcrisis World, a development perspective, (World Bank, 2010)

Therefore, the economic meltdown started with the bursting of the Us housing bubble in 2007 but had quickly a domino effect on the rest of the world through financial and trade channels. The remarkable succession of events started in 2007 which affected the world economy leads to the conclusion that this downturn has clearly been the first global recession of the 21st century which can be compared to the 1930s Great Depression. The scope and the impact of this recession on the globalization suggest that this crisis is first and foremost a "crisis of globalization".

Indeed, the core of the recent wave of globalization has been the financial system rather than trade, and the financial turmoil started in 2007 has triggered the globalization slowdown. However, at the same time the financial crisis proved the resilience of the GVCs, which have become the enduring structural feature of the world economy.[5]

According to many scholars, such as Olivier Cattaneo and Gary Gereffi, instead of reversing globalization, the crisis has accelerated two long- term trends in the global economy: the consolidation of the GVCs and the growing salience of markets in the South.[6]

The main feature, which is at the same time the leading difference with the other relevant crisis happened before 2008, is that the 2008 financial recession did not remain regional in scope, as it happened in Asia in 1997, but spread to the large part of the world, including Europe. Thus, the crisis soon became global due to the globalized nature of financial markets.[7]

According to the Development Report "*Global Value Chains in a postcrisis world"* published by the World Bank, the different crisis that overwhelmed the world and global economy confirmed the theory according to which globalization, economic and financial ties are a double-edge sword: on one hand they can help ease domestic and regional shocks, but on the other hand increase exposure to external shocks. The economic crisis underscored the fundamental role played by GVCs since they are the trade channel which facilitates the transmission of the economic crisis. Indeed, the current business models rely on global production and trade networks.

---

[5] *Ibidem*

[6] V. De Marchi, Catene globali del valore come canale per uscire dalla crisi: alcuni spunti di riflessione, (Siepi, 2020)

[7] O. Cattaneo, G,Gereffi, C. Staritz, Global Value Chains in a Postcrisis World, a development perspective, (World Bank, 2010)

The GVCs introduce new microeconomic dimensions to the traditional macroeconomic mechanisms used to understand the transmission of economic shocks. Furthermore, GVCs explain the overreaction of international trade to the financial crisis. Because of GVCs, adverse shocks affect firms and companies in different ways, that is to say, not only through the sales of finished goods, but also through fluctuations in the supply and demand of intermediate goods via forward and backward linkages in GVCs. Therefore, the ratio of global imports and exports per unit of output has been raised by the globalization of production.

In the Development Report whose title is "*Global Value Chains in a postcrisis world"* recent surveys conducted by Lindenberg confirm the role of GVCs in the Great Trade collapse. The magnitude and the speed of adjustment have increased as GVCs have become a larger channel for financial and economic shocks.

Even though financial globalization has yielded many benefits over the past 20 years, the major malfunctions have been emerged with the breakout of the financial shocks, putting in evidence their weaknesses. The question that is still open is whether the 2008 financial crisis is the first truly global crisis and if globalization is responsible for this crisis, contributing to the breakout and to the propagation of the global financial crisis. The main causes of the crisis are distortions at the level of global regulation and not the globalized markets. Financial globalization amplified the impact of underlying distortions, such as inadequate regulation of credit markets. Globalization process was not undertaken in a sufficiently balanced manner.

The global financial crisis represented an important testing ground for the financial globalization. In this framework, the opposite and contrasting experiences of emerging and advanced economies during the global crisis have some ties with the very different modes of engagement with financial globalization during the pre-crisis period.[8]

The performance of global value chains during trade collapse provides a comprehensive assessment of the impact of the 2008 economic and financial crisis.

To begin with, we will distinguish between firm-level transactions among two alternative organizational modes of GVCs: internalization of activities (intra-group trade/ trade among related parties) or establishment of supply contracts (arm's length trade/ trade

[8] P. R. Lane, Financial globalisation and the crisis. (Centre for Economic and Policy Research,2012)

among unrelated parties). Data underscored that intra-group trade in intermediates was characterized by a faster drop followed by a faster recovery than arm's length trade.[9]

One of the most striking features of the 2008 global financial crisis is the "Great Trade collapse" which has had severe consequences for the worldwide economies.

Empirical studies suggest that trade flows dramatically decreased, and this drop has been very fast, severe as well as synchronized across all countries. Additionally, the fall in trade has been homogeneous across all countries since data demonstrated that more than 90% of OECD countries have suffered a decline in exports and imports exceeding 10%.The trade drop, triggered by financial meltdown, is considered unique due to such features with respect to the other trade declines related to previous economic crises. The drop in trade during the crisis because of its nature has been defined "severe, sudden, and synchronized" by many scholars, including Baldwin and Evenett.[10]

Moreover, a series of transmission mechanisms has played a pivotal role which can explain the unique features of the Economic and financial crisis. The most important transmission mechanism is the increased presence of vertical specialization, which basically happens when goods are produced in two or more sequential stages and when at least one stage of production consists of reliance on imported inputs and some part of that production is exported. This means that when US was hit by negative financial shock which triggered a declined in its output, this output decline resulted in an income reduction in income for households as well as firms. Firms, in turn, reduced their spending and part of this reduction is on imports. This had serious implications for countries that export to the US, which as a consequence of the reduced exports experienced a decline in their output. Thus, trade decline affected both US and its trading partners.[11]

In few words, in this framework, the emergence over the last decade of global supply chains and the compositional effects of the demand shock entailed by vertical linkages on trade have to be taken into account.

The GVCs are the key element which allow us to explain the magnitude of the trade collapse. From the diversified organizational modes of the supply chain stemmed

[9] C.Altomonte, F. Di Mauro, G. Ottaviano, A. Rungi, V.Vicard; Global Value Chains during the great trade collapse; a bullwhip effect? (European Central Bank, Eurosystem, 2012)

[10] R. Baldwin, S. Evenett, The collapse of global trade, murky protectionism, and the crisis: reccomendations for the G20, (Centre for Economic and policy Research, 2009)

[11] *Ibidem*

different dynamic responses. More precisely, related-party trade in intermediates was characterized by a faster drop followed by a faster rebound with respect to arm's length trade in intermediates. This means that trade developed within multinational groups has reacted faster to the negative demand shocks and has also recovered faster than arm's length trade.[12]

As it has been proved, the GVCs and their transmission mechanism contribute to the propagation of the crisis since in a world increasingly characterized by vertical specialization when the crisis hit one of the links of the chain, the impact is felt by all countries engaged in the stages. Since goods are produced sequentially in stages across countries, the same component of final good is exchange several times before the final product reaches the consumer. Therefore, consequently to the given reduction in income, trade declines "not only by the value of the finished product, but also by the value of all intermediate trade flows that went into creating it". [13]

During the crisis a greater observed variation in demand was felt by each participant to a supply chain and the initial negative shocks propagated up to the value chain.

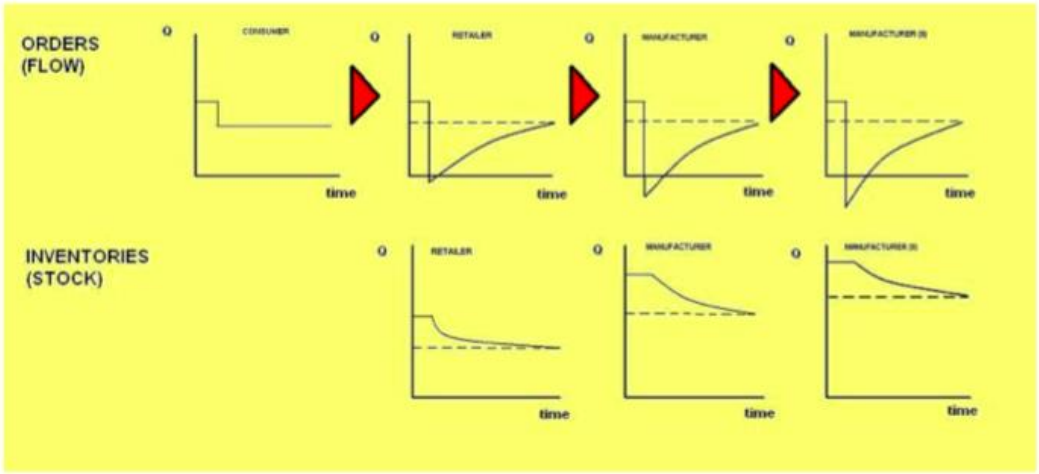
In other words, the wider fluctuations in terms of trade elasticities are an overreaction due to the adjustments in the stocks of intermediate inputs by firms involved in complex supply chains. This theory known as "bullwhip effect", was coined by Forrester and is represented in the figure 1.1. The explanation that lies behind is that in the face of the volatility of the final demand, businesses typically tackle forecast errors, and in order to cope with them they build safety stocks of inventories. Indeed, the inherent adjustment in inventories that occurred after a demand shock is a second channel which relates the scope and the synchronization of the trade drop. Greater demand volatility is experimented by upstream participants than downstream ones, thus, the more you move up the value chain, the more there will be need for such stocks. In other words, the more you move away from the final customer, the more fluctuations in final demand are amplified. With falling demand, orders decreased more than proportionally since firms succeeded in drawing on inventories after expectations of lower future demand. Firms participating in value chains

[12] C. Altomonte, F.Di Mauro. G.Ottaviano, A.Rungi, V. Vicard, Global Value Chains during the Great Trade collapse: a bullwhip effect? (European Central Bank, Eurosystem ,2019)

[13] *Ibidem*

reduced their stocks more than proportionally as the shock propagated up the value chain.[14]

Figure 1.1: The bullwhip effect triggered by negative demand shock



Source: European Central Bank, C. Almonte et al. 2012

The following part dedicated to the analysis of the bullwhip effect is grounded on the paper "*Global Value Chains during the Great Trade collapse: a bullwhip effect*?" and explains the link between trade collapse and recovery. Dynamics of value chains depend on their organizational mode: trade of intermediates among related parties experimented a faster drop at the outburst of the crisis, but at the same time reacted with a faster recovery thereafter. The explanation concerns the fact that in the face of negative demand shock, verticalized multinational groups were able to adjust faster.

The origin of the Great Trade collapse has been the huge demand shocks. When the bubble burst in 2008, commodity prices tumbled. Supply chains reacted to demand shock by carrying out adjustments in inventories by single firms engaged in complex buyer-supplier relationship. In time of crisis, as in our case concerning the 2008 meltdown, firms reduced stocks with the aim of adjusting for new expectations about future demand.

In addition, the reaction and the impact of trade collapse depended on the 3 broad categories of products: consumption goods, intermediates and capital goods. Considering that trade in intermediate goods and capital goods relies on firm- to firm relationship,

[14] *Ibidem*

while consumption goods are directed to final consumers, the first two categories tended to react much more than the latter. The magnitude of the drop in total trade volumes is undoubtedly the outcome of the negative growth rates of both intermediates and capital goods which are originated by the emergence of Global Value Chains, which in turn have a higher weight on the overall export and import trends. When firms faced falling profits and uncertain demand, they have to reduce production capacity, waiting for better future times.

The decision that a single firm can take is to relocate part of the production abroad by establishing affiliates or by licensing an unaffiliated supplier outside its own boundary of economic activity.

In the literature, there are contrasting findings. According to many scholars and economists, such as Cattaneo and Kaplinsky it's possible to observe that after the crisis, trade originated by value chains shifted substantially towards emerging economies. On the contrary, according to studies presented by the European Central Bank there is no evidence that trade originated by value chains shifted towards emerging economies and that the involvement of Brazil, Russia, India and China, the so-called BRICS, took place before the outbreak of the crisis, whereas it stops afterwards with negative growth rates. However, the China's case is an exception. Indeed, the crisis did not hamper arm's length trade which instead recorded + 0,1%.

Figure 1.2: Organizational modes and trade collapse, monthly growth rates year-on-year basis (2007-2009)

	arm's length		intra-firm	
	pre-crisis	post-crisis	pre-crisis	post-crisis
OECD	4.08	-16.54	5.73	-16.16
emerging economies	7.78	-11.77	9.57	-13.34
EU-27	6.05	-18.29	7.25	-15.15
EU-15	6.19	-16.61	2.68	-16.99
New EU members	5.9	-20.25	12.98	-12.83
NAFTA	2.8	-13.17	5.46	-13.20
United States	0.12	-7.00	-1.37	-11.98
Canada	6.53	-20.06	6.78	-0.83
BRIC	15.11	-12.20	17.4	-24.65
China	13.34	0.09	11.31	-5.67
Brazil	16.23	-17.94	14.53	-25.25
India	14.49	-13.58	23.5	-26.50
Russia	16.35	-17.38	20.26	-41.17
ASEAN	0.33	-11.34	27.9	-8.70
Africa	8.81	-2.83	10.85	-6.64
Middle East	9.53	-6.58	2.03	-3.41
South America	2.88	-4.07	3.89	-15.21

Source: European Central Bank, C. Altomonte et al, 2012

In its analysis, for instance, the ECB used the case of France and noticed that during the crisis, import and export growth rates recorded respectively a1.3n average of -4% and -6%, whereas intermediates averages are -32% and – 30%.

The main question is whether trade performance due to the participation to value chains has had some important implications for the scope of the crisis, especially for the trade drop. The second goal is to identify if the two modes of organization of inter-firm linkages are characterized by different resilience during the crisis, for both imports and exports. Data confirms that trade flows within multinational groups during the period that goes from 2008 to 2009 are prone to be more resilient than those undertaken by independent firms.

The overreaction at the beginning of the period, followed by a faster recovery, is particularly evident for verticalized multinational groups vs. arm's length trade. This is the evidence of the different and faster response of value chains organized by multinational groups because it's likely that the internationalization of activities within the boundary of a group allows for a better management of information flows that come from the bottom of the value chain. In this way, production and inventories can be more swiftly adjusted to demand shocks.

GVCs rapidly transmitted real and financial shocks, amplifying consequently the national fluctuations of demand for final goods. According to many economists, including Baldwin, the input-output linkages in GVCs directly triggered the synchrony of the collapse in world trade.

The questions arising are the follow: How did firms operating inside the value chains react? Were firm's individual characteristics and strategies relevant determinants of their resilience? Did they play a fundamental role during the crisis, given their position in the value chain?

In order to give further evidence, this work exploited French, German and Italian cases, since these economies are the core and the engine of European economy.

In the last part we have utilized French case, but at this point we will rely on data from the EFIGE survey concentrating on German and Italian case. The EFIGE dataset chose these countries because they are both industrialized countries and leaders in Europe manufacturing export. Moreover, their industrial firms are fully involved in and affected by globalization. Another aspect which is particularly relevant concerns the fact that a large portion of firms, especially in Italian case, work exclusively as intermediate firms. This element is a key factor because it helps us explain the heterogeneous resilience to the crisis.

First, in the history of globalization, the 2008-09 crisis is a very interesting case. As it has been stated initially, it originated from the US financial crisis of the summer 2007 and therefore can be considered exogenous to the German and Italian economic and financial conditions. In two years, German and Italian GDP drop by 4 and 7 per cent. From the firm's strategic decision point of view the crisis can be considered a severe "stress test", because in a little amount of time it required the capacity to react and adjust to such conditions.[15]

Unlike developing countries which are deeply characterized by the intermediate firms which prevail, in advanced economies final and intermediate firms coexist. Baldwin holds that this has some implications: one of them is that they tend to become either a "headquarters or a "factory economy". During a great economic shock, as in our case, it's possible to identify a country's best specialization under extreme economic conditions.

[15] A. Accetturo, A. Giunta, Questioni di Economia e Finanza, "Value chains and the great recession: evidence from Italian and German firms ; Questioni di economia e finanza" N. 304 (Banca d'Italia, 2016)

The analysis of micro dynamics at firm-level is an important tool to assess firm's strategies and their ability to cope with a major macroeconomic shock. At the same time this tool is useful from a policy maker's point of view.[16]

1.3 Firms in GVCs and the Great Recession

During the crisis, trade declined quite homogeneously across all countries; a drop in export and imports exceeding 10 per cent overwhelmed more than 90% of OECD countries. Deep and marked declines in both industrial production and merchandise trade severely affected European Union, which experimented a trickle- down effect. The GVCs are the main source of propagation of the global downturn but in this paragraph, we will try to explain why and how the transmission mechanisms work.

There are many theories which tried to explain the transmission mechanisms and the role of firms in the GVCs. Among these theories, Freund and Cheung and Guichard hold that the response is that the share of intermediate products in international trade has greatly increased over the last decades. The leading idea is that vertical specialization and links among firms led to a sharper reduction in intermediate demand.[17]

However, this is not the only argument. Indeed, in literature there is a slightly different point of view which singles out the cascading effect of disruption along the supply chain. The origin of aggregate fluctuations can be traced back to any shocks taking place at a specific unit operating along the chain. Given the firm's interconnectedness, the disruption will cascade down to firms, generating a severe impact on the aggregate behavior. Furthermore, there is another likely channel of transmission, which instead is based on the inventory adjustments firms devise to tackle demand reduction. In response to a reduction in final demand, final firms decreased orders across GVC firms. The inventory adjustment mechanism is comparable to some extent to the well-known bullwhip effect. Nevertheless, on one hand many scholars agree that inventory adjustments along GVCs contributed to the great trade drop, but on the other hand do not

[16] *Ibidem*

[17] C. Altomonte, F.Di Mauro, G.Ottaviano, A. Rungi, V. Vicard, Global Value Chains during the Great Trade Collapse,A bullwhip effect? (European Central Bank, Eurosystem 2012)

completely share the view on the role played by the "inventory effect", claiming that many other factors might have been relevant.[18]

The questions raising from the GVCs' role as transmission mechanism concern the types of firms which are most vulnerable to downturn and thus, that were hardest hit by the crisis. More in detail the questions are the following: to what extent did their position in the GVC, intermediate or final and their individual features, as size, strategies, imports, human capital and so on, was determinant in their performance during the crisis? Unfortunately, the only data upon which we can rely on are those produced by Altomonte et Al. (2012) in the working paper n. 1412 entitled *"Global Value Chains during the great trade collapse: a bullwhip effect?*" This data based on firm level analysis is the best fit for the analysis of the bullwhip effect caused by 2008 GFC and it will be used in the following part. Their major contribution relies on the introduction of modes of organization of inter-firm linkages, which are a key factor for in explaining firm's different levels of resilience during the crisis. Through their analysis they detect two organizational forms which have been previously explained: the first is typical of the multinational firms that entails trade among related parties and the second where the buyer and the supplier trade at arm's length.

The conclusion reached by the authors of the paper was that firms whose trade originated within "hierarchies of firms" reacted faster to a negative demand shock and recovered faster in the following period than the second case.

While Altomonte et Al took the case of France, other authors chose German and Italian case. A common feature of the last two countries is that they have a similar production structure: family-owned German firms represent almost 90 per cent of total firm. Both countries are heavily involved in GVCs, and this is confirmed by the participation index. The data regarding Italy's participation index value in 2009 was slightly lower than Germany's. The survey utilized in this case contains data which was collected within EFIGE project. The sample includes about 3000 firms from France, Germany, Italy and Spain.

Before assessing the transmission mechanisms of GVCs and their functioning, the first necessary step is to identify two variables by using firm-level dataset elaborated by Antonio Accetturo and Anna Giunta who in their analysis on GVCs as a transmission

[18] *Ibidem*

mechanism during the 2008 downturn, proxied the participation in a value chain with two variables. The first variable indicates whether a firm participates in a value chains as a supplier. The data utilized by Accetturo and Giunta regards sales of produced- to order goods as a share of total turnover, which has been called with the acronym SPTO (share of produced- to order). These strategies based on produced to order goods allow customers to purchase products that are specific to their needs. The version of SPTO is discretized which is a dummy variable equal to one in the case of a fully intermediate firm.[19]

In addition, the EFIGE data has also the goal of detecting whether the main customers of the produced- to order reside within the national borders or abroad. This difference clearly underscores the fact that in the first case the firm is part of a national value chain, whereas in the second the firm participate in a GVC. The implications arising from this difference and this categorization are that the firms adopt different strategies and have different features according to their participation in the national or global value chain. On the contrary, the second variable qualifies firm participation in a GVC as a purchaser. In this case, it will be used a dummy equal to one if we are dealing with a firm which buys customized intermediate goods abroad (customized purchases of intermediaries, known as CPI), meaning components which are exclusively directed to the firm.[20]

In the face of the crisis, sales dramatically fell. Nevertheless, the standard deviation is enough high, thus reflecting a large heterogeneity in firm performance. Data proves that more than three-fourths of a firm's sales consist of customized intermediate goods to other firms. The portion of fully intermediate firms is equally split between those with national main customers (INT-DMC) and foreign main customers (INT- FMC). On the contrary, only a small portion of firms (5,6 per cent) purchases customized intermediaries (CPI). This information is a signal of the fact that the actual number of firms in a downstream position is very limited in the dataset. A small share of intermediate firms (4,8%) is also engaged in the purchase of specialized intermediate goods (INT&CPI): in this case we are dealing with a group of intermediate companies (INT) that according to dataset, successfully developed their own supply chain.[21]

---

[19] A.Accetturo, A.Giunta, "Value chains and the great recession:evidence from Italian and German firms;Questioni di Economia e Finanza, N.304 (Banca d'Italia,Eurosistema, 2016)

[20] *Ibidem*

[21] *Ibidem*

The tools that we have used so far contain dataset regarding Italian and German firms. As a reference group, we consider firms that do not buy customized intermediaries and do not sell produced to order goods. These firms are labelled as "generic firms". The share of fully intermediate firms is lower in Germany (35%) than Italy (60%). Whereas, in Germany CPI or INT&CPI firms are more common, thus reflecting that German firms are able to organize their own value chains. Furthermore, they are located more downstream on the value chains. This analysis is grounded on the occasional paper "*Value Chains and the Great Recession: evidence from Italian and German firms"* published by Bank of Italy and allows us to assess the impact of 2008 GFC on GVCs through firms' lens. In order to carry out this assessment, Bank of Italy has utilized some tools, including EFIGE dataset.

In 2008-2009 intermediate firms reported a larger decrease in total sales compared with generic companies. On the contrary, firms that purchase specialized intermediate goods (CPI) and firms that are both INT and CPI are larger and their performance in this period was somewhat comparable with the reference group.

However, the set of fully intermediate firms is not homogeneous and despite this heterogeneity, during the crisis their performance was instead quite similar.

The conclusion that EFIGE dataset has confirmed that during the crisis intermediate firms experienced a more dramatic fall in sales.

In order to have a comprehensive view of firm performance during the crisis, it is interesting and useful to consider the relationship between firm performance and its positioning in GVCs.

The results of many studies carried out by Bank of Italy developed in the paper "*Value Chains and Great recession: evidence from Italian and German firms*" proved that being intermediate is related to a negative performance during the crisis. Conversely, for what concerns CPI and INT&CPI perspective, firms engaged in the purchase of customized intermediaries (in a downstream position in a GVC) managed to limit the fall in sales during the crisis.

Additionally, group affiliation which has been added as one of the firm-level controls is relevant in the face of the crisis. Among the other firm-level controls, we also find the share of total and imported intermediaries may affect the downstream status of the firm. What is emerged is a process of mean reversion. On the contrary, in larger firms the drop

in sales during the crisis was eased. For instance, during the crisis in Italian industry, which is characterized by small and intermediate firms the performance was very badly.
In conclusion, GVCs have been one of the main transmission mechanisms of the Great trade collapse that shook all OECD countries in 2009. Within each country, intermediate firms are smaller than final firms and their strategies are less ambitious in terms of human capital accumulation and innovation. Moreover, intermediate firms with foreign main customers tend to be generally much larger and more innovative that intermediate companies mostly involved in national value chains.
Recent studies have shown that the 2008 economic downturn hit firms in GVCs asymmetrically. Whereas intermediate firms experienced a more severe contraction of sales, firms in a more downstream position were hit by a less severe turnover reduction. The scale and the magnitude of the reduction for intermediate firm was similar for both domestic and international suppliers.[22]
In the years immediately after the global financial crisis, the expansion of GVCs dramatically slowed. Despite the slowdown, the 2008 financial crisis did not result in a significant change in the network topology in 2009. This can be explained by the fact that the structure of global production networks expressed by the topology of country-to-country relationships is resilient. Indeed, one of the most remarkable consequence of the 2008 economic recession has been the reinforcement of Global value chains (within some countries and in chief of some firms) with the strengthening of major global buyers. Another important aftermath of the 2008 financial turmoil has been the change in the geography of production and consumption, which has led China to be one of the main final markets, as well as the biggest global factory. The 2008 financial crisis has resulted in the regionalization and the GVCs shortening, further exacerbated by trade war between China and US. The regionalization and the retrenchment of GVCs consist of transferring production processes closer to consumers.[23]

[22] A.Accetturo, A.Giunta, "Value chains and the great recession:evidence from Italian and German firms;Questioni di Economia e Finanza, N.304 (Banca d'Italia,Eurosistema, 2016)
[23] CRI online, Tra la globalizzazione e la collaborazione, (Cri online Italiano, 2019)

1.4 Globalization and GVCs: the Tariff war between US and China

Ten years after the outbreak of the 2008 economic and financial crisis, the global trade system has been racked by another dramatic event which involved two of the most important global economies: China and United States. Since the beginning of 2018, the US has implemented several measures aimed at limiting trade with its partners, in particular China. Trump administration adopted an offensive unilateralism consisting of waves of sanctions in the form of tariff increases, directly addressed at targeting and damaging China.

The GVCs were seriously affected by the US- Sino trade war which had serious repercussions on the global economy and impacted global trade system already weakened by 2008 economic and financial crisis. The major economies suffered most from US-SINO trade war were European ones. The tariff barriers damage trade partners including those exempt from duties because they distort trade flows and disrupt global value chains. Scholars, economists and politicians agree on the fact that trade war hurts not only the targeted country, which in this case is China, but also the country imposing the tariff.

In this framework, the GVCs are a key factor and play a fundamental role since they prompt countries to decrease tariffs when the domestic content of foreign– produced final goods and the imported content of domestic production of final goods are high. As it has been stated, tariffs have an indirect effect on third sectors and countries through global value chains. Moreover, tariffs fueled retaliation, which in turn causes high trade tensions at the global level. Global value chains determine the shape of trade policies and have an impact on trade protection as well as on its effects. The reasoning is based on the fact that GVC linkages can alter countries' incentives to impose import protection. Secondly, tariffs should be decreasing in the domestic content of foreign- produced final goods and in the imported content of domestic production of final goods. In order to have a comprehensive view of the condition of globalization and of the GVCs before the spread of Coronavirus, it's necessary and useful to assess the implications of the rounds of tariff hikes implemented by the US and Chinese governments on Global Value Chains. One of the major effects of the tariff war between China and US was that whereas US integration within GVCs contracts, China increases its participation as a seller to global networks. Moreover, in response to US contraction, the European countries strengthened their linkages with the US and European regional integration deepened as a consequence of

the tariff war between the US and China. The 2018 tariff war, which can be deemed as one of the biggest trade wars in economic history, led to the increase in trade barriers between key players, which in turn brought about a domino effect on the global trade system. This increase in trade barriers had repercussions that go well beyond their national borders.[24]

The main question is how the GVCs beard the burden of trade tariff since global production is increasingly organized within GVCs and trade in intermediates is a relevant feature of global trade shaping countries backward and forward linkages within global production networks. While with the term "forward linkages" we refer to a country's value-added exports that are not absorbed in the final demand of that country's direct trade partners but are further exported to third markets, the term "forward linkages" instead refers to the foreign content used to produce a country's exports.[25]

According to the paper *"Evaluating the impact of the US-China trade war on euro area economies: a tale of Global Value Chains*" the link between the GVCs and the effects of tariff war on them can be explained by the fact that the international exchanges of intermediates and services are required to produce final goods and increased tariffs on imports can negatively affect domestic producers' competitiveness in international markets given that they reduce access to the most efficient inputs, also impacting domestic firms exporting intermediate inputs processed abroad and then imported back. Furthermore, tariffs faced in the destination market have ripple effects on the production activities that are linked to the GVCs, spanned across different countries. Since the size of US and Chinese economy is remarkable, trade measures impacted the countries directly interconnected with them and thus, affected suppliers of intermediate goods and services wherever they are located.

The analysis and the assessment in our case is based on Computable General Equilibrium (CGE) modelling used in the paper "*Evaluating the impact of the US-China trade war on euro area economies: a tale of Global Value Chains"* which will be utilized in this part of the chapter as it allows us to understand. Recent studies focused on the optimal US bilateral tariffs imposed on the main target partners and partners' optimal response. The result was relatively modest optimal US tariff rates vis-à-vis China. The optimal tariffs

[24] I.Fusacchia,Evaluating the impact of the US-China trade war on euro area economies: a tale of Global Value Chains, (Roma Tre University and Rossi-Doria Centre for Economic and Social Research,2019)
[25] Ibidem

could be lower once supply chains linkages are taken into account. The studies carried out by Blanchard et Al. prove that when foreign content in domestic goods is high, some of the benefits of protection are passed back up the supply chain to foreign suppliers, thus lowering optimal tariffs. Once production linkages and intermediate goods are taken into account, the optimal tariff may in fact be negative.

The effects of US tariffs can be summed up in 3 main arguments. First and foremost, when scale economies and variety effects are considered the welfare cost for the global economy is higher. In addition, tariff hikes yielded a reallocation among sectors. Yet sectoral gains are small, to the detriment of other sectors and mostly offset by retaliation. Finally, there may be economic benefits for other regions through trade diversification.

By focusing on the effects of the bilateral trade war on a third country Bolt et Al. show that EU for instance, gets access to cheaper imports from China since they are diverted from the US and gains improved competitiveness in the US in response to tariffs imposed on Chinese products. GVC-related effects concern the variation in the output which is required to produce traded goods wherever the production of each ring within the chain takes place, in addition to standard trade diversion effects. In other words, countries that are not directly affected by the tariff's imposition may intensify trade with belligerent countries.

In our analysis we utilize a model by incorporating trade in intermediate goods with the aim of observing GVCs and assessing the impact of tariff changes on globalization and on key systematic sector of the economy. The approach utilized which is based on CGE incorporates a decomposition of trade in Value added (VA) metrics. In this way it will be feasible to observe indirect effects due to GVCs through the identification of countries which create the value that is embodied in US-China trade flows.

The tool utilized in this model consists of integrating the VA decomposition of gross bilateral trade into a CGE model. In the CGE framework, and by incorporating trade in VA decomposition in this model, we can observe all the implications that the tariff war may have on the complex set of general equilibrium interdependencies between countries and sectors. According to this model which uses intermediate trade as a rough proxy for GVCs, the US-China trade tensions spread through the global economy, notably among Canadian, Mexican and other Asian economies, which either are part of the global supply chain affected by the tariffs or give close substitutes to Chinese and US exports. By the

same token, we consider the effects of the US tariffs on the reallocation of assembly processes away from the US and China. The conclusion is that whereas North America and East Asian value chains have been negatively affected by the US and retaliatory tariffs, EU for instance, attracted some trade related to value chains.

In a situation of a bilateral tariff war, considering that bilateral trade between the 2 belligerent economies becomes costly, more value would be exported multilaterally through other countries in the global trade system whose trade costs have not undergone variations.

The increased costs of trading between US and China result in restructuring effects on regional and global value chains. The aftermath is the contraction in the backward integration into GVCs of both the US and China. In other words, it means that the cost of importing intermediate inputs, as a consequence of the increased import tariffs, force belligerent countries to rely more on domestic providers, lowering the import content of their export. Additionally, the tariff war between China and US inevitably brought about a disruption of trade between these 2 countries which in turn had repercussions on their demand for foreign inputs impacting suppliers of intermediates.

This sort of return to protectionism characterized by the increase of tariff took place in a world where Global Value chains are the core of the trade system. In this sense fragmented production should discourage tariffs on imports of final goods embarking previously exported domestic value added, and on imports of intermediate goods entering into the domestic production process. Indeed, the tariffs have a direct impact on the targeted products and countries but also GVCs generate further effects. Chinese retaliation affects US exports of final and intermediate goods. In addition, US exports undergo a loss of competitiveness on all markets, including national one and the reasoning depends on the increases of production costs in industries which use taxed imported goods as inputs. According to many studies carried out in the last 4 years the induced drop in US exports is equivalent to a 2% tariff imposed on US exports. Likewise, restricting Chinese exports to the US market that contain previously exported US intermediate inputs undermines the US value added.[26]

[26] I.Fusacchia,Evaluating the impact of the US-China trade war on euro area economies: a tale of Global Value Chains, (Roma Tre University and Rossi-Doria Centre for Economic and Social Research,2019)

As it has been stated previously, tariffs hurt the targeted country, but also the country that imposes them. This means that China loses but the US as well, whereas the effects of this US-Sino trade war have been slightly favorable to many European economies, such as Germany, Italy and France. One of the main conclusions is that in the long run United States and China could undergo GDP losses by 0.41% and by 0.59% respectively and these aggregated effects are the aftermath of vertical linkages along the value chains. Moreover, data show that 20 out of 26 US sectors decreased their value added.[27]

The modelling of General equilibrium used in this analysis is highly useful since it distinguishes demand of goods according to their use, for final or intermediate consumption, meaning representing GVCs. This tool shows that firms interact either in a monopolistic competition or in a perfect competition context (a representative firm by sector and region charges the marginal cost).

Trade consists of two different structures, one for final consumption and one for trade in intermediates. This double structure accounts for GVCs.

The effects of trade war on GVCs and on globalization are measured in terms of deviation from a dynamic baseline which uses a ten-year perspective with the aim of capturing the dynamic adjustments of the economies. In other words, the aim is to illustrate how the involvement of belligerents in GVCs shaped the adjustment of sectors and potentially led to value added and thus, income losses.

It's unquestionable that tariff war drastically reduced bilateral trade between the main actors involved in the conflict, that is to say China and US, leading to a reorientation of exports which in turn triggered a decrease in world trade by -0.96% and world GDP by -0,11%. Trade war has had some aggregate impacts and among these we can find the decrease of US exports equivalent to 7.88% as a consequence of sanctions. Yet, there is another one which is directly linked to the role of the GVCs, the competitiveness, as the cost of imported intermediate inputs increase translates into increases in producer prices.[28]

This last part of the chapter has been unfolded by gathering many data from the Report entitled "*Shooting Oneself in the foot? Trade war and Global Value Chains"* which give strong evidence to the effects of Chinese retaliation From China's perspective, overall

[27] *Ibidem*

[28] C.Bellora, L. Fontagnè "Shooting Oneself in the foot? Trade war and Global Value Chains " (CEPII, 2019)

Chinese exports were hit by a – 4.23% decrease, which it implies that China managed to offset reduced access to the US market, by readdressing exports, although be it at the expense of reduced producer prices. Chinese exports to the US suffered a -50.4% drop which was counterbalanced by reorienting its exports towards Canada (+13.1) and Mexico (+12.2%).

If we consider the outlook of other countries, for instance Canada and Mexico, we notice that the presence of GVCs introduces a potential additional benefit for them. Indeed, data show that production is reallocated in assembly lines located in these two countries.

On the contrary, US exports to China recorded a -38.2% decrease, but whereas Chinese counterparts managed to offset their losses on other markets, US exporters do not compensate these losses by trying to reorient its exports. The reason consists of the retaliation by certain destination countries. In other words, US exporters lost ground on all markets in the world. Indeed, the amount of their losses is equivalent to -4.2% in Korea and Japan and to – 5.5% in Germany.[29]

The sector of Electronics is an emblematic case; indeed, Chinese exports to the US market concerning this sector experimented a sharp decrease equivalent to – 57.1%.

Furthermore, the situation was even worse for intermediate products targeted by US sanctions which suffered a -71.9 % drop. Unlikely, Mexican market was an exception which proved resilient with 7.4% in total, driven by a +11.7% increase in exports of intermediate products and ASEAN market (+0.3% overall and +2.8% in intermediate products).The disruption of GVCs was the cause of the loss of ground undergone by Chinese exporters. Instead, for what concerns car industry and chemistry, Chinese exports drop to the US is also important, (-53.5%) but this loss was counterbalanced by a reorientation of exports to other markets. Going further, an increase of the production costs was suffered by producers located in the US, because of sanctions aimed at affecting intermediate consumptions produced by other sectors.[30]

The impact of trade war on GVCs can be distinguished in 2 sections: trade in final goods versus trade in intermediate products. What emerges from these data is a massive cut in US imports of intermediate inputs, parts and components from China equivalent to –61%.

[29] C..Bellora, L. Fontagnè "Shooting Oneself in the foot? Trade war and Global Value Chains " (CEPII, 2019)

[30] *Ibidem*

An almost equivalent value of imports of final goods disappeared but this represents only -43% of US imports of final goods from China.

The difference is the effect triggered by the attempt of the US to disrupt GVCs while limiting the direct cost of the trade war which is beard by US consumers.[31]

On the contrary, the cut of Chinese imports from the US which were drastically reduced as a consequence of the war, was much more limited and most of it was intermediate products. In this kind of situations, a trade war, an economic and financial downturn or a pandemic crisis, reorganizing value chains is not so easy.

Now we have to assess how the producer prices react to three main mechanisms of the trade war, that is to say, the increase in the price of intermediate inputs, the drop in demand on export markets due to retaliations and the reduced competition in the US market brought about by border protection. Retaliations hit hard farm products which reacted to reduced market access by producer prices cuts. The US trade was seriously affected by this chain of events. Chinese retaliation affected the agricultural sector, indeed, in this field the producer prices drop by –3.5%. Instead, from the Electronics, iron, steel and chemistry sector's perspective, the net effect of the three mechanisms consisted of an increase in the producer price, giving that these sectors were most protected by tariffs. The data suggests that these sectors respectively recorded an increase equivalent +1.4%, +1.1% and + 0.8%, which in turn provoked a domino effect on automotive (1.2%), Metal products (+ 1%), and other manufacturing (0.6%).[32]

From Chinese perspective, whereas producer prices increased in sectors which gained benefits from Chinese retaliation (Oilseeds +1.2%), in other sectors Chinese producers were forced to reduce their production prices, for instance machinery -1.2%, chemistry -1.2% and Electronics -0.9%. Due to this reduction, Chinese trade deteriorated. These adjustments led to a change in terms of value added. In other words, US recorded a -13.2% drop in the value added in the Oilseeds sector and a – 7.7% drop in the value added of the Fiber crops sector. On the other hand, Iron and steel experimented a +9.4% increase in their value added due to the protection granted by article 232 (of the Trade Expansion Act of 1962). Another sector which was positively affected was the Electronics one which recorded a +7.3% in its value added as well as Metal products and machinery, even if in

[31] *Ibidem*

[32] C.Bellora, L. Fontagnè "Shooting Oneself in the foot? Trade war and Global Value Chains " (CEPII, 2019)

the latter ones the increase was more modest (respectively +3.6 and +1.9%). These sectors reduced their exports and the assessment that emerges is that domestic market is protected enough to pass the increase in production costs to the final consumer.[33]

All these data, including the following ones, have been collecting by using the paper entitled "*Shooting Oneself in the foot? Trade war and Global Value Chains*" which provides us remarkable evidence of the effects of US-China trade war on GVCs. In this context, it is interesting to observe that car industry is a peculiar case since it combines increased costs for steel and aluminum, increased costs on components imported from China and lastly Chinese retaliations on final products.

In terms of value added, Chinese electronics sectors was most affected, whose drop was -9.9%. Metal products and machinery too were affected (-1.7% and -1.3%).

On the other side, sectors which obtained benefits from the retaliation enjoyed an increase in their value added, as in the case of Oilseeds which recorded a +11.7% and Fiber crops +7.9%.

One of the main conclusions is that trade war fails to create value. This is also confirmed by the fact that in the electronics sector, the Chinese value added recorded a 9.9% decrease and on the other hand, US gained 7.3%. This industry recorded a massive destruction of value. The US automotive industry was seriously hit by loss of competitiveness on all markets as a direct impact of the increase in its production costs, caused by higher prices for steel and Chinese car components. Chinese retaliation affected US in Oilseeds, indeed, US value added drop by – 13.2%; Chemistry too dropped in value added which was hit by a – 2.4%.

In few words, when trade in intermediate goods is hit, directly or indirectly by sanctions and retaliations, the economic impact is transmitted throughout the value chains. Nowadays, GVCs are pivotal for trade and a trade war damages all belligerents, as also the imposing country can be hurt by its own policy because domestic components are present in imported final products, or because foreign components enter as inputs in the production of exported products. The imposed sanctions and retaliations reshape the sectoral value added of belligerents.

The direct effect of retaliation and tariffs increase the cost of imported intermediate consumption, bringing about the reduction of competitiveness of the imposing country'

[33] *Ibidem*

exports. Moreover, tariffs on components and parts also increase the final consumer price of final goods. By the same token, tariffs imposed on final goods hamper export of value added of the domestically produced components contained in these imports. A trade war protects certain industries, or retaliated effectively, but this is detrimental for the entire economy since GVCs are ubiquitous in most of its sectors. In conclusion, such policies adopted by US and China have created economic consequences disrupting global value chains.

GVCs development reduces the incentives to apply trade protection. According to recent studies, tariffs and trade protection are applied less when GVC linkages are strongest, especially vis-a vis China. GVCs linkages are threatened by the application of antidumping on intermediate goods. Many studies in 2018 find that for instance, Indian firms that were forced to pay Antidumping duties to import key inputs, cut back in production. Regardless of political economy adopted by a state, higher tariffs lower the world price of the good in question, which in turn reduce profits and hurt domestic upstream production. Goods and components that are traded within firm- boundaries led Domestic value added (DVA) growth rates at higher degree than those that are traded at arm's length.[34]

The relationship between GVCs and trade protection is based on an FDI/offshoring argument, whereby a country would be loath to restrict imports that include substantial DVA. Indeed, these dynamics show that increased vertical FDI and intrafirm trade caused lower demands for AD protection by US companies.[35]

GVC trade, which is the expression of the "made in the world" global production revolution, is measured as a rise in the trade in value-added sub-components relative to gross trade.

As it has been stated previously, since the rise of GVC trade has reshaped the economic and political consequences of trade protection, trade wars are particularly expensive and divisive in the GVC era.

The first conclusion is that if on one hand GVCs discourage the imposition of tariffs, on the other hand they amplify the effects of the tariffs given that every border crossing increases the total tariff bill associated with production since tariffs are applied to the

[34] C.P. Bown, A. Erbahar, M.Zanardi, "Global Value Chains and the the removal of Trade Protection" (Peterson institute for International Economics, 2020)

[35] *Ibidem*

gross value of a good when it crosses the border. This implies that in a system based on GVCs the costs of higher tariffs, especially in a trade war is greater than in an otherwise equivalent world without it. However, the leading implications is that higher tariffs and trade war drive firms to shorten or reshape their global supply chains.

Furthermore, GVCs system means that the burden of tariffs is distributed differently among consumers, workers and firms involved throughout the value chain.

Yet, upstream producers in the country imposing tariffs may bear a share of the costs of trade protection, whereas import-competing firms which enjoyed some of the producer-side benefits from trade protection may passed them along to foreign interests.

The most important implication for our analysis is that trade war and tariffs may have large, long-lasting and unanticipated consequences for the pattern of global production because GVC structure is the outcome of foreign investment decision of globally engaged firms. Indeed, trade war and rising tariffs led firms to change how and where products are made in the world. Higher tariffs trigger the production dislocation, besides prompting firms to consolidate their global supply networks into fewer countries, border crossing and therefore vulnerabilities. Nonetheless, the firms' choice to consolidate their production depends on many factors such as proximity to expected consumers, but also to raw materials, critical inputs suppliers, local economic regulations access to skilled and low-cost labor.

The 2018 trade war with the imposition of tariffs was not only aimed at hurting Chinese counterpart but also at inducing producers to re-shore production in the US. Global firms depend on these GVC linkages, also because they are very important for the potential escalating costs of trade wars.

Changes in trade costs affect the extent to which various countries participate in domestic, regional or global value chains. For instance, one of the events triggered by trade war between China and US is that many American firms were encouraged to look for an alternative, by leaving China and transferring production processes within national boundaries or outside China. These firms are constraint to re-organize themselves through reconfiguration plans concerning the different economic activities. The relocation is not an easy process and entails a series of considerations such as skills, low-cost labor, proxity and so on.

As a consequence of the trade war and tariffs, China has built a manufacturing base which has no rivals throughout the world in terms of length of Global Value Chains.

However, in many cases for some firms is impossible to displace the production outside Chinese boundaries since this entails a loss of profits, which in turn leads to the sharp reduction of supply chain. Developing the breadth of GVCs is a process which requires a medium-long term project and therefore many firms could remain without immediate alternatives to Chinese products.

The trade war, especially whether two big and important economies are directly involved, is a serious threat to the global economy, which is already weakened by the 2008 economic and financial crisis. This remarkable succession of events, from the 2008 economic and financial crisis to the trade war, drives the global economy toward a separation of Global Value Chains.

From Chinese outlook, the trade war has speeded up a Chinese partial brake on international markets, leading China to bring a share of international production processes only for what concerns little strategic phasis and with little creation of value added. At the same time, in more traditional sector where it was losing competitiveness, it has built regional production chains for instance toward Vietnam and East Asia.

The last conclusion of our analysis consists of the fact that losses are divided among the different components of the GVC. If on one side, the tariff barriers hurt downstream industries due to the increase in the prices of intermediate goods imported from other areas of the world, on the other side, upstream domestic firms suffer from a loss due to the increase in the prices of components assembled in foreign countries. In the medium term, tariff hikes can dampen the economic activity of industries which are dependent on foreign inputs.[36]

To sum up, countries' participation in global production networks has been affected by the disruption of trade between the US and China, but trade war acted as a restructuring force for regional and global value chains. The kind of linkages countries have, determines the extent to which increased bilateral tariffs impact countries' GVC integration. As increased import tariffs raise the cost of importing intermediate inputs, both the US and China are encouraged to rely more on domestic providers and to substitute for imports from other providers.

[36] P. Meinen, "The effects of tariff hikes in a world of global value chains" (European Central Bank, 2019)

Since China is the main provider of foreign intermediate inputs for US firms, the effect is particularly strong for the US. Therefore, US integration in GVCs contracts. China and US are not the only actors involved in this framework, since also European countries are important players in GVC- related trade with the US and China.

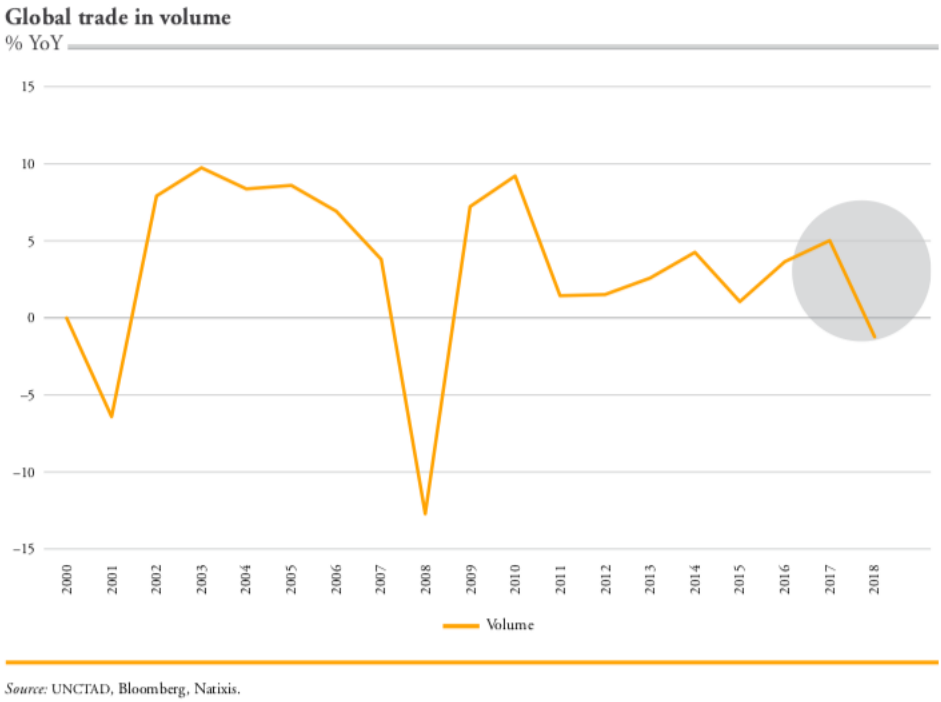
Trade in complex products organized in GVCs has been more sensitive to global downturns than has trade in simple products which do not require the different stages of production throughout the world. In this sense, trade in simpler products is more resilient to global downturns.

1.5 Globalization after 2008 economic and financial crisis and trade war between China and US: a setback

Globalization process has halted since the global financial crisis. Despite the increase in trade volume which grew by an average of 3.5% from 2009 to 2018, this growth is much slower than the 7.6% average growth before the 2008 financial crisis, meaning that trade did not grow at rates similar to those previous to the slowdown.[37]

Figure 1.2: Growth of trade volume (2000-2018)

[37] A.Garcia Herrero, From globalization to deglobalization: zooming into trade, (Bruegel, 2019)



Source: UNCTAD, Bloomberg, Natixis, 2019

In addition, now the trade volume records a zero-growth rate, and this is understandable on the back of US-China trade war which implied a series of several protectionist waves, such as the US with Europe as well as between Japan and Korea. By the same token, cross-border capital flows have also declined especially foreign direct investment (FDI). In 2018 the growth rate of FDI recorded a drop of -28% as the aftermath of the escalation of trade tensions.[38]

For what concerns people movement, globalization was still on the go after 2018, and this is demonstrated by the fact that the number of international migrants has been rising, meaning that movements of labor remained actively increasing. However, a slight sign of increasing restrictions is seeable, since migrant and visitor numbers in the world experienced a slower growth.

The more and more hostile relation between the two largest economies, notably US and China is a key aspect. This is explained by the fact that trade war between China and US added additional deglobalization forces. With the imposition of tariffs, the US has been moving away from the current global status quo. Indeed, the introduction of the tariffs by the US proves that the US wanted to change global trade flows. Rounds of conflicts and

[38] Ibidem

attempts to negotiate raptured global supply chain over and over again. The Sino-US trade war has been an additional event for deglobalization forces in the field of trade. This has been proved by the decline in global trade both in value and volume in 2018 followed by relevant disruptions of the global supply chain. In other words, another push towards the trend of deglobalization has been caused by the distortion of global trade and capital flows, as well as massive reshoring away from China. There seems to be an embryonic move towards financial decoupling due to geopolitical trends.[39]

Yet, this deglobalization process started in 2008 with the economic and financial crisis and this trend was exacerbated by US-Sino trade war. The evidence of this trend with a consequent trade volume is that the growth- rate trade has been halved with ana average annual growth- rate of 3.5%. [40]

Another aspect which has not been considered so far is that trade war with the imposition of tariffs provoked a sharp reduction of job occupation.

It's a common idea that the raising of tariff barriers initiated by Donald Trump in 2018 has been considered as the "killing of globalization". The growing trade unbalance brought about by trade distortion led to the "halt" the current picture of globalization. When the largest international market for consumer goods closes to the largest producer of finished products and intermediate goods, the aftermath is the beginning of a progressive closure of all national markets. This reminds us the series of protectionist measure started by US with the outbreak of 2008 financial crisis.

In this analysis it has emerged that American firms, whose activities were dislocated across the world, had to cope with many troubles, arising from the imposition of tariffs and the consequently trade war.

In the last 14 years, with the occurrence of these two remarkable events, globalization process has been shaping. The set of ongoing changes had determined a slowdown of globalization, or as many economists state it would be better to say a deglobalization process. This trend is ongoing since 2008, when the financial and economic crisis destroyed the American mechanism which beard the America economy based on the growing influx of capital from all other countries.

[39] *Ibidem*
[40] *Ibidem*

US has been the center of world economy for many decades before 2008, but in the last 14 years, its role has been modified also with the emergence of another key actor, China. The two models differ as they correspond to different phases in the evolution of the economies. In other words, Chinese model is based on exports beard by an efficient productive system while American one relies on domestic consumptions fueled by imports, giving more importance to services than production. The long expansive cycle which has characterized Wall Strett has been running out for 9 years, without China being able to aspire to replace US as the locomotive of global development.

The future developments should be determined by the assessment that the main firms will do about their involvement in the current GVCs, considering also the possibility to redefine them in a more advantageous way at the time of the outbreak of the crisis.

Before the spread of Covid-19, the GVCs were experimented a phase of slowdown. This process is known as *slowbalisation,* (a merge between the term slow and globalization). The 2008 crisis contributed to the consolidation of these processes, provoking a significant brake of globalization. The analysis of 2008 recession and 2018 trade war led to the conclusion that participation in the GVCs leads to a more vulnerability to such crisis. Yet, at the same time, firms interacting with global firms, especially if they play a role of strategic suppliers, are particularly performant. This last statement especially concerns medium-sized firms that have been able to build relationships with global lead firms and have kept connections with production capacities of local territories, for which membership in the GVC has represented a "shield effect in previous crises.[41]

The pandemic emergency, which has become an economic and social crisis triggered by Covid-19, broke out during a particular phase for world economy.

[41] M. Battisti et al, Politica Economica; traiettorie europee, sfide per l'Italia, (Confindustria, 2020)

CHAPTER II: Global Value Chains: How do they work?

2.1 The role of the GVCs in the global economy

The changing nature of globalization has determined deep shifts in the international trade increasingly characterized by a high level of interdependence among countries, in large part due to the emergence of the Global Value Chains which are made up of leader firms, their subsidiaries and numerous independents which supply goods and services. This change allows firms to set networks of production with other firms located where it's possible to exploit the comparative advantages in the production of intermediaries. The new organization of production resulted in the growth in international trade of intermediaries.

Nowadays, a large share of foreign investments is addressed to intertwining with the production of goods included in GVCs.

The new globalization is more sudden and less manageable since is more and more driven by transmission mechanisms and computational capacity.[42] In the recent wave of globalization, GVCs have become a dominant feature of world trade encompassing developing, emerging and developed countries. The GVCs are the form of organization of the international production, trade and investment consisting of the different stages of production processes which are located across different countries. This means that GVCs design products in one country, procure parts and components from several countries and assemble the final products in yet another country.

A global value chain is a series of stages in the production of a product or service for sale to consumers. This definition of a GVC is associated with either international trade in raw materials (aluminum for instance), in intermediate inputs (as in the case of car parts) or in tasks (such as back-office services). The fragmentation of production across borders leads to a finer division of labor, as well as greater gains from specialization. The advantages of GVCs stem from the fact that within GVCs resource are allowed to flow to their most productive use, not only across countries and sectors but also within sectors across stages of production.[43]

[42] D. Bevere, Torino, Analisi dell'interesse economico nazionale, (Analytical for intelligence and security studies, 2020)

[43] World Bank Group, World Development Report 2020: Trading for Development in the Age of Global Value Chains, (World Bank 2020).

The new form of production privileges transnational organizational models which are controlled by leading firms. The leading firm has the power to decide the division of the value chain and the role will be assigned to each firm. The coordination mechanisms among the firms put in evidence different networks which depend on the combination of the 3 factors: the complexity of transactions, their codifiability and the suppliers' proficiency. According to the combination of these factors there are several types of chains based on the level of governance.[44]

The first type is known as modular chains and allows the producer to elaborate more varieties of a product. In this case, the suppliers produce on the basis of technical specifications of customers and by doing so the suppliers take the responsibility concerning the technology management and the productive equipment.

Instead, the relational chain works differently. The production process requires complex machinery, and this brings about the fact that transactions are based on technical specifications for the activities and thus the contracting parties become mutually dependent. In this way firms can get access to know how which is held by suppliers. The high costs of coordination trigger a strong dependence between the customer and the supplier.

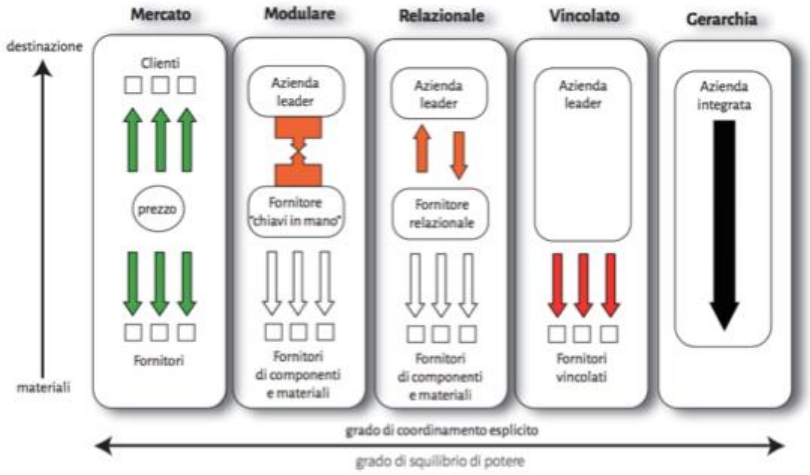
In addition, the third type of chains are the so-called captive since the suppliers is constrained due to its dependence on a big customer. These chains are characterized by high degree of control from the leader firm.

Another chain is Market-type and in this case the production of a specific product does not need a specific investment in production machinery. This implies that both customers and suppliers have a very wide range of choices. Furthermore, in this case there is no high level of control.

The last type of chain is the hierarchical which concerns the relations within a vertically integrated firm, such as corporations.

[44] Gereffy, Sturgeon, Humphrey. "The governance of global value chains", (Review of International Political economy,2005) , 12/1 (2005),pp. 78-104

Figure 2.1: Different type of GVCs governance



Source: Analytica for intelligence and security studies; D. Bevere, 2020

In today's global economy more than half of the international trade (about 70% precisely) involves GVCs as services, raw materials, parts and components cross borders often numerous times.[45] Exports from one country to another require complex interactions among different domestic and foreign suppliers. Trade in the context of GVCs is defined by strategic decisions of firms to outsource, invest and carry out activities wherever there is availability of necessary skills and materials at competitive cost and quality.

In the recent wave of globalization coordination and management of the stages of production became easier and faster because of the new technologies and this improvement broke ties that kept all the phases of production at a single location.

Whereas in the past the power of the state was based on its territorial expansion and military power, now its strategic importance stems from its level of connectivity, meaning its participation to the great flows of resources, capital and assets of high value. The countries' participation in GVCs entails the possibility to reap benefits that stem from these linkages and interconnections, but countries have to address their own barriers to trade.

[45] OECD, Global Value Chains and trade; The trade policy implications of global value chains, (OECD, 2020).

The advantages coming from engaging in the global value chains are available for all countries at all levels of development, and therefore they can be shared if all countries enhance social and environmental protection. GVCs connect firms and states in the global economy and more connectivity produces more growth and more flows.[46]

GVCs expanded quickly from 1990 to 2007 due to the technological advances in communications, transportation and technology. Another factor which contributed to the expansion of GVCs was the reduction of trade barriers which drove manufacturers to extend production processes beyond national borders. At macroeconomic level, the functioning of GVCs is also linked to the institutions and to the relations which reflect ethnic inequalities. In political terms, it means that the economic advantages which affect the development of GVCs are actively shaped by the firms involved which in turn benefit from free market.

Furthermore, geopolitical conflicts and uncertainties can to some extent affect the trend of GVCs. Indeed, as we have seen in the previous chapter, trade and GVC growth have slowed due to the 2008 economic crisis and the tariff war with the increase in protection affected the evolution of GVCs leading to a retrenchment or a segmentation of GVCs.[47] This leads to the conclusion that it can no longer be taken for granted that trade will remain a force of prosperity. The international fragmentation of production is a continuous process which has led to the creation of increasingly complex GVCs.

GVCs entail structural reforms in developing countries shifting people from less productive activities into more productive manufacturing and services activities.[48] Another peculiar aspect of GVCs lies in the fact that they tend to reduce poverty given that they boost income and employment growth. In general, trade reduces poverty primarily through growth and provided that gains in economic growth from GVCs tend to be larger than from trade in final products, poverty reduction from GVCs is greater than that from standard trade.For instance, Mexico and Vietnam which are characterized by intensive GVC participation reduced their poverty rate. [49]

[46] D.Bevere , Catene globali del valore e interesse nazionale, (Analytical for intelligence and security studies, 2020)

[47] A.Tooze, Lo schianto 2008-2018: Come un decennio di crisi economica ha cambiato il mondo. 1st ed. Milano (2018)

[48] World Bank Group; World Development Report 2020: Trading for Development in the Age of Global Value Chains (World Bank, 2020).

[49] Ibidem

The difference between GVCs trade and standard trade depends on the fact that transactions in the traditional trade involve only 2 countries (an exporting and importing country), whereas GVCs trade crosses borders multiple times. Furthermore, the two main features of GVCs trade that make the difference between the latter and traditional trade which amounts to 30% of total trade are hyper-specialization and durable firm- to firm relationships.[50] GVCs trade better promote and support growth and poverty reduction than traditional trade by virtue of the two aspects.

However, GVCs can imply also harmful effects on the environment which are associated with the growing, more distant trade in intermediate goods compared with standard trade. Despite the risks created by GVCs, new technologies of both production and distribution such as automation and digital platform tend to enhance trade and GVCs, and the evidence lies in the fact that these technologies have increased productivity and have contributed to larger scale of production.[51]

The fuel and the engine of the recent wave of globalization has been falling trade costs due to technological developments, including containerization and policy reforms.

The countries' participation in the global value chains can occur in different ways. For instance, many states such as Argentina, Indonesia and Ethiopia operate in simple manufacturing production chains while other states like Chile and Nigeria export commodities or raw material for further processing. In addition, other states such as United States and India are engaged in producing services that are being increasingly traded and embodied in manufactured goods. In the three trade hubs, meaning East Asia, Europe, and North America, GVCs linkages have expanded fastest because these regions account for a large share of production in the sectors whose production processes have become the most fragmented across countries.

Countries participate in GVCs in different ways which allow us to distinguish 4 different types of participation: commodities, limited manufacturing, advanced manufacturing and services and innovative activities. It's possible to detect clear distinctions among regions; indeed, East Asia, Europe, and North America are engaged in advanced manufacturing

[50] World Bank Group. Trading for Development in the age of Global Value Chains, World Development Report 2020. (World Bank, 2020)

[51] Ibidem

and services GVCs and innovative GVC activities, while Latin America, Central Asia and Africa mostly operate in commodities and limited manufacturing GVCs.

For what concerns advanced countries, small open economies tended to record the highest participation. Between 1990 and 2015 China, Poland and South Africa intensified their activities and recorded a rapid growth in GVCs participation. In addition, South Africa shifted from commodities to limited manufacturing whereas Poland and China moved from limited manufacturing towards advanced manufacturing and services.[52]

In the context of GVCs the definition of backward and forward participation is essential for the comprehensive understanding of GVCs mechanisms. With the term backward participation, we refer to the ratio of foreign value- added content of exports to the economy's total gross exports. This is the "buyer perspective or sourcing side in GVCs, where an economy imports intermediates to produce its exports. Instead, the term of "forward participation" refers to the ration of the domestic value added sent to third economies to the economy's total gross exports". This definition captures the domestic value added contained in inputs sent to third economies for further processing and export through supply chains.[53]

In general countries specialized in commodities are characterized by a lowest backward integration, and the backward integration begins to expand for countries in the limited manufacturing group. Countries in the innovative group are characterized by a slightly lower backward participation because their activities are less dependent on imported inputs. Participation in limited manufacturing lowers forward integration since commodities are less important in trade and at this stage manufacturing output is less likely to be used as inputs in destination countries.[54]

Between 1990 and 2015 GVC participation worldwide grew about 7 percentage points. There are 2 possible reasons for this growth: the first is that in many countries fragmentation took place in the production processes and this phenomenon is known as intensification effect, while the second is related to the fact that countries and sectors that

[52] P. Antràs,and A. De Gortari, "On the Geography of Global Value Chains". NBER Working paper 23456, (National Bureau of Economic Research, 2017)
[53] A. Borin and M. Mancini. Input-output database. (World Bank, 2019)
[54] World Bank Group, Trading for Development in the age of Global Value Chains, World Development Report 2020

were already GVC-intensive boosted their share of world trade. In the latter case we refer to a scale effect.[55]

Among countries which contributed to the GVC intensification we find Germany, US, Japan, Italy and France which began using more imported inputs in their exports. Services represent an essential part of GVCs since transportation, financial services and telecommunications allow and contribute to the geographic dispersion of production in all sectors. Service production is itself being fragmented across countries. In many countries, such as France, Germany, Italy, United Kingdom and the United States more than half of the total value added embodied in exports comes from services. Even in China, which is traditionally considered as an exporter of manufacturers, services contribute more than a third of the value added in its exports. It is firms, not countries or industries that participate in international trade since firms are the main actors in GVCs. The reasoning is simple: trade directly involves firms, not countries or industries.[56]

Moreover, in all countries, trade is highly concentrated in a small share of large firms that both import and export. Indeed, firms that are importers and exporters, have a dominant role in GVC participation. For instance, 41% of trading firms in China, 22% in Mexico and 32% in South Africa both import and export. An important element is that all three are characterized by a large GVC participation.[57] The expansion of GVCs does not only ensue a finer division of labor but it also implies other additional elements and four of them are particularly pivotal: making relationship-specific investment, matching buyer and seller, living with limited contractual security, and exchanging intangibles.[58]

In the context of GVCs, matching buyers and sellers has to do with the fixed costs of exporting and importing which are associated with the costs of finding suitable suppliers of parts and components or suitable buyers of a seller's products. In this sense, these fixed costs contribute to create "sticky" buyer-seller relations, or in other words a "stickiness" among GVC participants. Given the high interdependence among GVC participants, they often make relationship-specific investments (as in the case of the purchase of specialized

[55] Ibidem
[56] World Bank Group. Trading for Development in the age of Global Value Chains, World Development Report 2020.
[57] *Ibidem*
[58] A. Wyckoff, K. Ash, M.Durand, D. Pilat, K.De Backer, N. Ahmad, S. Miroudot, D. Rouzet, M. Gestrin, N. Yashiro, Interconnected economies: benefiting from Global value Chains, (Organization for Economic Cooperation and Development, 2013)

equipment or customization of products) and so if the GVC linkages were broken they would get a much lower return. This is explained by the fact that in the face of an increase in the demand for its goods, a firm cannot easily scale up by buying more foreign inputs from some centralized market. Normally, only some suppliers worldwide can be providers of the additional customized inputs to scale up.

Additionally, another feature of GVCs concerns the flows of intangibles. Firms in GVCs do not trade only tangible goods with other members of their value chains but they often exchange intangibles such as technology, credit and intellectual property. However, the exchange of these intangibles is much more complex than that of simple goods.

Many transactions within these chains require a strong legal environment to bind producers together but GVCs do not ensure the creation of this strong legal environment, because cross-borders exchanges of goods cannot be regulated by the same contractual safeguards that instead are typical in the case of exchanges within borders. The aftermath is that in order to ensure implicit contract enforcement, GVC participants must have repeated interactions.[59]

Several multinational enterprises which control many value chains have their production organized across different locations. Their organization of production may depend on proximity to new customers and therefore this reduces the costs of trade. In this case it deals with a market- seeking investment. In other cases, instead, it's a matter of taking advantage of lower costs of factors of production and thus, we refer to efficiency-seeking investment. Even if both types of investments have facilitated the international dispersion of production, the efficiency-seeking investment has been especially important for GVC growth.[60]

2.2 GVCs and drivers of participation

The following part is grounded on the Report published by World Bank Group entitled "*Trading for Development in the Age of Global Value Chains*" which is instrumental to understand which factors determine GVCs participation. The participation in the GVCs is determined by many factors, notably market size, institutions, factor endowments and

[59] World Bank Group, Trading for Development in the Age of Global Value Chains, World Development Report 2020, (World Bank, 2020)

[60] *Ibidem*

geography. These fundamentals alone are not sufficient to ensure a country's participation within GVCs because an important role is also played by the right policies adopted by governments. Indeed, choosing the right policies can shape each one of these fundamentals and thus GVC participation. In this sense, trade policy can be a tool able to overcome the constraints of a small domestic market. Indeed, liberalizing trade at home and negotiating trade liberalization abroad can succeed in freeing firms and farms from dependence on limited local inputs and narrow domestic demand. Furthermore, in order to reduce the disadvantage of a remote location, improving transport and communication infrastructure could be a useful solution. Another tool which is addressed at improving domestic institutions can be the participation in deep trade agreements that encompass policy areas beyond traditional trade policy.

Factor endowments matter. Backward participation in GVCs requires low-skilled labor and foreign capital. In addition, the goal of integrating in more complex GVCs entails the need to upgrade skills. An abundance of natural resources drives forward GVC integration. Foreign capital can enhance host country integration in GVCs which is deeply associated with backward GVC participation.

Moreover, geography is a remarkable fundamental which affects GVC participation. Indeed, longer geographical distances to the major GVC hubs, namely China, Germany and US, negatively affect both backward and forward participation. The solution should be to overcome remoteness by enhancing connectivity which in turn could promote GVC participation. However, on the other hand longer distances increase a country's likelihood of specializing in commodity GVCs. High transport costs hinder entering, establishing and upgrading in GVCs. Inefficient transport and logistics services worsen the costs in many manufacturing GVCs. Trade in parts and components within GVCs relies on efficient logistics performance and certainty in bilateral international transport times. The aim of improving connectivity, necessary to overcome remoteness, requires effective communication among the participants in GVCs.

Institutional quality matters. The quality of contractual institutions has an impact on GVCs since the growth in GVC participation also depends on better institutional quality especially in the case of sectors relying more on contract enforcement. The institutional quality can be enhanced by entering deep preferential trade agreements, which in turn increases GVC participation.

In addition, market size is central driver of participation. Trade liberalization can be a useful tool to expand market size and promote participation in GVCs. Lower tariffs on manufacturing goods foster backward GVC participation in manufacturing.

The first of these drivers that we will analyze is factor endowments. According to traditional trade theory, factor endowments determine the specialization in GVCs, as well as shaping the positioning of countries in GVCs. There is a link between the abundance of natural resources in a country and high forward GVC integration because agricultural products and commodities are used in different downstream production processes that typically cross several borders. It has been confirmed the positive link between backward integration and low-skilled labor endowments. The evidence based on 87 countries, proves that lower wages facilitate participation in the final assembly stages of GVCs. Yet, labor costs could rise with a country's continued involvement in and upgrading of GVCs. Through a firm-level analysis it has been demonstrated the association between the higher skill intensity of a workforce and higher wages on one side, and the likelihood of being a GVC firm on the other side.

Different types of workers are necessary for different types of involvement in GVCs and the employee cost, especially in countries with innovative GVC activities such as Japan, United States and Germany, reflects their higher skill intensity and productivity. The cross-country analysis suggests the existence of a positive correlation between skills and integration in innovative GVCs. The growth in GVC participation is faster in sectors which use skilled labor more intensively.

Forward GVC participation is also linked to the higher relative endowments of land or natural resources. This means that countries which have plenty of extractive resources tend to record higher shares of domestic value added embodied in their partner's countries exports downstream.

Another solution to increase GVC participation is provided by higher capital endowments which not only boost GVC integration but also GVC upgrading. Indeed, Eora database suggests that GVC participation in capital-intensive sectors is hindered by relative scarcity of capital. Basically, FDI inflows play a strong role in the extent of backward GVC participation shares and level because FDI inflows can spur GVC integration by solving the issue of relative capital scarcity. FDI is also associated with lower forward GVC participation shares driven by GVC integration of agriculture and services.

Attracting FDI in manufacturing may have the effect of reducing exports of raw agricultural goods and intermediate services embodied in exports of resource-intensive goods, thus lowering country's forward GVC participation. FDI create linkages of sectors and firms which can further deepen countries' participation in GVCs and these linkages between FDI and GVC participation makes them difficult to disentangle their determinants. [61]

Large economies such as United States, China, and Japan record lower backward participation in manufacturing as a percentage of total exports. Since larger countries are characterized by larger industrial capacity, they prefer specializing in contiguous stages of production, thus reducing the use of imported inputs relative to domestically sourced inputs in their exports. Furthermore, large countries tend to be geographically close to consumers of final goods so their more central location should make them more prone to specialize in downstream stages of production embodying more foreign value added. In case of production disruptions, this facilitates the replacement of domestic suppliers. Larger forward GVC participation and smaller backward GVC participation characterize markets with larger manufacturing sectors.

Geography is another important driver of GVC participation. In this context, proximity to the hubs in the global trade networks has a remarkable relevance especially given that instead of being global, many value chains are regional. For instance, Vietnam's proximity to its regional suppliers of electronics inputs, has contributed to its GVC participation. Proximity is pivotal especially for those sectors which require high transportation costs. The automotive sector gives us clear evidence since it relies heavily on fairly short regional value chains for 3 main reasons. The components used in the automotive sectors such as car seats, engines are heavy, bulky and can be easily damage. These aspects increase transportation costs. Just- in-time production and high product variety often require that subcomponents be produced near final assembly. High trade costs are determined also by inefficient infrastructure and delays in clearing customs. Additionally, the cost of supply chain disruptions is particularly high when firms cannot rely on alternative suppliers. Trade delays caused by inefficient connectivity hampers relational GVCs which instead requires coordination and just-in-time delivery. Remote

[61] World Bank Group, Trading for Development in the Age of Global Value Chains, World Development Report 2020, (World Bank, 2020)

location and inadequate air connectivity can damage cooperation and interactions among the several agents operating in the chain.[62]

Eora database has also proved that longer geographical distances play a negative role for GVC participation especially in the manufacturing sector. The longer geographical distances to the GVC hubs in China, US, and Germany, led to an increase of specialization in commodities. On the contrary, the proximity to GVC hubs increase country's likelihood to participate in limited manufacturing GVCs. Geographical proximity is more relevant for trade in GVCs than for trade in final goods. Remote location can be addressed by improving transport and communication infrastructure. The geographic centrality of a country can attract downstream production stages in GVCs. Geographic centrality is more linked to centrality in the transport network than to distance. Indeed, it's likely that economic distance matters more for GVC participation.

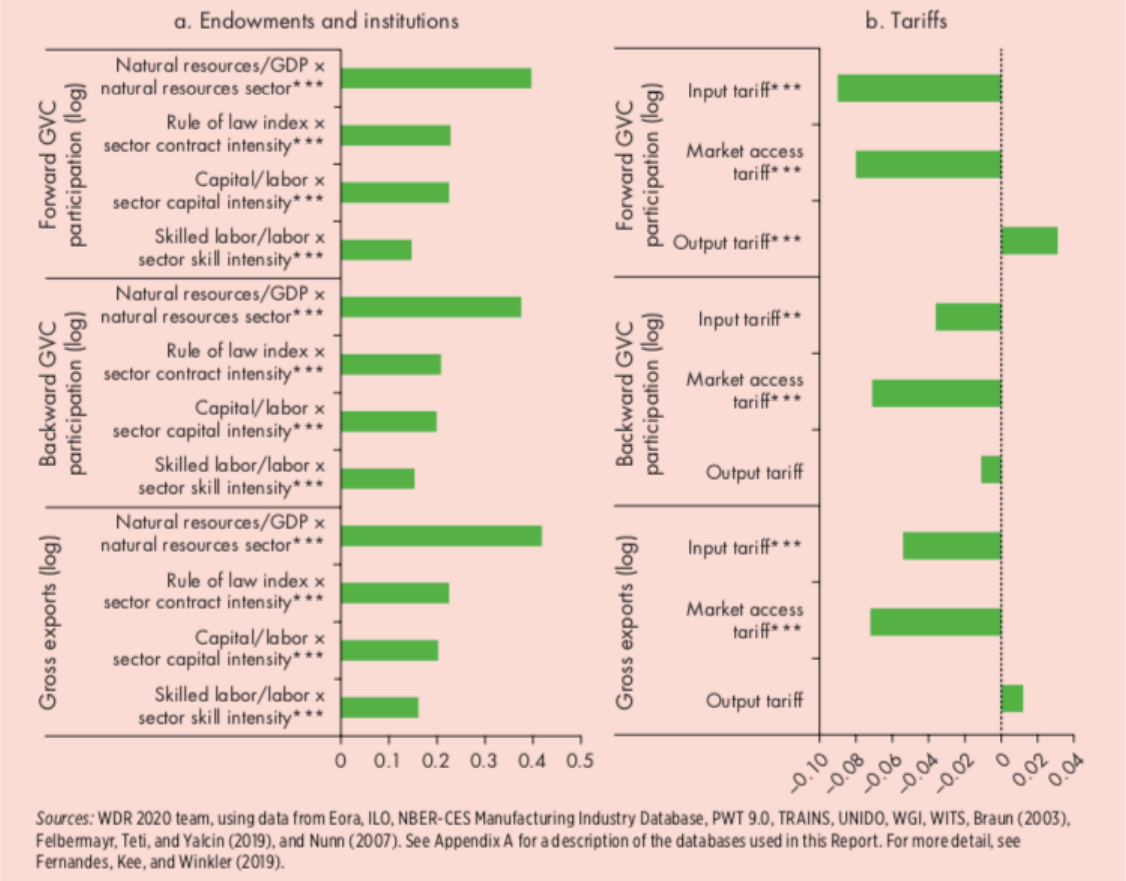
Air transport could help bridge slow land transport or long geographical distances but its high-cost limits low-income country exports to goods with very high unit values (such as gold and silver), time-sensitive goods (such as fast fashion clothing) and perishable goods. The most sensitive trade flows are those involving parts and components.

Different transport mode choice can lead to delay in transit which in turn can have a tariff equivalent of 0.6- 2.1 percent. In many countries, GVC participation is due to the lack of requirements for timely production and delivery.[63]

In other words, in international production networks, trade in parts and components highly relies on logistics performance, whereas trade in final goods is less sensitive to timely delivery. Furthermore, stronger backward GVC participation is related to better scores in the logistics performance index.

Figure 2.2: Drivers of GVC participation based on a country-sectors' GVC participation

[62] *Ibidem*
[63] *Ibidem*



Source: World Bank, Yalcin et al., EORA database 2019

Moreover, efficient and timely delivery requires an effective quality of the national road infrastructure. Connectivity does not only deal with physical supply chain of goods, but it also refers to effective communication between the GVC participants. In this framework, the use of Internet and of the English language can improve effective communication. A stronger use of internet can make GVC integration stronger. The reasons concern the fact that a large share of inputs embodied in exports are services, such as logistics, information and communication technology and many other business services rely on the Internet. Secondly, in GVCs firms need to communicate with both their suppliers and their customers through internet-based technologies.

Countries specializing in commodities have very low Internet coverage, whereas countries participating in advanced manufacturing and services GVCs are online.

By the same token, the use of English has contributed to enhance attractiveness of offshore destinations for business services in the Philippines. Language frictions inhibit knowledge spillovers in GVCS since high communication barriers between domestic

managers and Chinese, Japanese and Korean managers constitute an obstacle to the productivity spillovers from FDI.

Institutional quality is the last factor which can determine country's participation in GVCs. GVCs is associated also with the quality of contractual institutions because the performance of a GVC depends on the strength of its weakest link and production delays driven by weak contract enforcement could hurt GVCS. The institutional quality plays a potential role as a remarkable determinant of relation GVC participation which could be reinforced by the presence of relationship-specific investments and the exchange of large flows of intangibles (intellectual property, technology and credit).

Furthermore, according to World Development Report 2020 "*Trading for Development in the age of Global Value Chains*"published by World Bank, political stability has a strong impact for backward GVC integration. Greater increases in GVC participation are determined also by contract enforcement in countries with better institutional quality. By contrast, countries with lower political stability experience higher forward participation. In this sense, PTAs (preferential trade agreements) can spur the improvement of domestic institutions because they help import both reform and technical and financial assistance which prompt stronger GVC participation. The depth of trade agreements results in international fragmentation of production since behind-the-border policies need to be disciplined in trade agreements for GVCs to work efficiently. Therefore, participation in more advanced GVCs depends also on countries' engagement with more PTA partners. Indeed, deep trade agreements succeed in promoting countries' backward integration in GVCs. The evidence is that specific trade agreements, such as those represented by the European Union and the association of Southeast Asian Nations (ASEAN) have ties with substantially higher backward GVC integration for their members. The tool and the channels of PTAs able to fuel GVC participation regard lower tariffs, shorter distances to GVC hubs, stronger regulatory frameworks aimed at increasing political stability and larger FDI inflows. Nonetheless, not all PTAs have nurtured GVC participation. Mercosur for instance, hurt member's backward GVC participation. Argentina presents low backward integration into GVCs because of its restrictive trade policies, but high forward GVC integration due to its rich natural resources. Deepening existing PTAs by adding for

instance commitments to investment and reforms to remove entry barriers would strengthen Argentina's GVC integration.[64]

The rules of origin under PTAs can have consequences on the way in which GVCs form and expand since through the channel of the rules of origin, as well as preferential tariffs, PTAs can affect firm-level decisions on intermediate input sourcing and thus, their GVC linkages.

The relative importance of different factors for GVC integration depends on the type of GVC engagement and on the characteristics of countries. All determinants and policy areas must be enhanced, including political stability, logistics performance, tariffs and customs. The relative importance of these determinants changes according from country to country on the basis of the different regions. For instance, Sub-Saharan African countries are characterized by low FDI inflows which can be deemed as the most important element hindering backward GVC participation, whereas countries in the Middle East and North Africa are hit by conflict situations and therefore political instability represents a serious obstacle. Countries in South Asia, Latin America and the Caribbean stand to benefit the most from tariff liberalization.

The figure 2.3 presented by WDR shows backward GVC participation and its determinants by taxonomy group. As we can observe, in the commodities group, countries tend to be characterized by low political stability (-0.6), low FDI inflows, high manufacturing import tariffs which amount to 6.6%, low customs efficiency (35 days to import) and low level of the logistics performance (2.6).[65]

Instead, in the limited manufacturing group countries see on average improved political stability, 60% higher FDI inflows, average tariffs is lower than commodities group, amounting 5.6%, improved customs efficiency (20 days to import) and higher scores in Logistics performance index compared with the commodities group (2.8)

The World Development Report 2020 entitled "*Trading for development in the age of Global Value Chains*" upon which is based this analysis, puts in evidence also that countries in the advanced manufacturing and services group show on average further improved political stability, higher FDI inflows, tariff rates amounting 2.6%. In addition,

[64] World Bank Group, Trading for Development in the Age of Global Value Chains, World Development Report 2020, (World Bank, 2020)

[65] *Ibidem*

countries belonging to this group record better customs efficiency (13 days to import) and scores in logistics performance is higher relative to limited manufacturing group.

The last sector is the innovative activities group, whose countries see improved political stability, 90% higher FDI inflows, lower tariffs by 0.9 percentage points, as well as higher customs efficiency requiring 8 days to import and higher LPI in comparison with advanced manufacturing and services group. The figure 2.3 puts in evidence also the fact that whereas tariff rates drop drastically from the limited manufacturing to the advanced manufacturing and services group, the time to import enhances substantially from the commodities to the limited manufacturing group. For what concerns the innovative activities group, it shows improvements on all fronts, particularly in political stability and in logistics performance.[66]

Figure 2.3: Backward GVC participation and determinants, by taxonomy group

Taxonomy group	Average backward GVC participation share (%)	Average political stability index	Average FDI inflow (log)	Average tariff rate (%)	Average days to import	Logistics performance index
Commodities	13.9	–0.6	6.7	6.6	35.4	2.6
Limited manufacturing	24.1	–0.3	7.3	5.6	19.9	2.8
Advanced manufacturing and services	39.8	0.1	8.8	2.6	13.0	3.3
Innovative activities	37.3	0.8	9.7	1.7	8.9	3.8

Source: WDR 2020 team.

Note: Averages shown cover the period 2010–15, using the GVC taxonomy for the year 2015. See box 1.3 in chapter 1 for a description of the GVC taxonomy used in this Report. Dark blue relates to the best performance across taxonomy groups, dark red to the worst performance, and lighter shades to intermediate performance. FDI = foreign direct investment.

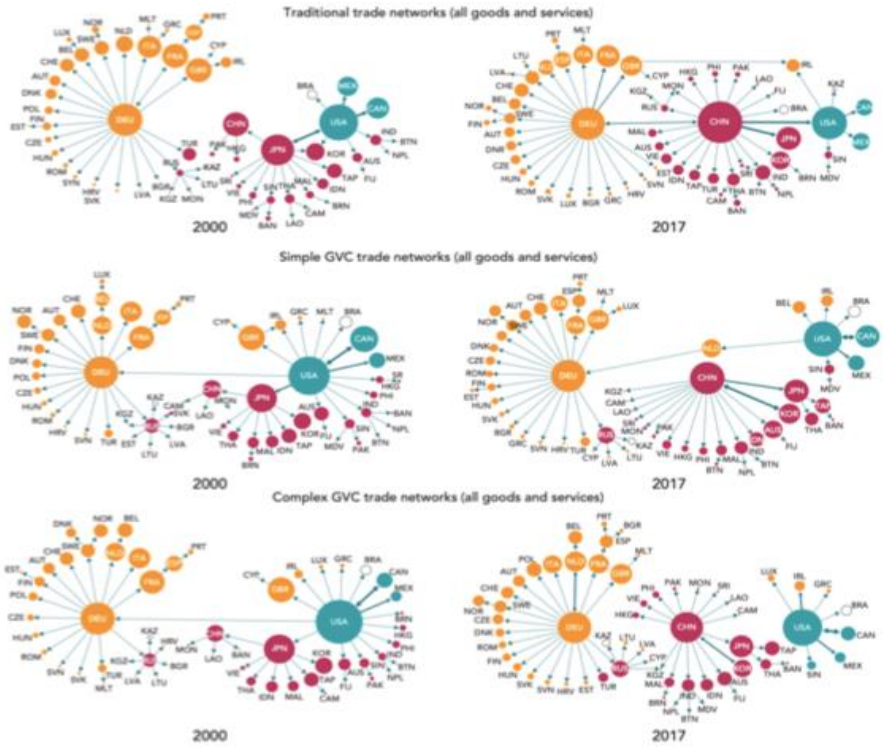
Source: World Bank Group, GVC taxonomy for the period 2010-2015, 2020

Until 2017 in the international trade many countries, such as Germany, United States and Japan have become the hubs, playing in this way a central role which have established remarkable connections with their neighbors. US has established contracts with 2 main North American partners, Canada and Mexico, with some Asian economies, notably Japan and Republic of Korea, as well as Brazil, Australia and India. Japan can be considered the Asian supply center. Germany instead is the main European hub given that

[66] World Bank Group, Trading for Development in the Age of Global Value Chains, World Development Report 2020, (World Bank, 2020)

most of imports with value added in the European final goods comes from German industry.

Figure 2.4: supply hubs of trade in value added in various networks at the aggregate level



Source: Meng et al. (2018) based on the UIBE GVC indexes derived from the ADB 2018 ICIO table

As we can see in the graphic, there are many sub-hubs which turn about the 3 macroareas, including Italy, France, Spain, China, Thailand and Singapore.

However, in the last decade, China took over Japan, thus becoming the leading hub of exports with value added because of the trade of final goods. On the contrary, the US have recorded a sharp decrease of relations with other countries which have preferred the Chinese counterpart. Indeed, China has become the biggest supply center, shaking away all the other regional hubs, thus getting a remarkable comparative advantage. In the last

years this comparative advantage has acquired an increasingly regional value, thus losing its original national connotation.[67]

In addition, China has played and is still playing a role more and more significant both as demand and supply hub of traditional trade and in GVCs simple activities. US and Germany have remained the most important hub in the complex value chains.

In few words, Chinese firms have recorded a speed growth up the GVCs, especially in the pre manufacture stages. GVCs can be deemed as an opportunity to reach bigger markets since they allow to take advantage of externalities, thus acceding to more advanced technologies as well as exploiting cost advantages. The 2 main Global Value chains are pivoted on North America and China.[68]

In the context of GVCs at international level countries choose to ratify international agreements concerning networks of production in order to achieve competitiveness and then industrialize through the purchase of workplaces within GVCs. The international organization of production has entailed a fundamental change, forcing each country to enhance the workers' proficiency and technological skills, as well as consolidating social cohesion.[69]

In conclusion, GVCs have become increasingly complex amplifying the risk that a breakdown in one link of the chain could trigger detrimental global effects to the entire chain as it has been demonstrated by the 2008 economic crisis. According to the OECD, this leads to the conclusion that the more firms spread their operations around the globe, the more vulnerable they become to disruptions from unexpected events.

2.3 Regional and global value chains: Asia and United States' model

Despite the perception that supply-chain trade is global in character, there is the growing belief that trade is taking place more within regions than among them. Indeed, many authors argue that international organization of production is mainly regional in scope.[70]

[67] X, Li, B. Meng, Z. Wang, Recent patterns of global production and GVC participation. Chapter 1. WTO (World Trade Organization,2017)

[68] D. Bevere, Torino, Analisi dell' interesse economico nazionale, (Analytical for intelligence and security studies, 2020)

[69] *Ibidem*

[70] See R. Baldwin and Lopez- Gonzalez, (supply-chain trade: a portrait of Global Patterns and Several Testable Hypotheses, 2013)

Whereas production is fragmented between countries, supply networks are predominantly regionally clustered. This is demonstrated by the fact that most supply chain trade takes place within “Factory Asia”, “Factory Europe” and “Factory North America”.[71]

According to recent research, since 2013 intra-regional share of global goods trade has increased by 2.7% with regionalization which has become the global innovation of the value chains.[72] Furthermore, WTO studies reveal that there exist clear structures within each region, with hubs leading the supply networks in different geographies.[73]

If the inputs along the value chains are among the most expensivive, they tend to be sourced from regionally diverse network. [74]

In other words, value chains have expanded both globally and regionally. Furthermore, more complex value chains have stronger regional linkages. While GVCs in East Asia and Europe are more focused on trade within the region, GVCs in North America rely somewhat more on global partners, meaning dependent on global integration as illustrated by the figure 2.5.

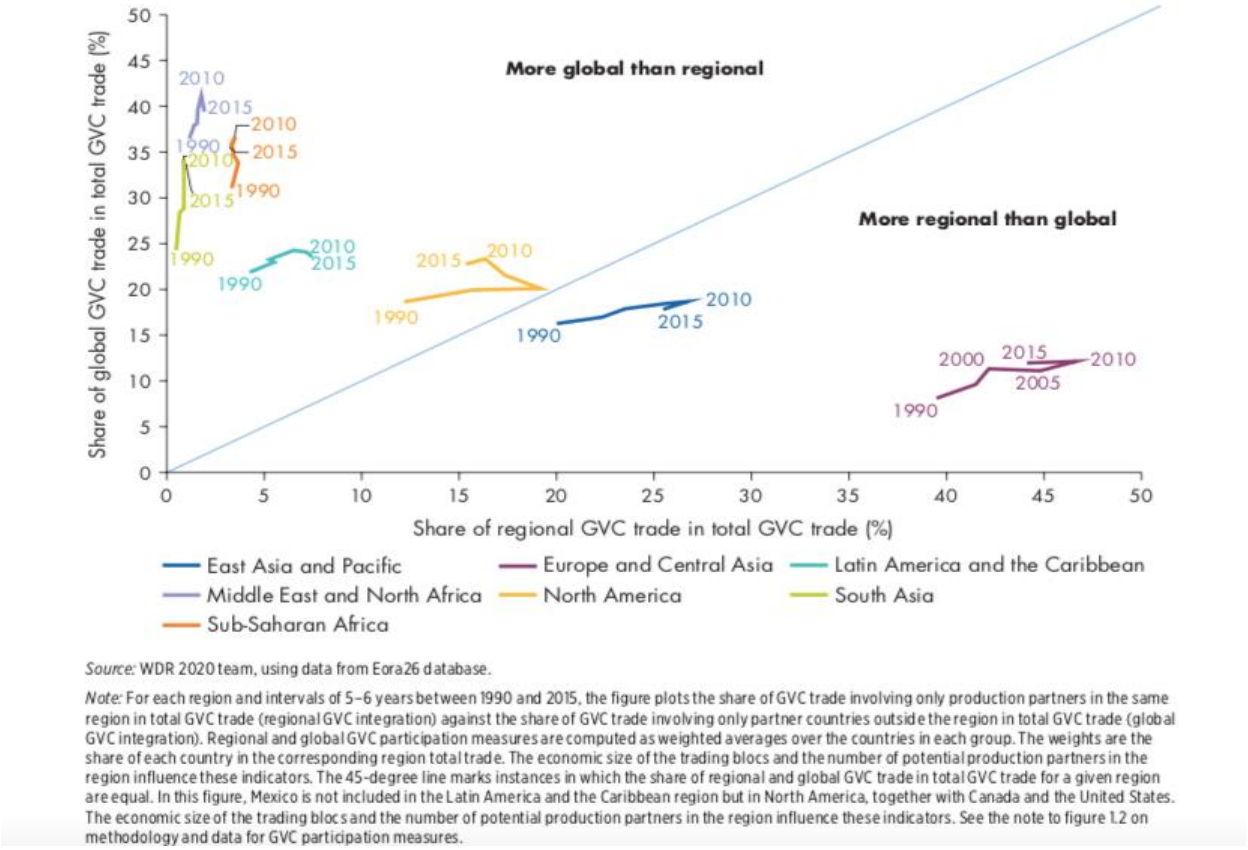
Figure 2.5: Global and regional Value chain activities (1990-2015)

[71] I. Zachariadis, Global and regional value chains, opportunities for European SMEs’ internationalization and growth, (European Parliamentary Research Service, 2019).

[72] S. Lund, J. Manyika, J. Woetzel, J, Bughin, M. Krishnan, J. Seong, M. Muir. Globalization in transition:the future of trade and value chains. (Mckinsey Global Institute, 2019)

[73] C. Degain,B. Meng, Z. Wang. Recent trends in global trade and global value chains, (World Trade Organization, 2017)

[74] J. Dedrick, K. Kraemer, G. Linden, “Who profits from innovation in Global Value Chains?;A study of the iPod and notebook PCs”, Annual conference May 2008 pp 2-14(Industry Studies, 2008)



Source: WDR 2020 team, using data from Eora26 database.

Note: For each region and intervals of 5–6 years between 1990 and 2015, the figure plots the share of GVC trade involving only production partners in the same region in total GVC trade (regional GVC integration) against the share of GVC trade involving only partner countries outside the region in total GVC trade (global GVC integration). Regional and global GVC participation measures are computed as weighted averages over the countries in each group. The weights are the share of each country in the corresponding region total trade. The economic size of the trading blocs and the number of potential production partners in the region influence these indicators. The 45-degree line marks instances in which the share of regional and global GVC trade in total GVC trade for a given region are equal. In this figure, Mexico is not included in the Latin America and the Caribbean region but in North America, together with Canada and the United States. The economic size of the trading blocs and the number of potential production partners in the region influence these indicators. See the note to figure 1.2 on methodology and data for GVC participation measures.

Source: World Bank, EORA26 database , 2020

Europe is the most integrated region with four times as many regional linkages as global linkages and in East Asia linkages are more regional than global, which have intensified substantially since 1990. On the contrary, North American Value chains have strong global linkages. While countries' trade with regional value chains involves only production partners in the region, extra-regional value chain trade concerns linkages with countries outside the region.[75]

The increase in GVC participation which took place between 1990 and 2015 is the result of the combination of regional and global trends. In Europe, the rounds of enlargement which took place in the period which goes from 2004 to 2007 with the entrance of Poland, Bulgaria and Hungary led to the increase in regional fragmentation of value chains. These new European members progressively joined older members' production networks.

[75] World Bank Group, Trading for Development in the Age of Global Value Chains, World Development Report 2020, (World Bank, 2020)

Nonetheless, larger European economies, notably France, Germany and United Kingdom, drove the global fragmentation through the expansion of their linkages with countries in Asia such as China and India.[76]

The World Development Report 2020 "*Trading for Development in the Age of Global Value Chains*" illustrates that in East Asia, despite the impressive prevalence of regional chains and therefore the regional integration, GVCs become more internationally fragmented after 1990 as a consequence of both regional and global fragmentation.

On the contrary, the NAFTA GVCs rely more on global partners than regional ones. In addition, integration has been increasing on both fronts. In the 1990s, the regional expansion of GVCs reflected the coming into force of the NAFTA trade agreement signed in 1994. In 2000s, instead, global GVC activities experienced a marked acceleration triggered by China entrance in the world economy as main actor. In fact, China's accession to the WTO in 2001 boosted global trade flows via global and regional value chains. [77]

In Latin America and Caribbean (LAC) value chains are more globally developed, despite their increase both regionally and globally.

Backward linkages show that production networks in East Asia, Europe and North America are mostly regional as proved by the figure 2.6 developed in 2018.

On average, in a European country 65 percent of the imported intermediates embodied in its exports originated from other European countries, meaning within its own region. This share is about 55percent for an average East Asian economy, while 40 percent for a NAFTA member. [78]

The share of imported intermediates embodied in exports stemming from regional partners is 26 percent in Latin America and Caribbean, but as low as 3 percent in South Asia. South Asia is integrated in production networks in East Asia and Europe. Likewise, Sub-Saharan Africa is integrated in European supply chains followed by those in East Asia. Through these observations we can reach the conclusion that geographical distances and trade costs are reflected in these regional patterns given that intermediate inputs move

[76] R. Stollinger, D. Hanzl-Weiss, S. Leitner, R. Stehrer, Global and Regional Value Chains: How important. How different? Research Report 427, (The Vienna Institute for International Economic studies, 2018)

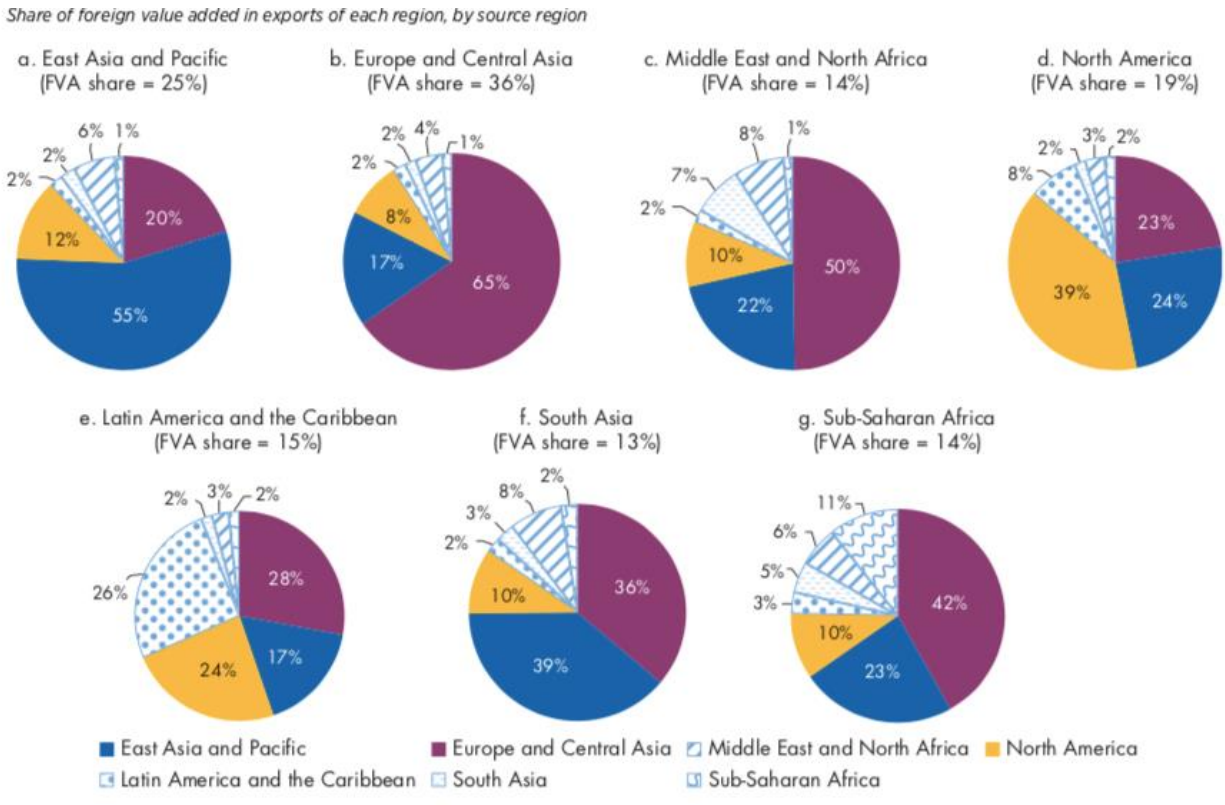
[77] I. Zachariadis, Global and Regional value chains; Opportunities for European SMEs' internationalization and growth, (European Parliamentary Research Service, 2019)

[78] World Bank Group. World development Report 2020: Trading for development in the Age of Global value Chains, (World Bank, 2020)

across borders several times. As it has been stated in this chapter, just-in-time manufacturing techniques drive firms to locate the production of time-sensitive components closer to home. Another element which determines the optimal location for individual production stages along the GVCs are trade costs.[79]

In the framework of global economy Africa has always played and still plays a marginal role since it is a small actor accounting for just 3 percent of global trade in intermediate goods. A big share of African exports is used as inputs for other country's exports, marking the still predominant role of natural resources and agriculture in African exports.

Figure 2.6: The organization of global production networks around the three main regions



Source:World Bank, 2018 EORA database, 2020

This data stresses that local and regional value chains play a fundamental role especially for developing countries due to the emergence of "Southern" end markets and the rise of

[79] X, Li, B. Meng, Z. Wang, Recent patterns of global production and GVC participation. Chapter 1. WTO (World Trade Organization,2017)

South-south trade. Indeed, in developing countries, domestic firms tend to integrate into local value chains (LVCs) and regional value chains (RVCs) which could in turn provide a stepping-stone for the involvement in GVCs. What has been overlooked in the literature is that in developing countries many domestic firms, notably small and medium-sized enterprises, the so-called SMEs, do not integrate into GVCs due to the challenges that hinder their GVC participation. In other words, LVCs and RVCs are useful means with which latecomer country firms can build capabilities before entering global markets since less-capable firms especially SMES fail to integrate into GVCs.[80]

Basically, GVCs capture the flow of goods and services at the global market level, meaning across two or more continents, whereas RVCs embody value chains activities at the regional market level.[81]

Regionalization is most apparent in global innovations value chains, given their need to closely integrate many suppliers for just-in-time sequencing and it succeeds in boosting the participation of low-income countries and developed countries in regional production networks enabling them to move up the value chain. Furthermore, regional integration helps reduce barriers in regional production networks.[82]

In Asia, regional cooperation in the production network is driven by attendant benefits in regional production networks. Instead in Africa, for instance regional cooperation among small and fragmented markets is one way national markets can be enlarged, specialization can emerge and risks can be reduced. Latin American economy relies on regional forums to reduce the costs of doing business and of trade across the region.[83]

South Asia is an emblematic case of regionalization and managed to attract regional production networks due to differences in wage and labor productivity level across member states which facilitate benefits from value chains through initiatives such as AFTA and ASEAN economic community. East Asia is the most active and successful

[80] Navas-Aleman, The impact of operating in multiple value chains for upgradimg :The case of the Brazilian furniture and footwear industries. 39/8, pp 1386-1397 (World Development ,2011)

[81] C.Keijser, R. Belderbos, M. Goedhuys, Governance and learning in global, regional and local value chains: The IT enabled services industry in South Africa, World Development 141, pp 2021

[82] World Bank Group. World development Report 2020: Trading for development in the Age of Global value Chains, (World Bank, 2020)

[83] *Ibidem*

region which pursue regional cooperation. Regional cooperation within value chains is a useful tool to promote fragmented trade and production network.[84]

RVCs constitute an integral part of GVCs and incorporate a number of member states. In ASEAN the spread of international and above all regional production networks resulted in the growth of its GVCs participation. The regional networks involve both transnational corporations and local firms as producers, thus forming value chains. Production value chains originated in ASEAN spread into several ASEAN counties, which lead to the formation of RVCs, which in turn may often go beyond the region, creating GVCs.

ASEAN member countries have boosted their production networks by importing more and more intermediate products which has contributed to the establishment of value chains. In 1990 at the very beginning of GVCs 38 percent of ASEAN exports was value added created by foreign countries, meaning that at least one third of exports from ASEAN consisted of foreign inputs. Over the past two decades, ASEAN countries have relied on impressive amounts of foreign inputs in their exports.[85]

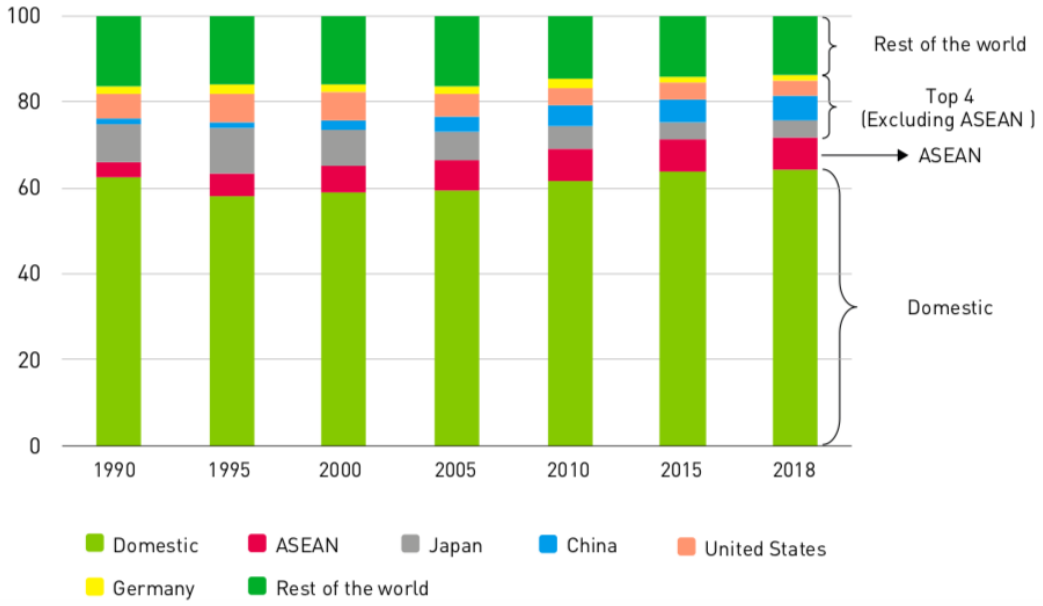
However, in 2000s after reaching 40 per cent this share slowly started to decline reaching 36 per cent. This decline has to do with the increases in the share of value added created by domestic entities, both local and foreign firms. More domestic value in trade is related to greater competitiveness in the ASEAN region. The graphic below explains that not only domestic firms are integrated in GVCs but also that imported parts and components have been replaced by local production in the region by foreign transnational corporations (TNCs).[86] Moreover, this figure shows that inputs from local firms, both foreign and domestic increased their importance.

Figure 2.7: Value added exports from ASEAN and other top four foreign country value added creators (1990-2018)

[84] OECD, Aid for trade at a glance 2013; connecting to value chains; Chapter 4: boosting Value Chains via regional aid for trade, (Organization for Economic Cooperation and Development, 2013)

[85] ASEAN-Japan Centre, Global Value Chains in ASEAN: a Regional Perspective, Paper 1, (ASEAN Promotion Centre on Trade, Investment and Tourism,20199

[86] I. Zachariadis, Global and regional value chains, opportunities for European SMEs' internationalization and growth, (European Parliamentary Research Service, 2019).



Source: AJC-UNCTAD-Eora database on ASEAN GVCs, 2018

Until 2000s the most important source country of foreign inputs had been Japan and the United States but since the mid-2000s this trend has changed due to the Japan and United States' loss of importance in contributing to ASEAN exports. By the contrary, the share of ASEAN inputs involved in their exports has been increasing which implies greater competitiveness of ASEAN products as intermediate products. Most of those inputs have come from Indonesia, Malaysia and Singapore. By the same token, China has increased its inputs over the years from 6 per cent in 2018. Another interesting fact is that although the foreign value-added share recorded a decline, ASEAN share is higher than that of other regional groups in developing countries since ASEAN is the destination of foreign direct investments (FDI) more than other developing regions. Indeed, for ASEAN, the share of FDI stock in GDP was 79 per cent in comparison with 29 per cent for Mercosur and 37 percent for COMESA (Common market for Eastern and Southern Africa).[87]

Over the past two decades the share of ASEAN value added in total exports recorded an increase amounting 72 percent. As it has been stated at the beginning of this chapter, integration into the GVCs is measured by two indicators: upstream and downstream participation. While foreign value added is the upward part of value chains, the

[87] ASEAN-Japan Centre, Global Value Chains in ASEAN: a Regional Perspective, Paper 1, (ASEAN Promotion Centre on Trade, Investment and Tourism,2019)

downstream part is domestic value added, which is also an important indicator of GVCs participation. [88]

For what concerns GVCs integration, among the ASEAN countries Singapore is the most integrated into GVCs followed by Malaysia, while Cambodia, and Myanmar are the least involved. In Malaysia, Singapore, Thailand and Vietnam more than half of their participation stems from the downstream part of value chains.

The extent to which ASEAN is integrated into GVCs appears to be larger than any other main regional groups in developing countries. This participation is derived from the upstream part of the value chains, instead ASEAN share concerning downstream part of the value chains is lower than that of most of the other regional groups. The reasoning lies in the export structure of ASEAN which is related to manufacturing including both intermediate and final goods.

The figure 2.8 shows the different level of GVC participation:

Figure 2.8: ASEAN member state participation into GVC (2018)

Source: AJC-UNCTAD-Eora database on ASEAN GVCs.

[88] *Ibidem*

Source: AJC-UNCTAD- Eora database on ASEAN GVCs, 2018

ASEAN has developed both international and regional production networks. Over the past twenty years, in ASEAN regional networks have expanded in both upstream and downstream part of value chains, which has risen in the years accounting for 25 per cent in 2018. While the level of GVCs has not undergone changes, remaining almost the same, RVCs have been increasing with a constant pace. Despite ASEAN involvement in international production networks, its member countries put more emphasis on regional production networks within the GVCs. [89]

The integration into RVCs rather than GVCs depends on industry and on sectors. The industries which exhibit a high level of involvement in RVCs are finance, petroleum products, transport services, electronic equipment and machinery, finance, three natural resource- related industries, notably electricity, gas, and water. These industries are prone to expand regionally rather than globally. Generally speaking, while the secondary sector tends to be on a more global scope, primary and tertiary industries are more regionally spread. [90]

If we assess three of the most relevant industries, namely automotive, electronics and textile and clothing we can observe that RVCs are the largest for the electronics while RVCs are much weaker in the automobile and textile and clothing sectors. This means that production networks are stronger with non-ASEAN members than with ASEAN members. These industries are characterized by a higher share of foreign value added in exports which trigger the establishment of larger production networks.[91]

Additionally, from the analysis carried out by ASEAN-Japan Centre in 2014 whose title is *"Global Value Chains in ASEAN: A Regional Perspective*" emerges that many global auto firms with have a strong presence in Asia pursue regional production networks strategy and many automobile firms, especially in Thailand and Malaysia drive value chain using parts and components from various countries as well as from within countries. In the electronics sector, the total value-added exports from ASEAN makes this industry by far the largest value added export source in ASEAN. ASEAN countries, notably China

[89]ASEAN-Japan Centre, Global Value Chains in ASEAN: a Regional Perspective, Paper 1, (ASEAN Promotion Centre on Trade, Investment and Tourism,2019)

[90] G. Gereffi, j. Humphrey and T. Sturgeon, The governance of global value chains, (Review of International Political Economy, 2005) 12/1, pp 78-104.

[91] Fujita, Masataka. Global and Regional Value Chains in ASEAN, prepared for ASEAN and UNCTAD (2014)

and Japan, as well as EU have provided almost the same share of inputs to electronics exports.

Clothing value chains are driven by brand holders and upstream material developers control textile value chains. The majority of the textile and clothing firms is foreign owned with investors from ASEAN economies. Furthermore, in clothing production networks value added is not large and is typically dominated by domestic firms.[92]

To sum up, RVCs in ASEAN and more generally, strengthen regional connectivity through production, business linkages, investment and trade. Cooperation, liberalization and promotion measures improve the overall environment for GVCs.[93]

2.3.1 How Global Value Chains impact ASEAN economy

GVCs contribute to development in different ways, such as through direct GDP and through employments gains and also by offering opportunities for industrial upgrading. However, GVC integration entails risks. GVCs can make a contribution to domestic value added even where GVC integration imposes the obligation of higher imported content of exports.

GVCs involvement can produce value added in domestic economies and contribute to faster GDP growth as well as generating employment and enhancing skills development through technology transfer.[94] It's important to assess the implications in terms of welfare gains from international production networks.

60-70 per cent of total value-added exports from ASEAN is the value created by domestic firms, while the 40-30 per cent is accounted for by foreign companies through their inputs to ASEAN products. Foreign affiliates operating in ASEAN contribute to generate a remarkable share in the domestic value. This means that overall contribution by foreign companies to ASEAN trade is impressive. Despite the risks involved in GVCs, data confirms the positive links between economic growth and GVC participation in both developed and developing countries, as well as ASEAN. Indeed, the graphic below shows

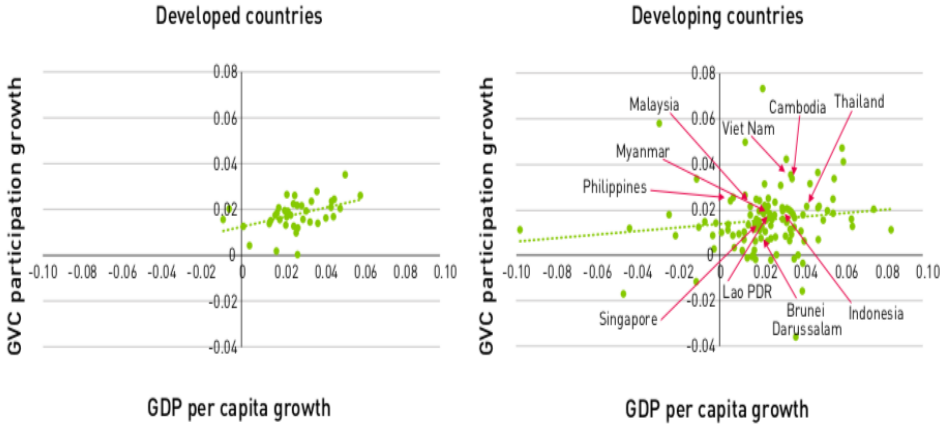
[92] C. Staritz, Making the Cut? Low-Income Countries and the Global Clothing Value Chain in a Post- Quota and Post- Crisis World, 2011

[93] ASEAN-Japan Centre, Global Value Chains in ASEAN: A Regional Perspective, Paper 1, (ASEAN Promotion Centre on Trade, Investment and Tourism,2019)

[94] ASEAN-Japan Centre, Global Value Chains in ASEAN: a Regional Perspective, Paper 1, (ASEAN Promotion Centre on Trade, Investment and Tourism,2019)

that the increase of ASEAN countries participation into GVCS leads to greater real GDP per capita.[95]

Figure 2.9: GVCs participation and FDI, 2017



Source: AJC-UNCTAD-Eora database on ASEAN GVCs (for GVC particpation); GDP data from UNCTAD GlobStat.

Source: AJC-UNCTAD-Eora database on ASEAN GVCs; GDP data from UNCTAD GlobStat.

Another element which has been previously quoted was the relationship between the presence of FDI and the GVC participation. Indeed, the more the FDI flow into the country and the region, the more the country will be integrated into GVCs. Nonetheless, while TNCs are prone to integrate FDI and trade in their operations, national governments are likely to separate trade and FDI policies.[96]

According to UNCTAD, GVCs are positively correlated to FDI income. The income associated with FDI is directly related to the participation of foreign firms into GVCs. In ASEAN foreign firms can freely do with this income given that there are no regulations which are imposed on the remittance of income. Host-country government would prefer the reinvestment by foreign firms operating locally, but things go differently because foreign firms tend to repatriate the majority of such income to their home countries. Data concerning foreign affiliates in ASEAN put in evidence the need for policy to encourage foreign companies to reinvest from their earnings. For instance, during 2014-2015 the

[95] W. Kee Hwee, H. Mirza. ASEAN Investment Report 2013-2014, FDI Development and Regional Value Chains (United Nations Conference on Trade and Development, 2014)
[96] *Ibidem*

share of reinvested earnings in total FDI flows was about one fifth and started to decline over the past ten years. [97]

A country's GVCs participation is a tool which can be used to assess the reliance of exports on GVCs both upstream and downstream. Additionally, it can measure the magnitude of the damage to GVCs and to the local economy, in case of a country's exports block. The 2008 economic and financial crisis had serious repercussions on ASEAN's clothing industry whose integration into GVCs had been already consolidated. ASEAN's high integration into GVCs exposes its sectors and industries to external shocks.[98]

In order to avoid and reduce at most the negative effects, policy actions are necessary, such as supporting firms, especially parts and components firms and their related industries also at the regional level.

At the same time, in order to maximize the benefits of GVCs it's necessary to reach a proper balance between domestic value added and foreign value added.

Trade and FDI are determinant factors in advancing value chains. In this framework, regional integration has a considerable influence in trade and FDI patterns. ASEAN integration fuels the growth of regional production networks and of global and regional value chains. ASEAN's integration creates many opportunities for TNCs to further engage in the region. Indeed, many Asian economies, notably, Vietnam, Cambodia, and Lao People's Democratic Republic increased their share of GVCs, a clear sign that GVCs are still offering trade and production opportunities for some developing countries.

Intra-ASEAN trade is very common in key product categories like automotive, machinery and automotive parts and components. The intraregional production, investment and business linkages which involve foreign and domestic firms operating in ASEAN have substantially increased due to the intraregional trade in key product categories.

As it has previously been stated, the degree of involvement in RVCs and links to global value chains (GVCs) depends on sectors and on industries, especially between the primary and manufacturing sector. Additionally, the rise in domestic value-added content in ASEAN's exports is clear evidence of growing RVCs. Despite RVCs regard economic

[97] ASEAN-Japan Centre, Global Value Chains in ASEAN: a Regional Perspective, Paper 1, (ASEAN Promotion Centre on Trade, Investment and Tourism,2019)

[98] C. Staritz, Making the Cut? Low-income Countries and the Global Clothing Value Chain in a Post-Quota and Post-Crisis World, (World Bank, 2011)

activities within the region*, "they involve the multifaceted interconnection of many firms which operate in different ASEAN member States (in- country and regionally) which encompass intra-firm and inter-firm relationships, including extensive webs of supplier connections in the region."*[99]

In addition, according to "*ASEAN Investment Report 2013-2014 on FDI Development and Regional value chains*", in ASEAN the RVCs involvement can be measured through different levels: sub-components and components manufacturing, assembly and post-assembly stage. At each of these stages, the major firms carry out their economic activities on a regional production network basis with multiple plants in a host country and connect in subsequent stages of the value chains with other suppliers or customers which operate in different ASEAN member states.

An interesting aspect is that in ASEAN the lack of regional integration does not hamper the development of RVCs. However, ASEAN's integration encourages and deepens RVCS for a number of reasons. ASEAN as a region is also part of the broader GVCs through TNCs and firms involved with RVCs.[100]

RVCs and regional production networks are not new to ASEAN; Indeed, since 1980s many TNCs have relied on regional production networks or global value chains of main TNCs that are engaged in the region. TNCs have been able to slice and distribute as well as coordinate different value chains segments and their ability has deeply contributed to the development of RVCs in ASEAN. RVCs will be more geographically widespread and intense where the regional integration is stronger and obviously where impressive complementary locational advantages exist. Especially in ASEAN, RVCs can be seen also as a tool to strengthen regional connectivity through production, investment, trade and business linkages involving operations by TNCs and suppliers at different levels (intra and inter-TNCs relationships). Even if regional integration is not a necessary element for the development of RVCs, ASEAN's integration prompts RVCs. The link between regional integration RVCs and ASEAN connectivity can be summed up by the figure 2.10

Figure 2.10: RVCs and Regional integration in ASEAN

[99] W. Kee Hwee, H. Mirza. ASEAN Investment Report 2013-2014, FDI Development and Regional Value Chains (United Nations Conference on Trade and Development, 2014) pp105- 134

[100] *Ibidem*

Source: UNCTAD 2014.

Source:UNCTAD 2014

The combination of corporate objectives and strategies and locational factors, such as regional integration elements will determine which segments of RVCs have to be produced and supplied by whom and from where.

In ASEAN, RVCs concern the interrelated value additions or creations coming from different segments of value added through the operations of foreign and local companies operating in the region. Firms' participation into RVCs offers the possibility to reap benefits from the specialization and support of other companies participating in the chain. Speaking in general, RVCs operate within a specific region or as part of wider GVCs.[101] In ASEAN, the role and the importance of RVCs is increasing because of the regional networks which have been established in both upstream and downstream positions of the value chains. Regional integration acts as a means able to enhance the regional policy framework. Furthermore, regional integration can boost cooperation among member countries through reduction of transaction costs. This is explained by the fact that a more coordinated and liberalized policy environment lowers barriers to investment, production and movement of goods across boundaries. In addition, other relevant factors are harmonized policies and measures as well as large regional market sustained by regional

[101] W. Kee Hwee, H. Mirza. ASEAN Investment Report 2013-2014, FDI Development and Regional Value Chains (United Nations Conference on Trade and Development, 2014) pp105- 134

integration. In ASEAN, but also in general, RVCs and regional production networks require the existence of economic complementarity among neighboring countries.[102]

According to the paper published by ASEAN-Japan Centre on Trade, Investments and Tourism entitled ", *Global Value Chains in ASEAN: A Regional Perspective*", in ASEAN, the wage cost differential and other different stages of economic and industrial development constitute a driver for many companies to pursue regional division of labour strategies. RVCs through regional integration foster a more efficient use of integrated business models. Geographical limitations, including land availability and agroclimatic constraints make the undertaking of all segments of a value chain within a country model of operations difficult. An integrated business strategy becomes easier to execute with regional integration. ASEAN is integrating strongly through the AEC (Asian economic community). RVC landscape in the region is significantly affected by this regional integration development since the latter encourages intra- ASEAN trade, supports intraregional services liberalization, promotes investments and strengthens infrastructure connectivity.

RVCs create a connection among ASEAN member states through regional production networks among TNC affiliates that can develop within a single country, between two or more ASEAN member states or throughout the entire value chains.[103]

TNC affiliates develop production networks which are form of RVC. This happens when two or more affiliates operate in different stages of production or if they produce different parts and components but are connected in the value or supply chain. Their linkage consists in the fact that, as in the case of GVC, the output of one affiliate becomes an input of another within the same group of companies. The production networks can take place also between different functions within a TNC group, such as between the manufacturing of intermediate inputs or components and their assembly by another affiliate into a finished or semi-finished product.[104]

In RVC, firms and countries' connectivity is strengthened by the inter-firm relationships between unrelated firms. In other words, when a TNC operating in an ASEAN member

[102] ASEAN-Japan Centre, Global Value Chains in ASEAN: A Regional Perspective, Paper 1, (ASEAN Promotion Centre on Trade, Investment and Tourism, 2019)

[103] W. Kee Hwee, H. Mirza. ASEAN Investment Report 2013-2014, FDI Development and Regional Value Chains (United Nations Conference on Trade and Development, 2014) pp105- 134

[104] ASEAN-Japan Centre, Global Value Chains in ASEAN: A Regional Perspective, Paper 1, (ASEAN Promotion Centre on Trade, Investment and Tourism, 2019)

country relies on contract manufacturers or service providers located in one or more ASEAN member states to supply intermediate products a RVC can create.

2.3.2 United States and GVCs

The US participate in GVCs through its exports and its participation is also determined by the use of US intermediate in other countries' exports. According to a study carried out in 2009, in the United States most of the final demand for manufactured goods and services represents value added which has been created domestically.[105]

Many American multinational corporations (MNCs), such as Apple and Nike, rely on GVCs for their products and optimally allocate stages of production, from design to marketing, to companies in different countries. Many American MNCs have been transformed into factory-less centers of product design and technology innovation.

US firms deeply depend on imports of intermediate goods produced abroad. By the same token, exports of foreign firms to US use American manufactured intermediates in their final products. United States is highly integrated in the Global Value Chains and larger integration implies more and more hardships to implement protectionist trade measures since protectionist measures would harm US firms directly as well, as it has been proved in 2018 with the trade war.[106]

US integration in the GVCs is particularly evident in the three Mexican industries: motor vehicles (18.1%), electronic equipment (17.2%) and electrical machinery (16.7%). For instance, in the case of Mexican motor vehicles 18.1% of final exports to the US consists of American value added. Moreover, US firms rely on intermediate goods coming from Canada, Mexico, China, Germany and Japan which indeed are the most important suppliers of intermediate goods whose final destination is US. A clear proof is that American export of motor vehicles, basic metals and fuel products depends most on foreign intermediates. In the face of a disruption of global value chains, US firms can

[105] OECD, Global Value Chains (GVCs): United States, (Organization for Economic Cooperation and Development, 2012)

[106] Y. Xing, Global Value Chains and the missing exports of the United States. (China Economic Review 2020) 61/101429

choose to substitute intermediates from countries being hit by protectionist measures. However, this clearly involves higher transaction costs.[107]

The reliability on imports of intermediate goods produced abroad can be summed up as follows: 43% of total US imports represents the share of intermediates, with intermediates from NAFTA countries which have a share of 50%. The same is applicable on the other way around, meaning that 60% of US gross exports consists of intermediate goods and services and only 40% represents the share of final products.[108]

In order to have a comprehensive view of US Global value chains integration with China, Mexico, Germany and Netherlands we have to assess the share of value added of American intermediates used in final goods destined for the US market and the dependence of US firms on foreign intermediate goods and services. In 2015 intermediate goods imports accounted for 43% of total US goods imports. Instead, the share from Canada and Mexico was 50%, much higher than China accounting for 28 percent and European Union 37 percent.[109]

According to 2017 analysis, 4.1 % of the total value of final goods and services shipped to the US consists of American produced intermediates. The degree of integration records an uneven distribution across industries and trading partners.[110]

In the case of Mexican motor vehicle industry, 17% of the export value of the Mexican automotive sector is sourced from the US. Except for Mexico, Chinese electronic equipment industry is the most integrated sector. No other sector instead in either China, Netherlands or Germany has an American value-added share exceeding 4%.[111]

However, since GVCs integration has two dimension, it's pivotal to take into account and assess how the US firms are dependent on foreign intermediate goods and services. In motor vehicle, basic metals and petroleum and fuels industry which are the most deeply dependent on foreign intermediates, roughly one- third of the value that is eventually exported consists of foreign value added. For instance, in US motor vehicle industry China constitutes the second- most important supplier of intermediates. In general China

[107] H. Erken, US global value chain integration: a major impediment for Trump's protectionist trade agenda, (Rabo Research- Economic Research, 2017)
[108] *Ibidem*
[109] J.Parilla, How US states rely on NAFTA supply chain, (Brookings, 2017)
[110] F. Biondi, The Mexican automotive industry and Trump's USA. (Bruegel, 2017)
[111] *Ibidem*

is among the most important suppliers of intermediate goods to American firms, together with Germany, Japan, Mexico and Canada.[112]

The American states' reliability on intermediate imports from those countries varies on the basis of geographical location and industry makeup. According to recent data from the United Nations' definition of intermediate goods shows that the American largest states have a bigger share of intermediate goods imports from North America. Indeed, Michigan, Ohio, Texas, New York and Washington import more than 15 billion in intermediate goods, accounting for over half of the nation's total. This means that in case of disruptions to trade in these states national economic growth can be negatively affected.

However, the production of many American states depends on NAFTA imports which is measured by the share of total intermediate goods imports that come from Canada and Mexico. The more the states rely on NAFTA intermediate imports as a share of their total import base, the more they tend to be involved in one of the main broad sectors, notably energy and advanced manufacturing.[113]

In 2019, the US production of motor vehicles amounted to 64.8%, while Mexico'share recorded an increase which goes from 7.1% in 1994 to 23.8% in 2019. During this period between 1997 and 2019 bilateral trade in motor vehicles and parts between the United States and Canada was relatively constant, whereas US- Mexico bilateral trade increased in nominal terms.[114]

Information in this part are grounded on the work published by Brooking entitled "*How US states rely on the NAFTA supply chains*" and explains how central is the role played by trade among NAFTA member for US regional value chains. For what concerns advanced manufacturing, many states experiment a great dependence on intermediate imports from Canada and Mexico. For instance, in Michigan the automotive industry has relied on Canadian and Mexican suppliers who provide 61 percent of Michigan total intermediate imports. North America chain relationships extend to the remainder of the

[112] H. Erken, US global value chain integration: a major impediment for Trump's protectionist trade agenda, (Rabo Research- Economic Research, 2017)

[113] *Ibidem*

[114] R.F. Ferer, A.B. Schwarzenerberg, Global Value Chains: Overview and Issues for Congress, (Congressional Research Service, 2020)

industrial Midwest. North American most prominent shared industry is automotive manufacturing.

In the US the second main sector that relies on NAFTA intermediate imports is energy. Indeed, the US is one of the major importers of crude oil from Canada and Mexico. Many states such as Illinois, Texas, Colorado, Oklahoma, Washington and Montana are greater intermediate goods importers, especially of crude oil which is the largest intermediate good import.

In addition, Mexican Petroleum ships through the Gulf of Mexico to main refining and chemical manufacturing hubs in Louisiana, Texas and Mississippi. In spite of the expansion of domestic energy production in the recent years, the US still relies on North America partners for the creation of the basic inputs to everything from plastic to chemicals.[115]

Between 2000 and 2014 the American supply chain which is the second largest supply chain in the world, underwent a process of progressive expansion due to the major contribution of the third economies.[116]

Between the beginning of 2000s and the onset of the global economic recession the amount of domestic value -added part of the American manufacturing production drop by 3 points (from 88,1% to 84,8%). Furthermore, the reorganization of production processes at international level has undergone a setback. This has been proved by the fact that in 2014 the American domestic participation settled around 84.4% which is higher than Italian manufacturing supply chain which amounted to 74.4%. In 2014 the amount of value added brought by NAFTA members to American manufacturing increased with the share which goes from 2.7% in 2000 to 3.3% in 2014. This phenomenon reflects the increase in trade relations established between Mexico and Canada on one hand and United States on the other hand. The direct implications of trade relationships within this area are in first place the delocalization of production processes, especially if we deal with automotive sector.[117]

[115] J.Parilla, How US states rely on NAFTA supply chain, (Brookings, 2017)

[116] Timmer, M.P., Dietzenbacher, E. Los B.,Stehree, R. and de Vries, G.J. An illustrated User Guide to the World Input-Output Database: The Case of Global Automotive Production, (Review of International Economics, 2015) 23/3; pp 575-605

[117] I. Sangalli, Il modello manifatturiero statunitense: quali evidenze dalle catene globali del valore, (Direzione studi e ricerche Intesa Sanpaolo 2018)

These ties are very strong due to the US active participation in Mexican and Canadian production chains as shown in the table 2.1:

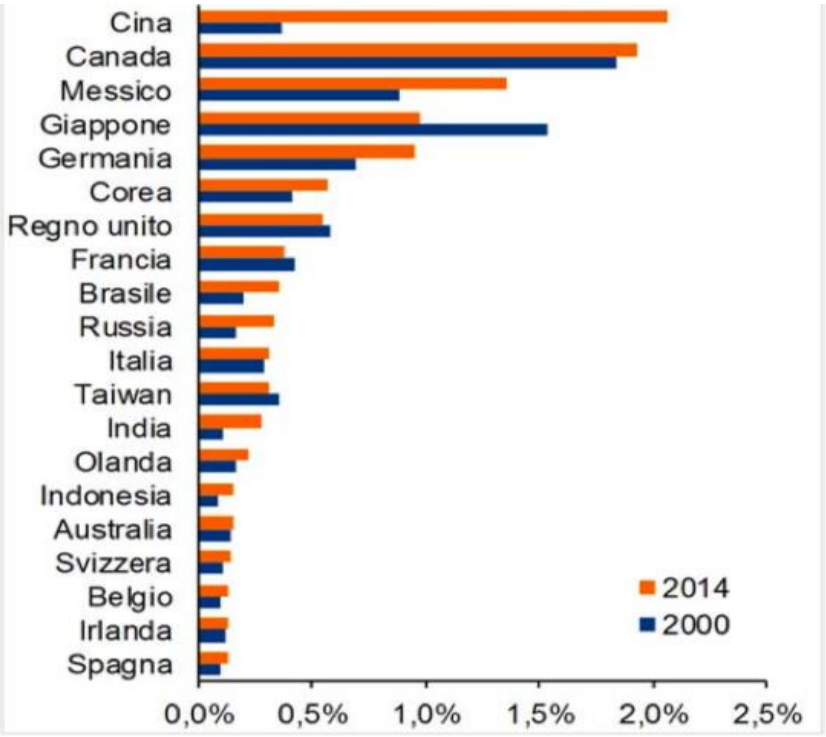
Table 2.1: US Value added embodied in the manufacturing production of third countries

	Livello (milioni di USD)	Peso degli USA nelle GVC di paesi terzi
Totale Mondo (incluso contributo alla GVC domestica)	2.163.812	15,1%
di cui:		
Resto del Mondo*	73.477	3,9%
Messico	51.830	14,9%
Cina	35.762	1,1%
Canada	33.232	17,1%
Germania	20.398	2,2%
Giappone	13.523	1,8%
Irlanda	12.076	19,2%
Brasile	11.943	2,4%
Francia	11.728	3,4%
Corea	11.017	2,8%
…	…	
Stati Uniti (contributo alla GVC domestica)	1.826.263	-

Source: Intesa San Paolo, Direzione studi e ricerche, WIOD database 2016

Table 2.1 illustrates us that the US contributes to Mexican manufacturing output with a share of 14,9% whereas the share for Canadian production amounts to 17,1%.
Moreover, Asian countries, including Japan, China, Korea and Taiwan play a growing and significant role in US manufacturing Value Chains. Asian contribution to US manufacturing sector increased from 2,9 in 2000 to 4,4% in 2014, taking over European contribution.

Figure 2.11: Value added embodied in American manufacturing production



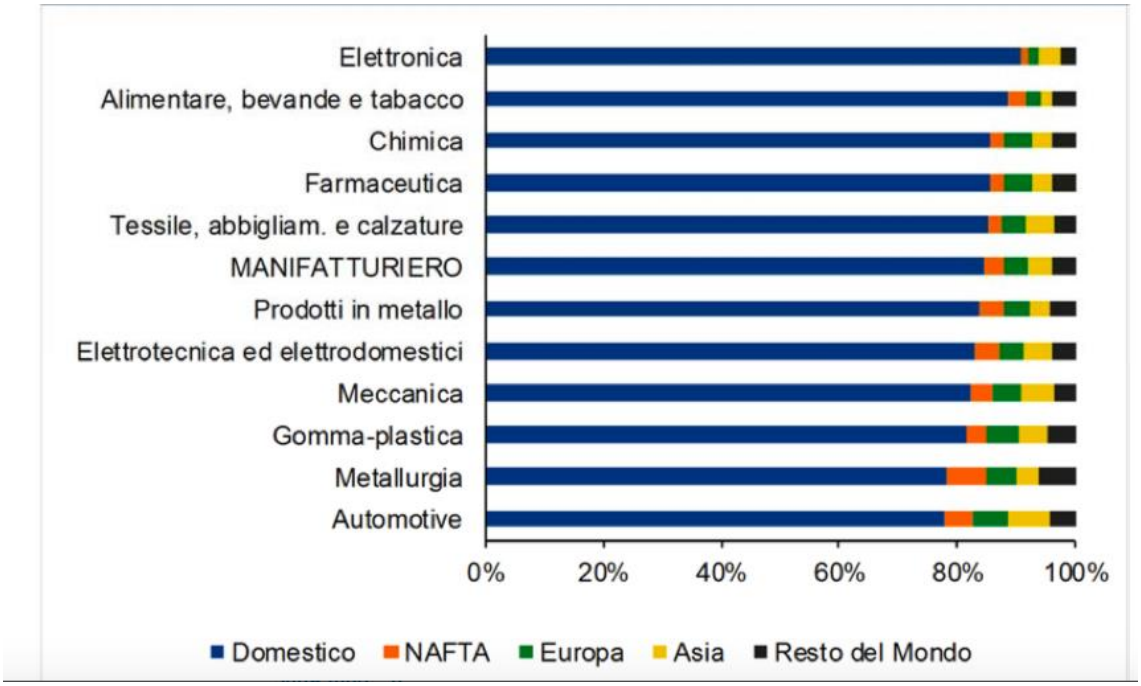
Source: Intesa San Polo Group, Direzione Studi e Ricerche; based on WIOD database, 2016

Looking at the figure 2.11 we can point out that if we single out NAFTA as a single player, thus considering Canada and Mexico as two separate members, China is the main contributor to US value chains, followed by Japan which is a US traditional trade partner. This data not only confirms the strong and sound productive ties between US and NAFTA countries,but shows a progressive Asian participation in US global value chains in manufacturing sector.

Furthermore, it's possible to analyze more in detail every sector of the manufacturing value chains, in order to deep dive each specific segment and the balance between domestic value added and foreign value added provided by other countries. It emerges that electronic sector has the biggest domestic contribution amounting to 90,7%. However, it's interesting to observe that all the other sectors are quite aligned. The automotive has the lowest domestic contribution (77,9%) respect to the electronic contribution as indicated before.[118]

[118] I.Sangalli. Il modello manifatturiero statunitense: quali evidenze empiriche dalle catene globali del valore, Direzione studi e ricerche, Ottobre 2018

Figure 2.12: Value added embedded in the main US manufacturing GVCs



Source: Intesa San Paolo Group, I. Sangalli, WIOD Database, 2016

In the field of mechanical engineering ties with NAFTA are strongly consolidated. Indeed, in the value chain concerning this sector NAFTA participation is characterized by a share of 14.5%. However, these sectors involve high Asian value added which provide a remarkable contribution, especially from China whose shares reach 7.2% in the automotive sector and 5.4% in mechanic. Additionally, Asia is a key player in the American GVC in the textile, clothing and footwear sector where Asian share amounts to 4.5%. European countries too actively operate in American value chain, especially in the automotive sector with a share of 5.9% as well as in the steel industry where European share amounts 5.3%.[119]

In this framework which is characterized by the active participation of many states, notably China and some European ones such as Germany and France, automotive supply chain represents the core sector for American economy, which directly uses metallurgical products. However, these products suffer from the ongoing changes begun with the trade

[119] *Ibidem*

war which as we have seen in the previous chapter, has shaken the international trade arena as the aftermath of the internalization of production.[120]

In this last part of the chapter grounded on the work "*Il modello manufatturiero statunitense,: quali evidenze dale catene globali del valore*" carried out by Direzione Studi e Ricerche San Paolo, we further proceed in the analysis of US value chains The American metallurgical supply chain is the fifth biggest in the world with a share of 4.2% in the global production relative to this sector. The domestic value added in relation to metallurgic sector is equal to 78.3% according to 2014 data. This data is aligned with the more recent analysis carried out by World Steel Association according to which that share in 2017 amounted to 76.8%. If we look at the supply relations which tie US and other countries, we find again NAFTA countries which contribute with a share equal to 4.5% and 2.1% respectively for Mexico and Canada. Instead in this sector China ranks as the third player with a lower contribution (less than 2%).

Furthermore, Russia and Brazil provide a remarkable share of semi-finished products which are often used in American industries. South Korea is another key player in the American value chain because of the existence of a main Korean-US joint venture on the spot, the so-called USS-POSCO industries. On the contrary, for what concerns European countries, France and Italy provide a narrower contribution to American output in metallurgical sector than Germany which in turn contributes with a share of 1%, whose steel is widely used in American production. The assumption to substitute the imported production with domestic one would not only trigger changes in the structure of the American value chain, but it would hurt US participation to other countries' GVCs. Indeed, US is key player in Canadian, German and Italian metallurgic production respectively amounting to 11.8%, 2.7% and 2.3%. Moreover, shifts in the domestic production model could bring about unbalances on final prices. Therefore, price increases would disadvantage American producers which are placed in a downstream position in the steel supply chain.

On the contrary, US automotive sector occupied the second place as a supply chain with one of the biggest values of production in terms of vehicles and means of transportation. What clearly emerges is that this sector is characterized by one of the highest levels of domestic contribution amounting to 77.9%. In this framework it's pivotal to underscore

[120] Ibidem

that the input-output approach considers as domestic production also that realized by local factories under foreign control which is a very common phenomenon in this sector.

The strong trade tie between US and NAFTA is confirmed in this sector too which receives a share amounting to 4.9% for the American automotive production.

By the same token, US fuels Mexican and Canadian output of supply chains by contributing respectively with a share of 18.2% and 26.3%.

China remains one of the major actors in American chain whose contribution in terms of value added is 3.2% which is higher than that provided to European automotive GVCs.

In other words, a key role is played by the value-added embedded in Chinese automotive production. Instead, the participation of the major European economies to the US automotive supply chain is narrow. This is proved by the fact that the European core countries jointly contribute to the US output in terms of value added with a share of 2.9%.

In relation to European countries, just Germany's participation consists of 1.6% share to US supply chain which in turn contributes to Chinese value chain with a share of 2.2%.

US value added play a key role also in the French value chain with a contribution equal to 7%.

Table 2.2: Scomposition of US Value-added embedded in the world automotive production

	Livello (milioni di USD)	Peso degli USA nelle GVC di paesi terzi
Totale Mondo (incluso contributo alla GVC domestica)	516.687	16,8%
di cui:		
Messico	15.611	18,2%
Canada	15.296	26,3%
Resto del Mondo*	14.259	4,7%
Cina	7.263	1,0%
Germania	6.647	2,2%
Francia	6.280	7,0%
Corea	4.100	2,9%
Giappone	3.767	1,9%
Brasile	3.259	3,2%
Regno Unito	2.774	4,0%
India	1.502	1,8%
Spagna	1.193	2,1%
Italia	961	1,9%
...	...	
Stati Uniti (contributo alla GVC domestica)	427.338	-

Source: Intesa San Paolo Group, I.Sangalli, WIOD Database, 2016

According to the WIOD analysis carried out in 2014, 35 countries out of 43 record value added surplus against US. More in detail, the US biggest deficit emerges toward China and stems from the big difference in terms of value added since US contributes with a share equal to 121,6 billions of dollars, whereas Chinese contribution amounts to 326,8. From this assessment based on input-output trading and US supply chain it emerges that despite its global development and its worldwide integration even US manufacturing model in many sectors is based on less integrated value chain at international level. It's undisputed that NAFTA members remain US strategic partners in many sectors, but the global character of US value chain is conferred by Asian participation in US GVC. Indeed, Asian contribution to US value chain can be observed in the automotive sector (7.2%), in mechanical industry (5.4%), in the electrical engineering (4.7%) as well as in the American textile, clothing (4.5%) and electronic (4.5%) which is the US less integrated supply chain. This global character is strengthened also by European direct and indirect contribution to US value chain, especially in automotive sector.

Since each regional value chain is mainly dominated by one key hub, US represents the key hub for Factory North America as we have seen previously. Additionally, the US, followed by Japan and Germany, is the most central hub also for computing and electronics sector. By the same token, the US position for services is not far cry from that of goods; indeed, since 1995 US, as well as Germany has not dramatically reduced its centrality as service hub. In few words, US as central service hub include US financial, insurance, business and wholesale services.[121]

From both GDP and international trade volume's perspective China and US rank the top in the world. Nonetheless, they occupy completely different GVC positions. According to many economists, notably Miller and Temurshoev the difference in GVC position between US and China regards their different industrial structures since the share of manufacturing output in total output is larger in China than in the US. However, other studies, for instance those carried out by other scholars point out that different industrial structures between China and US is not the only reason for their different GVC positions. In this analysis, the direct difference in positions of each industry in the global value chains must be reckoned as a key determinant for the different GVC positions of the two

[121] F. Dai, R. Liu, H.Guo, X. DU. How does intermediate consumption affect GVC positions? A comparison between China and US, (China Economic Review, 2020) 63/101531

countries. The finding is that the intermediate consumptions of China and US vary widely.

In this framework indeed, the two countries played a different role in the international division of labor and due to this different role, the manufacturing and service sectors have different interactive structure.[122]

In conclusion, US value chains has developed both globally and regionally but one of the main differences between Asia and US value chain is that intra-regional linkages are much weaker in North American or Central and South American production networks. This is clearly proved by the fact that less than 20% of the centrality of US, Canada and Mexico stems from other North American linkages. This share is far lower than intra-regional Asian or European linkages. The pattern of weaker intra-regional sources of centrality holds more generally within many manufacturing sectors too.

[122] *Ibidem*

CHAPTER III: The impact of pandemic crisis on GVCs and on Globalization

3.1 The outbreak of Covid 19: an unprecedented crisis

After decades of increasing globalization both in trade, capital flows and people movements the trend has turned towards deglobalization. Indeed, even before the pandemic GVCs were experimenting a process of cyclical slowdown, partly physiological as a natural adjustment. The pandemic crisis took place in this framework, contributing to the acceleration of this trend characterized by uncertainty triggered by 2008 trade collapse and by geopolitical tensions created by US-SINO trade war.[123]

The world is in the midst of a dual crisis which represents a treat for both health of millions of people and the world economy. Compared with the global financial crisis and other severe economic and financial shocks the impact of Covid-19 on GVCs is far more global, larger scale and long lasting.[124]

The economic effects of Covid-19 have re-ignited discussions on the benefits and costs of GVCs. In particular, the economic and political debate focuses on whether GVCs increase risks and vulnerability to shocks. In other words, the issue at stake is whether the gains from expanding international specialization are worth the associated risks and whether more national and localized production would provide greater security against disruptions that can lead to shortages in supply and uncertainty for consumers and businesses.[125]

[123] G. Giovannetti, M. Mancini, E. Marvasi, G. Vannelli. "The role of global value chains in the pandemic: impact on Italian firms. Review of Economic Politics 2/2020 (Confindustria Servizi, 2020)

[124] E. Yeyati and F.Filippini. "Social and economic impact of COVID-19". (Brookings 2021)

[125] OECD. "Shocks, risks and global value chains: insights from the OECD METRO model". (Organisation for Economic Cooperation and Development, 2020).

In particular, COVID-19 raised once again questions concerning reshoring, nearshoring and regionalization of value chains. The pandemic crisis, followed now by the war in Ukraine, has challenged the configuration of global supply chains. The spread of Covid-19 with its consequent lockdowns seriously had an impact on the national economies, with severe implications for international trade. Indeed, Covid-19 pandemic with its consequent transport, labor and logistics disruptions had repercussions on both exports and imports side of different products to a similar extent.[126]This contributed to the acceleration of the slowdown which had already been ongoing. It is undisputed that the pandemic crisis triggered by the spread of Coronavirus was unprecedented in the history of global economy. One of the major serious aftermaths has been that the return to national production, looking for self-sufficiency and firms have tried to relocate through the phenomenon of reshoring basically consisting in bringing back home their economic activities which had been previously delocalized in Asian countries. In other words, the health emergency jointly with the geopolitical tensions has rekindled economic nationalism resulting in the repositioning of supply chains for critical goods and services.[127]

In addition, the pandemic and the war in Ukraine have jointly confirmed the fragility of many national leaderships and the weakness of many international organizations, such as UN. However, the spread of Covid-19, as well as the Russian aggression to Ukraine has forced states to act jointly by creating an efficient multilateral cooperation to successfully face the crises.[128]

This crisis is very different from the previous ones which had remarkable repercussions on the GVCs for several reasons. Firstly, the most involved areas are the main actors in the international trade. Indeed, Chinese economy was affected by a remarkable slowdown in terms of economic growth especially during the quarantine. In fact, China shrank by 2.6% down and economic growth slid to 0.4% from the earlier quarter's 4.8%. This undoubtably had also serious effects on the worldwide economies since China is the first world exporter and the second importer, meaning that the impact of its almost setback hit also other trade flows at global level. Indeed, in February 2020 Chinese exports

[126] *Ibidem*

[127] S. Cassanese. "Ma il mondo ora è meno globale". (Corriere della Sera, 2022)

[128] *Ibidem*

experienced contracted to 60% of those in February 2019. Furthermore, besides being one of the main exporters and a crucial market of final goods given its dimension and its role in the global economy, China bulky participates in the GVCs and its participation is pivotal in many sectors such as electronics, automotive, telecommunications and so on. Through its chains of production, the effects of slowdown quickly spread also towards the other countries which were not directly involved in the health emergency. Historically, these effects had been observed in 2002-2003 with the outbreak of SARS, started in China. Yet, the 2002 health emergency had been narrowed and much more contained. Moreover, at that time China did not play a key role in the world trade than nowadays. This means that the consequences had not been so heavy even though they hit many sectors in many areas. On the contrary, in the Covid-19 scenario, the worldwide economic activities recorded a dramatic drop in the production both of goods and services, as well as incomes. Indeed, in 2020 the value of exports of serviced in OECD countries declined by -16.7%, while the value of goods exports recorded a drop by -8.2%. The inevitable consequence was the fall of the demand for intermediates and final goods. [129]

Secondly, the closure and the slowdown of many economic activities clearly affected the production of the worldwide firms bringing about a trickle- down effect on international trade. The reason lies on the fact that trend of trade all over the world is associated with changes in production due to the strong interconnections among countries. Therefore, when one of the most pivotal economic system slowdowns, as in the Chinese case, the consequence is a domino-effect, meaning the transmission of shock to other interconnected system. For instance, an example lies on the fact that drops in demand due to COVID-19 supply chain impacts put 292 million jobs worldwide at risk in the manufacturing sector. In addition, health crisis resulted in a third of total GDP contraction because of transmission mechanism of GVCs.[130]

Thirdly, the 2020 pandemic crisis has had a completely new feature: in the first months of the spread of Covid-19 the movement of people, goods and capital halted as never before. This allows us to say that Covid-19 has disrupted the smooth operations of GVCs

[129] P. Agarway, A. Shingai. "Global Value Chain responses to previous health shocks: Lessons for Covid-19". (CEPR VOX eu 2020)

[130] R. Strange. "The 2020 Covid-19 pandemic and global value chains". (Journal of industrial and Business Economics 47, 2020; pp. 455-465)

through lockdowns and border closure which restricted the mobility of labor. In addition, the contagion effects spread via value chains globally hitting hard every country and the uncertainty undermined and hampered investment with a global FDI drop of 42% in 2020 as well as a loss of 12.6% of global GDP due to Covid-19 lockdowns. The impact of COVID-19 on FDI has remained longer than that on trade and the reasoning lies on the fact that MNCs are loathing to make investments plans in this scenario characterized by a high level of uncertainty in the global economy. [131]

In other words, in the last two years the world economy has attempted to cope with unprecedented shock, as the impact of the pandemic unfolded, global trade was struck in a manner as never experimented before. The analysis carried out in this last two years suggest that GVCs could remarkably amplify the decline in world trade. However, this finding had been already reached also by analyzing the impact of the previous crises, such as 2008 Global financial collapse.[132]

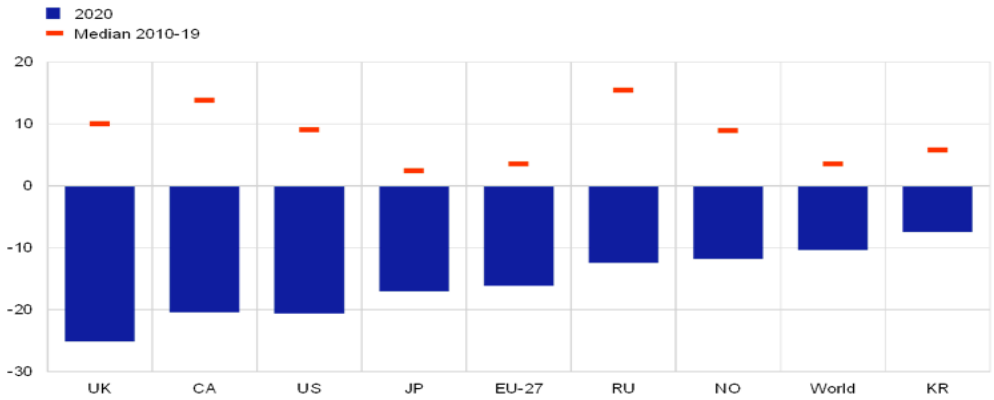
In COVID-19 scenario, world trade has fallen sharply as result of Covid-19 pandemic which struck the smooth operations of GVCs. Some signs of recovery have emerged recently, after an expected decline at unprecedented pace of around 13% in 2020 before returning to positive rates of growth of 8% and 4.3% respectively in 2021 and 2022. Part of this decline stems from disruptions in GVCs since Covid-19 has hit value chains in Asia, Europe and the Americas bringing about the domino effect with feedback loops which in turn amplified the collapse in global trade.[133]

Figure 3.1: Chinese exports of intermediate goods

[131] WTO. "Global Value Chain Development Report 2021: Beyond production, Key messages and findings". (World Trade Organisation, 2021)

[132] R. Bems, R.Johnson and Yi K-M-M."Demand spillovers and the Collapse of Trade in the Global Recession". IMF Economic Review,Issue 58/ 2 (International Monetary Fund, 2010)

[133] S. Cigna, L. Quaglietti. "The great trade collapse of 2020 and the amplification role of global value chains". (European Central Bank, 2020)



Source: Trade data monitor and ECB staff calculations, ECB, 2020

The figure 3.1 provides us a view of the effects triggered by the sharp fall in Chinese exports of intermediate goods across most destinations in the period from January to March 2020. The figure clearly suggests that Chinese lockdown resulted in hard and wide blow to GVCs since the very beginning.

Although since 2008 the expansion of GVCs has reached a standstill due to the Global financial crisis, trade in intermediate goods still plays an important role. The trade of intermediates has significant implications for demand and production, as well as trade itself. This means that in a world characterized by complex international supply chains, changes in demand in third countries are core factors. In this part, the analysis regarding the unprecedented features of COVID-19 has utilized the article published by the ECB in 2020 whose title is "The great trade collapse of 2020 and the amplification role of global value chains". As the title of ECB's article said, the global production networks act as a channel through which demand shocks are transferred to input suppliers with the initial shock being magnified by the "bullwhip effect" which it has been already mentioned in the first chapter dealing with 2008 Global financial crisis and its consequent trade collapse. Supply disruptions can, in turn, be transmitted downstream. As we have observed in the 2008 trade collapse, the "bullwhip effect" concerns a situation in which a shock translate into disruptions to demand for parts and components which heighten the further upstream a firm is located in the supply chain. Firms are prompted to adjust their inventories along the supply chain to meet new expected levels of demand.

The propagation and amplification effect of demand shocks associated with the pandemic can be observed in the global input-output tables carried out by OECD which has been

used as a tool to assess sectoral losses brought about by the pandemic for 20 major advanced and emerging economies through the global production structure. The overall response of world trade depends on sectoral composition of losses across countries. The partial elasticities computed by ECB on the basis of input-output data are useful to translate domestic and foreign demand shocks triggered by the pandemic into proportional changes in output and imports and exports of intermediate and final goods to and from all countries and sectors. According to this analysis it has been confirmed that GVC linkages remarkably amplified global trade decline. In the US for instance, imports and exports drop by 8% and 20% respectively due to the amplification role played by GVC linkages. In China, Japan and UK imports-related spillovers have been larger.[134] COVID-19 shock struck GVCs in two ways: directly on the supply side, meaning via disruption to people, capital, infrastructure and transportation or indirectly, via interrupted flows of intermediate goods and services upstream, and also on the demand side. Covid-19 has proved us how GVCs can play a crucial role by hastening pandemic via international travel, geographic agglomeration, population density, urbanization and high socioeconomic globalization. Covid-19 containment measures, including lockdowns, borders closings and spillovers dramatically reduced production which in turn triggered declines in labor-force participation. [135]

Basically, unforeseeable shocks can occur in both economic regimes, notably the localized regime and the regime with production fragmentation in GVCs. A localized regime where economies are less interconnected via GVCs, has remarkably lower levels of economic activity. In this case, in the face of economic slowdown triggered by pandemic GDP losses would be further bigger with an increased localization. A localized regime is characterized by less geographical diversification of production stages in supply chains. What emerges is that a localized regime is not less vulnerable to shocks than the other regime involved in GVCs. The reason can be explained in this way: it's true that the external shocks have fewer and narrower trade channel to propagate, but at the same time the localized regime does not offer immediate and many opportunities for adjustment to these shocks. In other words, the lack of adequate, effective and immediate adjustment channels and mechanisms increases the instability in trade, incomes and prices as well as

[134] *Ibidem*

[135] *Ibidem*

household incomes and expenditures. By the same token, domestic shocks generally have bigger effects on the home economy than external shocks. In addition, in the localized regime these shocks are also magnified since it's more difficult to cushion impacts through trade. As last point, even under a localized regime the production stages cannot be fully undertaken domestically, meaning within the home country, and this implies the need to rely on trade in intermediate inputs and raw materials for certain productions. In this kind of regime when there is a disruption somewhere in the supply chain, it's more costly and harder to find ready substitutes. The consequence is greater risk of insecurity in supply.[136]

The pandemic crisis has raised many questions concerning the gains and the costs of the international specialization in GVCs, particularly whether governments should use policy tools to "re-localize" GVCs. The "re-localization" policy is a double-edge sword, because on one hand countries and industries reduce their exposure to foreign shocks to some extent, but they are also less efficient and less able to cushion shocks through trade.[137]

The risks associated with GVCs emerged in the first phase of the pandemic in early 2020. Indeed, as most global manufacturers have some economic activities in China many businesses have been affected by the disruptions to supply chains, production and trade. One peculiar element of the spread of COVID-19 and its consequent pandemic was the global shortage of medical devices, including shortages of supply of personal protective equipment (PPE) and ventilators. These global shortages were caused by the unprecedented demand shock spurred by the propagation of the pandemic crisis around the world, not from the supply side.[138]

The issue of shortages of ventilators is also related to investments since ventilators require heavy investments to be produced. The situation is different for COVID-19 tests kits can be effortlessly produced given that their inputs (chemicals and reagents) are not difficult to manufacture. [139]

---

[136] OECD. "Shock, risks and global value chains: insights from the OECD METRO model". (Organisation for Economic Cooperation and Development, 2020)

[137] C. Arriola et al. "Global Value Chains: Efficiency and Risks in the context of COVID-19, Tackling coronavirus (Covid-19): contributing to a global effort". (Organisation for Economic Co-operation and Development, 2021)

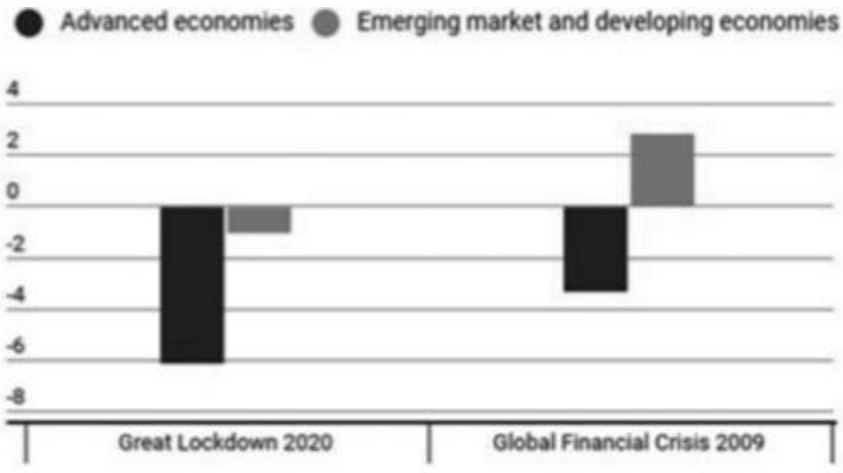
[138] S.Cassanese. "Ma il mondo ora è meno globale". (Corriere della Sera, 2021)

[139] R. Baldwin, S. Evenett. COVID-19 and Trade Policy: why turning inward Won't Work. (Centre for Economic Policy Research, 2020)

At the beginning of 2021, one year later the breakout of Covid-19, the effects of the crisis were still heavy, but it seems that some of these disruptions have proven to be temporary. For instance, Chinese exports, especially of medical products, were already back on track in February 2021. Despite some bottlenecks in the domestic processing and retail distribution, GVCs in the food industry succeeded in proving their resilience as well as their robustness. More important is the contribution of the GVCs in alleviating demand pressures for essential supplies. China itself for instance, was successful in addressing the shortage of facemasks, by ramping up its production to supply countries in need.[140]

In this framework, it's important to examine more in detail the role of the GVCs in the international transmission of shocks during the Covid-19 pandemic. According to the IMF, during the 2008 financial crisis the share of countries with a negative GDP growth rate was more than 60 per cent, while in the recent health crisis the share was 90 per cent. Another difference between the pandemic crisis and the 2008 Great Recession is that whereas in the financial crisis the emerging economies kept to some extent a positive growth trend, in the pandemic they have been seriously affected.[141]

Figure 3.4: **Comparison of GDP decline during the Great Lockdown and 2008 Financial crisis**



Source: Istituto Affari Internazionali, 2021

[140] IMF. World Economic Outlook, 2020: The Great Lockdown. (International Monetary Fund, 2020)

[141] A.M. Pinna, L. Lodi. "Trade and Global Value Chains at the Time of Covid-19". The International Spectator. 56/ 1 (2021) pp 92-110. (Istituto Affari Internazionali, 2021)

Furthermore, in 2009 India and China were able to recover fast but in the recent crisis they have faced more difficulties. The initial drastic lockdown with all the restrictive measures resulted in the contraction of economic activity. Only in the first quarter of 2021 trade in China and India, as well as South Africa recovered, while in other major economies the rebound began in the fall of 2020.[142]

Nonetheless, the most remarkable element which is undoubtably unprecedented is the detrimental combination of domestic and external shocks. To begin with, the system has been overwhelmed by a level of uncertainty due to the evolution of the health crisis and the measures taken to fight against the virus entailing severe economic and financial implications which cannot be compared to any other previous event. Secondly, the Covid-19 first affected countries which are part of the global manufacturing heartland, notably China, France, Germany, Italy and US. As it has been stated previously, during the pandemic emergency the world experienced a joint supply and demand shocks, and this effect was amplified by the interconnections among countries and firms. This implied that even less affected countries have been seriously hit due to their interconnections which triggered a domino effect.[143]

Another aspect is the unprecedented speed with which supply-side impact expanded causing downturn in business activity never experimented before. In this dramatic framework, for the first time since the Great Depression, advanced nations, developing economies and emerging markets entered a recession at the same time.

The comparison between 2008 financial crisis and the 2020 pandemic crisis puts in evidence some differences: first of all, the 2008 recession primarily impacted the US and Europe whereas today's crisis hit all the world's largest trading nations within few months. Indeed, China, US, Japan, Germany, Italy, France and UK accounted for 60% of world supply and demand (GDP). In few words, the aspects which characterize the global pandemic require exceptional measures to handle it because of its global and interlinked nature.[144]

---

[142] A. Nicita. "Global trade's recovery from COVID-19 crisis hits record high". (United Nations Conference on Trade and Development, 2021)

[143] R. Baldwin and R. Freeman. "Supply chain contagion waves: Thinking Ahead on Manufacturing' contagion and Reinfection from the Covid Concussion". (Centre for Economic Policy Research Vox EU, 2020)

[144] R. E. Baldwin, S. J. Evenett. COVID-19 and trade policy: Why Turning inward won't work. (Centre for Economic Policy Research, 2020)

3.1.1 The need of exceptional cooperative approach: How trade can fight the pandemic

Since the crisis is both exceptional and global likewise the response is to be exceptional and highly coordinated. The European Central Bank indeed adopted strong monetary policy and supervisory measures. European governments, followed by other states outside Europe implemented fiscal measures in order to cope with the economic fallout.[145]

Nations across the globe ordered the restrictions of cross-border trade and in this framework trade policy is aimed at facilitating national responses to the health crisis. According to Richard Baldwin and Simon Evenett turning inward is not a good solution because it is not efficient in the fight against the pandemic as well as leading to economic recovery. The pandemic situation especially at the onset of the first wave of the pandemic required the increase in the output of personal protective equipment (PPE) by 40 per cent as well as drugs and future vaccine. Given the huge effort which is required in order to satisfy the need of medical staff, production international supply chains are crucial in tackling an event which affected the globe without exceptions. Delays in the spread of Coronavirus helped in the fight against the pandemic because in this way for instance buyers could switch between suppliers and therefore the risks of dependence on any of them could be reduced. Furthermore, the risk of dependence on a concentrated, national or foreign production site, could be reduced by having the production localized in more than one place for several steps of the process which are accessible to a large number of countries. Many factors contribute to support the wall of resistance to using Global value chains as a tool for combatting the virus as well as facilitating recovery. All this information, including that included in the following paragraph are grounded on the work published by CEPR whose title is "COVID-19 and trade policy: why turning inward won't work". This paper written by Simon J. Evenett and Richard E. Baldwin help us understand why and to what extent re-nationalization hurts recovery.

[145] J. Anderson, E. Bergamini, S. Brekelmans, A. Cameron, Z. Darvas, M. Dominguez Jimenez, C. Midoes. "The Fiscal response to the Economic Fallout from the Coronavirus". (Bruegel 2020)

Due to the internationalization of firms, many developed economies have seen huge increases in productivity in manufacturing sectors. As we have seen in the previous chapters, the financial crisis led to a decrease in the importance of the global value chains in total trade which is still growing but at a lower rate than the previous decade. The pandemic has raised many issues concerning either a return to the nationalization of the supply chain or a diversification of production sites aimed at ensuring better security of supply and safe delivery. The changes in the geography of production may have positive impact, since that less common investment destinations could take advantage of the relocation of international supply which could allow them to expand their participation in global value chains.

Moreover, as it has been yet confirmed by the 2008 financial crisis, the reaction of the GVCs to the crisis is a potential re-design in the direction of shortening their legs. Many authors agree on the effects of renationalization in the face of pandemic-induced GDP change in a world with interconnections and in one where supply chains have adjusted by relying only on domestic inputs and what has emerged is that the nationalization of supply chains may be a feasible option in order to make national economies resilient but only where governments implemented less stringent lockdown measures. The logic is easy: in countries characterized by an entirely domestic production process, lengthy closures will produce more serious effects on GDPs. Additionally, in terms of quality and competitive prices consumer choices could be damaged by a radical renationalization having the aim of reducing import dependence. Indeed, this could be particularly detrimental for public health and for the system especially when the global economy needs rapid responses to crises.[146]

The matter of export restrictions is particularly important when dealing with medical products which normally are available at reasonable prices but in a situation of export restrictions, the aftermath is a costly trade policy, given that export restrictions increase international prices and have significant distributional implications between countries, with an impact on both importing and exporting countries. The absence of strong manufacturing capacity which ensures medical product to the population renders the countries more vulnerable to the limitations on cross- border movements. This feature is

[146] A. Stellinger, H. Isakson, I. Berglund. "To Protect Public Health, Preserve the Global Value Chains". (Centre for Economic Policy Research, 2020)

common in many developing countries and small and poor countries. Reliance on domestic production processes entails limited access to life-saving resources. According to many economists, notably Eichengreen and Irwin, restrictive trade policies were destructive and counterproductive, thus hampering recovery. Other authoritative experts agree on the effects of protectionism measures. For instance, the IMF'S chief economist, Gita Gopinath argues that protectionism measures are not a solution to the crisis because the adoption of restrictive trade policies is a threat which may reverse all the gains generated by globalization.[147]

However, today's protectionism related to Covid-19 crisis is slightly different from the previous protectionisms because during the Global financial crisis, protectionist measures were addressed to amping up exports than shutting off imports while today's protectionist policies have been mostly anti-export. The reasoning behind this sharp change in the form of intervention is that today's problem is mainly a lack of local supply rather than a surplus of local production as in the 2000s.[148]

Nonetheless, these measures are equally short-sighted, and the anti-export intervention may trigger a retaliatory spiral which in turn may destroy supply. Therefore, governments measures aimed at favoring domestic over foreign interests did not work during and after COVID-19 pandemic. The analysis of negative effects of protectionism is largely pandemic-specific. Concentrating production in domestic country does not ensure the non-occurrence of any risk, but on the contrary geographically concentrating production negatively impacts the resilience and robustness of supply chains.[149]

In other words, GVCs have proven their resilience during COVID-19. However, this does not mean that GVCs have reached their best performance and there is no need for further improvement. On the contrary, governments, policy makers and all the other stakeholders have to cooperate to enhance GVCs resilience to disruptions. Indeed, enhancing resilience of the GVCs and trade depends on the smooth functioning of trade logistics which require coordination as well as risk management among firms.[150]

---

147 R. Baldwin, S. Evenett. COVID-19 and Trade Policy: Why turning Inward Won't work. (Centre for Economic Policy Research, 2020)

148 *Ibidem*

149 S. Miroudot. "Resilience versus Robustness in global value chains: some policy implications". (Centre for Economic Policy Research, 2020)

150 I. Durant et al. "Impact of Covid-19 pandemic on trade and development; Lessons Learned". (United Nations Conference on Trade and Development, 2022)

Given that many goods especially medical products are produced using supply chains stretching across multiple national borders, the capacity of a nation's producers of these goods to scale up production during the pandemic is contingent on being able to source enough parts, components and raw materials from their supply chains. In this way, every trading partner involved in the supply chains does not hamper or delay the exportation of intermediate goods, and the GVCs performance is optimized. In a world trading system in which all states participate, buyers can switch between different suppliers, thus reducing the risk of depending on any one of them. This aspect of globalization and the structure of GVCs should be seen as a massive risk mitigation device. Indeed, turning inward policy adopted by too many states would exacerbate the collapse in world trade. International cooperation is extremely pivotal, especially in time of crisis since a condition of block in the supply-chain trade implies that local productive facilities are potentially nationalized in retaliation. [151]

The different governmental efforts require big synergies in order to curb the spread of Covid-19 as well as coping with its adverse effects in the long run which may concur to advocate unilateralism, protectionism and backlashes against economic globalization.

3.2 The role of the GVCs in the international transmission of shocks during the Covid-19

Resilience and vulnerabilities of GVCs to unpredictable shocks were already debated after the 2008 financial and economic crisis and the US-Sino trade war. However, the broke out of COVID-19 crisis has revived these discussions, particularly on whether they tend to mitigate or magnify global shocks. While economists and policy makers agree on the role of GVCs as a propagation channel of international supply shocks, the question on the role of GVCs as amplification tool is still open. Indeed, on one hand GVCs facilitate the propagation of the shocks which becomes faster and wider, on the other hand the fact that multinational firms are larger and differentiated in terms of input providers and destination markets makes them more resilient and contributes to their fast recovery. The role of international trade in the transmission disease had been confirmed even before pandemic crisis. This implies also that globalization and pandemics have been closely

[151] *Ibidem*

intertwined in the past and may interact in several subtle ways. In this debate a particular focus is on the goal of improving stability and resilience to shocks in GVCs.[152]

GVCs are characterized by multiple features which are necessary for the purpose of production efficiency but also determine the exposure to shocks and their propagation along the chain. Indeed, a high reliance of sales on foreign demand and a strong dependence on foreign value-added in production are determinants in the exposure to foreign demand and supply shocks. In addition, the propagation of the shock can be magnified by high centrality of some hubs in GVCs networks. These hubs have the task of driving benefits from GVCs, especially knowledge spillovers.[153]

The pandemic crisis broke out in 2020 has to be seen as a combination of supply and demand shocks ricocheting around the global economy in overlapping waves.[154]

Major GVC hubs were hit by the broke out of Covid-19. In China, the first effect of the pandemic was a production shutdown followed by a collapse in domestic demand. The spread of the Coronavirus towards other Asian countries determined the same shocks with consequent supply shortages of inputs from Asia across the globe. In few weeks more and more countries in the world were seriously affected by the economic consequences of Covid-19 which, as in the Chinese case, triggered production shutdowns. After China, the other countries which experienced such effects were Europe, the United States and the Middle East. The effects were more and less the same across the globe and therefore as in Asia, the local quarantine measures and rising unemployment brought about an initial supply shock followed by a demand shock. China's dependance on other countries' inputs was a remarkable factor in the propagation of shocks. In 2021 in East Asia and in the Pacific region new closures of factories were the corollary of COVID-19 flare-ups.[155]

The part that follows is based on the analysis computed by the European Central Bank in January 2022 which uses IO data. Different dynamics are triggered by demand and supply shock through the supply chain. Demand can be passed upstream through the production chain to input suppliers because of the supply linkages. On the contrary, supply

[152] E. Di Stefano. "COVID-19 and global value chains: the ongoing debate", Questioni di Economia e Finanza, 618. (Banca d'Italia, Eurosistema, 2021)

[153] *Ibidem*

[154] S. Cigna, V. Gunnella, L. Quaglietti. "Global value chains: measurement, trends and drivers" Occasional Paper Series 289. (European Central Bank, 2022)

[155] *Ibidem*

disruptions can be transmitted down the value chain, with the impact provoked by shock affecting the production of trade partners positioned downstream in the production network.

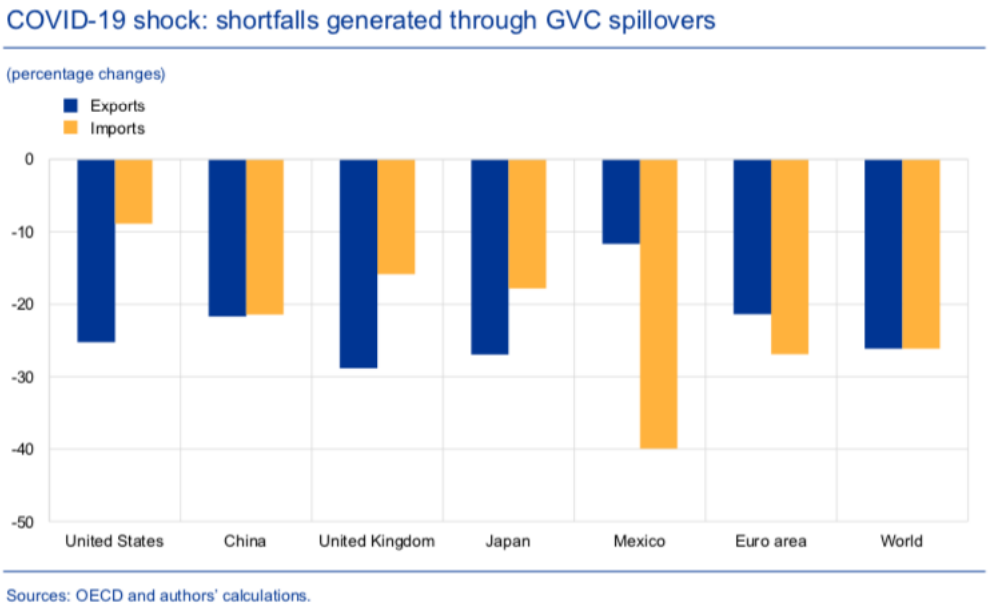
In first part of 2020, output drop in every sector of the global economy with slightly different degrees. According to the calculations carried out by Haver and other authors, food production, real estate and utilities rank among the least affected. Generally speaking, the more activities, businesses are based on direct interactions and physical contact, the larger were their drops. In this sense tourism, arts, transport, entertainment require constant interactions and relations among people.

IO data allows us to assess the role of the GVCs as a channel for the transmission of the sectoral output losses. In the first part of this analysis IO multipliers will be utilized to calculate partial elasticities which translate domestic and foreign demand shocks into proportional changes in production, imports and exports of final and intermediate goods to and from all countries and sector. After that phase, the second step consists of computing two different losses caused by the pandemic: the first group of losses stem directly from trade in final goods, while the second type of losses are indirect to some extent, meaning that are losses originated through the global supply chain; in other words this type of losses are triggered by changes in domestic and foreign demand in third countries and these changes lead to a reduction in the imports and exports of intermediate goods which cross at least two borders. This latter indeed, constitutes the channel through which the GVCs play a transmission role of the effects of the pandemic.

The Covid-19 provoked severe falls in the world trade which have been amplified by GVC-related spillovers which tended to be sizeable for many countries. The graphic below illustrates the potential amplification effect of the GVC trade on the country imports, exports and activity in the face of the pandemic crisis. GVC- related spillovers tended to amplify the shortfalls and drops in imports and exports by 25% for the world economy. The magnitude of the declines depends on the position occupied by each country within the Global Value Chains.[156]

Figure 3.5: Exports and imports-related spillovers in terms of shortfalls

[156] S.Cigna, V. Gunnella, L.Quagliett. "Global Value Chains: measurement, trends and drivers"; Occasional paper series 289. (European Central Bank, 2022)



Source: OECD and S. Cigna et al.' calculations, 2022

In few words, the logic behind the value chain contagion effect is very simple: disruption in the supply chain or the output decline in one country translates into a reduction in its exports to its trade partners because of the so-called supply effect.

Likewise, if a nation records a drop in its income, it will reduce its imports from its trading partners and this reaction is the demand-effect.[157]

From the very beginning of the pandemic crisis, supply chain contagion magnified the direct supply shocks in China transmitting it through the activity of the multinationals. Even before the Coronavirus reached other countries, such as Europe and US, manufacturing sectors in those countries which were not yet directly affected by the Pandemic crisis faced some difficulties in acquiring the necessary industrial inputs imported from that nation which was in the throe of the health crisis. It was self-evident that the transmission channel added further vulnerability to domestic economies. The key element is the worldwide production's reliance on intermediate goods, meaning parts and components of foreign output. For instance, in the manufacturing sector China is the main source of inputs for the three manufacturing countries, notably Japan, Germany and US. The pandemic has also proven that a very high level of reliance on parts and components

[157] A. Pinna, L. Lodi. "Trade and Global Value Chains at the Time of Covid-19", Research Article, The International Spectator, Vol.56, N. 1, pp. 92-110. (Istituto Affari Iinternazionali, 2021)

produced outside the national borders may be a risk and not a very wise strategy for firm since this move may increase the effects of temporary shocks. For instance, firms tend to increase investments in automation in order to reshore production, a strategy which was adopted by the US after the 2008 financial crisis.

However, on one hand the renationalization of the supply chain may make national economies less resilient to severe shocks such as the pandemic crisis.[158]

From the analysis of the GVC trade pattern emerges a regional (intra-bloc) interdependence especially with regard to intermediate goods. The countries first hit by Covid-19 play the most important role. Global interdependence can be seen from different perspective, for instance taking into account how the top traders are crucial partners of smaller countries. The role of the GVCs as a transmission channel in this sense is easy to predict: these interconnections among the states, as well as among industries and firms generates a domino effect. The occurrence of a drop in GDP in the developed world will have an impact on the other neighboring areas, thus affecting their economic stability. In order to cope with this domino effect domestic and international institutions have to coordinate their responses. The main option advocated by governments regards a restructuring of global supply chain, meaning shortening chains. In other words, from global perspective, complex and strong interconnections play a double role since GVC trade is both a magnifier of the consequences of shock provoked by health emergency and a driver of faster recovery. [159]

3.3 GVCs and the effects of Covid-19: the path toward further regionalism

COVID-19 affected GVCs through a series of mechanisms. The first of these mechanisms is related to the adjustments in demand and supply because these adjustments trigger "stress responses" by firms, investors, governments and individuals through domestic and international channel. The forced quarantine and Lockdown measures imposed remote working with a consequent soaring in demand for information and communication technology products, online services and medicines. On the contrary, demand for

[158] *Ibidem*

[159] S. Cigna, L. Quaglietti. 2020. "The Great trade collapse of 2020 and the amplification role of global value chains". (European Central Bank Economic Bulletin 5/2020)

manufactured goods and services plunged, like tourism, airlines, and restaurants which require face to face communication. The effects of virus propagated across countries through the supply side (meaning the closure of economic activities due to lockdown measures) and through demand side (namely reduction in the income as a result of lockdown). According to UNCTAD, the indirect effects of initial lockdowns and closures in China affected other countries. In terms of international trade for instance, UNCTAD calculated that trade drop fluctuated between -13% and -32%.

The spread of Covid-19 triggered shifts in medium-and-long-term investment decisions due to the uncertainty about the recovery of economies and sectors. Indeed, according to UNCTAD, reduction in FDI ranged between 5% and 15% only in March 2020. Yet, when Covid spread to US and ricocheted around Europe the reductions became increasingly drastic with values between 30% and 40% in 2020 and 2021. Chinese manufacturing sector recorded a drop of 22 points only in March 2020. This generated trickle down effects in the supply of intermediate goods on annual basis. The most affected area was Europe which recorded a loss amounting to 15,6 billion of dollars. In Europe, the sectors most affected have been automotive, mechanics and chemical sectors. US too ranks among the countries most impacted with a loss of 5, 2 billion. In US instead the sectors which suffered most have been the sector in the production of precision instruments and machinery and motor vehicles. Japan, due to the linkages with China in the supply chain of intermediate goods, recorded a drop of 5,2 billion.

All the policy measures adopted by governments, such as social distancing, city lockdowns, school closures and national border closures, represent a treat to GVCs.[160]

The second factor playing an impressive role in the spread of Covid-19 is globalization. Indeed, Covid-19 reached every corner of the globe at surprising speed across borders because of highly globalized and interconnected economies involved in GVCs. In other words, Covid 19 took advantage of the higher stages of globalization which allow faster, easier, cheaper and more frequent cross-border business operations in GVCs.

In addition, another mechanism which is to some extent related to the previous one and which is a key element in the propagation of Covid-19 is the high level of complexity and integration of GVCs. All countries have had serious economic, social and health

[160] World Trade Organization. Beyond Production, Global Value Chain development report 2021. (World Trade organization, 2021)

repercussions due to the complexity of modern GVCs which heightened the risks from Covid-19. The countries which have deep linkages with the three global GVCs hubs, notably the US, China, and Germany, were economically affected by Covid-19 as consequence of the so-called ripple effects. Basically, once Covid-19 hit those hubs, the ripple effects generated consequences throughout all phases of production and distribution. There are three elements which concur to determine the magnitude of the impact of Covid-19 on a region or a country: the economic size, the ability to cope and the degree of participation and its linkages with GVC hubs. Two model- based analysis confirm the influence of these factors. The first analysis carried out by Guan et Al shows that Chinese GDP losses amounted to 16.7% of the China's annual GDP, but propagation via GVCs within and beyond China raised these losses to 21.5%. Likewise, the second analysis by Inoue and Todo proves that the lockdown imposed on Tokyo generated indirect economic effects via GVC propagation to other regions which were twice as large as the direct effect on Tokyo itself.[161]

The last but not less important element concerns FDI and the uncertainty related to GVCs dynamics. FDI is the most important form of GVCs and a key driver of these chains. The spread of Covid-19 and its consequent uncertainty about its duration, magnitude and impact in the long run triggered a vicious cycle which undermined investor confidence which in turn altered investment decisions creating spillovers along the entire GVC. Since MNCs control and organize GVCs, with the broke out of Covid-19 77% of MNC affiliates reported a drop in GVC reliability in middle and low-income countries with a decline amounting to 41%. In this framework, also small and medium enterprises play a role; indeed, they are vulnerable to demand and supply shocks, leading to sharp reductions in travel, hiring and other costs.[162]

The GVCs' governance type and the degree of dependence of intra-or inter-firm relation between MNCs (lead firm) and domestic firms (suppliers) or between large firms and SME (small and medium enterprises) are determinants of the impact of Covid-19 on a firm. Developed countries' services export and developing countries' goods exports rank among the most strongly affected by Covid-19. This can be partly explained by the fact

[161] D. Guan, D. Wang, S. Hallegatte, S.J. Davis, J.Huo, S. Li, Y.Bai et al. 2020. Global Supply-chain effects of Covid-19 Control Measures. Nature Human Behaviour. 4/2020. pp. 577-587

[162] WTO. Global Value Chain development report 2021; Beyond production. (World Trade organization, 2021)

that many MNCs from developed countries own IP rights or product designs for goods manufactured or assembled by factoryless producers located in developing countries rather than having production facilities. Therefore, whereas developed countries enjoy a comparative advantage in knowledge-intensive sectors at the high end of GVCs, for developing countries the comparative advantage is in labor-intensive sectors at the lower end of GVCs.[163]

The spatial dimension of Covid-19 is the most impressive driver of the global cost on GVCs. The global effects of Covid-19 lockdowns on GVCs in terms of value-added losses depend on the number of countries affected and the duration rather than the strictness of lockdowns. If the contagion of Covid-19 had not expanded beyond Chinese boundaries, Covid-19 lockdowns would have reduced global value added by only 3.5%. Instead, its contagious effect reached highly developed countries in Europe and US, and this decreased the value added by 12.6%. The impact of Covid-19 lockdowns led to a global GDP drop amounting to 26.8%. The magnitude of the declines in global value added depends on the dimension of the spatial spread of Covid-19 and on the length of temporal duration of lockdowns. Nonetheless, it's important to underscore that even if COVID-19 had not spread globally, many sectors deeply dependent on GVCs, like Germany's automotive industries and China's electronics, would have been vulnerable. As it has been stated many times in this work, this transmission mechanism is triggered by forward and backward linkages within GVCs. Furthermore, propagation effects will continue to generate disruptions even after the pandemic has been controlled.[164]

In this framework, each government has taken action, but the policy adopted to cope one adverse impact may end up exacerbating another. This conclusion has been reached by the WTO which studied the short and medium- and long-term effect of COVID-19. In the long run, Coronavirus crisis may have an impact on the development of GVCs through the adoption of new corporate strategies in designing GVCs. The most important features of GVCs restructuring from the Covid-19 involve shortening GVCs and diversification of input suppliers. The pandemic shock has strengthened also the effects of previous trends which had been affecting the GVCs development. These trends do not necessarily

[163] *Ibidem*

[164] WTO. Global Value Chain development report 2021. Beyond Production. (World Trade Organization, 2021)

mean that GVCs need to undergo substantial changes, but rather they may affect the design of future GVCs. Radical and deep transformations of complex GVCs could be costly and difficult as GVC structures is composed of many fixed relationship and linkages. [165]

Coronavirus has boosted factors discouraging dispersion of production, but on the contrary has strengthened the process of GVCs regionalization which encourages the shortening of GVCs. The pandemic crisis resulted in GVC risk management strategies based on production chains with less production stages and more concentrated location. Another corollary of Coronavirus pandemic is the promotion of further regional value chains even if this could hurt global production networks.[166]

The effects of Covid-19 can be distinguished between direct impacts and indirect impacts. In the first case companies participating into GVCs stopped production due to health measures, notably social distancing rules. This direct impact is not specific to GVCs per se, but to locations where the virus has spread. GVCs can be affected indirectly through the supply chain impact. This "mechanism" is triggered when production in one location requires inputs from another location which is directly impacted. In the context of Covid-19, this means that companies and firms relying on inputs manufactured in one country which is the first hard hit (China in this case) had serious repercussions because of supply chain linkages. At the onset of the health emergency, supply chain disruptions happened when Chinese production halted but continued in the rest world.[167]

Moreover, disruption in international transport networks can impact supply chains. In this case instead, the source of shocks does not affect the production of inputs but rather the intermediary means of transportation. Indeed, Covid-19 had serious repercussions on services including transportation. Even domestic supply chains are vulnerable to such risks since also domestic outsourcing and domestic transport networks are affected. During the crisis, international transport networks stalled because of restrictions on the movement of people and additional requirements at the border for customs clearance. For

---

[165] H. Simola. "The impact of Covid-19 on Global Value chains". BOFIT Policy Brief Bank of Finland, 2 (Bank of Finland Institute for Emerging Economies, 2021)

[166] *Ibidem*

[167] OECD. Covid-19 and global value Chains: Policy options to build more resilient production networks, OECD Policy Responses to Coronavirus (Covid-19). (Organisation for Economic Co-operation and Development, 2020)

instance, in March 2020 global road transport was 50% below the 2019 average, while in April 2020 commercial flight activity was 75% below 2019. This proves that all forms of transport, both nationally and internationally have been affected. The severe setbacks experienced by movements of goods is correlated to the movements of people. In fact, the movement of goods involves people, meaning pilots, crews, workers in ports, etc. In the air transport, a significant share of air cargo was shipped via passenger flights which have been canceled.

As we have seen in the first paragraph of this chapter, health crisis impacted both supply and demand side. Indeed, the demand impact is the aftermath of the lack of consumers willing to buy goods despite the continuous production. However, a demand impact can also be triggered by a surge in demand, as in the case of key medical supplies during Covid-19 or a shift in demand as happened for some food products with the closure of restaurants and hotels. Domestic supply chains have been affected because of volatility in demand and this confirms the role played by GVCs in the transmission of economic shocks through demand channels. Indeed, when demand for final products is lower in a given country, this results in a reduction in the demand for inputs produced in other countries. This means that when the crisis is global, as in the case of Covid-19, the mechanism can affect multiple locations at once. In their report already quoted previously, Baldwin and Evenett pointed out that the main impact of Covid-19 on GVCs is on the demand side. The demand side can be split in two parts: on one side, GVCs for medicines and medical supplies have continued operating due to their pressing and necessary need, on the other side instead, the measures taken including lockdowns and economic crisis, as well as the changes in consumer behaviour drastically reduced demand for many manufactured goods and services. In other words, demand has decreased for all manufacturing GVCs. Risks related to trade and investment policy are a consequence of Covid-19 on GVCs, as many firms and companies have started considering the possibility to re-nationalize the production due to some uncertainty on the future trade and investment regimes. The existence of this risk which has been assessed by firms, will consequently impact the organization of their value chains.

It's self-evident that many businesses have reported remarkable disruptions in the supply chains during COVID-19 pandemic. Both international and domestic supply chains have been impacted. Despite the overall GVCs situation during the spread of Coronavirus, it's

interesting to observe that many GVCs have carried on operating during COVID-19 crisis even if with lower output and albeit their activities did not rank among the productions of essential goods. IT and electronics production are an example. In fact, during the crisis Apple launched a new model, (the iPhone SE) which has been sold mostly on-line because of the closure of shops. It's true that the manufacturing of smartphone had been partly realized before the broke out of COVID-19, but the following fall Apple has launched four new iPhone models just with one month delay in the production. Likely, Samsung which is its main competitor did not report any meaningful production disruptions. [168]

During the health emergency, especially in the first months when China was hit by Coronavirus disease, medical supplies and devices industry raised many concerns related to GVCs. In fact, shortages of supply in personal protective equipment (PPE), ventilators and face masks raised the issue of the high trade interdependencies especially in the medical devices sector. Since the production of face masks takes place in large part in China before the crisis, the inability to source them when China was overwhelmed by the outbreak of Coronavirus highlighted the risks of foreign sourcing. Therefore, the global shortage of face masks is the corollary of unprecedented demand shock. The anticipation and re-evaluation of different risks as well as international cooperation to increase overall supply should be included in the future planning. In the face of shortages in face masks, China ramped up its production by factor of 12, supplying face masks to all countries in need. [169]

In the throes of a crisis GVCs are more often a solution than a choke point or a bottleneck for the supply of essential goods and this has been confirmed by Korea's experience in the case of COVID-19 test kits. In fact, according to the report published by OECD in June 2020, before the identification of the virus, not only Korea was not among the main exporter of in-vitro diagnostic tests, but no country could produce COVID-19 test kits. However, 3 months later the outbreak of Covid-19, Korea ranked among one of the main exporters with 40 companies serving more than 100 countries. This shows that many

[168] OECD. "COVID-19 and global value chains: policy options to build more resilient production networks. (Organisation for Economic Co-operation and Development, 2020)
[169] *Ibidem*

countries instead of attempting to create domestic production capacity, turned to GVCs to cope with shortages and to increase supply.[170]

GVCs in the food industry which is an essential production has proven their resilience. COVID-19 has pushed most companies to relocate parts of their supply chains. This means also that Asian supply chain network will be both less China- focused and more diverse. [171]

After COVID-19 global companies are looking to strengthen resilience into their supply chains. In this way, meaning by developing quasi-independent regional supply chains in the Americas and Europe, a global company attempts to prevent future shocks to their network. [172] These companies succeeded in shifting production of key components from one region to another as the aftermath of lockdowns and factory closures. In a context of ongoing risk and great uncertainty, companies are focusing on seeking greater value in storing inventory in strategic locations from where it can be easily accessed and delivered to customers. This relates not only to final goods, but it also applies to strategically important components. Companies will be able to join regional supply chains which have resulted in the restructuring of global networks by dominant companies. This is particularly important for small and medium enterprises. However, regionalization of supply chains will lead to a surge in the final goods prices, hurting product's competitiveness. In a more regionalized supply chain companies may focus more on local tastes amid a greater capacity for product differentiation. In the medium term, companies may be able to reach higher price points for their products, thus counterbalancing the increase in the production costs ensuing from the regionalization of supply chains and holding larger inventories. The regionalized supply chains are an enduring outcome of the pandemic crisis.[173]

In this scenario, characterized by COVID-19, which now has been exacerbated by the war in Ukraine, GVCs require two different features: resilience and robustness. While the first one implies the ability to resume operations after a disruption, robustness is the

---

[170] R. Baldwin and S.Evenett. COVID-19 and Trade policy:why turning inward won't work. (Centre for Economic and Policy Research, 2020)

[171] C. Arriola et al. "Global Value Chains: Efficiency and Risks in the context of COVID-19. (Organisation for Economic Co-operation and Development, 2021)

[172] "The Great Unwinding, COVID-19 and the regionalization of global supply chains". (The Economist intelligence Unit, 2020)

[173] *Ibidem*

ability to continue operations even during a disruption. Robustness is a fundamental element in companies engaged in the production of essential goods since it's aimed at ensuring continuous production. Robustness entails diversification of suppliers. Robustness requires interconnected economies because in the case of fully localized regime the shock can happen within domestic regime and therefore fully localized production fails to promote robustness. Samsung Electronics is a useful example. The latest generation of smartphones are generally produced within Korea while the older ones are manufactured outside Korea. The main plant is established in Daegu which during the pandemic was the epicentre of COVID-19 in Korea. The closure of the factory determined the halt of all activities and in order to cope with this stall, Samsung partly switched its production to Vietnam where it operates other factories. [174]

Anyway, when tackling disruptions triggered by Coronavirus, firms did not only resort to geography of production because in order to anticipate disruptions the exact knowledge of the level of inventories is important as well as output along the value chain. Despite many analogies between resilience and robustness, resilient firms are more likely to reduce their risks rather than investing significantly to avoid disruptions. Thus, in the case of resilience firms tend to go through them with the goal of minimizing the impact and guarantying the gains ensued from GVCs.[175]

3.4 GVCs' resilience to Covid 19 and policies to strengthen resilient production networks

The following analysis is grounded on the work carried out by CEPR whose title is "COVID-19 and Trade Policy: Why turning inward won't work" illustrates how production networks and GVCs can be strengthened and how resilience can be improved. GVCs resilience refers to the ability of tackling disruptions with an emphasis on the task of maximizing capacity to absorb shocks, adapt to new realities and reestablish operations in the shortest possible time and the capacity to react efficiently with the goal of recovering fast. However, the nature and the magnitude of shocks determine the degree

[174] S.Miroudot. "Resilience versus Robustness in global value chains: some policy implications". (Center for Economic and Policy Research; 2020)

[175] *Ibidem*

of GVCs resilience. Indeed, in general the smaller the shock, the more resilient the GVCs are.

Moreover, sector-or region-specific shock play a role in affecting GVC resilience. GVCs can reduce their exposure to localized shock by diversifying demand and supply. Industries tend to be more resilient if they manage to relocate effortlessly to other country when facing policy interventions. On the contrary, industries heavily constrained due to localized network and lock-in effects encounter more difficulties to achieve resilient. GVC structure and bottlenecks too are dimensions affecting GVC resilience. If intersectoral linkages are asymmetric, shocks' propagation is stronger. For instance, iron and steel mills, petroleum refineries as well as real estate, can act as potential choke points. Large MNCs tend to be less resilient to particular shocks due to its complexity. Sectors with higher specificity located in the upstream position are more likely to propagate GVC shocks. [176]

Additionally, availability of substitutions has to be taken into account too. If there is low substitutability, the result is the occurrence of disruptions leading to a block of the entire production. Instead, higher substitutability allows to meet sudden surges in domestic demand via external supply. In this context, time horizon is crucial: elasticity of substitution can be low in the short run, while longer time horizon enable eventual substitution which mitigates shocks.[177]

In order to assess relative GVC resilience there is a method which can be used which is based on three criteria: scarcity of alternative suppliers, level of sunk costs and volume of informational exchange between partners. As we have seen in the second chapter, GVCs are strongly characterized by a reliance on specific investments, like purchasing specialized equipment or customized product. Knowledge-intensive GVCs which often operate in specialized and localized ecosystems cannot be easily substituted. Firms with intangible assets refrain from engaging with too many suppliers due to fear of IP expropriation. Therefore, they strengthen their incentives to choose vertical integration

[176] S. Lund et al. "Risk, resilience, and rebalancing in global value chains". (McKinsey&Company, 2020)

[177] E. Solingen, B.Meng, A. XU." Rising Risk to Global Value Chains". Global Value Chains Development Report 2021. (World Trade Organisation, 2021)

where they have the control suppliers. Resilience to exogenous shocks is reduced in the case of specific GVC relationship. [178]

So far, we have seen that GVCs are a double-edge sword since on one hand they amplify the impact of shocks but on the other hand they enhance resilience and mitigate their effects. Basically, this means that GVCs participation increases vulnerability to foreign shocks, but it can also lower vulnerability to domestic ones.

Diversified suppliers and cross-national production networks can adjust more easily to risks and shocks. The impact of the shocks can be mitigated through two different channels: first each single component of the chain matters less in production, decreasing the risk of volatility; instead, the second channel consists of different varieties which are substitutes offsetting the shock. In other words, reliance on diversified suppliers counterbalances disruptions stemming from GVCs participation. This implies that while outward- oriented strategies tend to increase resilience, inward-oriented strategies are more likely to expose firms and sectors to vulnerability.[179]

The likelihood to be exposed to risks increases with longer GVCs. Indeed, since firms 'operations take place across longer distances not only geographically but also from an economic, cultural, and institutional perspective, challenges increase.

Substantial GVC nationalization or regionalization risks reducing the diversification of suppliers and opportunities especially for some developing countries. By the same token, increased geographical diversification represents an opportunity for industries and firms closer to major markets.[180]

During the pandemic, the absence of strong coordination across countries and firms exacerbated damages to GVCs. Furthermore, during and after Covid-19 firms adopted essentially three strategies; the first strategy consists of localization of production of essential supplies, as well as the reduction in irreversible investment abroad. In second instance, in order to cope with Covid-19 and unavoidable profit losses firms enhanced diversity of trading partners in GVCs with the goal of allowing easier substitution.

---

[178] *Ibidem*

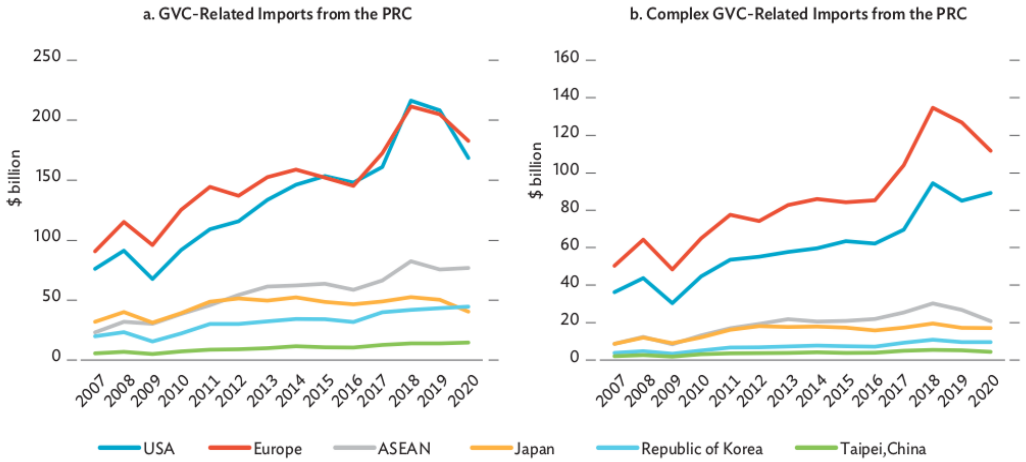
[179] R. Baldwin and R. Freeman. "Supply chain contagion waves: Thinking ahead on manufacturing' contagion and reinfection' from the COVID concussion", (Centre for Economic and Policy Research, 2020)

[180] C.Z. Qiang, Y. Liu and V. Steenbergen. "An investment perspective on Global Value Chains." (World Bank, 2021).

Covid-19 has also required the acceleration of the adoption of digital technologies since many firms have introduced a new working mode, known as work from home which is still utilized. Moreover, Covid-19 has deepened concerns with GVC dependence especially in medical equipment, pharmaceuticals and vaccines since market for critical inputs is dominated by individual economies. Cooperation on GVC on matters related to Covid-19 was made difficult. GVCs disruptions lengthen "time to build" (the delivery lag of capital) by 1 month, contracting GDP by 1.0%.[181]

Covid-19 shock and its compounded risk effects are particularly evident in semiconductor shortages where Covid-19 created choke points throughout critical GVCs. Indeed, Covid-19 triggered global semiconductor shortages in 2020 and 202. The graphic below (a) clearly shows that total European and US GVC imports from China which started to decline with the US-Sino trade war, recorded a drop throughout 2020 due to Covid-19. The graphics made a further distinction between simple and complex GVC. Simple GVCs declined mildly and only in 2020 when Covid-19 exacerbated geopolitical conflict. More in detail, simple GVC-related US imports from China dramatically drop in 2020 as corollary of the spread of Covid.19 and its unavoidable lockdowns and closures. [182]

Figure 3.6: Aggregate Effects on Global Value Chain-related imports from China



Source: World Trade Organization, Global Value Chains Development Report 2021

[181] E. Solingen, B.Meng, A. XU. Rising Risk to Global Value Chains. Global Value Chains Development Report 2021. (World Trade Organisation, 2021)

[182] *Ibidem*

It is undisputed that Covid-19 triggered remarkable consequences on firms and GVCs because of its scope and scale. However, as it has been pointed out by the WTO in chapter 5 of the World Development Report 2021, firms and GVCs adapted to the risks by resorting to automation, digitalization, diversification as well as multiple sourcing within and across economies. Yet, other important strategies adopted by firms operating in GVCs which have emerged as a resilient response, concerns "just in case" inventories, redundancy, nearshoring of production or suppliers, better GVC mapping. Automation and digitalization are standard and dominant GVC response to uncertainty, as in the case of Covid-19 but have also remarkable implications for employment, inequality and poverty in both developing and developed countries. The trend of accelerated digitalization of GVCs which had started before 2020, speeded up with Covid-19. Nonetheless, not all the adverse effects of Covid-19 cannot be mitigated by these technologies and the strategies since GVCs still require face-to-face interaction to complement virtual interaction. Furthermore, digital technology itself has some negative effects; it increases vulnerability to cyber security risks to GVCs. The pandemic risks, together with the geopolitical ones triggered by US-Sino war have contributed to the increase of cyber risk, negatively impacting a number of global industries operating in GVCs.

Risks related to Covid-19 have generated incentives for economies and firms to invest remarkably in enhancing resilience to these risks. All these measures adopted in response to spread of Covid-19 have resulted in a narrowed decline in the China's role as the factory of the world which is not considered as a temporary change. Nonetheless, it could strengthen GVC decoupling under more extreme inward-oriented geopolitics.

Reshoring would decrease GDP further without remarkable improvement in resilience.[183] Radical renationalization with dismantling of GVCs can hamper globalization, thus reducing the benefits stemming from it. As we can observe, if on one hand GVCs magnify the shock, on the other hand they alleviate them. Initially, in order to contain the spread of Covid-19, governments imposed export restrictions, which in turn shed light the fragility of GVCs in knowledge-intensive sectors, health care and pharmaceutical and essential goods, but once these drastic measures have been loosen GVCs have proved

[183] C. Arriola et al. "Global Value Chains: Efficiency and Risks in the context of Covid-19". (Organization for Economic Co-operation and Development, 2021)

their resilience. Moreover, reshoring and renationalization of production reduces the risks to external and foreign shocks but it increases the exposure to domestic shocks since GVCs are still dependent on single suppliers and this does not shelter from disruptions in production.[184]

In addition, enhancing GVC resilience is not equivalent to the policy of self-reliance which besides being costly and inefficient, is counterproductive. If the global geographic diversification is limited, the aftermath is the surge of vulnerability to shocks. Instead, reliable dependable outward- oriented strategies succeed in fostering GVCs with wider access to goods, services, innovation and specialization. Outward-oriented strategies, especially in the pandemic situation, tend to promote more cooperative and sustainable policies, also from an environmental perspective. GVCs have enhanced transparency and precise mapping as this facilitates timely substitution and geographic diversification The goal of heightening sensitivity to domestic distributional considerations from participating in GVCs contributes to reduce the trend towards extreme inward-oriented strategies.

Relaxing restrictions gradually led to lower declines in GVCs value added (39.5%) than would have been the case with the quick lifting of restrictions which would have entailed recurrent future lockdowns, with declines of 49.5% and 61.5%. [185]

The adoption of disease control measures by each single country without considering their overall effects on GVCs results in negative outcomes. The better solutions which have been proposed require developing a global cost- sharing instrument which could allow a fairer distribution of the costs of containing and suppressing the spread of disease as well as enhancing common efforts for early action.

Covid-19 pandemic is considered the biggest and broadest shock in the recent memory. The impact of Covid 19 on GVCs depends on the combination of different factors such as its duration, the ripple effect it triggers across industries and geographies and whether the shocks hits only the supply side or also demand side.

---

[184] S. Nenci, I.Fusacchia, A. Giunta, P.Montalbano, C.Pietrobelli. "Mapping value chain participation and positioning in agriculture and food:stylized facts, empirical evidence and critical issues". (Associazione Italiana di economia agraria e applicata, 2022).

[185] E. Solingen, B. Meng, A.xu. Rising risk to Global Value Chains. Global value chain development report 2021: Beyond production. (World Trade Organization, 2021)

Pandemic shocks, such as Covid-19 have a major impact on labor-intensive value chains. Covid-19 is a particular type of shock which hard hit both the supply and demand side. However, while the demand for non-essential goods and travel has plunged, agriculture, food and beverage production have continued to see strong demand due to the essential nature of their products. This means that value chains in these sectors (agriculture, food and beverage) did not record a drop in demand, but only the supply side, meaning the production has been affected.[186]

Besides helping companies to meet sudden spikes in demand, having sufficient backup inventory of key parts and safety stock can cushion and minimize the financial impact of disrupted supplies. In the throes of pandemic crisis, companies were forced to focus on building resilience in their supply chains and operations. In the face of Covid-19 disruptions companies re-organize their production structures and suppliers' networks to improve risk management.[187]

It's universally accepted and recognized that the onset of pandemic and its unfolding have amplified and accelerated what had been already ongoing before 2020. Therefore, Covid-19 did not substantially change GVCs trend, but it has simply accelerated the process of further regionalization which had been already ongoing since 2008. Many observers feared that pandemic not only accelerated the trend started after the Global Crisis but that could lead to a massive restructuring of value chains. However, such effects are not necessarily straightforward or given. Yet in the long run the GVCs have proven their resilience. In this scenario, the optimal longer-term strategies not necessarily imply value chain restructuring. [188]

The following part is grounded on the paper already mentioned "COVID-19 and global value chains: policy options to build more resilient production networks" published by OECD. This paper points out that firms are directly involved in the achievement of resilience in the supply chains through different phases. In order to achieve resilience, it's necessary to proceed step by step. To begin with, in supply chain risk management, firms have to identify and evaluate the risk. This is related to the need of firms to classify and assess the likely impacts of different risks. For instance, in the case of COVID-19 we

[186] S. Lund et al. "Risk Resilience and rebalancing in global value chains". (Mckinsey & Company, 2020)
[187] *Ibidem*
[188] R. Amui et al. Impact of the Covid-19 pandemic on trade and Development; Lessons Learned. (United Nations Conference on Trade and Development, 2022)

have three types of risks: supply risk as inputs were not delivered, demand risk with a drop or a surge in demand, and an operational risk as in the case of breakdown of operations since workers were exposed to the virus. In a second phase instead, firms should focus on designing risk management strategies. Among these strategies there are avoidance (for unacceptable risk), postponement such as producing or shipping goods only after that customer orders are received, speculation, notably production or shipment before the arrival of the orders which is the opposite of postponement. Furthermore, hedging can be engaged as strategy based on the diversification of suppliers and locations of production; control is another one such as through vertical integration with ownership of main suppliers, as well as sharing risk.

The right strategy depends on many factors, including the type of risk, the magnitude of the shock and its effects, but in order to detect the right strategy, the key element is to ensure information on the supply chain and the level of risk at different stages. Transparency in the value chain must be guaranteed including information on suppliers for the possibly assessment of inventories for critical inputs. For this purpose, the most advanced firms are characterized by the presence of "control towers" which are used to follow, in real time flows of inputs and to anticipate disruptions. If this mechanism does not succeed in anticipating disruptions and shocks cannot be avoided, firms attempt to mitigate the impact of the shock through what is known as agility or reactivity which can be defined as the ability to respond to changes in an organization's internal and external environment by quickly assembling resources and capabilities.

The resilience strategies consist of developing agility according to the nature of the risk and disruption which may vary case by case. "*This means that there is no one size fits all approach for managing supply chain risk."*[189]

As we have seen previously, robustness, meaning the ability to not halt the production process during the crisis is a priority especially for firms producing essential goods (e.g., medical supplies, food or pharmaceutical) as well as firms whose production processes cannot be resumed easily once halted, such as nuclear reactors in the energy industry or furnaces in the steel industry. In these cases, firms will pay higher cost in terms of resources to mitigate risk and to ensure ongoing security of supply. The GVCs robustness

[189] OECD. "COVID-19 and global value chains: Policy options to build more resilient production networks." (Organisation for Economic Co-operation and Development, 2020)

requires some degree of supplier redundancy since depending on a single supplier entails risks of interruption and therefore, these firms need to have a range of alternative suppliers for each of their inputs. Additional costs are imposed upon companies as they need to invest in multiple suppliers to ensure that parts and components from different manufacturers fit together, and in many cases adjustments to production processes are necessary.

Furthermore, enhance GVCs robustness may encounter some difficulties, for instance geographic distance to suppliers may represent an obstacle since it's a key element in domestic and international supply chains. Generally, firms attempt to combine the advantage of domestic supply with the benefits ensuing from offshoring and international trade, notably in the supplier diversification.

In order to tackle COVID-19 and other risks associated with it, the second main objective is the improve GVCs resilience which has to be understood as the capacity to return to normal operations in a few amounts of time after the disruption. Thus, resilience focuses on the speed of recovery. Firms investing in resilience rather than robustness, can privilege long-term relationship with single suppliers. In this case we don't have the possibility of switching to other suppliers; what we have instead is the trusted relationship with the same supplier which can lead to higher investment by the suppliers in avoiding or mitigating disruptions and facilitating fast recovery. Empirical evidence proves that while supplier diversification often entails slower recovery from supply disruption at the firm level, long-term relationships is associated with faster recovery.

The "just in time" and "lean production" have proven efficient for many companies.

From economic point of view, COVID-19 has three stages: crisis, recovery and new normal. In the first phase, the goal is to ensure the provision of essential goods, notably medicines and key medical supplies. In other words, maintaining the operations of essential GVCs is a paramount objective when disruptions occur and transport and logistic have to react to the crisis.

Instead, in the recovery phase, GVCs have to ensure supply through reduction of the time needed for production to reach pre-crisis levels. In the case of COVID-19, the virus was still a threat during the recovery, there is a further obstacle in relation to how to restart the economy while maintaining necessary health measures. The value chain is as strong as its weakest link and bottlenecks can appear if specific firms need more time for

recovery. The last phase instead is a period characterized by the resume of economic activities and the virus is no longer a threat. However, in this phase governments and firms should prepare for the next crisis in order to take the necessary measures to be better prepared. These steps will be taken not only at the firm level but also governments play a key role because they give incentives to firms to improve risk management and resilience strategies. Resilience strategies and risk management may face the issue concerning the asymmetry of information in the context of complex GVCs. In fact, it has been proved that even when there is diversification at first-tier suppliers' level, firms encounter difficulties to know what happens with second- tier and third-tier suppliers. Governments can collaborate with the private sector by sharing information on potential concentration and bottlenecks upstream in supply chains. The review of the network of trade agreements and investment regimes beyond direct partners is a tool jointly used by trade and investment policy- makers to assess obstacles and incentives to supplier diversification. The mitigation of the risk, as well as the resilience improvement, can be achieved by identifying the best practices and this may happen through the knowledge sharing platforms which facilitate discussions among firms and governments. In this way, digital technology can improve information systems for risk management. [190]

Governments can develop stress tests for specific supply chains and this option could be particularly useful for critical supply chains, notably pharmaceutical and personal protective equipment (PPE). The creation of strategic stockpiles which can correctly evaluate the inventories and buffer stocks can be included in these tests.

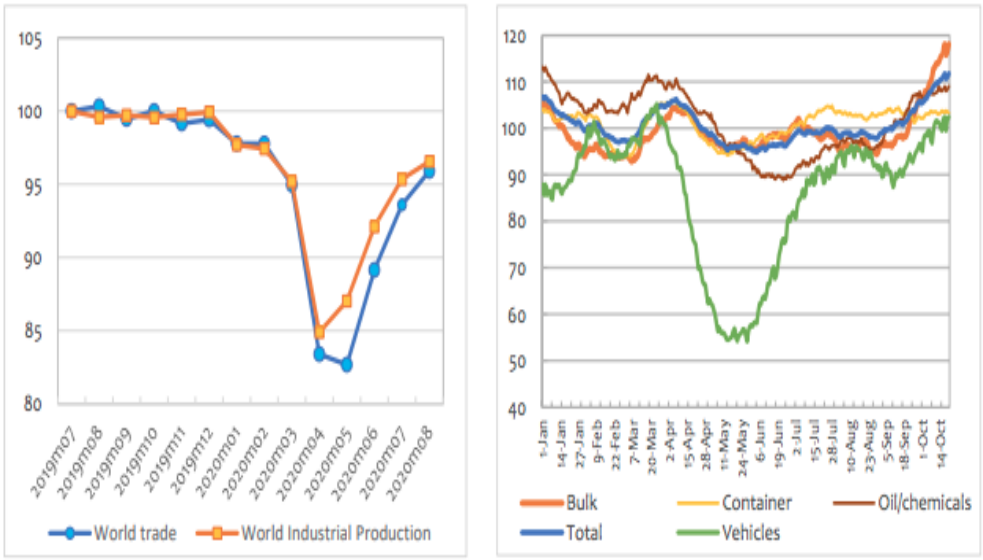
Furthermore, subsidies, tariffs, investment restrictions and local requirements can be taken into account as tools to implement reshoring policies. Normally, these measures trigger economic distortions through reduction of the income of countries and the welfare of citizens. Re-shored companies reduce their competitiveness, which in turn may cause a second wave of protectionism, rekindling retaliation across countries which in turn drastically lowers income and welfare. The additional economic and social risks of extensive reshoring policies and nationalization far outweigh any perceived gains in terms of security of supply. [191]

[190] ibidem

[191] OECD. "COVID-19 and global value chains: Policy options to build more resilient production networks. Tackling Coronavirus (COVID-19) contributing to a global effort". (Organisation for Economic Cooperation and Development, 2020)

The proof of GVCs Resilience to COVID-19 is emphasized by the V-shaped recovery. In fact, during the initial months of the crisis world trade experienced a dramatic decline reaching a bottom in May 2020 with a cumulative decline of 17.3%. In the following months however, trade flows increased at a fast pace marking a reduction in trade decline with a much moderate pace (4.4%). Moreover, during the crisis industrial production markedly drop but the response of world trade has been slightly larger. This decline in the industrial production is correlated to the fact that the current pandemic struck more the services sector than the industrial one. The rapid recovery leads to the conclusion that firms should avoid reshoring activity domestically and severing international ties. This fast recovery, known as V-shaped recovery, is illustrated in the graphic below. [192]

Figure 3.7: V-shaped recovery



Source: Harvard scholar, 2021

[192] WTO. "World trade primed for strong but uneven recovery after COVID-19 pandemic shock". (World Trade Organisation,

The health emergency confirmed that even during the crisis GVCs managed to maintain trade relationship which in turn help pave the way for a strong-led recovery. Despite the historic magnitude of Covid-19, in the first quarter of 2021 the remarkable rebound was linked to the strong performance of East Asian economies which succeeded in capitalizing booming global demand for Covid-19 related products. Furthermore, by the fifth quarter world trade reached higher pre-crisis levels, recording an increase of about 3% relative to Q4 2019. However, the path was slightly different for trade in services which remained substantially below average. In comparison with the Global Financial crisis, global trade took nine quarters to recover.[193]

We can rule out that GVCs' resilience and governmental responses to COVID-19 will suddenly solve the preexisting structural issues of the global economy but developing countries should strengthen regional value chains to diversify risk and reduce vulnerability. In other words, the crisis could be used as a stress test to improve investment competitiveness in certain GVC segments and encourage robust economic recovery. [194]

3.5 The economic consequences of the Ukraine war on GVCs: an additional risk for post-Covid GVCs

GVCs have not fully recovered from the pandemic shock, and the process of restructuring is still ongoing. In this framework characterized by post-COVID regional networks, the war in Ukraine has exacerbated the existing condition. Many studies underscore the role played by Russia in global value chains. In fact, Russian economy sits very high in those value chains as it exports raw materials, such as metals, chemicals and energy, notably coke and petroleum.[195]

The geopolitical tension with Russia, which has become also an economic and trade conflict caused severe disruptions which in turn are having a global impact through price hikes for energy goods. This mechanism has generated a domino effect which is having

[193] A. Nicita." Global trade's recovery from Covid-19 crisis hits record high". (United Nations Conference on Trade and Development, 2021)

[194] C. Z. Qiang, Y. Liu, V.Steenbergen. An Investment perspective on Global Value Chains. (World Bank, 2021)

[195] L. Garicano, D. Rohner, B. Weder di Mauro. "The economic consequences of the Ukraine War: A new eBook". VOX eu (Centre for Economic and Policy Research, 2022)

serious repercussion for transportation costs, as well as for all GVCs. Supply chain disruptions multiply as they extend. According to the analysis carried out by Michele Ruta, Nadia Rocha, Simon Evenett and Alvaro Espitia, the inertia tends to preserve supply chains and even when substitution takes place from one country to another, it's unlikely to affect costs significantly. Governments' responses based on autarky and reshoring result in remarkable losses in productivity and high economic costs. The main issue regards the persistence of the costs because it has been proved that when violence lasts over time, as it happens in this war, the relocation effects provoked by aggression are likely to persist in the long run.[196]

Once relocation away from a certain supplier or buyer occurs, it remains after peace is established. Therefore, supply chains tend to remain permanently altered by the conflict, away from Ukraine and Russia. Russia and Ukraine play a strategic role in the GVCs, notably for wheat and corn exports. In fact, they accounted for over a quarter of global wheat exports, and Ukraine accounts for 14% of global corn exports. The consequence is that prices have soared and will probably remain very high. Energy prices skyrocketed too. This impact is particularly felt by developing countries which recorded a welfare losses accounting to 10%. Impressive repercussions on the energy sector are the main driver of the impact in high-income countries, while poorer and developing countries have been more affected by the sharp increases in food prices. The impact is very heterogeneous since depends on the net position of each country. Indeed, net exporters countries will likely record an increase in prosperity, whereas countries which are net food and energy importers may see hunger, misery as well as increase in intergroup conflict.[197]

Russian invasion of Ukraine and its consequent trade disruptions further confirmed the vulnerabilities of relying on a limited range of suppliers for imports with few substitutes. The occurrence of this dramatic event which adds up to COVID-19 shows that the impact of the war through Russia's participation in GVCs relates to its upstream position. The countries facing higher risks are those which are geographically closer to Russia because of their direct trade links with Russia. However, countries participating in the GVCs and

[196] T. Korn and H. Stemmler. "Russia's war against Ukraine might persistently shift global supply chains". (Centre for Economic Policy Research Vox EU, 2022)

[197] *Ibidem*

deeply relying on products from Russia have been severely affected, especially if those products have fewer substitutes, such as rare metals.[198]

The war in Ukraine re-confirms how spillovers of regional and global reach through trade and financial link, play a role in the functioning of GVCs. Russia is the major supplier of commodities and this role places it at the foundation of a wide range of global production. In addition, Russia's role is especially important also in the exports of primary and intermediate goods and services used in other countries' export at an early stage of production. The commodities that drive this upstream link into GVCs are energy, metals, chemicals as well as transport and business services. In backward GVCs' participation, Russia does not play a key role as buyer since its reliance on imported inputs to produce its exports is very low. Regional economies highly dependent on Russian supplies have been affected by disruptions of Russia 'exports through GVCs and via major global production hubs for trade. Generally speaking, GVCs have been hit by the soaring of energy prices. Russia's largest trade partners both as importers of Russian commodities and as exporters of GVC goods are Germany, US and China. Denmark and Belgium highly rely on Russia for over 80% of their imports of semi-finished iron. Logistics disruptions and longer delays have had repercussions on trade and transit flows not only between Russia and Europe but also between East Asia and Europe. Furthermore, Russia together with Ukraine and Brazil (jointly accounting for over three-quarters of global exports) dominates pig iron exports. With the outbreak of the war in Ukraine, this naturally implies many difficulties in replacing pig iron imports from Russia. In the case of Germany for instance, replacing inputs sourced from Russia, Ukraine or Belarus would not be economically viable, and therefore German industrial firms would face severe damages in the short term. In the longer run, the possible solutions for firms could be the strengthening of supply chain resilience. Once again, resilience improvement may be the core issue when dealing with idiosyncratic shocks. The resilience can be enhanced for instance by diversifying firms' global suppliers or by reducing dependence on production processes using conventional energy sources. In other words, GVCs reliant on products that have fewer substitutes will be hit harder. [199]

[198] D. Winkler, L. Wuester. "Implications of Russia's invasion of Ukraine for its value chains" (Centre for Economic Policy Research Vox EU, 2022)

[199] *Ibidem*

In addition to obstacles caused by war between Russia and Ukraine, the Omicron spread in China has forced the country to implement a strict blockade in major economic hubs. China's exports are plunging after having reached a peak last October and it's expected to continue for next few months.China adopted the so-called Zero strategy, which will exacerbate congestion at seaports challenging in sourcing goods and costs for businesses from US to Europe.[200]

The current conflict has led to cut off many important shipping routes, constraining many transport companies to halt their services and the surge in air freight prices which has caused serious disruptions to global supply chains. Many companies in the supply industry have been forced to suspend delivery service to and from Russia. The risk of shelling provoked the closure of the seaports in Odessa and Mariupol determining a blockade in the transport of goods. Another consequence is the stall of container shipping operations with a lot of cargo stuck at these ports. Air transportation too has had to cope with the same situation since Ukraine's aerial space is closed to civil flights. Many Airlines refrain from flying over Russian airspace, triggering a surge in air freight rates which in turn impressively reduces the movement of goods which relies on this type of transport. The cancellation of flights and their reroute disrupt supply chains by causing significant delays. Indeed, if inputs in materials and fuels are not supplied in time, like oil, steel, platinum and aluminum, factories in many countries, notably Europe, Ukraine and Russia are exposed to the risk of shutting down.[201]

Since Ukraine is also the supplier of about 50% neon gas and 40% krypton gas to the world, supply disruptions as a result of the current war have led to a rush to find suppliers outside Eastern Europe which in turn has caused shortages and prices hike. Additionally, supply chain disruptions could be exacerbated by a shortage of shipping crews from Russia- Ukraine as a result of the conflict.[202]

To sum up, the geopolitical crisis between Ukraine and Russia has put additional pressure on the already tense GVCs which had been affected by pandemic crisis.

---

[200] N. M. Ngoc, D. T. Viet, N. H. Tien, P.M. Hiep, N.T. Anh, L. D. Anh, N.T. Truong, N. S. T. Anh, L. Q. Trung , V. T. Dung, L. T. H. Thao. "Russia-Ukraine war and risks to global supply chains". (International Journal of Mechanical Engineering 7/6, 2022)

[201] *Ibidem*

[202] *Ibidem*

Although Russia's role in the world economy is not like that of China, which is the main manufacturing power, a central hub in GVCs, Russia can be considered as a big "gas station" and its shutting down could cripple the functioning of the factories depending on it, notably in Europe which imports 40% of its natural gas and 25% of its oil from Russia. In general, the effects of the war on GVCs could be long-lasting and the new challenges are causing delays in the transportation of goods and higher delivery costs. Regionalization, as well as the risk of re-nationalization have become the latest trends for firms, slowing in this way the peace of globalization.[203]

[203] K. Wiggins, A. Gara, J. Smyth."Business leaders warn that three-decade era of globalization is ending". (Financial times, 2022)

CHAPTER IV: The case study of air cargo and air freight during and after COVID-19: an analysis through value chain lens

4.1 The value of air cargo in GVCs

In a world characterized by highly integrated economic system and deeply interconnected economies air cargo sector is critically important and the COVID-19 has proved us. Indeed, air cargo plays a crucial role since jointly with shipping cargo enables cross-border movements of components and parts.

Air cargo transports over US $6 trillion worth of goods which accounts for approximately 35% of value of global trade even though it covers only 1% by volume. It is key in the current global trading system as it plays a greater role for trade in advanced, industrial and high value goods and other sectors which require fast and reliable transport. In particular, these features of air cargo (security, speed and reliability) are factors which contribute to keep inventories low and to complete the final assembly of parts and components in a little amount of time. Moreover, the aspects which characterize air cargo represents an advantage and a benefit in case of disruptions in the surface transport as a result of natural or social triggers. [204]

The relationship between air cargo and integration into GVCs is confirmed by the fact that countries characterized by well-developed air cargo connections and efficient customs services present high degree of GVCs participation. The tool used to measure a country's air cargo connectivity is the Air Connectivity Index (ACI) which shows that countries with higher ACI score are characterized by higher total trade volume. In particular, an increase of 1% in air cargo connectivity is related to an increase of 6.3% in total exports and imports. Furthermore, the strong correlation between Air cargo and GVCs is confirmed by the fact that a one-point increase in the ACI is associated with an increase of 2.9 percentage point in GVC participation. This correlation can be observed in all regions as well as at all income levels. Air cargo can also help firms move up GVCs to higher value-added activities. Basically, air cargo eases the mechanism for participation and moving up. Air cargo is faster than maritime shipping and for this reason

[204] B. Shepperd. Value of Air Cargo: Air Transport and Global Value Chains. (International Air Transport Association, 2016).

is preferred by express carriers as well as manufacturers producing goods with high value-to weigh ratio.[205]

In a nutshell, air cargo is a driver for GVC extension and development, mainly in lower income countries willing to invest on world markets. Thus, in this way air cargo boosts GVC participation. This next part is grounded on the Final Paper published by International Air Transport Association (IATA) entitled "*Value of Air Cargo: Air Transport and Global Value Chains*" and provides us an understanding of the role of air cargo and air freight in general in GVCs which rely on the movements of goods and service across the globe. Indeed, through air cargo firms easily succeed in reaching consumers and dispersing production processes across countries.[206]

ACI sheds light on the fact that air cargo is a quickly and reliable enabler of connections between distant markets which does not require high costs. This has deep implications for a country's trade. The improvement of air transport infrastructure and services boosts backward and forward linkages.

The crucial role of air cargo is also evident in the case of perishable products which require to be rapidly shipped or because, for instance, that good is destined for a GVC which require a just-in-time protocol. For these characteristics exporters of parts and components participating into GVCs rely on air transport which is an optimal choice especially for manufacturing GVCs where the chain's "just in time" strategy is supported by express shipments. In the context of GVC integration, while air cargo and air freight play a central role for goods GVCs, air passenger transport is crucial for services GVCs. In fact, employees and experts in firms operating in the GVCs services sector move around the world for meetings and client engagements. Services such as finance and businesses rely on air transport services in order to allow temporary and fast movement of service providers and intracorporate transferees.

The Air Connectivity index utilized in the Final Report mentioned above employs a tool known as "SRS Analyzer" which regards cargo, passenger and mixed services. The latter one (mixed services) are also known as belly cargo which accounts for half of global air cargo. According to ACI, the income level plays a role in the performance of air cargo. In fact, higher scores are recorded for countries with higher income. In terms of global

[205] *Ibidem*

[206] [206] B. Shepperd. Value of Air Cargo: Air Transport and Global Value Chains. (International Air Transport Association, 2016).

air transport network, low-income countries are marginal to some extent and the reason probably lies on geographical, policy and private sector development challenges.

In this framework it's also relevant to mention Montreal Convention which paved the way for modernization program for air cargo transactions, followed by Revised Kyoto Convention and Trade Facilitation Agreement (TFA).

Air cargo performance can be assessed also by the ability to undertake transaction electronically. These electronic processing of air cargo reduce time and cost for both exporters and importers. This implies that electronic processing translates into shorter delays at borders, reduced transaction costs and improved security and reliability. All these aspects represent an advantage for firms' involvement in GVCs. GVCs rely heavily on parts and components between production sites and assembly locations.

The linkage between GVC integration and air cargo connectivity is almost always confirmed. Yet, there are few exceptions as in the case of Germany which is even more integrated into machinery GVC than its strong connectivity performance. This exception can be explained by the fact that in Central and Eastern Europe, German lead firms play a remarkable role as a source of investment and technology in the region. The same applies in the case of China which developed its value chains by making use of air connectivity. It's undisputed that this is just one if the main factors which contributed to its development because for instance, China's participation into GVCs would have been impossible without economic liberalization. Moreover, when dealing with manufactured products ASEAN region, China particularly has a crucial role in GVCs in relation to air cargo sector since it generates substantial inbound and outbound air cargo flows. The role of ASEAN region in the air cargo is relevant also in relation to electronic sector; indeed, the production of smartphone and laptops which takes place in China rely on air cargo as a primary transport mode.

Air freight is particularly relevant with movements of goods having a relatively high value to weigh ratio. For instance, in 2008 air cargo accounted for 80% in GVC-intensive sectors such as scientific equipment and electrical goods. In addition, improvement in air cargo performance can contribute to the production of higher value, higher price as well as higher quality goods. All these elements jointly play a key role in the process of moving up the value chain. Air cargo flows are determined by trade flows which in turn are shaped by bilateral gross domestic product positions. In fact, growth in GDP represents an

additional determinant for volumes of air cargo. GVCs logistic integration is the driver of the dynamics of business models in air cargo handling. In addition, online web-shops and platforms (the so-called e-commerce) and their forward integration triggered a change in the competitiveness of air cargo market which will have repercussions on air cargo operators. Demand for air freight depends on many factors, including local and global economic cycles, and external shocks.

The air freight represents 2,4% of world GDP. The entire air freight value chain, including producers of aircraft, airlines and airport management companies is characterized by high-capital intensive activity and with high fixed costs. The air freight market is controlled by few big firms. Indeed, the chain of aircraft production is dominated by just two companies, namely *Boeing* and *Airbus* which play a key role in the air cargo global supply chain as well as air freight in general. The air cargo supply chain can be divided in three parts: airport services which provides the main contribution in terms of direct employee (62%), followed by airline companies (26%) and the remaining 12% is employed in aircraft production.[207]

The aerospace supply chains are strikingly complex as they are made up of different types of suppliers, including original equipment manufacturers (OEMs) prime contractors and integrators, repair and overhaul providers (R&O), small parts suppliers maintenance support. The air freight supply chains are vertically integrated and operate on a just in time basis. This ensues a difficult management of supply chains which worsens when GVCs are threaten by Covid-19 or other shocks. Given the high integration of aviation and aerospace companies into GVCs the aftermath had been particularly severe.[208]

Air cargo can be seen as a by-product of passenger travel, since most freight is shipped in the bodies of airlines moving people to foreign countries. Yet, dedicated integrated cargo handlers have become more and more important next to dedicated cargo subsidiaries of airlines also engaged in passenger travel. According to Merkert Van de Voorde and de Wit it is possible to detect two business models in the air cargo industry: the first consists of integrated full-service delivery by companies, including FedEx and DHL which organize around GVCs. The second model instead consists of a combination

[207] A.Montanino , A. Carriero, C. Dell'Aquila, R. Giuzio and L.Recagno. "Trasporto aereo e COVID-19; Alcuni fatti stilizzati". (CDP Think Tank, 2020).

[208] Legal500. "GC Insider: Aviation and Aerospace Supply-Chains- At the Tipping Point". (Legal500 gc, 2020).

of passenger and cargo flights, the so-called "belly cargo". Belly cargo on passenger flights accounts for at least half of global air cargo.

To sum up, the main findings of the Final Report published by IATA used in this work to explain the role of air cargo performance in the GVCs and the existing linkages between them is that structuring GVCs rely on two key elements: on one hand speed and reliability which are specific features of air cargo and on the other hand trade in high value to weight intermediates. The level of air cargo performance depends on trade facilitation. Furthermore, air cargo facilitates the creation of links between local companies and GVCs as well as influencing the decision of making specific investments. In other words, air cargo and air freight fueled by airlines are the backbone of international trade and Global Value Chains.

4.2 The effects of Covid-19 on Air cargo and air freight in GVCs

COVID-19 has posed unprecedented challenges to the world especially to the air transport sector. In fact, the air cargo sector has been seriously struck by COVID-19 pandemic experiencing an unprecedented contraction due to lockdowns, in the different geographic areas. According to IATA in April 2020 passenger demand plunged by 94.3% in comparison with April 2019. Industry losses amounted to 391 billion US dollars and with continuous declines in 2021.[209] In August 2020, the number of flights worldwide drop by more than 50%. However, it is possible to detect some differences between passenger travel and air cargo market. Indeed, while the latter has rebounded quickly due to the rising e-commerce, passenger travel took more time to recover. The impressive data which emerges is that at the end of 2020 loading rates were higher than pre-pandemic levels in terms of volume.[210] Indeed, according to IATA market analysis for air cargo in December 2020, the industry-wide cargo load factors expanded by 7.7 percentage points in 2020. Furthermore, these substantial differences can be found also across the globe. For instance, European Union and Asia reacted differently: while travel restrictions in EU resulted in prolonged economic contraction, in Asia the recover was fast. As we have observed in the previous chapters, this is not the first time that the World has tackled

[209] G.W. Xuan. "The impact of COVID-19 on Air Cargo Development". (To70, 2021).
[210] C. Findlay, H.Roelfsema, N. Van De Wuow. Feeling the Pulse of Global Value Chains: Air Cargo and COVID-19. (ERIA, 2021).

similar (despite differences in scope and magnitude) crises and air cargo sector has already faced severe disruptions as in the case of 2008 financial crisis or with the outbreak of SARS in 2003.[211]

There is a link between the technological shift and digitalization which are the core of the ongoing trends in GVCs and the pandemic on one hand, and the air cargo sector on the other hand. Basically, many big tech behemoths, notably *Amazon,* play a key role in the air cargo industry due to the flywheel effect of these technologies. The evidence of "Amazon Flywheel" can be observed in the Rieti' supply chains where for manufacturing realities sales recorded an increase of 26% and businesses in 3 years. In few words, Amazon contributed to the growth and innovation of many Italian SMEs which have doubled their revenues through the online channel. This has had positive effects also for employment since the company has hired 2.0000 employees.[212]

In addition, the pandemic and its economic impact determined a strong interaction between private and public players. One of the consequences of the health crisis has been the increasing engagement of public actor in the airline sectors. Indeed, as of August 2020, governments have provided about USD 160 billion of support to airlines.[213] This means that the pandemic crisis resulted in tensions between private companies and governments.

The analysis that follows is grounded on the Discussion Paper "*Feeling the pulse of Global Value Chains: Air Cargo and COVID-19*" and it is instrumental for the assessment of COVID-19 effects on aerospace value chain with a focus on air cargo. Air cargo demand dropped by 9% in February 2020 in comparison to February 2019 and the following month airlines cancelled 10% of flights, with an increase amounting to 40% in April and 80% when restrictions were enforced across the globe. Yet, despite the initial hard blow inflicted on air cargo, full cargo models have been promoted by many operators. In the first phase of the pandemic, it had been recorded a triple increase of the price of air cargo. Given that passenger airlines reached a standstill during the pandemic, they were converted into cargo aircraft. In April 2020, capacity was down 35%, 17% from ASEAN to North America, 30% from Asia to Europe and 35% within Asia.

---

[211] *Ibidem*

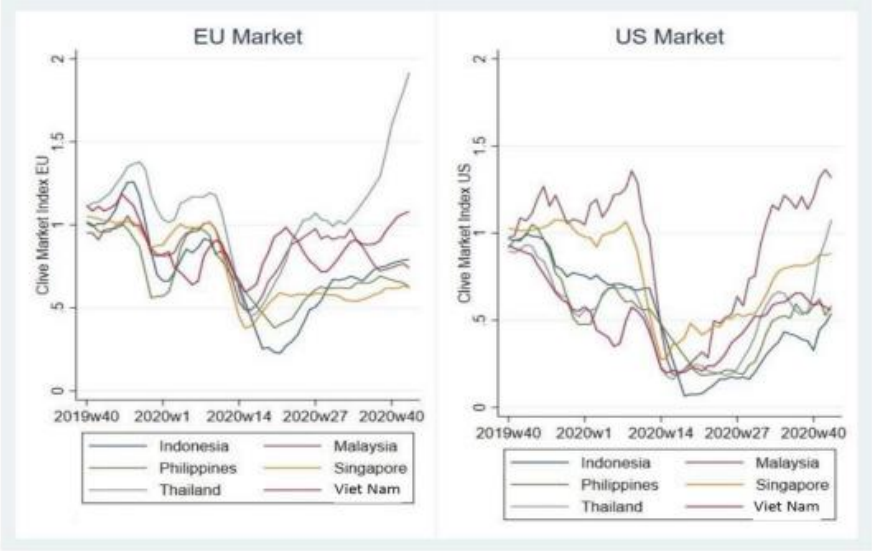
[212] P. Licata. "Amazon, effetto volano sulla filiera reatina: + 26% di ricavi per le imprese della logistica". (Corcom, 2022).

[213] OECD. "COVID-19 and the aviation industry; Impact and policy responses". (OECD, 2020).

It is interesting to observe that the decline in the air cargo sector is also linked to a decline in employment since with the pandemic many companies were forced to reduce their workforce. For instance, Virgin Australia was obliged to reduce its employees by 8,000 and Garuda Indonesia fired 180 pilots. Other important choices were made; for example, Vietnam Airlines sold its 49% stake. At the beginning of the pandemic, in Asia the overall operational capacity experimented a cut of 51% while in Europe's operational capacity recorded a reduction of 80%.

In order to assess the impact of COVID-19 on air cargo, the tool which had been utilized is the CLIVE database. Basically, it consists of detailed flight data obtained by CLIVE clients (airline companies) providing data on load factors, volumes and weight of cargo. From an overall perspective, air cargo movements have bounced back even if to different extent depending on region and export market. For example, in the sharp phase of pandemic, air cargo movements in Vietnam besides remaining unchanged, its exports to Europe increased. Singapore too regained its exporting position in the US market. Yet it took more time to return to its pre-pandemic position in EU. The most impressive shifts in air cargo flows can be observed by observing European and US market for air cargo from ASEAN. Figure 4.1 shows these trends during the pandemic.

Figure 4.1: Air cargo weight in relation to EU and US Markets



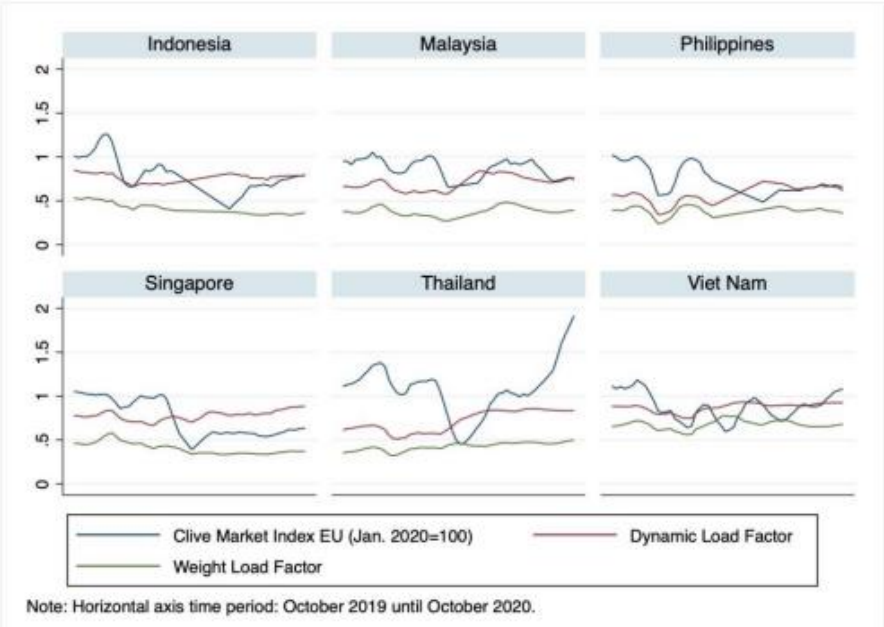
Source: CLIVE Market Index (2020)

Dynamics loading factors are seen as a mix of the effects of shifts in the carrying capacity which has been reduced due to the outbreak of COVID-19 and foreign markets' demand. To begin with, let's focus on air cargo flows between ASEAN countries and Europe. The focus on these two regions is related to the fact that Asia is still considered the "factory of the world" in which is located one of the main hubs of the regional value chains, namely China. By the same token, Europe is the destination market for many countries in Asia. In ASEAN region, cargo destined for Europe recorded a sharp decline in the initial stage of pandemic as a result of COVID-19 restrictions. In the air cargo sector too, the recovery, as well as the decline has been uneven since it differs across countries. The volume decline is the outcome of a double dip ensuing from early warnings of COVID-19 and the official outbreak of pandemic in March 2020. While the first drop had been remarkably felt in Philippines, Thailand and Vietnam, the same decline had been less pronounced in Singapore and Malaysia.[214]

The uneven recovery instead is evident between Singapore and Thailand as shown in the figure 4.2. The reason lies on the fact that Thailand ranks among impressive latex producer and shipper which during the pandemic recorded an increased demand for protective equipment.

Figure 4.2: COVID-19 effects on Air Cargo from ASEAN to European Union

[214] C. Findlay, H.Roelsfema, N. Van De Wuow. Feeling the pulse of Global Value Chains: Air cargo and Covid-19. (ERIA, 2021)



Source: CLIVE, CLIVE Market Index 2020

In general, what emerges from this figure is that load factors have reached higher point than before the pandemic. Furthermore, higher loading factors stands for the air cargo volume component.

The assessment of effects Covid-19 continues in this part by analyzing which factors triggered by COVID-19 which play a role in shaping air cargo flights outside ASEAN region. Also, this analysis is carried out by referring to the already mention discussion paper published by ERIA in 2021.

According to the analysis carried out by IATA in July 2021, the first quarter of 2020 saw a substantial fall of industry-wide cargo ton-Kilometers (CTKs). The figure 4.3 highlights the sharp decline happened in the initial months of pandemic. Then, as we can observe, air cargo industry deeply bounced back from May 2020, meaning when strict lockdowns were lifted.[215]

Figure 4.3: Fall of industry-wide cargo ton-Kilometers (CTKs)

[215] J.Wood, M.Knowles. "Impact of COVID-19 on cargo-related claims". (ReedSmith, 2022).

Source: IATA Economics, IATA Air cargo market Analysis, July 2021,

Passenger aircraft has been even more pronounced than air cargo movement as demonstrated by the figure below. Indeed, the figure 4.5 shows that the drop has been remarkably sharper to the point that can be defined vertical due to its magnitude. In addition, the figure highlights a recovery in the passenger aircraft of only 50% in comparison to pre-Covid-19 levels.

Figure 4.4: Fall of global air passenger volumes (RPKs)

Source: IATA Economics, IATA Monthly Statistic, 2022

The health emergency affected the price for air cargo. In fact, before the crisis, air cargo was 12 times more expensive than sea freight. In the early phases of the pandemic, prices remarkably soared when supply drop, they have since fallen to competitive rates when compared with container shipping. [216]

Air cargo operators have been exposed to the risk of disruptions and delays and the potential damages to cargo stemming from the delay deprive the beneficiaries of any profitability of operations. The solution could be tracking changes in the schedule, equipment and route in order to adapt to such changes. However, what emerges is the inability of freight forwarders to predict and bring forward these changes. COVID-19 has remarkably affected the entire global supply chain also in the air cargo industry which during the early stages of the pandemic played a pivotal role, in ensuring transportation of medicines, medical equipment, food and other essential goods. These observations have been illustrated in the article published by ReedSmith entitled "*Impact of Covid-19 on cargo related claims*".

Moreover, pandemic restrictions provoked severe global supply-chain congestion and created hardships for aircrew moving across international borders. [217]

In comparison with May 2019, the weekly flight frequency for global passenger airlines dropped by about 70%. Before 2020 which marks the onset of pandemic crisis, 54% of the world's air cargo was transported in the hold of passenger aircraft (belly cargo). In this framework, despite freight forwarders have not halted their air cargo operations, they differ from commercial passenger aircraft since most of these aircraft are hub-focused and their route network is more limited than commercial passenger aircraft. This implies that the air cargo industry has reduced the efficiency and convenience provided by belly cargo transport. Jointly with the drop in air cargo capacity, which in November 2021 was 7.6% below November 2019 (-7.9% for international operations), the pandemic resulted in the volume of cargo requiring transportation, for instance medicines, medical equipment, essential goods and so on. As we have seen previously, the demand for air cargo capacity has been shaped by the rising growth of e-commerce which will have a

[216] *Ibidem*

[217] IATA. "Key to Air Cargo Resilience Post Pandemic: Cooperation, Safety, Sustainability, Modernization. (International Air Transport Association, 2021).

long-term impact on the air cargo industry. Additionally, the substantial losses brought about by the plunge in passenger ticket sales were mitigated by the buoyant air cargo market through the redeployment of their passenger aircraft.[218]

Other effects of COVID-19 which to some extent confirms the overall impact of COVID-19 on GVCs and all sectors integrated into them is the increase in regional air cargo and supply chain diversification. Indeed, firms are increasingly attempting to diversify their supply chains in order to reduce cost and mitigate risk. The regional air cargo traffic is the outcome of nearshoring and reshoring. For example, US businesses have moved their production from China to closer countries such as Mexico and Canada. COVID-19 impacted air freight industries also by accelerating some trends, including omni channel logistics and the use of cargo drones.[219]

From March 2020 onward air freight was engaged to offset the hardship in the global shipping industry. As a result of these two years in which airline companies, aircraft manufacturers, suppliers in the aerospace supply chains have been overwhelmed by supply chain disruptions, demand for freight and passenger-to-freighters- conversions is likely to grow down the road despite COVID-19 has overthrown air cargo and logistics market.

Trade of goods in the GVCs has been impacted also through services, meaning through disruptions in the transport industry. Basically, the decrease in passenger flights provoked a reduction in the supply of air cargo services. Indeed, OECD statistics reported that drop in services during the pandemic has been more pronounced in comparison with fall services during the 2008 Financial crisis. While trade in services during the 2008 financial crisis had recorded a drop of -15%, during the pandemic, it experimented a fall of – 25%. [220]

In other words, quarantine, continuous lockdowns, restrictions and sanitary measures struck the transport services. Pandemic showed us that trade in final goods, trade in parts and components and trade in services are intertwined. However, as there is a lot of heterogeneity across services, they can be split in two parts: financial services, telecommunication, information services as well as other business services on one hand, and services exports, such as transportation and travel on the other hand. While the first

[218] R. Hakes, O. Beiersdorf. Global Air Freight's future: The sky is the limit. (ReedSmith, 2022)
[219] *Ibidem*
[220] S. Miroudot. "Resilience in Services Value Chains". (Council on economic policies, 2022).

ones have been partially affected by the pandemic and quickly recovered from May 2020, the latter faced more hardship in coping with COVID-19 effects. For instance, let's focus on transport on one side and financial services on the other side. According to WTO Statistics, during the pandemic shock, busines services fell only by 5%, whereas the drop in transport was about of 50%. The reason regards the fact that jobs in businesses and financial services can effortlessly switch to working from home whereas services involving movement of producers or consumers are more affected during a shock like pandemic than services which can be supplied cross-border digitally. The case of air transport, especially for what concerns freights is an issue of robustness and resilience. The resilience of air cargo transport is demonstrated by the fact that air cargo quickly bounced back in Q1 and Q2 2021.From an overall perspective air cargo services supply chains are likely to be more resilient to economic shocks than manufacturing value chains.[221]

In the case of European Union for instance, in the relation between export gaps and dependence on exports by air, European Union's exports recorded the smallest negative gaps or the largest positive ones in goods which are normally exported via air, including Pharmaceuticals, precious metals, electronics.[222]

Going further, the aim of the following analysis is to demonstrates that air cargo transport is a pivotal service in the regional and global value chains and the reduction in air transport consumer demand brought about by pandemic crisis led to lower GDP from 0.4% to 2.1%. [223]

The negative shock of the COVID-19 on the air cargo transport industry unavoidably hit other economic sectors operating into GVCs. The assessment of impact of COVID-19 on air cargo has to be done through the lens of GVCs. Disruptions in air transport have halted trade activities among the GVCs participants. As air transport is a key driver for all the other sector activities, the fact that it has coped with COVID-19 entails that other sectors have been affected too. This linkage is grounded on the fact that many industries reliable

[221] *Ibidem*

[222] C. Arriola, C.Cadestin, P.Kowalski, F. Van Tongeren. "International trade during COVID-19 pandemic: Big shifts and uncertainty". (Organization for Economic Cooperation and development, 2022).

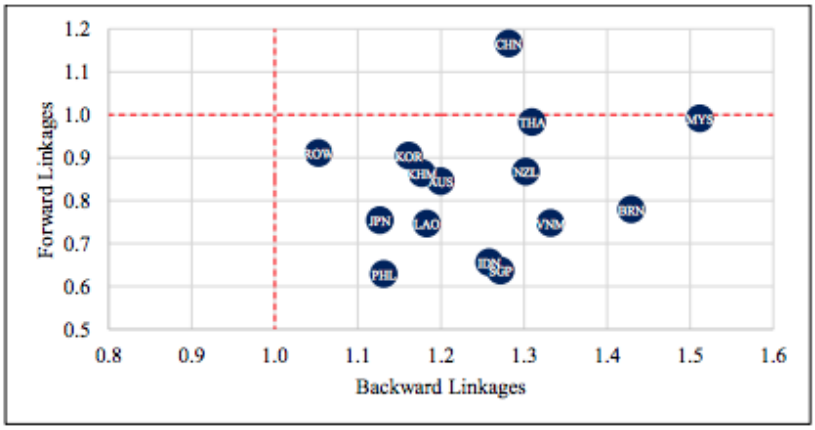
[223] T.Sarmidi et al. The Covid-19 pandemic Air transport Perturbation and Sector Impacts in ASEAN plus five: A multiregional input-output inoperability Analysis. N. 368 (ERIA, 2021).

on air transport have encountered multiple difficulties getting necessary inputs for their production processes.[224]

According to the analysis carried out by ERIA in the work entitled "*The COVID-19 pandemic, Air transport Perturbation and Sector Impacts in ASEAN Plus five: A multiregional Input-Output Inoperability Analysis",* air transport industry is deemed a periphery sector, which basically means that has less importance than core sectors. However, despite this "secondary role", changes taking place in this sector inevitably will have important repercussions on the economic activity for a country as a whole. Moreover, manufacturing sector is the biggest contributor to the input-output flow to the air transport sector. This means that any change in the output for air cargo industry and air transport, such as contraction or expansion, the manufacturing sector will be the most impacted in comparison to other sectors. In a context characterized by GVCs in which any economic activity is deeply integrated and interconnected with all sectors, including air cargo and air transport changes and shocks in one of these sectors will trigger changes in all the other sectors. The relevance of air transport industry in driving domestic, regional and global economies is observed through the backward and forward linkages which allows us to measure the level of dependencies between intermediate input purchases and intermediate input sales for a given sector. The methodology used in this work is based on the disaggregation of the linkages into domestic economy and regional economy in order to observe the respective roles.

Figure 4.5: Backward and Forward Linkages for Air Transport Sector in the Regional Economy

[224] *Ibidem*



Source: ERIA, 2021

The figure above illustrates the backward and forward linkages for the air transport sector in the ASEAN regional economy. The factor which stands out is that the value of backward linkages in all ASEAN countries is higher than 1 which basically means that air transport sector has high linkages with the source sectors in the region. On the contrary, from forward linkages' perspective, all ASEAN countries are characterized by value below except for China. The air transport sectors in China play a crucial role in the regional economy compared to other countries which confirms that China is the main intermediate input supplier.

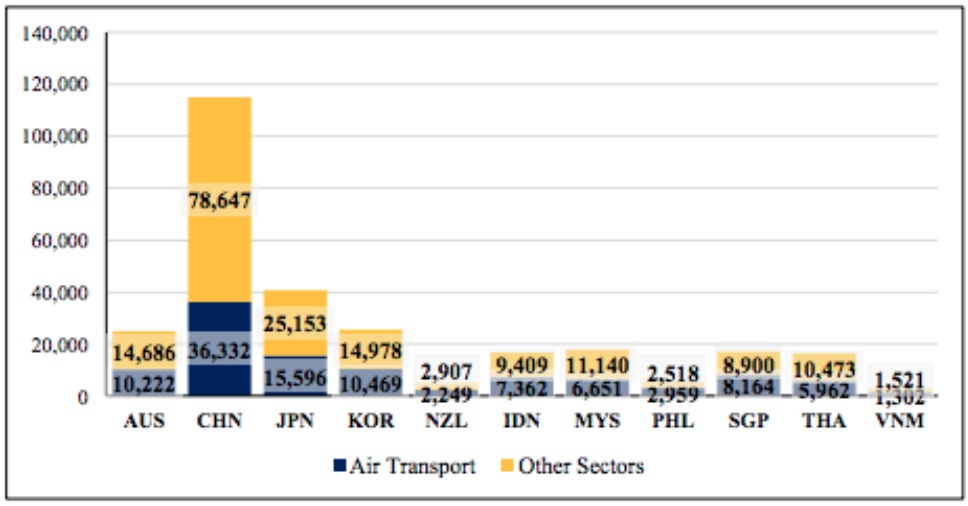
The following part grounded on the Discussion paper entitled "*The COVID-19 pandemic, Air transport Perturbation and Sector Impacts in ASEAN Plus five: A multiregional Input-Output Inoperability Analysis"*, will analyze the effects of demand-side perturbations on the airport sector due to the pandemic. The demand reduction on the air transport sector determined an increase in the inoperability rates on the air sector in each country. These inoperability rates are the result of the combined indirect effects due to *interadependence* (dependency within itself) and *interdependence* (dependency with other sectors) of the air transport sector. For instance, Thailand initially recorded a final demand reduction on air transport sector amounting to 52.0% which has caused an additional demand reduction in the air transport sector due to sector dependency by1,8%. Thus, the inoperability rate will be the sum of 52.0% plus 1.8% (53.8%). The highest inoperability rate has been experienced by Thailand, followed by Malaysia (52.3%) and Korea (52.2%). At this point it's important to point out that despite the Thai highest inoperability rate, Thailand recorded the quickest and remarkable recovery. Indeed, as we

have seen previously, the quick recovery is due to role played by Thailand in the latex production which has been crucial for the increased demand for protective equipment.

The air transport sector experimented the biggest economic losses for all countries. Yet, in ASEAN region, Brunei Darussalam is an exception because of the lesser inoperability in air transport sector in comparison to other sectors. In the context of GVCs, Brunei Darussalam economic losses have been particularly felt in the oil sector compared to the air transport sector. The correlation between these two sectors can be explained in the following way: slight reduction in the air transport sector can bring about biggest reduction in the output of oil sector.

In a nutshell, high level of dependency on air transport sector has provoked consistent losses in many other sectors, such as petroleum and coal products. This is further evidence of the domino effect among sectors (known also as "bullwhip effect" or trickle down-effect) operating into GVCs. Yet, another way to observe the effects of COVID-19 on air transport in relation to their integration into GVCs is through the lens of Value added. The graphic below provides us a comprehensive view of the loss from air transport in terms of value-added. The focus is still on ASEAN countries given their organization as regional hub as well as the China's role as "factory of the world".

Figure 4.6: Value-added Loss from Air transport and other sector



Source: ERIA, 2021

From each country's perspective, China's value-added loss amounts to $28,9 billion followed by Japan which value-added loss is about $10.2 billion. Instead among the ASEAN countries, Lao PDR, Cambodia and Brunei Darussalam recorded the smallest

value-added losses which have been excluded by the figure because their value is difficult to be appreciated in this graphic.

The delays undergone GVC trade especially in the first phase of the pandemic are due to quarantine measures for air crews and further sanitary controls related to Covid-19. COVID-19 exposed international air freight and GVCs international production networks to vulnerabilities and disruptions in the logistics of supply chains. The outbreak of COVID-19, restrictions on flights as well as on the movements of passenger and transport crew led to disruptions of Global and regional value chains. The reduction in air traffic and the resulting difficulties in transporting air cargo led to bottlenecks with cascading effects throughout the entire value chains. Indeed, according to recent data published by the European Parliamentary Research Service, global delivery times especially in the manufacturing sector are the longest since data collection began 23 years ago.[225]

Furthermore, a survey carried out by IATA in October 2021 observes that a value below 50 indicates that business reported on average longer delivery times compared to the previous month. In 2020, this value reached 28. The surprising data shows that supplier delivery times extended in 2021 reaching a value slightly above 10. Only at the end of November 2021 the value of Supplier Delivery Time Purchasing Managers Index (PMI) increased again, reaching 36.4. In other words, this delay in the supplier delivery hampered production of goods requiring inputs sourced abroad triggering supply chain disruptions which ricocheted throughout GVCs. The lack of air cargo capacity was down 12.2% in Jan-August 2021. In normal times, values below 50 are favorable for air cargo, but in current conditions it points to delivery times lengthening because of supply bottlenecks.[226]

The economic loss suffered by airlines amounts to 84,3 billion and it's the highest in the history of air freight supply chain. Instead, the 2008 Global financial crisis caused an economic loss to the air freight supply chain amounting to 31 billion.[227]

Airline suppliers and the entire air transport supply chain rely on continuing to to deliver new equipment and supplying spare and parts. All the major commercial aircraft programs are dependent on global supply chain for raw materials and components.

[225] European Parliamentary Research service. "Resilience of Global supply chains; challenges and solutions". (European Parliament, 2021)
[226] IATA. "IATA Economic's Chart of the Week". (International Air Transport Association, 2021).
[227] World Economic Forum. Crisis faced by Airlines. (World Economic Forum, 2020).

Additionally, aircraft supply chain requires available workforce to physically build engine parts and maintain production facilities, final assembly and test facilities.[228]

The practical impacts of COVID-19 on the aerospace supply chain may be different; for example, imports-exports interruptions affected air cargo supply chains. Many states, notably European countries, enacted different measures regarding import of goods and services from countries having a COVID-19 high risk. These measures were allowed by European Commission and were aimed at safeguarding the health of its citizens. Going further, the closure of many production and test facilities with drastic output reduction had serious repercussions on air freight supply chain. For instance, *Airbus* was constrained to halt production in Spain and France due to the compliance with COVID-19 restrictions. The same happened in US with *Boeing* production. Travel bans and border closures hindered overseas-based specialist, such as maintenance and operation specialist, to get the location of work.[229]

Furthermore, many airlines take their equipment on the basis of long-term support contracts. The payments are made by airlines and suppliers rely on payments -based on hours flown. Yet, in the current crisis the hours flown have experienced a drastic reduction at least in the initial phase. [230]

The hard blow experienced by air freight supply chain provoked many detrimental effects on aircraft manufacturers. Among the multiple effects, for example, bankruptcy has been experienced by *Virgin Australia* and *Flybe*. *Lufthansa* started a strong restructuring of its fleet, through a reduction by 100 aircraft throughout the pandemic shock. Additionally, many airlines annulled or postponed orders and thus aircraft manufacturers found themselves in coping with the emergence of white-tail-fleets (meaning that fleets are not produced for a specific airline company) since many aircrafts have not been engaged in an advanced stage of the manufacturing process. The new depleted market has forced aircraft manufacturers to temporarily revise production rates downwards.[231]

The effects of COVID-19 on aerospace supply chains have been felt also by defense industry in the medium-term. For example, *Impresa Aerospace* which is a key firm in the

[228] L. Fattorini, P.Briggs, S.Phippard, A.White. "COVID-19 & air transport and aerospace supply chain: a ten-step guide". (Bird&Bird, 2020).
[229] *Ibidem*
[230] *Ibidem*
[231] A. Kuzmanovic, J.L. Rassineux. "Post COVID-19 Aerospace industry". (Deloitte)

defense supply chains by making sheet metal parts and assemblies for military aircraft constructed by Boeing declared bankruptcy.[232]

The consequence in light of Covid-19 is that the difficulties in the aviation sector generate spillovers into the defense industrial base through defense supply chain.[233]

As the impact of COVID-19 has spread to a larger group of companies via GVCs, also suppliers in developing countries faced the same difficulties and the repercussions have been felt also by their employees. The main challenge for aviation and aerospace sectors is linked to the fact that the supply chains in this industry are specialized and require companies to be pre-qualified. In order to be pre-qualified, companies invest time and high costs.

In November 2021 data confirmed a slower growth for global air cargo markets. Economic conditions remained positive for the sector regardless disruptions in supply chains. In 2021 global demand measured in cargo tonne- kilometres (CTKs) was up 3.7 compared to November 2019 (4.2% for international operations). What stands out is that this percentage is remarkably lower than the 8.2% growth experienced in October 2021 which marks the phase of recovery. This data confirmed a slower growth for global air cargo markets. Economic conditions remained positive for the sector regardless disruptions in supply chains. There are many elements in the economic condition which allow us to state air cargo growth, including the increase in global goods trade which rose 4.6% in October 2021 and the inventory-to sales ratio remained low in November 2021 which is a positive sign for air cargo as manufacturers turn to air cargo to rapidly meet demand.[234]

Now, it will be developed a more detailed analysis of aerospace supply chains. The volumes of output in aerospace value chain drastically reduced triggering a cascade effect from OEMs (Original Equipment manufacturer) spreading to the rest of value chain reaching all supply chain tiers and service providers. This implies that all the actors involved in aerospace value chain had to adapt their production processes to the new environment trying to avoid bleeding unnecessary cash. The unprecedented impact of

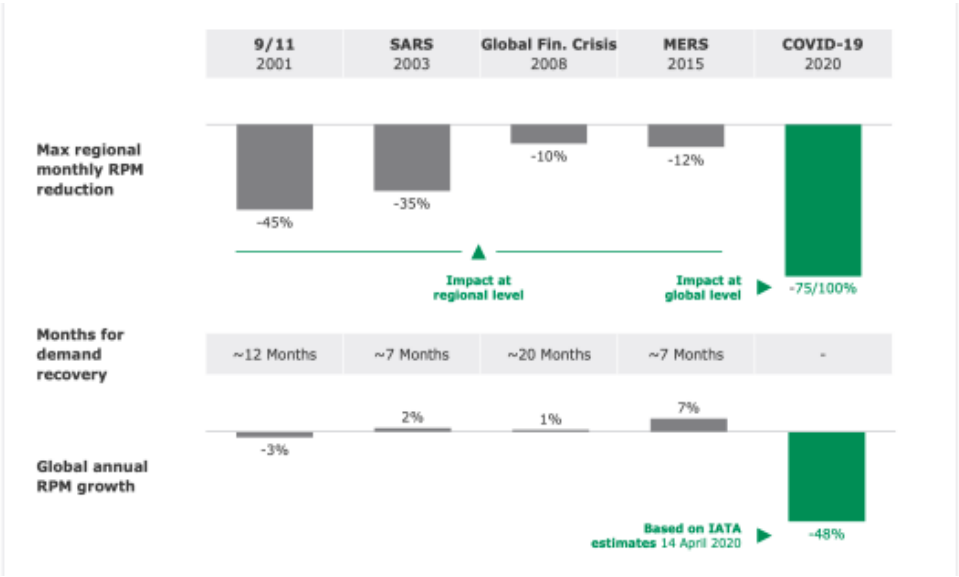
[232] N.D. Hensel. "The impact of COVID-19 on the U.S Defense Industrial Base". (Department of Defense manufacturing technology program, 2022)

[233] Legal500. "GC Insider: Aviation and Aerospace Supply-Chains- At the Tipping Point". (Legal500 gc, 2020).

[234] Times Aerospace. "Supply chain disruptions halve November air cargo growth" (Times Aerospace, 2022).

COVID-19 explained in the third chapter is confirmed also in the aerospace value chain. The commercial aviation reached a standstill which remained for months. In fact, as a result of COVID-19 the maximum monthly RPM (Revenue Passenger Mile) reduction overcame 75% causing an impressive annual reduction. In comparison to other shocks, the terrorist attack, for instance, resulted in a maximum monthly RPM reduction of 45% especially for the North American market. By the same token, if we compare RPM reduction brought about the 2008 Financial crisis and the RPM reduction caused by covid-19 the difference is striking as confirmed by the figure 4.7 .[235]

Figure 4.7: Differences of the impact of various crisis on air travel demand



Source: IATA; ICAO; 2020

In 2020 pandemic shock, the whole supply chain has been affected; indeed, 2020 commercial aviation sales drastically declined by up to 70% globally.[236]

The Coronavirus crisis first struck airlines and their affiliated service companies, such as ground services, catering and Maintenance Repair and Operations (MRO). The response adopted by airlines in the face of travel bans was flight reductions, short-time arrangements for the workforce, retirement of entire fleets. The services involved in the

[235] S.Ohl, C.Leber, D.Makowski, K. Schottle. "After the covid-19 Pandemic- How the Structural crisis can be overcome". (Alixpartners, 2020)
[236] *Ibidem*

aerospace supply chain such as MRO and aviation services faced many hardships. For instance, if we analyze the consequences experienced by MRO operators, sharp decline in the demand for aircraft maintenance and other services provoked a fall in revenue for over 60% in 2020.[237]

The aircraft industry was struck by demand drops with a slight delay, but the decline has been felt with full force. In the aviation industry, the two leading companies, namely *Airbus* and *Boeing* collapsed by 40-60% in 2020 respect to the previous years. In addition, the reduction in production rates had serious repercussions on the entire commercial aerospace supply chain. The information presented in this part of the chapter have been gathered from the paper published by AlixPartners in 2020 entitled "*After the COVID-19 Pandemic -How the Structural Crisis can be overcome"* and allows us to look more in detail the impact of Covid-19 throughout the entire aerospace value chain. Suppliers in the aerospace value chain found themselves in coping with sudden demand fall and the consequent liquidity shortage exacerbated by long lead times in the supply chain. Furthermore, decoupling of production shifts and physical distancing led to a reduction in efficiency.

Figure 4.8: Orders at risk for Airbus and Boeing

	Family	Orders	Orders at Risk	Adjusted Orders	Share at Risk
Narrow Body	Airbus	6,615	828	5,787	13%
	Boeing	4,164	709	3,455	17%
	Total	**10,779**	**1,537**	**9,242**	**14%**
Wide Body	Airbus	886	272	614	31%
	Boeing	996	65	931	7%
	Total	**1,882**	**337**	**1,545**	**18%**

Source: Alixpartners, 2020

The figure above shows the effects of pandemic on order books in the two main companies in the aerospace industry. Upcoming bankruptcies jeopardized 10-20% of orders. The falling demand for OEMs and suppliers was also exacerbated by the high fixed costs which characterize this sector.

[237] *Ibidem*

The pandemic shock shed light on the problems arising from highly fragmented small suppliers, whereas the level of fragmentation as well as the supply chain robustness is an issue which varies segment by segment.

As we have seen so far, it's undisputed that aerospace supply chain and air cargo sector have been hard hit by COVID-19 and the effects of Coronavirus on this value chain have been so heavy to the extent that allows us to claim that air transport industry is one of the most affected. However, despite many challenges and multiple threats posed by COVID-19, air cargo industry and in general its supply chain have proven their resilience.

4.4 The resilience of Air cargo industry

The air cargo industry has proven to be impressively resilient to the impact of COVID-19 pandemic. This has been confirmed by the recent data published by IATA in August 2022 which show us that despite economic uncertainties and revenue losses, air cargo industry reacted positively in the medium term. Basically, an example of its resilience consists in the fact that while on one hand COVID-19 reduced demand for passenger flights, on the other hand it stimulated air freight demand.

By observing data, we can see that in 2021 air cargo revenues reached a record $204 billion, meaning double in comparison to 2019 and accounted for some 40% of total airline revenues in 2021.[238]

As the figure 4.3 shows, in August 2022 seasonally adjusted cargo tonne-kilometers (CTKs) bounced back recording a growth of 1% in comparison with July. Furthermore, the increase of available cargo tonne-kilometers (ACTKs)of 6.3% contributed to the first positive growth in industry-wide load factor since the onset of 2022. If we look at the ASEAN region for instance, the bounce back in Asia market generated positive growth in air cargo demand in some of the largest cargo markets. Asia Pacific recorded the most impressive increase in seasonally adjusted ACTKs from 2.4% YoY to 12.4%, while Latin America kept its double-digit growth of 24.7% YoY and North America stabilized at 5.4%. The air cargo growth is less remarkable in Europe and Middle East respectively with an air cargo growth rate at 0.8% and 0.5%YoY in August. In Europe the effects of the war affected the air cargo performance All this data, even if in some cases they are

[238] IATA. "WCS to focus on Building Resilience in Air cargo". (International Air Transport Association, 2022)

not particularly striking, confirm the resilience of air cargo industry not only to COVID-19 but also to the recent geopolitical tensions. Another sign of resilience can be seen in industry-wide cargo tonne kilometers. Indeed, while in July it has been recorded a decrease of 9.7% YoY, in August industry-wide cargo tonne-kilometers (CTKs) were down 8.3% YoY. [239] Airlines in the ASEAN region benefited from the slightly increased levels of trade and manufacturing activity due to the relaxation of COVID-19 restrictions and available capacity in the region increased 13.9% compared to August 2021, an impressive increase exceeding 2.7% growth in July.

In this framework characterized by post-COVID rebound in air cargo, the war in Ukraine is affecting cargo capacity bringing about distortions to air cargo carriers.

The main indicator for air cargo shipments is the new export orders which did not reach high level. Yet, US is an exception as it saw a feeble bounce back contrary to other major economies which kept the downward trend. Among these major economies, we can find China as COVID-related restrictions affected air cargo activities. Nonetheless, air cargo demand is expected to recover down the road. [240]

The case of air transport during the pandemic, especially for what concerns freights is an issue of robustness and resilience. The resilience of air cargo transport is demonstrated by the fact that air cargo quickly bounced back in Q1 and Q2 2021. From an overall perspective air cargo services supply chains are likely to be more resilient to economic shocks than manufacturing value chains. [241]

Air cargo has been pivotal throughout the COVID-19 pandemic as it has ensured the smooth functioning of Global Value Chains. The pandemic has clearly tested the importance of harmonized approaches to ensure air transport connectivity. The extraordinary situation provoked by pandemic crisis has required the cooperation between companies involved in GVCs 'activities in order to ensure the supply and fair distribution of scarce products to all consumers. [242]

The resilience of air cargo has been particularly evident in relation to GVCs as it has kept global supply chains functioning for many of the most sensitive and high value materials

[239] IATA. "Air Cargo Market Analysis". (International Air Transport Association, 2022).
[240] *Ibidem*
[241] S. Miroudot. "Resilience in Services value chains". (Council on economic policies, 2022).
[242] European Commission. "European commission Guidelines: facilitating Air cargo Operations during COVID-19 outbreak. (European Commission, 2021).

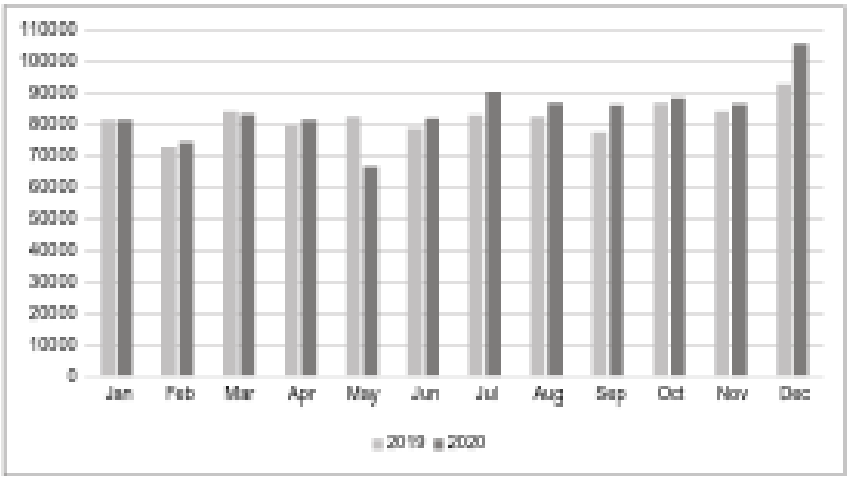
such as technological products. In addition, it acted as a critical complement to the transport of freight by land and sea.[243] Indeed, in order to bypass supply chain disruptions firms have begun increasingly to rely on air freight. Since the onset of pandemic shock supply chain air cargo has experienced an unprecedented surge in demand from firms which have attempted to avoid congested ports and looking for speedier routes to get their goods into consumers 'hand.[244]

Another change triggered by Coronavirus was the reduction air freight prices which before the pandemic were 13 to 15 more expensive than ocean freight. In fact, air transport only encompassed high value, low-weight goods, such as pharmaceutical and perishable goods as well as technological products. A remarkable share of that cargo was transported in the bellies of passenger aircraft but after the onset of health emergency supply chain air cargo prices rose due to the reduced capacity and increased demand. However, by the end of 2021's fourth quarter, supply chain air cargo rates fluctuate around 3 to times the price of ocean freight. This contributed to make the trade off more attractive to firms. [245]

The data which confirm air cargo resilience have been published by IATA in 2021 which show that air cargo volumes had returned to January 2019 pre-COVID levels. The figure below allows us to note that in terms of flights, in all but 3 months of 2020 during the height of the initial wave of pandemic, the number of pure cargo flights exceeded those in the same month in 2019.[246]

Figure 4.7: The number of global cargo flights (international and domestic) in 2020 compared to global cargo flights in 2019

[243] *Ibidem*
[244] CTSI. Global. "Supply Chain Crunch Boosts Profits for Air Freight;How the supply chain crunch is transforming air cargo". (CTSI-Global, 2022).
[245] *Ibidem*
[246] L.Budd, and S. Ison. Chapter 14: The impact of Covid-19 on air cargo logistics and supply chains. (Science Direct, 2022)



Source: ICAO. 2021

By looking at the figure, December 2020 recorded an increase of the number of cargo flights worldwide amounting to 13.71%. The increase of the demand for mere cargo flights amid pandemic meant that the number of active cargo aircraft went from 6,751 aircraft in 2019 to 7,021 aircraft in 2020 (which basically means an increase of 4%) in comparison to a reduction of 50% in the global active single -aisle passenger jet fleet.[247] Due to the ongoing supply chain disruption, freight forwarders and other air cargo operators may take advantage of their position by passing on fuel price hikes to passenger and firms loathing to pay more. Yet, the war in Ukraine has curb this trend since consumers and firms begin to feel the weight of inflation and increased interest rates.[248] Global supply chains cannot halt their operations despite disruptions regardless their magnitude. In the context of GVCs, the engine and the driver for firm's operations, including airlines engaged in air freight are consumer expectations. The striking data recorded during and after the worst times of COVID-19 concern the unchanged consumer expectations. Indeed, since the outbreak of pandemic consumer expectations have not drastically changed but have increased as a result of e-commerce and online shopping. This dynamic has dragged on air freight performance.[249]

Since March 202, European- US air freight volume increased 25%. Supply chains have been affected by constrained capacity and rising costs, but air freight acted and still carries

[247] *Ibidem*

[248] CTSI-Global. "Supply chain Crunch Boosts Profits for Air Freight; how the supply chain crunch is transforming air cargo". (CTSI-Global, 2022)

[249] American Global Logistics. "Air shipment achieving agility, speed and resilience". (AGL, 2022)

on acting as a useful tool in risk mitigation. From the onset of the pandemic, air freight has been able to strengthen resilience and agility through diversification of delivery modes.[250]

Air cargo supply chains has proved its resilient in many different ways, for instance by quickly adapting to the fast-evolving situation. Indeed, many e- commerce companies such as *Amazon* which have already affected global supply chains addressed this troublesome issue, meaning logistics disruptions caused by pandemic, by prioritizing its operations in the US where shipping times have sharply increased.[251]

In this framework characterized by a high degree of resilience a role has been played also by Neutral Air Partner (NAP) which is the premier global network of leading air cargo architects and aviation specialist. NAP represents the independent SME air cargo logistics firms and during pandemic launched a project, called "*NAP Global Airline Partner program*", jointly with TIACA with the goal of driving buying power across the air cargo supply chain in these times overwhelmed by uncertainty due to COVID-19. This project encompasses preferred global carrier status, marketing, global or regional BSA/CPA agreements, special cargoes support and volume incentives on a regional or global scale.[252]

The successful key to tackle difficulties and challenges posed by COVID-19 outbreak in the air cargo sector has been the coordination to match cargo supply and capacity demand. In particular, this coordination has involved time, labour and negotiation-intensive activities. Most of this has been achieved through unilateral arrangements such as government- driven initiatives operated by national carriers.

Governments adopted financials support programs with the goal of helping companies to perform the investments necessary for deep and radical transformations. Aircraft manufacturers should indeed capitalize on this period to improve operations by developing digital capabilities. These innovations helped business rebound on both manufacturing and supply chain. The benefits which have been reaped concerns four main performance aspects: production capacity utilization, product quality, operations

[250] *Ibidem*

[251] C. Robinson. "Overcoming COVID-19 pandemic challenges to the air cargo Sector". (The International Air Cargo Association, 2022).

[252] M. Zographos. "Industry collaboration and the vision for air cargo in a post-COVID19 world". (The international Air Cargo Association, 2022).

and maintenance costs and safe and security. These technologies have been deployed across aircraft manufacturers operations.[253]

The governmental aid programs are likely to hinder the necessary re-shaping of the aerospace supply chain. In fact, worldwide airlines received multibillion- dollar support packages.[254]

However, one of the most important factors in the recovery which has been one of the most powerful tools for aerospace supply chain restoration has been the availability and effective deployment of vaccine to fight against the virus. This has allowed the increase of global travel activities. Indeed because of the vaccine the passenger confidence has been restored and required sanitary measures allowed the gradual relaxation of flights.[255]

The management of the risk and the consequent resilience has been possible also by supply chain consolidation. In other words, complex supply chains in the aerospace sector have been reduced allowing a much easier management. For instance, in the aerospace value chain the number of existing suppliers experimented a reduction by approximately 50%. This led to a market consolidation. Indeed, the current pandemic crisis represents also an opportunity to speed up the supply chain consolidation. In this framework a possible option could entail increasing vertical integration of OEMs and Tier 1 suppliers to grow market share.[256]

A further proof of resilience and recovery is given by Airbus company which announced at the end of 2021 an increase in A320 production rates and the return to service of the 737MAX. Furthermore, despite in early 2020 aircraft production rates for the A320, A220 AND 737 have almost halved, the Airbus industry has delivered two times as many aircraft than December 2021. This is strengthened by further future expectations as by 2025 A320 production rates could overcome pre-Covid levels. It's important to specify that there is a debate on how realistic these production rates are but at the same time, the ramp up is inevitable regardless of how steep it is.[257]

---

[253] A.Kuzmanovic, J.L.Rassineux. "Post Covid-19 Aerospace Industry.An opportunity to embrace the 4.0 Era?". (Deloitte, 2020)

[254] S. Ohl, C. Leber, D.Makowski, K. Schottle. "After the COVID-19 pandemic-How the Structural crisis can be overcome". (AlixPartners, 2020)

[255] *Ibidem*

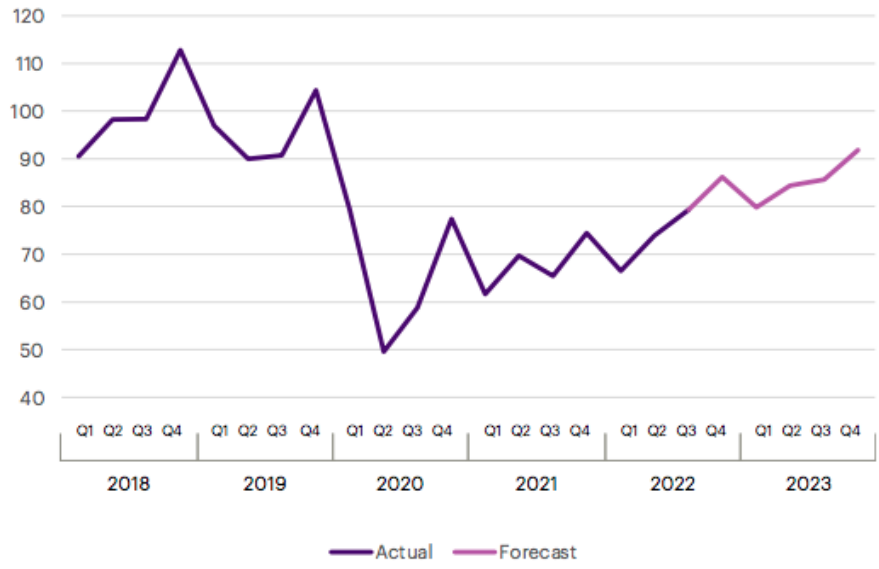
[256] *Ibidem*

[257] M.Hader, N.De Silva. "Civil Aerospace post-Covid19 rate ramp-up: can your operations handle it? ". (Roland Berger, 2021)

The darkest period for air transport seems to be overcome. The most recent data confirm it. This rebound has been driven by strong consumer demand as well as reopening of international borders due to tested efficacy of vaccines. Asia Pacific aerospace sector witnesses an increase of 10% in the revenues level in 2022 compared with 2019 levels. The situation is slightly different for North America and Europe which respectively may still be 15% and 23% down versus 2019 levels. Moreover, the resilience of aerospace supply chains is also confirmed by their ability to weather turbulent conditions in 2020 and beginning of 2021. In fact, global commercial aircraft utilization in July 2022 was 26% higher respect to 2021.[258]

According to the paper "*Commercial Aerospace Insight Report: Navigating Recovery*" published by Accenture in October 2022, overall commercial deliveries have increased by 13% in 1H22 and for the whole 2022 delivery increase will be 24% YoY.

Figure 4.8: Global commercial aerospace index



Source: Accenture, 2022

According to the Report mentioned above in June 2022 industry- wide passenger load factor reached 82%, up 13 percentage points YoY. This data is important because since January 2020 for the first time the industry has overcome 80%. The industry capacity has gone hand in hand with passenger traffic, with Available Seat Kilometers (ASKs)

[258] J. Schmidt, J. Prieto. Commercial Aerospace Insight Report: Navigating Recovery. (Accenture, 2022).

increasing by 49% YoY even if the capacity is still below to pre-pandemic levels, (28% lower compared with 2019).

In the second half of 2022 airlines have continued to bounce back by reducing the remaining losses. However, despite the gradual recovery from the disruptions caused by COVID-19 to the entire aerospace supply chains, Russian invasion of Ukraine has further disrupted A&D supply chains as well as trade flows. For instance, Ukraine supplies about 50% of the global neon gas demand, essential for semiconductor chip production. The Russia-Ukraine affected semiconductor supply chain constraints which may hold production as nearly 90% of neon. Neon is broadly used by US companies for etching circuits on silicon wafers. Furthermore, Leading global aerospace OEMs are heavily dependent also on Russian titanium for wide-body aircraft; indeed, Russia supplies 50% of the titanium grade required for aerospace manufacturing.[259]

4.5 Outlook for Aerospace Industry: a post-COVID-19 scenario

It's not an easy task to forecast the future scenario for the air cargo industry since, according to the literature, there are four potential outcomes. In first place, digitalization and automation of air freight systems can be the technological trends triggered by COVID-19 pandemic. In fact, the air cargo market will probably be further overwhelmed by the use of e-commerce and platforms increasing air cargo traffic exponentially. Moreover, since many carriers have realized that they cannot run their cargo operations effectively without digitalizing them, they accelerated migration to online sales. This implies connecting their internal cargo management systems (CMS) to an e-sales channel whether their own website or a digital distribution marketplace Secondly, one of the main pandemic outcomes could be an increase sustainability awareness supported by policies which will constrain tourism. Yet, this is just one of the several social trends that can be eased by the pandemic. The third possible aftermath is that technological development will foster further progresses in videoconferencing and blockchain technology. Furthermore, many businesses will likely face financial hardship due to the pandemic. The post- COVID-19 scenarios may be different for air cargo industry, and this hampers

[259] J. Coykendall, J. Kilpatrick, A. Hussain, Building and managing supply chain resilience in aerospace and defense, (Deloitte 2022)

the convergence on a single scenario. However, the scenario for the air cargo sector will converge mainly around two business models. The first business model relies on the increased investment in long-haul technology for wide-bodied planes. This business model is characterized by point-to-point long-haul passenger flights and involve the creation of distancing bubbles to reduce contact. Instead, the second business model is focused on lowering human interaction by combining artificial intelligence and big data to manage the software-driven supply chain. In this case, integrators, meaning air cargo specialist providers, play a substantial role. For what concerns the latter trend, air cargo had already undertaken this path (dominant role for specialized integrators) before the outbreak of pandemic. For example, DHL and FedEx handle both B2B (Business-to-business) supply chain integration and B2C e-commerce.

While in the long run the industry will probably be affected by blockchain, in the medium term the two business models will be separated in a much more robust manner.[260]

In the considerations for future outlook, the environmental concerns and its consequent restrictions on air travel will have repercussions also on-air cargo sector. In the post-pandemic phase air cargo industry has focused on sustainability, modernization and safety which are deemed as key priorities for air cargo.

If we look at the growth rate expectations we can notice that the global freighter fleet is expected to grow by more than 70% over the next 20 years. More in detail, according to Boeing's World Air cargo forecast cargo market will grow at an annual rate of 4 per cent over the next 20 years. [261]

The coming years present further challenges and opportunities along this value chain. What we can expect is that air cargo and all the other services associated with it will become an integral part of the aviation industry as well as a complementary element to the usual passenger services. [262]

The air cargo logistics sector and associated supply chains have been fundamental in the global response to pandemic shock. It has confirmed its ability and readiness to innovate and solve new challenges. The outlook for the air cargo supply chain seems to be one of growth. Despite potential obstacles to sustain and meet new demands for cargo in the

[260] C. Findlay, H.Roelfsema, N. Van De Wuow. Feeling the pulse of Global Value Chains: Air cargo and COVID-19. (ERIA, 2021)
[261] R. Hakes, O.Beiersdorf. Global Air Freight's future: The sky is the limit. (ReedSmith, 2022)
[262] *Ibidem*

medium and long run, the air cargo will remain a core element of the commercial air transport industry.[263]

Yet, important considerations have to made, especially in relation to the fact that the future scenario is shaped also by the geopolitical conflict between Russia and Ukraine which represents another treat to supply chain air cargo. In fact, Russian carriers which are among the main actors in Asia-Europe air freight routes have been cut off from markets.[264]

The current pandemic crisis, as well as Russia-Ukraine war, represents also an opportunity to speed up the supply chain consolidation. As in the medium term the supply chain base will probably require the consolidation, and to secure supply chains there is the need of a "watch tower" which can identify supplier risks for performance and viability as well as communicate rate changes.

The outlook remains positive despite subdued 1H22 results from *Boeing* ($10.4B, 1% increase YoY and Airbus (17, 5B., - 1.6% decline YoY). The future scenarios show a steady recovery as confirmed by *Airbus* and *Boeing*. Indeed, *Boeing*'s operating margin for its commercial airplanes business improved to -3.9% in the second quarter of 2022 versus -7.8% in the same period of 2021. While Airbus' operating margin improved to 14.4% in the second quarter of 2022, up from 13.5% in the same period of 2021[265]

Additionally, in 2022 there are expectations of an increase by 98% in the revenue passenger kilometers but in the more optimistic scenario, the entire return to profitability is forecast by 2023. According to IATA forecasts in 2022 the net loss has been of $10B for airlines which mark a striking improvement from 2021 when losses amounted to $42B. However, in this current framework we have to take into account Russia-Ukraine conflict which may hamper anticipated growth. The prolonged zero-COVID strategy in China may be considered as a headwind to future scenario. In particular, for what concerns the impact of war in Ukraine, many aerospace companies for air cargo transport and air passenger freight rely on multiple raw materials sourced from Russia, including

[263] L.Budd, S.Ison. Chapter 14: the impact of COVID-19 on air cargo logistics and supply chains. (Science Direct, 2022).
[264] CTSI-Global. "Supply chain Crunch Boosts Profits for Air Freight; how the supply chain crunch is transforming air cargo". (CTSI-Global, 2022)
[265] J. Schmidt, J. Prieto. Commercial Aerospace Insight Report: Navigating Recovery. (Accenture, 2022).

copper, steel, nickel, titanium and aluminum. As a result, this is causing continuous disruptions to the aerospace supply chains.[266]

The outlook for aircraft production forecast an uneven recovery among aerospace companies and in this framework, the aerospace-related production outlook undergoes pressure by supply chain issues. Despite the OEMs increased production as air travel recovers supplier's cash flows have been affected by earlier production cuts. Yet, suppliers remain still optimistic. As we have seen previously, *Airbus* expects to increase its production of narrow-body programs to 75 unit per month by 2025 and Boeing announced an increase of production of its 737 model to 38 per month in the first half of 2023 despite many hardships with engines supply. The short- term analysis shows that production capacity will be stable. Whereas 64% of operators expect their capacity to be the same in the next six months, 33% expect an increase. This analysis is grounded on the report published by Accenture "*Commercial Aerospace Insight Report: Navigating Recovery*" and is instrumental to explain the future scenarios which probably will take place in the aerospace supply chains. In some cases, some elements and features, such as e-commerce and digitalization are already ongoing trends, but they likely to be boosted down the road.

From supplier delivery outlook instead, despite supply chain disruptions triggered now by Russia-Ukraine conflict will endure even if to a lesser extent, supplier deliveries have improved and will continue on this path. Supply chain will meet OEM expectations as they adjust to changes in demand which is getting stronger. Both *Airbus* and *Boeing* CEO have found the same difficulties in the face of supply chain disruptions. Despite these difficulties Tier 1 suppliers are experiencing a growing demand from OEMs. An example is the case of Rolls-Royce which produces aircraft's engines as well as cars. Its focus in the last period has been put on the supply chain consolidation by making direct acquisitions of best performers. This strategy has been pursued also by a precision engineering company *Mecachrome* which in order to cope with supply chain issues has undertaken a consolidation process by completing a takeover of smaller aerospace supplier (WeAre Group) which has created one of the biggest parts manufacturers in Europe.

[266] *Ibidem*

Going further, in the future scenario there is a risk for production input cost which are being affected by raw materials shortages and rising costs as a consequence of Russia-Ukraine war. This risk in the ongoing and future scenario is leading the aerospace sector to look for alternative and innovative ways for such inputs. This new approach entails reducing reliance on these inputs sourced from Russia. An example is the program adopted by the IRT Saint-Exupery Research and Technology institute in France. The program known as *"Metallic Advanced Materials for Aeronautics*" (MAMA) is aimed to reduce the need for titanium parts on Airbus aircraft by 30%. [267]

[267] J. Schmidt, J. Prieto. Commercial Aerospace Insight Report: Navigating Recovery. (Accenture, 2022).

Conclusions

What has been the impact of Covid-19 on GVCs? And what effects will it have in the future, also in light of the recent outbreak of Russia-Ukraine war which may contribute to further exacerbate the ongoing situation? The research question focuses on analyzing the effects of the health emergency on GVCs. The aim of this work sheds light on these dynamics and on the role of GVCs during and after COVID-19 shock in order to illustrate not only the impact of an unprecedented crisis on GVCs, but also to demonstrate as an interconnected economic system which encompasses social, cultural and technological development, as well as economic growth, can be a powerful tool to cope with economic crisis, geopolitical conflicts and social and cultural diversities.

Global Value Chains are the backbone of the current globalization and have not only contributed to growth, employment, technological development over years, but have also reduced poverty. Throughout the economic history, the current economic system based on GVCs was forced to face times of financial turmoil, economic turbulence and natural disaster but never an event of such magnitude as COVID-19.

Through the unfolding of these four chapters, the striking feature which can be inferred is that, despite the unprecedented magnitude and scope of COVID-19, GVCs have proven their resilience and they successfully tackle COVID-19. No other event in the globalization and the economic history has threatened the global economic system as COVID-19. Even the 2008 economic and financial crisis cannot be equally compared to the impact of COVID-19. However, despite the dire features of COVID-19 not only in terms of health shocks, but also in terms of economic and financial losses which undoubtably affected the GVCs in manner never experienced before, the GVCs trade for both goods and services acted as a channel through which facilitate recovery.

What has emerged in this analysis is that GVCs are a double edge sword: on one hand they facilitate the propagation of external shocks to other links of the chains and therefore, GVCs expose states and firms to such vulnerabilities, but at the same time they strongly allow fast recovery. The situation would have been undoubtably worse in case of localized and nationalized regime as demonstrated in the third chapter, because it is undisputed that the nationalized regime may reduce vulnerability to external shocks, but this comes at the cost of higher exposure to domestic shocks which in turn would require

much more efforts to face the crisis and to improve resilience. Resilience and robustness are the core of GVCs and despite some common strategies between them, the resilient firms are likely to reduce their risk, preferring going through disruptions and minimizing the impact, rather than investing to anticipate disruptions. The other important point which has emerged from this analysis is that resilience and regionalization are the two sides of the same coin, because if on one hand pandemic-crisis confirmed GVCs' resilience, on the other hand it has speeded the process toward further regionalization. Indeed, Covid-19 resulted in reshoring (or nearshoring/friendshoring), but this work denies that this practice consisting of transferring a business operation or economic activity back to the country from which it was originally relocated, can improve resilience.

Each chapter has been instrumental to reach such findings. The first chapter has provided us a view of the existing situation before the outbreak and the spread of COVID-19. Indeed, in this chapter it has been confirmed that the shortening of GVCs and the regionalization process had started long before the outbreak of COVID-19. These two processes which are directly linked, had started in 2008 with the Global financial crisis with the burst of the financial bubble in US and its consequent propagation to Europe. This event marks a watershed in the global economy and in the GVCs structure. From a more general view, in terms of globalization, the slow down process began with 2008 global financial crisis. With the 2008 GFC, the growth of GVCs and trade slowed. This slowdown is in part cyclical: trade growth has reduced respect to years previously to 2008, because output growth has lowered in the major trading economies, notably Europe which accounts for one-third of world trade and China. However, this slowdown is also structural. GVCs trade growth has reduced its responsiveness to income growth in the last decade, especially in China and US which are the two main players in the GVCs arena. The second major event which has given a further push toward GVCs regionalization and slowbalization has been the US- SINO trade war. This conflict involving two central regional and global hubs proved that strong reliance on few suppliers may be detrimental. This conclusion has also been reached in the third chapter dealing with the impact of COVID-19- related disruptions on GVCs.

Going further, the second chapter has provided us a general view on the development of GVCs from its origins and has shown as GVCs have been and continue to be a

determinant for economic growth, technology, social and cultural development. The evidence which has emerged in relation to this chapter is that GVCs act as a glue among states by binding them through investments, technological development and production in parts and components. In this framework, cultural differences which have always been intertwined with politics play a key role in GVCs trade since trade policy are closely related to the organization and the structure of GVCs, as it has been demonstrated by trade war between China and US. Indeed, national policies if coordinated can revive trade growth. In this chapter, the second conclusion we have reached in relation to GVCs development and restructuring is that the ASEAN and US have become the two main regional hubs since the beginning of regionalization of value chains, and China still remains the "factory of the world" for manufacturing sector.

The third chapter which has specifically dealt with the impact of COVID-19 on GVCs, has dug deep the effects of COVID-19 on GVCs, observing also the GVCs' transmission mechanism through which shocks propagate. The result of this analysis was that during pandemic crisis, GVCs act as channel through which the shock is magnified because of the so-called "bullwhip effect", known also as domino effect already mentioned when dealing with 2008 GFC in the first chapter. Covid-19 disruptions are emblematic to explain such effect which basically consists of a shock which triggers disruptions to demand for parts and components which increases the further upstream a firm is located in the supply chain. In relation to COVID-19, for the world economy, GVCs linkages amplified the decline in imports and exports by around 25%.

From the analysis of this chapter, we can also reach the conclusion that from COVID-19 pandemic we can learn some lessons. First of all, especially when public health is threatened, turning inward and protectionist measures are rarely the right solution since they hamper and restrict access to medical equipment and medicines. In other words, international trade is not the problem, but part of the solution, as a globally open market allows the continuous flows of more and more innovative goods, services, people and data. Moreover, further shortening GVCs could not be the effective solution, but it would be more suggested to leverage them in order to ramp up production quickly and efficiently in response to global shocks.

The fourth chapter instead, has contributed to illustrate the effects of Covid-19 on a specific sector which to some extent is a key player in GVCs, meaning aerospace supply

chain with a particular emphasis on air cargo. I have decided to focus my study on air cargo for two reasons: the first one is related to the speed of air transport, as in the throes of a health emergency, access to vital medicines and medical equipment is pivotal and air transport is the best fit for these types of deliveries because of reliability and speed, while the second one concerns the importance of air cargo in relation to high-value goods. Additionally, this chapter has basically confirmed the resilience of GVCs in the aerospace supply chain even if slightly reduced in comparison to GVCs trade for goods. Indeed, as we have seen in the third chapter GVCs resilience has been more pronounced in GVCs goods than services. Indeed, according to UNCTAD, GVCs trade in goods started to bounce back from the fall of 2020, and by the fifth quarter, (Q1 2021), global trade was higher than pre-crisis level, recording an increase of about 3% to Q4 2019.

Despite challenging conditions air cargo succeeded in delivering critical medical supplies and vaccines across the globe and kept international supply chains open. While passenger number in air transport plunged by 94.3% in comparison with April 2019, the air cargo managed to cope with pandemic more easily since it effortlessly recovered in the second quarter of 2020 with the gradual removal of restrictions. Moreover, in 2021 air cargo revenues reached a record accounting for around 40% of total airline revenues. In 2022, instead the demand is expected to exceed pre-pandemic levels by 13%. One of the main factors emerged in the aerospace supply chain, especially in relation to air cargo, has been the strengthen of e-commerce. This further confirms the importance of technological development and digitalization in GVCs.

In the context of GVCs, especially in the midst of a pandemic crisis, the more effective response is not everyone for themselves, but rather a common endeavor in the name of humanity.

Bibliography

Primary sources

Accetturo A.,Giunta A. "*Value chains and the great recession:evidence from Italian and German firms;Questioni di Economia e Finanza*, N.304 , (Banca d'Italia, Eurosistema, 2016)

Arriola C. et al. "*Global Value Chains: Efficiency and Risks in the context of COVID-19, Tackling coronavirus (Covid-19): contributing to a global effort"*. (Organization for Economic Co-operation and Development, 2021)

Arriola C., Cadestin C, Kowalski P.,Van Tongeren F. "*International trade during COVID-19 pandemic: Big shifts and uncertainty*". (Organization for Economic Cooperation and development, 2022).

Bems R., Johnson R. and Yi K-M-M."*Demand spillovers and the Collapse of Trade in the Global Recession*". IMF Economic Review, Issue 58/ 2 (International Monetary Fund, 2010)

Cattaneo O., Gereffi G., Staritz C., *Global Value Chains in a Postcrisis world; a development Report, (World Bank, 2020)*

Cigna S., Gunnella V., L. Quaglietti L.,"*Global value chains: measurement, trends and drivers*" Occasional Paper Series 289. (European Central Bank, 2022)

Cigna S., L. Quaglietti L. "*The great trade collapse of 2020 and the amplification role of global value chains"*. (European Central Bank, 2020)

Congressional Research Service, *Global Value Chains: Overview and Issues for Congress,* December 2020

Di Stefano E. "*COVID-19 and global value chains: the ongoing debate*", Questioni di Economia e Finanza, 618. (Banca d'Italia, Eurosistema, 2021)

Durant I.et al. "*Impact of Covid-19 pandemic on trade and development; Lessons Learned*". (United Nations Conference on Trade and Development, 2022)

European Commission. "*European commission Guidelines: facilitating Air cargo Operations during COVID-19 outbreak*". (European Commission, 2021).

European Parliamentary Research service. "*Resilience of Global supply chains; challenges and solutions*". (European Parliament, 2021)

Fisher S., "*Globalization: Valid concerns*? (International Monetary Fund, 2000)

Hensel N.D. "*The impact of COVID-19 on the U.S Defense Industrial Base*". (Department of Defense manufacturing technology program, 2022)

IATA. "*Air Cargo Market Analysis*". (International Air Transport Association, 2022).

IATA. "*IATA Economic's Chart of the Week*". (International Air Transport Association, 2021).

IATA. "*Key to Air Cargo Resilience Post Pandemic: Cooperation, Safety, Sustainability, Modernization.* (International Air Transport Association, 2021).

IATA. "*WCS to focus on Building Resilience in Air cargo*". (International Air Transport Association, 202

IMF. *World Economic Outlook, 2020: The Great Lockdown*. (International Monetary Fund, 2020)

OECD. "*COVID-19 and the aviation industry; Impact and policy responses*". (OECD, 2020)

OECD. "*COVID-19 and global value chains: Policy options to build more resilient production networks. Tackling Coronavirus (COVID-19) contributing to a global effort*". (Organization for Economic Cooperation and Development, 2020)

OECD. *Covid-19 and global value Chains: Policy options to build more resilient production networks, OECD Policy Responses to Coronavirus (Covid-19)*. (Organization for Economic Co-operation and Development, 2020)

OECD, *Interconnected economies: benefiting from Global value Chains,* (Organization for Economic Cooperation and Development, 2013).

OECD, *Global Value Chains and trade; The trade policy implications of global value chains,* (Organization for Economic Cooperation and Development, 2020).

OECD, *Global Value Chains (GVCs): United States*, (Organization for Economic Cooperation and Development, 2009)

OECD. "*COVID-19 and global value chains: Policy options to build more resilient production networks.*" (Organization for Economic Co-operation and Development, 2020)

OECD. "*Shocks, risks and global value chains: insights from the OECD METRO model*". (Organization for Economic Cooperation and Development, 2020.)

Shepperd B. *Value of Air Cargo: Air Transport and Global Value Chains.* (International Air Transport Association, 2016).

Simola H."*The impact of Covid-19 on Global Value chains".* BOFIT Policy Brief Bank of Finland, 2 (Bank of Finland Institute for Emerging Economies, 2021)

Solingen E., Meng B., XU A." *Rising Risk to Global Value Chains; Global Value Chains Development Report 2021*". (World Trade Organization, 2021)

UNCTAD, *ASEAN Investment report 2013-2014, FDI Development and Regional Value Chains, (*United Nations Conference for Trade and Development, 2014)

UNCTAD. Nicita A. "*Global trade's recovery from COVID-19 crisis hits record high*". (United Nations Conference on Trade and Development, 2021)

UNCTAD, Amui R.et al. *Impact of the Covid-19 pandemic on trade and Development; Lessons Learned*. (United Nations Conference on Trade and Development, 2022)

World Bank Group, *World Development Report 2020: Trading for Development in the Age of Global Value Chains*, (World Bank 2020).

World Bank Group, Qiang C.Z., Liu Y. and Steenbergen V. "*An investment perspective on Global Value Chains*." (World Bank, 2021).

World Economic Forum. Crisis faced by Airlines. (World Economic Forum, 2020).

WTO, *Chapter 4: boosting Value Chains via regional aid for trade Fujita, Masataka. Global and Regional Value Chains in ASEAN, prepared for ASEAN and UNCTAD*, (World Trade Organization, 2014).

WTO. *Global Value Chain Development Report 2021: Beyond production, Key messages and findings*. (World Trade Organization, 2021)

WTO. *Global Value Chain development report 2021; Beyond production*. (World Trade Organization, 2021)

WTO. "*World trade primed for strong but uneven recovery after COVID-19 pandemic shock*". (World Trade Organization, 2021)

WTO., Li X., Meng B.,Wang Z., *Recent patterns of global production and GVC participation. Chapter 1*. (World Trade Organization, 2020)

WTO, Degain C.,Meng B.,Wang Z. *Recent trends in global trade and global value chains*, (World Trade Organization, 2020).

Secondary sources

Monographs

American Global Logistics. "*Air shipment achieving agility, speed and resilience*". (AGL, 2022)

Bevere D.,*Analisi dell'interesse economico nazionale.* (Analytical for intelligence and security studies, Torino, 2020)

Biondi F., The Mexican automotive industry and Trump's USA. (Bruegel, February 2017)

Cassanese S. "*Ma il mondo ora è meno globale*". (Corriere della Sera, 2022)

Economist Intelligence Units, "*The Great Unwinding, COVID-19 and the regionalization of global supply chains*". (The Economist intelligence Unit, 2020)

Giddens A., *"Le conseguenze della modernità*", Bologna, (Il mulino, 1994)

Kuzmanovic A.,Rassineux J.L. "*Post COVID-19 Aerospace industry*". (Deloitte)

Licata P. "*Amazon, effetto volano sulla filiera reatina: + 26% di ricavi per le imprese della logistica*". (Corcom, 2022).

Legal500. "*GC Insider: Aviation and Aerospace Supply-Chains- At the Tipping Point*". (Legal500 gc, 2020).

Minsky H.P., *The Financial Instability Hypothesis*, (Levy Institute,1992)

Miroudot S. "*Resilience in Services Value Chains*". (Council on economic policies, 2022).

Parilla J., *How US states rely on NAFTA supply chain*, (Brookings, 2017)

Staritz C., *Making the Cut? Low-Income Countries and the Global Clothing Value Chain in a Post- Quota and Post- Crisis World*, 2011

Times Aerospace. "*Supply chain disruptions halve November air cargo growth*" (Times Aerospace, 2022).

Tooze A., *Lo schianto 2008-2018: Come un decennio di crisi economica ha cambiato il mondo. 1st ed.* Milano 2018

M.Knowles M. "*Impact of COVID-19 on cargo-related claims*". (ReedSmith, 2022)

Xuan G.W. "*The impact of COVID-19 on Air Cargo Development*". (To70, 2021)

Wiggins K., Gara A., Smyth J., "*Business leaders warn that three-decade era of globalization is ending*". (Financial times, 2022)

Edited volumes

Anderson J.,Bergamini E., Brekelmans S., Cameron A., Darvas Z., Dominguez Jimenez M., Midoes C. "*The Fiscal response to the Economic Fallout from the Coronavirus*". (Bruegel 2020)

CTSI.Global. "*Supply Chain Crunch Boosts Profits for Air Freight; How the supply chain crunch is transforming air cargo".* (CTSI-Global, 2022).

Dedrick J., Kraemer K., Linden G., "Who profits from innovation in Global Value Chains? A study of the iPod and notebook PCs", (Industry Studies 2008)

Fattorini L., Briggs P., Phippard S., White A. "*COVID-19 & air transport and aerospace supply chain: a ten-step guide"*. (Bird&Bird, 2020)

Findlay C., Roelfsema H.,Van De Wuow N., *Feeling the Pulse of Global Value Chains: Air Cargo and COVID-19*. (ERIA, 2021).

Gereffi G., Humphrey J. and Sturgeon T. *The governance of global value chains,* (Review of International Political Economy,2005) 12: 78-104

Guan D., et al. 2020. *Global Supply-chain effects of Covid-19 Control Measures*. (Nature Human Behaviour, 2020) 4/2020. pp. 577-587

Hader M., De Silva N. "*Civil Aerospace post-Covid19 rate ramp-up: can your operations handle it?* ". (Roland Berger, 2021)

Lund S. et al. "*Risk, resilience, and rebalancing in global value chains*", (McKinsey&Company, 2020)

Lund S., Manyika J., Woetzel J., Bughin J., Krishnan M., Seong J., Muir M., *Globalization in transition: the future of trade and value chains*. (Mckinsey Global Institute, January 2019)

Navas-Aleman, *The impact of operating in multiple value chains for upgrading: The case of the Brazilian furniture and footwear industries*. (World Development Report,2011) Vol. 39 pp

Nenci S, Fusacchia I.,Giunta A., Montalbano P., Pietrobelli C. "*Mapping value chain participation and positioning in agriculture and food: stylized facts, empirical evidence and critical issues*". (Associazione Italiana di economia agraria e applicata, 2022).

Ohl S., Leber C., Makowski D., Schottle K. "*After the covid-19 Pandemic- How the Structural crisis can be overcome"*. (Alixpartners, 2020)

Pinna A.M., Lodi L. "*Trade and Global Value Chains at the Time of Covid-19*". The International Spectator. 56/ 1 (2021) pp 92-110. (Istituto Affari Internazionali, 2021)

Schmidt J.,Prieto J., *Commercial Aerospace Insight Report: Navigating Recovery*. (Accenture, 2022).

Scientific articles

Agarway P., Shingai A., "*Global Value Chain responses to previous health shocks: Lessons for Covid-19*". (CEPR VOX eu 2020)

Antràs P. and De Gortari A., "*On the Geography of Global Value Chains*". Working paper 23456, (National Bureau of Economic Research, 2012)

ASEAN- Japan Centre, *Global Value Chains in ASEAN, A Regional Perspective*, (ASEAN Japan- Centre 2019)

Baldwin R., S. Evenett S. COVID-19 and Trade Policy: why turning inward Won't Work. (Centre for Economic Policy Research, 2020)

Baldwin R. and Freeman R. "*Supply chain contagion waves: Thinking Ahead on Manufacturing' contagion and Reinfection from the Covid Concussion*". (Centre for Economic Policy Research Vox EU, 2020)

Budd L., and Ison S., *Chapter 14: The impact of Covid-19 on air cargo logistics and supply chains*. (Science Direct, 2022)

Dai F., Liu R.,Guo H.,DU X. *How does intermediate consumption affect GVC positions? A comparison between China and US*, Vol. 63, 101531 (China Economic Review, 2020)

Erken H., *US global value chain integration: a major impediment for Trump's protectionist trade agenda,* (Rabo Research- Economic Research, 2017)

Fusacchia I., *Evaluating the impact of the US-China trade war on euro are economies: a tale of Global Value Chains*, (Rossi-Doria Centre for Economic and Social Research, 2019)

Garicano L., Rohner D., Weder di Mauro. "*The economic consequences of the Ukraine War: A new eBook*". VOX eu (Centre for Economic and Policy Research, 2022)

Giovannetti G., Mancini M., E. Marvasi E.,Vannelli G. "*The role of global value chains in the pandemic: impact on Italian firms"*. Review of Economic Politics 2/2020 (Confindustria Servizi, 2020)

Hakes R., Beiersdorf O. *Global Air Freight's future: The sky is the limit*. (ReedSmith, 2022)

Kee Hwee W., Mirza H., *ASEAN Investment Report 2013-2014, FDI Development and Regional Value Chains, (ASEAN-Japan Centre, 2014)*

Keijser C., Belderbos R., Goedhuys M., *Governance and learning in global, regional and local value chains: The IT enabled services industry in South Africa*, World Development 141, pp 2021

Korn T. and Stemmler H. "*Russia's war against Ukraine might persistently shift global supply chains*". (Centre for Economic Policy Research Vox EU, 2022)

Miroudot S. "*Resilience versus Robustness in global value chains: some policy implications*". (Centre for Economic Policy Research, 2020)

Montanino A., Carriero A., Dell'Aquila C., Giuzio R.and Recagno L."*Trasporto aereo e COVID-19; Alcuni fatti stilizzati*". (CDP Think Tank, 2020)

Navas-Aleman, *The impact of operating in multiple value chains for upgrading: The case of the Brazilian furniture and footwear industries*. (World Development Report, 2011) Vol. 39 pp

Ngoc N.M et al. "*Russia-Ukraine war and risks to global supply chains*". (International Journal of Mechanical Engineering 7/6, 2022)

Robinson C.. "*Overcoming COVID-19 pandemic challenges to the air cargo Sector*". (The International Air Cargo Association, 2022).

Sangalli I., Direzione studi e ricerche Intesa Sanpaolo, *Il modello manifatturiero statunitense: quali evidenze dalle catene globali del valore,* ottobre 2018

Sarmidi T. et al. *The Covid-19 pandemic Air transport Perturbation and Sector Impacts in ASEAN plus five: A multiregional input-output inoperability Analysis*. N. 368 (ERIA, 2021).

Stellinger A., Isakson H., Berglund I., "*To Protect Public Health, Preserve the Global Value Chains*". (Centre for Economic Policy Research, 2020)

Stollinger R., Hanzl-Weiss D., Leitner S., Stehrer R., Global and Regional Value Chains: How important. How different? Research Report 427, (The Vienna Institute for International Economic studies, April 2018)

Strange R. "*The 2020 Covid-19 pandemic and global value chains*". (Journal of industrial and Business Economics 47, 2020) pp. 455-465

Timmer M.P. et al., G.J. *An illustrated User Guide to the World Input-Output Database: The Case of Global Automotive Production*, (Review of International Economics)., 23:575-605

Xing Y., *Global Value Chains and the missing exports of the United States*. Vol. 61, 101429 (China Economic Review, 2020)

Winkler D., Wuester L. "*Implications of Russia's invasion of Ukraine for its value chains*" (Centre for Economic Policy Research Vox EU, 2022)

Zachariadis I., *Global and regional value chains, opportunities for European SMEs' internationalization and growth*, European Parliamentary Research Service, 2019.

Zographos M. "*Industry collaboration and the vision for air cargo in a post-COVID19 world*". (The international Air Cargo Association, 2022).