



The Impact of Export Restrictions on International Trade in Medical Products

An Analysis of Supply Chain Disruptions between China and the United States during the Covid-19 Pandemic

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Abstract

This thesis investigates the impact of export restrictions on supply chains within the medical supply industry during the Covid-19 pandemic. A multiple linear regression model is estimated on monthly data between January 2020 to December 2022. The regression model is provided to help analyze China's trade values of medical supplies with the United States in relation to textile face-masks. Different measures which influenced supply chains were implemented by the governments in response to the health crisis. The model for this thesis included factors such as export restrictions in the form of licensing and permit requirements, lockdowns in China and also confirmed number of Covid cases in China and the United States respectively. The results aligns with the hypothesis that export restraints as well as lockdowns and the confirmed number of cases in China had a negative significant impact on China's exporting trade value of textile face-masks to the United States while the number of confirmed cases in the United States showed a positive relationship to China's trade values.

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1. Introduction

The Covid-19 pandemic has had a profound impact on the global economy and caused widespread disruptions to global economic activities leading to challenges for governments and business across borders. Flows of goods and services across countries were affected and this highlighted the importance of global supply chains as a critical component of the modern economy. The disruptions also raised questions regarding the resilience of global supply chains and their ability to cope with shocks.

The Covid-19 pandemic resulted in restrictions being imposed by governments around the world such as export restrictions, national lockdowns and travel restrictions. These restrictions have made it difficult for businesses to maintain their operations and encounter the demands of consumers. One sector that has been critically affected by disruptions in supply chains is the medical supply industry. This is a substantial sector in providing goods to patients and healthcare workers throughout the years of the pandemic. The disruptions however resulted in different consequences such as delays in delivery of medical supplies along with shortages.

The significance of medical supplies during a global health crisis cannot be overstated. Both China and the United States are major actors in the medical supply market. China being one of the top largest producers and exporters of medical supplies and the United States being one of the largest consumers of medical products. Thus, disruptions between China and the United States can have crucial consequences, for the countries in question, as well as the rest of the world.

The aim of this thesis is to provide valuable and conceptual insights on supply chain disruption and the impacts on international trade from export restrictions that were developed as a response to the spread of the Covid-19 virus. The aim is to examine with both empirical and theoretical framework the impact of export restrictions on international trade in medical supplies between China and the United States during the pandemic years of 2020 to 2023. The empirical study for this thesis has a focus on medical supplies in the form of trade values of textile face-masks exported from China to the United States. As a theoretical framework the gravity model of trade is included to contribute to providing insights and estimates on volume of bilateral trade flows and help to quantify influence from factors such as distance and economic size.

The remainder of this thesis is organized as follows. Section two provides a review of literature on supply chains and disruptions, the Covid-19 impacts, trade regulations as well as an overview of the gravity model, a theoretical framework related to international trade flows. Section three discusses the method used for this thesis, exhibits the regression, limitations for this study as well as a descriptive statistic for the dependable and explanatory variables. This section also covers a brief empirical motivation and hypothesis on each of the explanatory variables. Further, section four presents the results of the study including the model of analysis on the impacts from export restrictions on trade values. Section five

provides a discussion of the findings and is lastly followed by section six which concludes the study with a brief conclusion of the research.

2. Literature review

2.1 Overview of supply chains and its significance

A supply chain is a vital network infrastructure that consists of different parties that are directly or indirectly involved in distribution of goods and services to fulfill customers requests. Supply chains are complex and interconnected networks that include various stakeholders including suppliers, distributors, manufactures, retailers and the final consumers or end-users. A supply chain is dynamic and requires a continual flow of information, products and funds through each of its stages (Chopra & Meindl 2012). Further, Chopra and Meindl (2012) explain the customer as an integral as well as primary part and purpose of any supply chain. The chief aim of any supply chain is to gratify the consumers while additionally also generating profit.

The consequences of disruptions in global supply chains from the Covid-19 pandemic contributed to the increasingly clear understanding of the importance of supply chains. It is a crucial component of modern economies and societies with the world becoming more interconnected and businesses developing and becoming more globalized. Global supply chains are essential for businesses to reach new markets and to stay competitive. According to the World Trade Organization global trade has grown significantly in the last decades, the value of merchandise exports reached 19.3 trillion dollars in 2020 despite the challenges posed by the Covid-19 pandemic (World Trade Organization 2021).

Supply chains enable efficient production and distribution of goods and services since it allows businesses to optimize production and distribution processes by reducing the costs and increasing efficiency. When countries are sourcing inputs from different countries and regions, businesses can take advantage of specialized expertise and lower costs and conclusively provide consumers products with higher quality at lower prices (Chopra & Meindl 2012).

Arvis et al. (2016) describes how supply chains are a significant origin of employment, particularly in low-skilled jobs such as warehousing and transportation. Supply chains play a role in driving economic growth, international trade and job creation. Global supply chains are a notable source of employment as well as economic activity and help the growth of communities and industries all over the world. In multiple developing countries the jobs involved in the different stages of the supply chain are a crucial source of income for families thus also for a country's economic growth (Arvis et al. 2016).

As mentioned earlier, supply chains enable companies and businesses to enter and access new markets, new ideas and technologies and therefore contribute to innovation and product development. It gives suppliers opportunities to cooperate with different countries and industries thus promotes businesses to get new insights and encourages more innovative and valuable products and services (Arvis et al. 2016). Chopra and Meindl (2012) explain the importance of supply chains. Competitive advantage is one aspect that explains how supply

chains can offer competitive advantage by delivering goods quicker, cheaper and with higher quality. In result it helps firms and businesses to achieve and increase overall performance.

Due to globalization supply chains have become more important since it results in increased competition and larger complexity in supply chain networks. Effective management within supply chains also assists firms to navigate challenges and remain competitive on the global market (Chopra & Meindl 2012).

Further, Chopra and Meindl (2012) also imply how supply chains play a crucial part in deriving customer satisfaction as well as enhance innovation partly by enabling collaborations and exchange of knowledge through cooperation between the different organizations, this also provides opportunities in developing new technologies and products. Consumers tend to derive their utility in the access of larger varieties of goods, Marrewijk (2017) explains Krugman love-of-variety concept as consumers love for variety. When two countries trade, consumers access a larger variety of goods that are available on the market. This clarifies the importance of trade and global supply chains and how it can extend the market and lead to variety gains (Marrewijk 2017).

2.2 Overview of disruptions in supply chains

Any form of unexpected event that interrupts movements and flow of goods or services is referred to as a disruption in supply chains. Disruptions can have an extensive impact on the affected businesses in form of delays, higher expenses and decreased customer satisfaction. Disruptions in supply chains can be both a temporary or permanent breakdown in flows of goods and services thus can result in economic, environmental as well as social impacts (Chopra & Meindl 2016).

The impacts can be far-reaching, affecting several supply chain functions. Disruptions can be caused by various factors including for instance geopolitical events, natural disasters, trade restrictions, technological failures or as this study focuses on, a health global crisis or pandemic. The duration of supply chain disruptions can widely vary depending on the circumstances (Chopra & Meindl 2012). To mitigate the impacts, Chopra and Meindl (2012) further explains how governments and business can work with several different forms of actions to prevent further fall-out.

2.3 Covid-19 impact on supply chains

The Covid-19 pandemic affected different activities worldwide thus had an essential effect on global supply chains. During the first half of 2020 the virus spread to a clear majority of the countries across the globe, which consequently lead to disruptions in production processes to an extent in which according to a survey from the Institution of Supply Management (2020), 75% of the companies in the United States reported some form of supply chain disruption. And 80% expected disruptions in a close future. The average lead

time was reported to have more than doubled for 57% of the companies, mainly for productions that involved components from China. Lead time is the process from the inception to the completion of a production process (Institution of Supply Management 2020).

As a response to the Covid-19 pandemic many countries restricted exports of medical products which affected the global supply chains. The aim was to allocate the domestic supplies to the national healthcare systems and population. The increased demand for medical supplies globally outstripped both the existing emergency stocks already on hand and the available supply capacity (Hoekman et al. 2020). Javorcik (2020) explains how the trade-policy shocks and the pandemic have changed and affected the global supply chains and most probably will have a continued effect in the upcoming future. The author explains how the trade war and restrictions on medical supplies and agricultural products between China and the United States have created uncertainty for the future of free trade. The following events of the covid health crisis will lead businesses to force a reconstruction of their global value chains (Javorcik 2020).

Magableh (2020) also describes how the pandemic had significant effects on global supply chains particularly within the food and medical supply industry. The author provides a framework to explain the disruptions and its various impacts. There was a large range of impacts such as supply shortages since the pandemic caused shortage in raw materials as well as manufacturing components. Transportation disruptions in networks resulted in reduced capacity, cancellation of shipments thus increased transit periods. Illness and quarantines led to labor shortages which affected production level and delivery delays. Increased costs due to shortages and highthend demand along with uncertainty in supply chains affecting business managements led to several challenges as well (Magableh 2020). While there were numerous factors resulting in disruptions in supply chains, the pandemic demonstrated one crucial factor that has been a challenging factor is export restrictions on medical supplies (Evenett 2020).

2.4 Trade regulations

Due to the global spread of Covid-19 virus governments around the world have implemented measures to restrict or ban exports of essential medical products across countries. In the context of the Covid-19 pandemic trade regulations refers to policies that govern movements of medical supplies such as export restrictions, to ensure availability domestically (Hoekman et al. 2020). Governments have the authority to impose different forms of restrictions under international trade agreements and national laws. During a crisis the World Trade Organization (2021) allows restrictions on exports for essential goods, under certain conditions.

Many countries banned or limited exports of vital medical supplies during the times of the pandemic. Governments around the world took different actions to ensure availability and to prevent disruptions within the domestic market and demand. As of mid-April 2020

about 75 governments, including China, the EU, India, Turkey and the United States among others, had implemented some form of export curb on medical supplies to prioritize the domestic need (Hoekman et al. 2020). Further it was also reported that in March 2020 over 50 countries were restricting supplies of certain medical products along with travel barriers arising around the world (World Economic Forum 2020).

Lockdown policies are considered as one form of trade regulation implemented to help control the spread of the virus. Lockdowns policies were active from early 2020 and did result in reduction in global trade (Hayakawa & Mukunoki 2021). Furthermore, Hayakawa and Mukunoki (2021) research showed that the lockdown orders had different varying degrees of impacts within different industries. Different forms of lockdown also showed to have various effects for instance such as stay-at-home orders and workplace closures (Hayakawa & Mukunoki 2021).

This thesis focuses on examining export restrictions in a form of licensing and permit requirement and applies to China's trade values for exports of personal protective equipment, specifically textile face-masks, to the United States. This research scope has been selected to give an in-depth analysis of different influential factors on China's export values of medical supplies. This may contribute to a greater understanding of how export restrictions along with other factors might have affected global supply chains in resembling situations.

Export restrictions is one form of measure that governments can impose to limit the exports of certain goods and services from a country. These regulations or measures take different forms such as licensing requirements, export controls or export bans. The main objective of them is to control the flow of goods and services in and out of a country. In response to the Covid-19 pandemic, countries from around the world implemented temporary export restrictions on certain goods, among others, medical goods were restricted to be able to mitigate potential future shortages (U.S. Congressional Research Service 2021).

China was reported to have implemented licensing and permit requirements on export over certain periods of time. This is one form of export restriction, it is used as a regulatory tool to monitor a country's export of certain goods or services. This includes a mandatory official permission before exporting goods across borders. This can be implemented in different occasions such as to ensure safety requirements for pharmaceutical products or as in this thesis examine domestic healthcare systems, supply and to be able to face a spike in domestic demand. This is mainly done to manage distribution of critical medical products such as textile face-masks and overall personal protective equipment (Mildner et al. 2020).

2.5 The Gravity model of trade

Not only empirical studies but also theoretical models can contribute to our understanding of trade flows and the effects from export restrictions on trade value.

The gravity model of trade is a key tool for research on trade-related policies and helps to provide an adequate testing ground for determining the extent to what different policies affect trade flows between nations (Shepherd 2016). The gravity model is a theoretical model within international trade that helps approximate bilateral trade flows with the laws of the gravity equation. When describing patterns of bilateral trade flows between country A and B, Jan Tinbergen in 1962 compared them to Newton's universal law of gravitation (Tinbergen 1962). Feenstra and Taylor (2017) further substantiate the origin of the gravity equation as from Newton's universal law of gravitation in which the force of gravity, $\overline{F_g}$, between two objects is:

$$\overline{F_g} = G \times \frac{M_1 \times M_2}{d_2^2}$$

Where \overline{G} is a constant that explains the magnitude of the relationship, the greater each object is and the closer they are to each other, the greater the force of gravity becomes (Feenstra & Taylor, 2017). The economist Tinbergen applied the theoretical gravity model on international trade and stated that the trade flows between country A and B are proportional to the gross national products of the countries, as well as inversely proportional to the distance between them (Tinbergen 1962).

Bacchetta et al. (2012) further explains how the gravity model implies that countries trade in proportion of the size of their economies and the distance between the countries. Distance is a way to measure costs of transportations, hence longer distances assume higher costs for transportation. Larger economies tend to spend more on imports since they have a larger revenue. Countries with larger economies also tend to attract consumption in other countries because of their often greater extent of production (Bacchetta et al. 2012). The equation that was proposed by Tinbergen to explain trade was similar to Newton's law of gravity. Instead of measuring the mass of two objects we take the GDP of the two countries and predict the quantity of trade between them (Feenstra & Taylor 2017; Tinbergen 1962).

$$\overline{Trade} = \overline{B} \times \frac{\overline{GDP}_1 \times \overline{GDP}_2}{\overline{dist}^n}$$

The relationship between trade and the gravity term is expressed by the general constant \overline{B} . Trade is the amount of trade between two countries. \overline{GDP}_1 and \overline{GDP}_2 are the gross

domestic product for each country and \overline{dist}^n is the distance between the countries (Feenstra & Taylor 2017).

Hence the general equation indicates that bigger economies with less distance trade more with each other. It is possible to broaden the general equation and extend the range of use by examining trading effects of additional variables.

Andersen and Van Wincoop (2004) emphasize the importance in considering relative trade costs to bring forth a well-specified gravity model. The general gravity model only considers distance as a measure of trade cost which can limit the abilities, therefore the authors express the potential importance of including other measures of trade costs as well. Hence, to only include one variable for distance may in some cases be insufficient.

The gravity model is presented as a theoretical model to help understand underlying factors that can affect trade flows between China and the United States. However, the empirical method used to analyze the impacts from export restrictions on trade values between China and the United States will be presented in a multiple linear regression model in following sections. In this context both China and the United States are large economies, thus trade flows between these countries would be expected to be high. Within the framework of a pandemic such as the Covid-19 pandemic factors such as export restrictions, changes in demand and supply may have influenced the trade flows. Therefore a multiple linear regression model will be presented as an empirical method in conjunction with the theoretical gravity model to clarify the export restrictions impact on trade value.

3. Methodology and data

3.1 Method

The statistical approach used to examine the impact of export restrictions on trade values of medical supplies between China and the United States is a multiple linear regression model. This regression was performed on Minitab. To reduce numerical issues, normalize distributions of data and to ensure that each variable values are at the same scale, the decision to take the logarithm of continuous variables was made. One regression is made to help examine the impact of the export restrictions that were imposed in China during the months of January 2020 to December 2022. To conduct the analysis monthly data of each variable was collected. The trade values are measured in monthly exports to the United States and are specified down to trade values of textile face-masks with the HS commodity code 630790 (World customs organization, 2022). The analysis for this thesis is therefore limited to China's export of textile face-masks to the United States during 36 months.

3.1.1 Regression model

Presented below is the functional form used for the regression where $\ln(\text{Trade value})$ is China's trade value of textile face-masks measured in USD and β_0 is the coefficient corresponding to the constant. Furthermore, we have the coefficients β_1 for export restrictions, β_2 for lockdowns in China and β_3 and β_4 are the confirmed number of Covid-19 cases in the United States and in China. The t subscript in each variable represents the months and lastly ε is the error term which represents differences that may have occurred due to variables and factors that have not been included in the model.

$$\ln(\text{Trade value}) = \beta_0 + \beta_1 t (\text{export restriction dummy}) + \beta_2 t (\text{Lockdown dummy}) + \beta_3 t (\ln(\text{Confirmed Covid-19 cases US})) + \beta_4 t (\ln(\text{Confirmed Covid-19 cases China})) + \varepsilon_t$$

3.1.2 Theoretical Predictions

The gravity model of international trade is as earlier discussed similar to the physical law of gravity, and it predicts the bilateral trade flows based on economic sizes measured in GDP and the distance between two economies. Hence in this case with China and the

United States both countries being large economies, indicates a positive coefficient. The United States is the world's largest GDP followed by China being second (World Bank 2023). Thus, due to their large output levels and consumer market, this implies a positive sign for the GDP coefficients which suggests a high volume of trade between the nations. Similarly, as GDP affects demand and supply in the gravity model of trade, the number of Covid-19 cases is a proxy for demand and supply in the regression model. It is reasonable to predict a negative relationship between lockdowns in China and trade values as it includes supply chain disruptions caused by business closures, travel restrictions and logistical issues. Measures like lockdowns increase the risks for a decreased production, demand and limited transportations which all tend to reduce trade values.

An increased number of Covid-19 cases in China also have a negative sign prediction since it also would indicate a higher demand domestically but also a decrease in the country's production capacity due to shortages in materials and labor. A heightened domestic demand would include the need to ensure adequate domestic supply and governments might therefore impose measures to prioritize domestic needs which is predicted to result in a decrease in China's trade value.

The expected sign for the relationship between the confirmed number of Covid-19 cases in the United States and trade values can however depend on numerous different factors. A higher number of Covid-19 cases in the United States could indicate a higher demand for medical products such as personal protective equipment and face-masks. Thus an increased demand for these essential products can in its hand result in higher trade values as nations and their healthcare systems require the supplies to combat the pandemic. Therefore a positive relationship is expected for the confirmed number of cases in the United States and China's trade values of textile face-masks.

Although it must be highlighted that empirical results can differ due to various reasons. Trade flows between the two nations can be influenced by several additional factors and it is therefore important to keep the dynamic nature of international trade in mind.

3.2 Data

3.2.1 Descriptive statistics of variables

Table 1 presents the descriptive statistics of each variable for this thesis multiple linear regression model. These variables were selected based on their relevance to the research question. By including them in this analysis the aim is to examine their individual impact on trade values of one type of medical equipment from China to the United States. The reported data in Table 1 is the raw data which later was transformed into logarithmic form.

Table 1. Description of variables.

<i>VARIABLE</i>	<i>DESCRIPTION</i>	<i>MEAN</i>	<i>STD. DEV</i>	<i>MIN</i>	<i>MAX</i>	<i>N</i>
InTradeValue	Trade value of China's export in textile face-masks	593605471	785148945	36297404	3653069488	36
Export_restraint_dummy	Export restrictions in China	0.0585	0.3507	0	1	36
Lockdown_dummy	Lockdowns in China	0.0732	0.4392	0	1	36
InCasesUS	Number of confirmed Covid-19 cases in the United States	2760746	3586828	9	21354690	36
InCasesChina	Number of confirmed Covid-19 cases in China	11272489	33416670	16566	193839608	36

3.2.2 Dependent variable

The dependable variable in this model is China's monetary worth of trade values for textile face-masks to the United States. This variable is given in United States dollars and has been transformed into a logarithmic form to avoid a skewed distribution. The data collected for the dependent variable of China's trade values is obtained from the United Nations Comtrade database. The UN Comtrade database provides detailed information and is an international comprehensive trade database with data on imports and exports of goods between countries, including information on monetary trade values which was utilized for this regression. The process of collecting data includes accessing the UN Comtrade database with specific and relevant parameters. For this thesis the search has been narrowed down to trade flows of medical supplies in the form of textile face-masks between China and the United States. The reported HS commodity code was 630790 and were collected from the World Customs Organization (2022). The classification for this commodity code includes several types of textile face-masks including surgical masks, disposable face masks and the face-mask known as the N95 particulate respirators. This specific commodity code was chosen to ensure inclusion of relevant product categories, in this case protective garments for face and eyes. Choosing a specified sort of medical

supply enables a more precise examination of trade value to a specific medical product and what factors may have influenced its trade flows. Textile face-mask among other medical equipment was a highly demanded product around the world during the pandemic, in which China was one the biggest exporters.

The data collection was conducted for the period January 2020 to December 2022 for the purpose of covering a highly critical period of the Covid-19 pandemic. The data collected is monthly trade data thus there are 36 observations for each month. Monthly data was chosen to be obtained to be able to identify potential trade patterns or variations over time.

3.2.3 Explanatory variables

The explanatory variables for the model are export restrictions, lockdowns, confirmed number of Covid-19 cases in the United States and China respectively. The confirmed number of cases for both the United States and China have been transformed into a logarithmic form. Data for each variable have been collected for the period between 2020 to 2022 with a total of 36 observations each.

In this multiple linear regression model export restrictions are included as a dummy variable. The data is collected from Market Access Map (2022) and World Trade Organization (2020). The type of adapted export restriction measure in China that has been collected for this study is licensing and permit requirements to export. The effect on trade is registered as restrictive and has affected all partners and was therefore relevant for this study with the United States. The export restriction dummy takes a value of 1 if there was an implemented and active restriction in form of licensing and permit requirements for that month and 0 otherwise. The expected outcome from implemented export restrictions on trade value is connected to the limited availability of export goods that occur. By limiting availability of medical products to export it may reduce trade values and disrupt supply chains (Haveman et al. 2003). Furthermore, the authors Haveman et al. (2003) explains how different measures of protection on trade flows significantly can reduce trade flows as well as result in a deflecting effect on trade preferences. The impact from export restrictions can fluctuate depending on the extent of the restraints and also depending on the duration. Thus a time series of 36 months was covered in this model, to capture the impacts on trade value for medical supplies, in this case textile face-masks.

A dummy variable for lockdowns was used to capture the impact from the lockdown measures that were implemented in China during the pandemic. Lockdowns was also a form of government implemented policy during the pandemic and by incorporating lockdown as a dummy variable it enabled to assess the impact it had on trade values of medical supplies. Such lockdowns policies were active from early 2020 and did result in reduction in global trade (Hayakawa & Mukunoki 2021). Onwards, Hayakawa and Mukunoki (2021) research showed that the lockdown orders had different varying degrees of impacts within different industries. Different forms of lockdowns also showed to have various effects for instance such as stay-at-home orders and workplace closures

(Hayakawa & Mukunoki 2021). For this model the lockdown variable serves as an indicator whether there was a lockdown in place or not for each month of observation. This can assist to examine influence on trade flows and enables the model to control possible confounding influence from nationwide lockdown measures in China. Data for lockdowns were collected from Our World in Data (2022) in which the data was collected and examined for stay-at-home requirements, required cancellation of public events and gatherings, and lastly also required school and workplace closures.

Lastly for the explanatory variables, a confirmed number of Covid-19 cases were presented. Data was collected from the World Health Organization (2023) for both China and the United States. The World Health Organization website provided a weekly number of confirmed cases which then was counted together and presented in total number of monthly cases in each country respectively. These numbers were also transformed into logarithmic form to avoid numerical issues. The selection for these explanatory variables were of interest to include and examine as the numbers reflect on the spread of the Covid-19 virus as well as a proxy for the level of demand for medical supplies. Higher numbers of confirmed cases in the United States suggests a greater demand for medical supplies and resources in general. It provides insights to the dynamics of global supply chains during a public health crisis and helps to explain the economic implications of the Covid-19 pandemic. Including the confirmed number of cases in the United States enables us to analyze the relationship between demand for medical supplies and trade values of medical supplies, as well as capturing the effectiveness of policies implemented to control the spread.

When viewed from China's perspective, as the exporting country, the number of confirmed Covid-19 cases can have a different and more complex impact on trade values. It is therefore essential to examine and consider both with direct effects on trade value and supply chains but also on consumer behavior. A higher number of cases can eventually result in implementation of different forms of restraints such as, export bans, export quotas, permit requirements or heightened export regulations overall. Measures like these limits the availability of export products and are often implemented to ensure the domestic distribution of medical supplies. Additionally, an increased number of confirmed cases and lockdowns can in its hand result in disruption of productions and distribution processes as well as labor shortages. Logistical challenges and lowered production capacity might occur hence it may result in lowered trade values.

4. Results

Following presented in Table 2 are the regression results. For each of the explanatory variables their coefficient, significance level and standard error are presented in the table. Table 3 also presents values for R-squared and adjusted R-square.

Table 2. Regression results.

VARIABLE	Coef.	P-value	Std err	Observations
Export_restrictions_dummy	-1.084	0.046**	0.523	36
Lockdown_dummy_China	-0.176	0.593*	0.325	36
lnCasesUS	0.2434	0.001***	0.0636	36
lnCasesChina	-0.1662	0.038**	0.0768	36

Variable statistically significant at 90%=, 95%=**, 99%=****

Table 3. R-sq and adj R-sq.

R-sq	R-sq (adj)
0.3815	0.3417

The coefficient of -1.084 for export restrictions with the standard error of 0.523 indicates there is a negative impact of export restrictions on trade values. This implies that an export restriction in the form of licensing or permit requirements is associated with a decrease in exports of 1.084 log points. The result suggests there is a statistically significant 5% level ($p = 0.046$). The negative coefficient exhibits the negative relationship between export restrictions that were implemented in China and the trade values. Further, the next dummy variable for lockdowns shows a coefficient value of -0.176 which also implies a negative

relationship between the lockdown measure in China and the nation's export of textile face-masks measured in trade value. This means that additional lockdown in China is associated with a decrease of 0.176 log points in exports of textile face-masks. In percentage terms this would mean a decrease of approximately 16%. However, the variable for lockdowns in China indicates that the result is significant at a 10% level. There is therefore evidence to support the conclusion that lockdowns in China did have an impact on trade values although the significance is not as strong as the remaining variables.

The coefficient for confirmed number of Covid-19 cases in the United States shows a value of 0.2434 which infer there is a positive relationship between the number of cases in the United States and the imported value of textile face-masks from China. The results also implies a high significance at a 1% level ($p=0,001$) suggesting that a higher number of cases corresponds to an increased value of trade. The results imply that one increased number of confirmed cases in the United States is associated with an increase of 0.2434 log points in China's trade values of the personal protective equipment textile, textile face-masks. The confirmed number of cases in each country is transformed using a logarithmic function, as well as the dependable variable. This implies that the interpretation is an elasticity, meaning that the elasticity of trade with respect to the confirmed number of cases in the United States indicates that a one percent increase in the number of cases is associated with a 0.24 log points increase in trade values which is measured in United States dollars.

And for the last explanatory variable there is an estimated coefficient of -0.1662 which indicates there is negative association between the logarithmically transformed confirmed number of Covid-19 cases in China and the exporting value of trade on textile face-masks. This means that one additional confirmed case in China is associated with a reduction of 0.1662 log points in trade values. The results for confirmed cases in China indicate it is statistically significant at the level of 5% ($p=0,038$). In the case of confirmed cases in China elasticity is also being used to measure responsiveness so a one percent increase in China's number of Covid-19 cases is associated with a 0.1662 decrease in China's trade value of textile face-masks.

The mean value for the variance inflation factor is 1.695, it suggests a low level of multicollinearity in between the explanatory variables for this model. Table 3 depicts the values for R-squared which demonstrate a value that indicates that the variables included in this model explains a moderate amount of the variation in the model. A higher R-squared value is generally more desirable, although a substantial portion of the dependable variable is explained it does still indicate there are additional factors that influence the trade value of face-masks. This model has some explanatory variables and can therefore provide valuable insights but do have room for improvement. However the results will be discussed further in the following section five.

5. Discussion

After running the regression the results presented in section four were obtained. The study has examined four different factors and their influence on trade values of medical supplies during a health crisis such as the Covid-19 pandemic. By the first half of 2020 China had 39.6% of the shares of exports in medical products. With China being one of the world's greatest exporters this study has examined the relationship of trade on specifically textile face-masks between China and the United States (Espetia et al. 2020).

The pandemic had profound impacts on global supply chains and trade volumes, in particular within the medical equipment industry. With a considerable increase of the spread and number of infected people a rise in the demand for medical supplies arose across borders. Meanwhile, the Chinese government like many other nations responded to the different challenges by imposing different forms of export controls and restrictions on medical supplies among other goods as well. To ensure domestic availability although thus it limited the availability and exports of medical supplies from China.

The result for this model indicates that three of the variables are significant. Export restrictions were significant at a 5% level as well as the confirmed number of Covid-19 cases in China. Further on the variable for confirmed number of cases in the United States turned out to have a higher significance at a 1% level. The coefficient for export restrictions in China is negative which implies that the licensing and permit requirements that were implemented within China's medical supply market had a negative impact on its trade values of textile face-masks to the United States. Furthermore, the significance for the coefficient implies that the observed relationship between the dependable and explanatory variable has improbable occurred by chance. Hence an implementation of export restrictions will decrease the trade volumes for that country. The negative coefficient indicates that when China implements an export restriction such as licensing and permit requirements trade values tend to reduce. The results for this variable were expected and aligned with several studies as well as literature describing the economic reasoning and mechanisms of export restrictions. Export restrictions limit the availability and quantity of goods to export which directly affects trade volumes and therefore also trade values. Equally it can also result in an increase in global prices due to a decreased supply and increased demand due to a global health crisis such as the Covid-19 pandemic (Krugman et. al 2018: Feenstra 2017).

The significance for the confirmed number of Covid-19 cases in the United States was somewhat expected as the variable was picked out to examine how the spread in the United States might have influenced the country's demand for personal protective equipment. The positive coefficient was also expected as it determines that the confirmed number of Covid-19 cases did have a positive effect on the exported trade value of textile face-masks from China. This implies that the logarithmically transformed number of Covid-19 cases in the United States had a positive relationship to China's trade value. The

results were highly significant suggesting there is a very diminutive chance the results occurred by coincidence, and it suggests that a higher number of confirmed cases of the Covid-19 virus in the United States corresponds to increased trade values. The results were quite intuitive as increased demand in one country through several interconnected mechanisms may result in an increase of exports. Further this aligns with the neoclassical theory for demand and supply. Mankiw (2012) describes the quantity demanded as the amount of a product consumers are willing to purchase and the law of supply as the quantity supplied of a good rises when the price of the good rises. This can be used to clarify the positive relationship between China's trade value and the quantity of textile face-masks exported. When the demand for a country's product rises it sends incentives to domestic producers to expand their production and face the heightened demand. And as production increases the surplus produced can be exported to foreign countries, which can help declare the results of the model as this would align with an increased trade value to the United States.

Increased demand also indicates a more beneficial market for exporters (Mankiw, 2012). The results for the relationship between cases confirmed in the United States were therefore somewhat quite intuitive since a health crisis or pandemic could explain a rise in demand for medical supplies in what China is a major producer of personal protective equipment (World Trade Organization, 2020).

For the confirmed number of Covid-19 cases in China on the other hand the results appeared slightly different. Although the variable for confirmed cases in China was expected to be significant as well. The logarithmically transformed number of confirmed cases in China showed a negative coefficient indicating there is a negative association between the number of confirmed cases and the country's trade value for textile face-masks. The negative coefficient and relationship was expected as well, mainly because increased spread of the virus in China was expected to have a relative impact causing supply chain disruptions within the domestic market as well as an increased domestic demand. Which partly would result in reduced domestic production and availability of goods to export to outside countries since the production might drop whilst the domestic demand increases. This also concurs with previous studies, Chang (2022) describes one factor leading to supply chain disruptions is the product supply. This indicates that delayed return-to-work and quarantine measures, which both are associated with the spread of the virus and the number of infected population, have affected distribution processes and entire processes of China's supply chains. Further the same study also implies how insufficient logistics is another impacting factor. Transportation and logistics is an undeniable essential part of the supply chains. A huge proportion of different adopted practices spread all around the world in the same vein as the virus spread. For instance, flight cancellations, custom restrictions and shipment suspensions resulted in making the distribution of trade more difficult (Chang, 2022).

A report published by OECD (2022) on policy responding to the Covid-19 also aligns and indicates how trade in several types of goods such as personal protective equipment came under huge pressure due to an extreme and ordinary demand. Shortages both in components and labor also aggravate the supply chains. Hence the expected sign was a negative association as the results depicted.

The variables for lockdowns are in a certain sense related to the previous variable discussed. This variable was not statistically significant, which was not predicted when picking out the explanatory variables. However, this could be because of several reasons which also will be discussed further in this section. Limited variation within the sample data could be one cause, this variable was measured as a dummy and when the observations have similar conditions detecting and identifying a relationship become more challenging. The sample size could have an effect on the results for the significance. A larger sample size might have improved the results since it generally provides a greater ability to detect statistical significance, although the aim of the study was to focus on the main years of the pandemic. Further on however, the result for the coefficient is negative implying that the lockdown variable has a negative impact on the exporting trade value for textile face-masks. The coefficient being negative was anticipated. A research paper by Meier & Pinto (2022) indicates how China's response to the outbreak of the Covid-19 pandemic led to widespread implemented lockdowns. Lockdowns disrupt supply chains and delimit the production. The World Trade Organization (2020) reported a decline of 9.2% in world merchandise trade. The introduction of lockdown policies being one of the influential factors to supply chain disruption due to the limitations of mobility. Therefore, such a result as a negative relationship between the lockdown variable and trade value of textile face masks was expected. Unemployment caused by closure of business and a general economic slowdown may also contribute to a reduced demand for the hardly affected populations and thereby also clarify the negative relationship between lockdown and China's trade values (World Economic Forum, 2020).

Other than the result for significance the value for the variance inflation factor (VIF) estimates the extent of multicollinearity. The results for the VIF-value were presented as 1.695 which indicates there should not be considerations about multicollinearity. Which is good and supports that the model somewhat is a good fit. Daoud (2017) explains having correlations in between explanatory variables as being undesirable. Multicollinearity also increases risks for statistical insignificance (Daoud, 2017).

A somewhat higher value for the R-squared was expected. The results indicate the model being a moderate fit. However, this study is not without limitations, one of them being missing variables that could be causing the moderate R-squared value.

There are limitations to this thesis that are important to consider. All relevant explanatory variables have not been included resulting in failure of capturing the full complexity of the explanatory power and relationships. The data obtained is quite recent, as the chosen period of years to examine is recent and there were a few limitations in what data available to include. This means there are limitations in the scope of data that is available which can influence the generalizability of the findings. In this context for instance, data availability related to trade values of medical supplies can be challenging to obtain for some countries and certain products, due to varying report standards. Due to a global health crisis such as the Covid-19 pandemic the risks for inconsistencies and delays in data can also increase. Another limitation is the various other influential factors such as demand fluctuations, production capabilities and transportation issues which also contribute to the effects of

trade values. The scope of the data may also be considered limited due to additional external factors that have not been included in the model, such as bilateral trade agreements and political relationships.

It is also important to mention the potential for reverse causality and spurious correlation. Reverse causality refers to where the reversal of the relationship between variables occurs while spurious correlation occurs by coincidental association between variables that don't have a causal relationship (Herbert 1954). Meaning that there is potential that China's trade value influenced the explanatory variables rather than the other way around. Or that there might be a correlation between high trade values and export restrictions but that could be driven by several other factors.

This analysis has one country in focus hence it is good to take into account that the results can not necessarily be generalized. External validity refers to the extent to which the findings in this thesis can be generalized, considered representative and applicable to wider ranges of scenarios. In this context external validity would include other countries or regions with similar circumstances as China during the Covid-19 pandemic. To enhance this the aim was to include reliable data however to further improve the external validity an expansion of sample size by including a broader range of countries and regions could be considered for future research. Incorporating more qualitative data with interviews or surveys could also help capture more nuanced results and enhanced applicability for different scenarios.

The variables that have been chosen are based on their theoretical relevance for this thesis. It should therefore be considered that there may exist additional factors that can affect the relationship between trade values of medical supplies amongst China and the United States. The selection of variables can affect or limit the explanatory power of the model as it is not possible to account for each single possible variation or collect data on all possible trade costs. However, the chosen variables are expected to have at least a moderate proportion explanatory power for the dependable variable.

6. Conclusion

As a part of their response to the Covid-19 pandemic, governments around the world imposed various containment policies to help prevent the health crisis. Different policies such as export restrictions and lockdowns were implemented in China, one of the world's greatest exporters of medical supplies during the health crisis. It can be safely said that the pandemic caused various forms of international supply chain disruptions among many countries. The industry within medical products was critical and was one of the industries in which global supply chains were hardly affected. China and the United States are two of the world's greatest economies and are therefore influential in many aspects of the global economy as well as global supply chains and distributions. The aim of this thesis was to examine what effect and influence some of the Covid-19 related policies had on China's trade value of personal protective equipment, particularly textile face-masks. Export restrictions in the form of licensing and permit requirements, lockdowns in China and the confirmed number of Covid-19 cases in China did show to have a negative impact on China's exporting trade value of textile face-masks. The confirmed number of cases in the United States itself showed a result of having a positive relationship to China's trade value.

A suggestion for future research within this area of examination would be to include additional explanatory variables for instance such as logistics data. This could be compared to examine if those would eventuate in a greater explanatory power and overall fit. To conduct more research in the future to compare the pandemics aftermath it can be helpful to further understand the intricate dynamics of the explanatory variables as well as a greater understanding for effective policy making and crisis management for potential future global health crises like the Covid-19 pandemic.

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