UNIVERSITY OF TURIN

Bachelor's Degree in Economics

Bachelor's Degree Thesis

The impact of Covid-19 on international trade: evidence from bilateral data

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"In technology we spend so much time experimenting, fine-tuning, getting the absolute cheapest way to do something. So why aren't we do that with social policy?"
Ester Duflo

Abstract

This paper provides arguments in favour of economic system robustness against unexpected downturns. Source of the decline, in the analysis, is the set of regulation and laws promoted to contain Covid-19 pandemic; instead, the toolkit used to prevent collapse is the set of fiscal policies. The relationship between economy's health and policies is studied trough a panel data made up by monthly information regarding the flow of exports, policies and regulations implemented and Covid-19 impact on the first 50 countries by contribution to international exchanges. To estimate this relation an extended gravity model in a fixed effects regression is used. Results of the research show for policies like debt relief and subsidy support, positive average coefficients of 8% and 12% respectively and for regulations as social stringency a value around -1%. Final findings consist of a greater efficacy of policies deployed in developing countries and a higher efficiency of stringency in rich ones, however both of them are only detected from the importer side.

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Chapter 1

Introduction

The world is only now recovering from the unexpected recession caused by the disruption of Covid-19 and the restrictions enforced to minimise its spread. In the last two years, due to mobility stringency, international trade has completely collapsed.

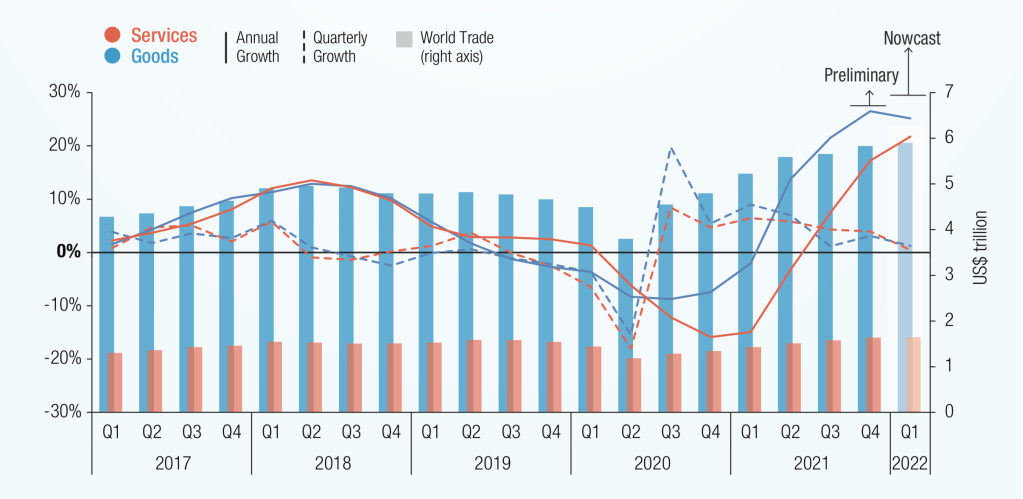

Figure 1.1: Trends of Global Trade in goods and services by quarters from 2017 to 2022

As Figure 1.1 [1] shows trade volumes have decreased by more than 20% between the second quarter of 2019 and the second quarter of 2020, univocally both in services and goods. To give a perception of the severity of these data and to credit the reasons that have driven this study, it's useful to look at and make a brief comparison with what happened during the Global Financial Crisis. In that economic disruption, global trade has decreased by "only" 15% as the chart in figure

1.2 [2] shows. Results of that catastrophe were a reduction of real gross product of 5% on average and a doubling in unemployment rate for the US economy, the biggest in the world at the time, which needed nearly eight years to recover.

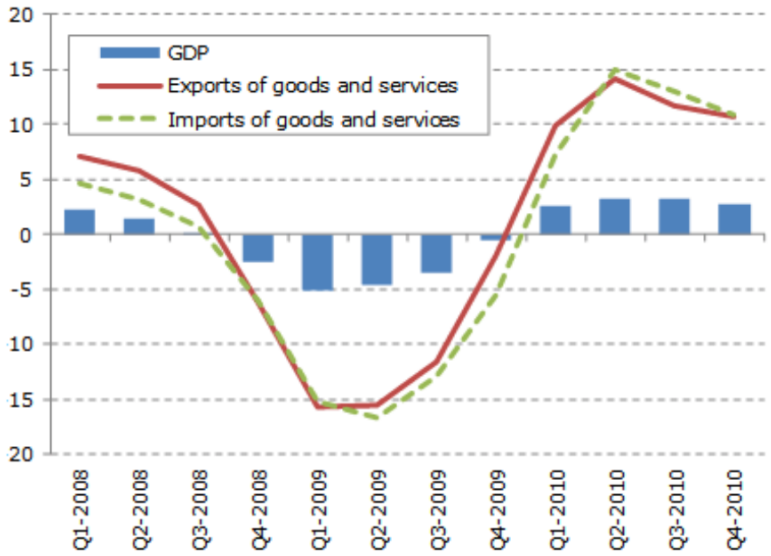

Figure 1.2: Trends of Global Trade in goods and services by quarters from 2008 to 2010

Another similitude can be found in the reactions of governments: in both occasions were promoted aids such as: direct subsidies, like coupons, and indirect ones like tax cuts and debt reliefs with the freezing of interests expenses. Even if similar in their effects and responses, the financial crisis and the Covid pandemic are different in their causes: the first one was, synthetically, the result of inaccurate bank legislation and the burst of real-estate bubbles; the second one has its origins not in the contagiousness or lethality of the virus, but mainly in the policies and in the regulations which were adopted by governments' officials to restrain its spread. Consistent with this, the collapse of world trade has been driven by confinement measures like stay-at-home impositions and closures of borders between countries more than higher counters of cases.
Due to the worsening in condition with respect to 2008 trends, a proper evaluation of the economic impacts of Covid-19 crisis is not only worthwhile but challenging as well, aiming to mitigate uncertainty and to identify internal mechanisms, related to fiscal policies, on which rely for the stabilization of the system. Finally, estimating the size of roles assigned to stringency measures and government support would shed light on their overall effectiveness and efficiency in relation to their costs.
The research sector on relationships between economic disruption and policies it's

plentiful of papers. Some authors convene on strong relationship between financial credit regulations and economic system downturns [3]; some others have focused their attention on imposed containment of agents' mobility and its correlation with volumes of exchanges [4] and, lastly, researchers looked at the effects of global supply chain and other demand factors on the propagation of one sector's drop to the entire system [5]. This analysis contributes to the literature merging in its object the first two studies previously mentioned and it uses monthly data to discover, from an empirical point of view, the effect of both fiscal expansions and stringent regulations on trade and ,with the latter being the core of the economy, [6],globally on the economic system. The study presented in the following pages focuses, going further than the past literature, on a specific change in people's life: the constraints' grips related to stringency that go from public transportation to closures of institutions and firms. The other factors that are, in an innovative way, highlighted belong to the fiscal field: one to the demand side, as the support given by government to economic agents in the form of subsidies relatively to salary losses, and the one to the supply side, like the freezing of a percentage of debt expenses.

To conduct a proper analysis and obtain meaningful results, the model used is the gravity in an extended form which considers the yearly difference between months and is estimated on a panel data. Combination of gravity and time series allows the analysis to get rid of some methodological issues related to omitted and unobserved variables biases and constant factors; moreover, yearly difference between months leads to the dispose of variations in trade due to seasonal changing of products and services and to a better focus on medium term consequences, major factor for the system stability.

The dataset employed collects monthly information for the first 50 countries which contribute the most to the international trade between April 2019 and April 2020. Studied characteristics consist of mortality, ICU patients, vaccines, total deaths, total and new cases, regional trade agreements membership, GDP, and, lastly, governments' actions as debt relief, subsidy support, and limitations to mobility.

The first result produced is a negative correlation between bilateral trade and Covid impact, which is proxy by mortality rate, for both importer and exporter. The second result is a negative relationship of volume of exchanges with promoted containment and an overall positive one with vaccines, debt relief and support, but heterogeneous on importers' income-level. These findings are robust to different statistics tests and to the introduction of different explanatory variables like vaccines and the governments support itself.

Chapter 2

Previous Literature

The specific literature covering the Covid-19 induced effects on trade can be catalogued as flourishing, but, at the same time, often incipient.
Some studies focus on trade shocks but, due to the scarcity of data, they are usually restricted to an export analysis which covers only one country. An excellent representative of this group is the paper made by *Büchel et al.* [7] which pivots its attention on Switzerland. They, combining monthly and weekly trade data, have found that during lockdown Swiss trade fell by 11% compared to the same period of the previous year; moreover, they discovered that this trade shock was more profound than the 2009 one and that contractions in Swiss imports are related to the stringency measures in the exporter country, with only pharmaceutical and chemical products resilient to the pandemic trade shock.
Other studies have provided additional evidences by considering a larger sample of countries. They have used monthly bilateral trade of EU members and plugged them into a gravity model to highlight the role of supply chain in the transmission of Covid-19 demand shocks. Examples of these euro-based papers are the ones of *Kejzar et Al.* [8] and *Espitia et al.* [9]; the first shows a negative relationship between constraints measures and labour supply, and the second, instead, highlights how Covid-19 has decreased European countries' participation in Global Value Chain, affecting sectoral trade growth. Finally, an alternative study which includes a larger number of countries is the one written by *Hayakawa and Kohei* [10] which focuses its attention on 35 countries and their 250 exports partners. Major limit of this paper is its restriction to only the trade of medical goods, this flaw is consequentially mirrored in the achieved result represented by negative relationship between stringency and exports.
Surprisingly, only small fraction of the studies have focused their attention on adapting their results to the income level of the countries involved in the trade. The main front-runner in this field is the research of *Barbero , de Lucio and Rodŕıguez-Crespo* [11], which, trough data from 2019 to 2020 on 68 different income

countries, implied that the effect between government's restrictions and exports is negative and it is more intense if import and export countries share the same income level.
The study described in this paper will not only be part the last mentioned trend but it will use new data from 2020 to 2021. It will differentiate, for the first time, governments' aids in demand and supply support, and , moreover, it will add to these the effects of vaccines, which weren't yet a reality when [11] was written.
In conclusion, are worth of attention a recent WTO article [12] which has displayed a difference in trade and information costs based on income among countries; a Canadian study by *Minondo and Requena-Silvente* [13] that has shown a more intensive and complex production skills needed in high-income countries than in low-income ones; the paper made by *Dingel and Neiman* [14] which has highlighted that low-income countries present a lower share of jobs that can be done at home; and , finally, the article by *McMahon, Peters et al.* [15] has underlined how certain healthcare commodities may not be affordable for the majority of low-income countries.
Due to the papers mentioned above, the results to which this analysis will lead present a crucial and relevant heterogeneity in the effects of fiscal policies and stringent regulations on the bilateral trade volumes.

Study	Coverage	Feats
Buchel et al.	Switzerland	Stringency and imports
Kejzar and Velic	EU	Supply chain and demand shocks
Espitia et al.	EU	Covid and Global Value Chain
Hayakawa and Kohei	35 Countries	Stringency and medical product exports
Barbero et al.	68 Countries	Stringency and income level
This Study	50 Countries	Demand,supply, health and income level

Table 2.1: Compilation of studies covering COVID-19 impacts on trade

Chapter 3

Empirical Analysis

3.1 The Dataset

The sample used in this paper covers 50 countries which are the first for contribution to exports of goods and services in 2022, as stated by the studies of the US Census Bureau released by *World Population Review* [16]. The data are collected from the data bank of the *International Trade Center* [17] and, due to the monthly nature of Covid-19 shock, they catch the bilateral trade flows from every country in the fifty previously mentioned towards all the other forty nine on a monthly base.
Variables related to the government's fiscal policies and stringency conditions have been taken from the *Oxford Coronavirus Government Response Tracker* [18] and their composition and implications are described more broadly in the following sections.
Information strictly correlated with Covid spread as the amount of total cases, monthly new cases, total deaths and ICU[1] patient are extracted from the database built by *Our World in Data* [19].
Finally data regarding countries' general characteristics as GDP per capita and distance between capitals are taken respectively from *World Bank* [20] and *CEPII*[2] [21] data-banks.

[1]Intensive Care Unit

[2]Centre d'Études Prospectives et d'Informations Internationale

3.2 Variables

3.2.1 Dependant Variable

The main dependent variable, as multiple times implied, concerns trade flows; it's labeled as *Exp* and measures the volume of bilateral net export flows for each of the 2450 couples of countries including both services and goods; its trend is showed in Figure 1.1.

3.2.2 Control Variables

Passing to the control variables which differentiate the effects of policies and regulation, a first split is made on the income level. Income is captured by the variable *GDP* that measures the GDP per capita of the exporter and importer, at a specific time. Since its main aim is to create two sets for developed and developing countries, it is binary variable which assumes value of 1 if the country has a GDP per capita, computed trough Atlas method[3], higher than 12,696$[4], and 0 otherwise, stating that country as low income. As figure 3.1 shows, of the fifty countries on which this analysis is based almost two thirds are high income level with only the remaining 19 being developing countries.

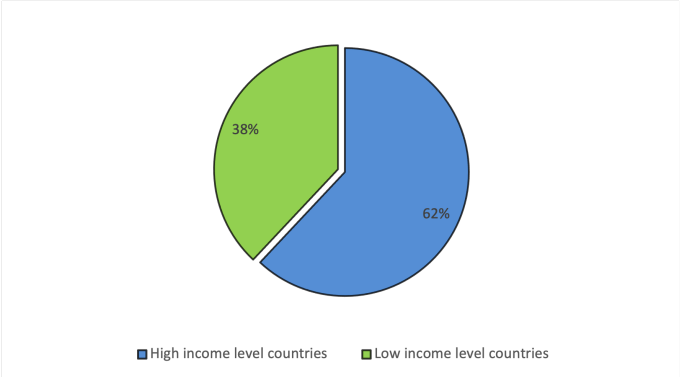

Figure 3.1: Countries by income level based on World Bank benchmark

[3]A country GDP is converted in US dollars using a Atlas conversion factor, which adjusts it for the fluctuations in the exchange rate and for the changes produced by inflation, and then it is divided by country's midyear population

[4]Benchmark for high income countries stated by World Bank on the 1 July 2021

A second categorization of data is applied based on the taxes and limitations to which exports are subjected. The variable which captures this smoothness in trade is called RTA, it looks at the existence of a RTA[5] in which both countries involved in the bilateral exchange are included. Since usually these kinds of agreements lead to a higher mobility of goods and people trough the border and a tax detraction or exemption, the variable can be seen as a valid parameter. If both the countries parts of the trade share a common agreement, RTA assumes value of 1, and 0 otherwise. Figure 3.2 counts that, on a total of 2450 bilateral flows analyzed monthly, only a third of them happens in a shared market. Finally, this asymmetry can be imputable to the relative youthful of this kind of deals and a lack of common markets between countries with big differences in domestic product, of which our dataset is full due to its special focus on income heterogeneity.

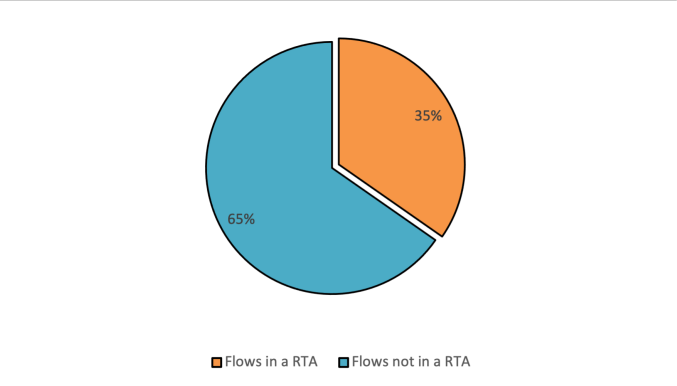

Figure 3.2: Bilateral trade by RTA

Last obstacle and constraint for trade is the distance between the countries involved; since farthest will the two countries be and higher will be the transportation costs, near commercial partners have a great competitive advantage against their competitors which have to face problematic routes. The variable which controls for this issue is called *dist* and measures the distance between the two countries' capitals in kilometres and as the crows flies.

3.2.3 Variables of interest

As previously stated in chapter 1, the major source in the international trade disruption was the spread of Covid-19 and the ways, direct and indirect, in which it has affected economy's pillars.

[5]Regional Trade Agreement

Real economies and financial systems have a common and crucial key for their stability, and this shared base is trust. Trust affects the size of risk that agents compute regarding future events, hence the expected payoff of their future actions like savings and consumption. It follows naturally that the bigger the perceived risk will be and the more agents will save, all this will result in a decrease in consumption and investments which will provoke a reduction in total production and trade that will end in the collapse of real economy.
The most immediate and general channel trough which the Covid-19 can affect perceptions of agents it's trough its mortality rate, since the more lethal the virus will be and the higher the grade of the threat people assign to their life will be. This measure is captured by the variable *Mortality*, which is the ratio between the the total cases and death, due to Covid-19, recorded in each country in a specific month. As figure 3.3 shows, the virus hits its lethality peak on April 2020 with a value of 0,065 during the first lockdown and then has been uninterruptedly decreasing.

Figure 3.3: Average mortality rate from January 2020 to April 2021

Another important element, which is not only linked to the expectations on virus' status but also to government's actions, is the introduction of vaccines. As stated in the study of *Huang and Kuan* [22], all types of vaccines can effectively prevent severe disease and thus reduce virus-related death. Mortality, then, it's a function of vaccines, making the latter capable of shaping predictions and consequentially production and trade too. Since vaccines and their administration are tasks fulfilled mainly by the government, dealing with private producers, this will make an agent of the system able to affect and possibly balance economy. The variable whose

effects will measure the agents' control over the system is Vax and it shows the number of total people vaccinated every hundred at a specific time. From their introduction, in January 2021, Vax is continuously increasing, as figure 3.4 shows.

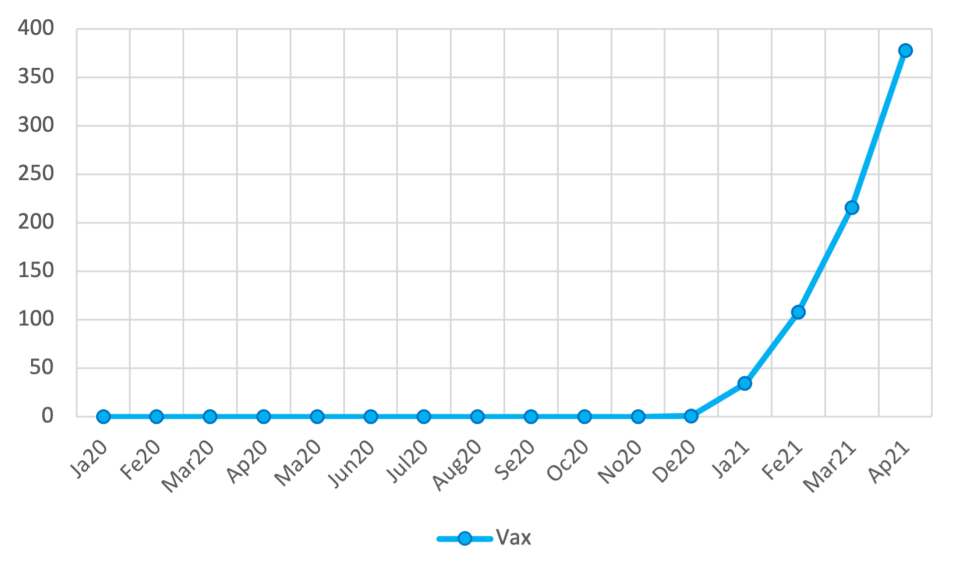

Figure 3.4: People fully vaccinated for hundred on average from January 2020 to April 2021

Looking instead to the short-run, Covid disposes of different channels trough which it can more directly affect production and trade. These mechanisms, due to their term's span, do not focus anymore on expectations but they rely on other concrete factors, like labour and capital, of which production and trade are function. Current quantity employed of these factors can only be affected by shifts in their market demand or supply; to do so, often, it is necessary an exogenous action, like the government's regulation, to shake the markets.
First of government's possibilities of action and labour related is stringency and containment; and the variable which capture the latter is called $Cont$. This measure is derived from a British study [18], which to compute it, sums the scores of nine indicators, each of which tests fields as: school, workplaces and transports closures, restrictions on gatherings, public events, internal and international mobility, and, as latest, stay-at-home and testing policies. Finally, the result obtained from the addition of these factors is rescaled to obtain a measure which goes from 1 to 100. As figure 3.5 shows, governments of the world, firstly, opted for a homogeneous line of action in April 2020 with the first lockdown, worried for the peak of mortality shown in the previous figure 3.3; then, they eased regulations in summer to let

economy breath and increased again their grip with the arrival of winter.

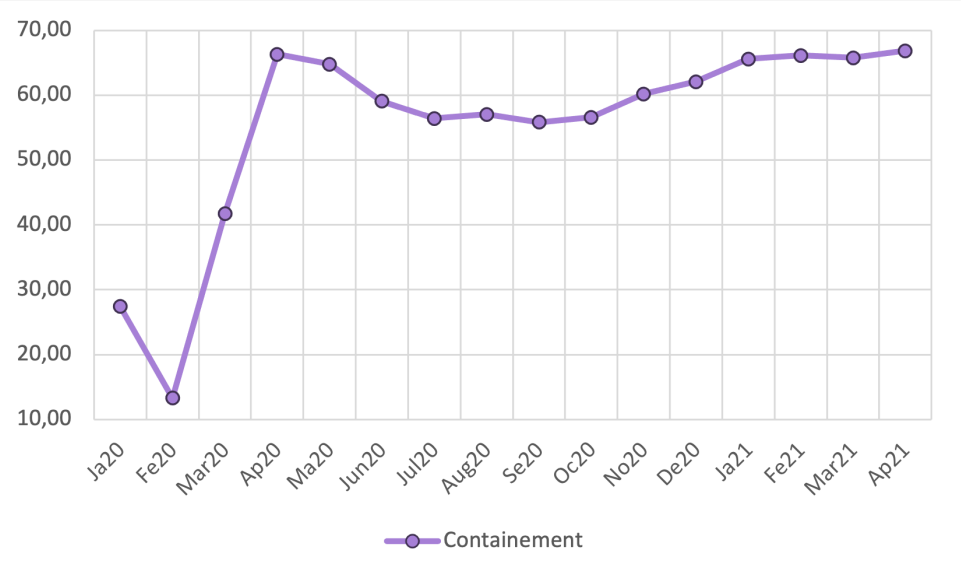

Figure 3.5: Average containment measures from January 2020 to April 2021

Last two short-term factors in government's hand which make it capable to shape trade are aids, in the forms of subsidies, and grants, as fiscal reliefs. The first of the two, is usually used by government to boost aggregate demand. This is possible since subsidies can be described as direct transfers of funds from the treasury to households and the latter will use them to consume more or the same as before, if economy has been subjected to a shrink, hence increasing consumption level and thus the aggregate expenditure. Variable which quantifies the level of aids for each country is coded as *Support*. Since subsidies are a too general matter with many possible applications, the just described variable, to proxy all of them, measures the support from government exclusively to the standard primary source of families' income, salaries. It includes three different stages of assistance, assuming integer values from 0 to 2, each of which is described by table 3.1.

Level	Meaning
0	No income support
1	Cover of less than 50% of salary lost
2	Cover of more than 50% of salary lost

Table 3.1: Income support levels

Regarding support's trend, shown in figure 3.6, governments as soon as they announced lockdown, April 2020, begun supporting households due to stay-at-home regulation being the key containment measure and, thus, taking away from agents the possibility to work and receive a wage.

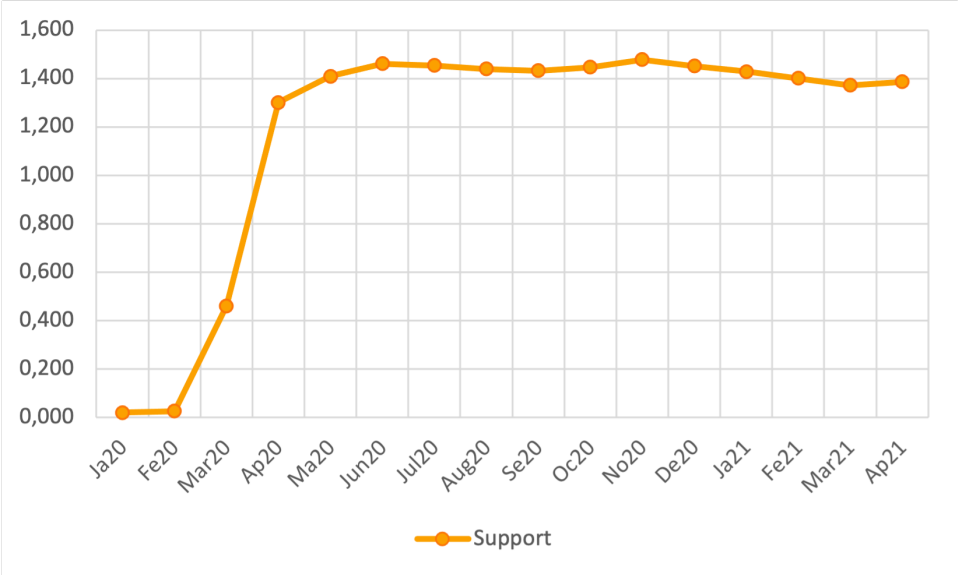

Figure 3.6: Average governments' support from January 2020 to April 2021

Finally, the second government's strategy resides in the exemptions which were granted to producers. Treatments like these decrease the weight of debts on companies' balance sheets, hence they give to them the possibility to maintain their previous levels of production, in case of a recession, or to buff them, increasing labour force or equipment, thus expanding investments and aggregate expenditure. The variable that achieves measurements of legislation of these kinds is coded as *Debt*. Given the too large diversification of relief operations, to proxy the latter the one variable focuses its attention on firms and categorizes aids, as shown in table 3.2, based on their size and their contract constraint with integer values that goes from 0 to 2.

Level	Meaning
0	No relief
1	Narrow relief and contract specific
2	Broad relief involving semi totality of contracts

Table 3.2: Debt relief levels

Since these aids sustain the production side of the economy they, as figure 3.7 confirms, increase at the same time of their demand counterpart. They began in April 2020 and immediately reached a peak, to avoid an extreme, direct and unpredictable shock hitting the economy; then, they decreased until a stabilization towards the end of the year, concluding with a new fall with the beginning of 2021.

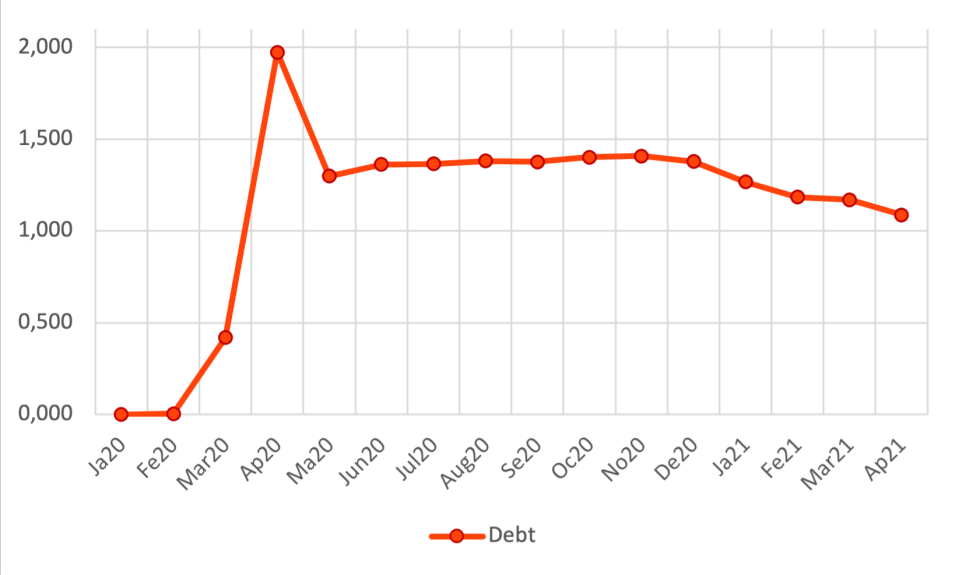

Figure 3.7: Average debt relief from January 2020 to April 2021

3.3 Regression model

For the purpose of accomplishing this research objectives, in the empirical analysis a bilateral trade gravity model is used; this has progressively become the reference methodology for analysing the causal impacts of specific variables on trade [23]. Baseline gravity equation and starting point for this analysis is the following:

$$Y_{ijt} = \alpha X_{it}^{\beta_1} X_{jt}^{\beta_2} dist_{ijt}^{\beta_3} \epsilon_{ijt} \tag{3.1}$$

Where subscripts i, j and t refer to exporter, importer country and month, respectively; moreover, Y is the dependent variable and usually represents the trade flow, α is a population constant, the Xs stand for the wealth of countries i and j, $dist$ for the distance between the two and finally ϵ is the error term. Since the level of export is reasonably a function of the size of the countries involved in the trade, to resolve this heterogeneity and have a smooth analysis from eq. 3.1, both its sides

are subjected lo logarithms. The result is a new model leveled on exporter and importer countries' dimension given by:

$$\log(Y_{ijt}) = \alpha + X_{it}\beta_1 + X_{jt}\beta_2 + dist_{ijt}\beta_3 + \epsilon_{ijt} \tag{3.2}$$

In this new model meanings of variables have not changed, what is different is the meaning of the correlated parameters, the βs, which measures the quasi-elasticity of the bilateral flow towards the Xs and $dist$.
This model can be further modified with the addition of more variables, as shown by [24] with infectious diseases and tourism flows. In this study the variables which will be added are all or partially, based on the specific regression, the ones which are described in the previous section 3.2. The potential model with the highest number of variable will be the following:

$$\log(Y_{ijt}) = \alpha + GDP_{it}\beta_1 + GDP_{jt}\beta_2 + dist_{ijt}\beta_3 + RTA_{itj}\beta_4 + Mortality_{it}\beta_5$$

$$+Mortality_{jt}\beta_6 + Vax_{it}\beta 7 + Vax_{jt}\beta_8 + Supp_{it}\beta_9 + Supp_{jt}\beta_{10} + Debt_{it}\beta_{11}$$

$$+Debt_{jt}\beta_{12} + Cont_{it}\beta_{13} + Cont_{jt}\beta_{14} + \epsilon_{ijt} \tag{3.3}$$

Last introduction in the model will be the interactions terms between both GDP and RTA and the other variables, obtaining:

$$\log(Y_{ijt}) = \alpha + GDP_{it}\beta_1 + GDP_{jt}\beta_2 + dist_{ijt}\beta_3 + RTA_{itj}\beta_4$$

$$+Mortality_{it}\beta_5 + Mortality_{jt}\beta_6 + Vax_{it}\beta 7 + Vax_{jt}\beta_8 + Supp_{it}\beta_9$$

$$+Supp_{jt}\beta_{10} + Debt_{it}\beta_{11} + Debt_{jt}\beta_{12} + Cont_{it}\beta_{13} + Cont_{jt}\beta_{14}+$$

$$+\sum GDP_t * X_t\beta + \sum RTA_t * X_t\beta + \epsilon_{ijt} \tag{3.4}$$

This model is applicable to a panel data like the one used in this paper, but due to the fact that exports and imports are functions of seasonality of goods and services and the lack of multiple observations for the same month, the error term will be extremely high for the multitude of omitted factors. For this reason the ultimate model this study resorts, focuses its attention on two periods only, with t which can now assume as values only 1 or 2, which are any month and its respective the next year. The month which is taken into consideration is April due to the mortality peak, higher level of confinements and aids, and the absence of vaccines in April 2020. The remaining unobserved factors will be controlled too due to the model being substantially a "Before and After" regression model, since its logarithm nature.

This model is estimated trough Fixed Effects "FE" estimators, and in its full potential extended version will appear like the following:

$$\log(Y_{ijt}) = \alpha + Mortality_{it}\beta_1 + Mortality_{jt}\beta_2 + Vax_{it}\beta 3 + Vax_{jt}\beta_4 + Avg\_supp_{it}\beta_5$$

$$Avg\_supp_{it}\beta_5 + Avg\_supp_{jt}\beta_6 + Avg\_debt_{it}\beta_7 + Avg\_debt_{jt}\beta_8 + Avg\_cont_{it}\beta_9 +$$

$$Avg\_cont_{jt}\beta_{10} + \sum GDP_t * X_t\beta + \sum RTA_t * X_t\beta + \epsilon_{ijt} \tag{3.5}$$

In the last eq. 3.5, since variables like GDP, RTA and $dist$, due to their categorization feature are reasonably constant in the short run, their parameter will be equal to 0, hence they are omitted. Other noteworthy changes are in the remaining variables since they're accompanied by Avg; this because, since the analysis is conducted only on two periods and policies' results are subjected to lags in their achievements or are based on a medium-long term, it would be more significant to measure the average intensity of these in the previous periods. For this last reason the variables which appear in the final model measure the average level of the relative policy between the specific month and all the past ones until its corresponding in the previous year.

Chapter 4

Results

4.1 Effects by Covid-19 lethality

After having given details on the procedures conducted, the analysis' results follow. First, it comes the estimation of the effect of the virus mortality on trade volumes, from both importer and exporter sides. To do this, a model similar to the one described in eq. (3.5) it's used, but with only two variables measuring the ratio between deaths and cases in the two countries involved. What is obtained is shown in column 1 of table 4.1 and confirms what hypothesized in subsection 3.2.3: the mortality rate is negatively related to bilateral exports. The coefficients associated to the variables are statistically significant and extremely large since, due to them being fractions, what is illustrated is the effect of an increase of mortality rate by 100%, which is very unrealistic. The main reason for the sign of this relationship is the fact that, what at the beginning shocked and scared more public opinion, defining the virus threat level, was its high kill counter linked to the relatively poor cases. When people started to acknowledge the potential danger represented by Covid-19, families stopped their consumption due to pessimistic expectations and stringency measures. From the other side, firms, predicting a fall in their revenues, blocked investments and tried to cut costs, which are mainly job places. Lastly, even earlier than any form of aid, governments started lockdown measures to restrict number of victims, stressing even more the upcoming downturn of trade and economy. All these factors are positive functions of mortality rate and affect negatively trade, explaining the sign of the coefficients reported in the first column. The analysis on mortality continues in the next two columns, where the results regarding two more regressions are illustrated: the first, in column 2, which includes the interaction terms with the income-level of the countries involved in bilateral trade, and the other, column 3, that to these ones adds the interaction terms with the possibility of that flow being in a RTA.

Starting with the second column, the coefficient associated with mortality from importer's side is increased in size, and only the respective positive interaction term with income-level is statistically significant. This implies that if a developed country is involved in bilateral trade as importer, the flow is less negatively affected by a change in the mortality rate. A possible explanation to this is the fact that since, usually, developed countries have an economy specialized in services or industrial refinement and poor supplies of raw materials and energy, they cannot find and deprive themselves of these fundamental factors for their activity, indeed they still purchase them, even with a moderate worsening of expectations.
Finally in column 3, the new factors added are not statistically significant and the only relevant difference from column 2 is a positive small change in the coefficient of the interaction between mortality rate and income of importer. The change is attributed to the fact that countries with high income-levels often are part of regional agreements; instead, the insignificance of interaction terms with RTA means that effects of mortality of the virus are homogeneous among couples of countries subjected to RTA and couples which are not.

	(1)	(2)	(3)
	log_exp	log_exp	log_exp
mortality_rate_A	-3.359***	-3.746***	-3.578***
	(-14.08)	(-3.62)	(-3.39)
mortality_rate_B	-4.452***	-9.922***	-10.16***
	(-15.54)	(-10.03)	(-10.03)
mortality_rate_GDP_A		0.658	0.865
		(0.63)	(0.80)
mortality_rate_GDP_B		5.984***	6.157***
		(5.92)	(5.97)
mortality_rate_RTA_A			-0.753
			(-1.51)
mortality_rate_RTA_B			0.244
			(0.42)
_cons	3.530***	3.684***	3.686***
	(245.74)	(117.59)	(115.64)
N	4900	4900	4900

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.1: Effects of mortality on trade

Other factors which, according to the already cited [22], are related to Covid-19 lethality and can reasonably affect agents' expectations are vaccines and their distribution.
The effects of these instruments are shown in table 4.2. The first column shows the results regarding a simple regression which includes only the number of people fully vaccinated per hundred in importer and exporter countries, namely Vax_A and Vax_B. Both their coefficients are statistically significant and positive; on average, one more person vaccinated on hundred in one of the two trade parts will improve volumes by 1% to 1.5%. Reasons to this effect are the following: more people are vaccinated, more workers can be employed again in labor force and thus in production or services, the resulting goods and agents can be devoted to trade; moreover, the more vaccinated people, the lower the death-cases ratio will be, implying a relax of public opinion and an increase of expectations with their following effects on production and trade.
The second column represents the results regarding the model of column 1 with interaction terms between vaccines' effect and income-levels as additions. Among the coefficients related to the new terms, again, only the one from the importer's side is statistically significant and negative. This implies that, if a country is well developed and it's an importer in the trade flow considered, the latter will benefit less from the vaccines' effect. Reason to this can be attributed to the nature of the products of high-income level countries: they offer mainly services and these can be usually offered in a virtual way; hence, due to this smart-working feature, a fraction of imported products of these countries will be unaffected by vaccines.
The third column figures the results of a more complete regression model which includes, as new entries, interaction terms between vaccines and the variable RTA. None of the added terms is statistically significant, meaning that the effect of vaccines in bilateral trade flow is independent from the two countries involved being part of a regional agreement. The other two variables related to importers are the only ones subjected to a change: a minimum increase in size, which is so small that the relationship between vaccines' effects, income-level and regional agreements can be considered irrelevant.
In conclusion, vaccines and mortality have opposite effects: the first increases bilateral trade and the second lowers it; this mirror can be found even in the way in which they affect imports based on countries' income level, with developing countries being less protected from virus lethality and benefiting less from vaccines.

	(1)	(2)	(3)
	log_exp	log_exp	log_exp
vaxA	0.0114***	0.00881***	0.00811**
	(5.41)	(3.21)	(2.11)
vaxB	0.0143***	0.0190***	0.0192***
	(12.10)	(6.69)	(6.04)
vax_gdp_A		0.00308	0.00330
		(0.86)	(0.86)
vax_gdp_B		-0.00562*	-0.00573*
		(-1.86)	(-1.89)
vax_RTA_A			0.00122
			(0.26)
vax_RTA_B			-0.000486
			(-0.20)
_cons	3.079***	3.079***	3.079***
	(414.28)	(420.10)	(428.44)
N	4900	4900	4900

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4.2: Effects of vaccines on trade

4.2 Effects by governments' policies

After having analyzed the effects of factors related to Covid-19 lethality, the description of the outcomes of fiscal policies and regulations elaborated by governments follows.
First studied governments' manoeuvre consists of containment measures; these are represented by the variables $Cont\_A$ and $Cont\_B$ which, as explained in subsection 3.2.3, are indexes, from 1 to 100, made by the sum of indicators which control for restrictions on average mobility, and closure of companies and institutions.
For the estimation of the effects of these two variables, four regression models, which include gradually more and more interactions terms, have been constructed. Their results are captured in columns of the following table 4.3:

	(1)	(2)	(3)	(4)
	log_exp	log_exp	log_exp	log_exp
vaxA	0.00453**	0.00414*	0.00410*	-0.0102**
	(2.02)	(1.83)	(1.80)	(-2.26)
vaxB	0.00766***	0.00742***	0.00739***	-0.00369
	(6.15)	(5.94)	(5.96)	(-1.00)
average_contA	-0.00635***	-0.00704***	-0.00675***	-0.0112***
	(-6.92)	(-4.45)	(-3.81)	(-5.54)
average_contB	-0.00871***	-0.0152***	-0.0153***	-0.0185***
	(-9.11)	(-8.99)	(-8.10)	(-8.58)
average_cont_gdp_A		0.00136	0.00142	0.00644***
		(0.87)	(0.88)	(3.37)
average_cont_gdp_B		0.00848***	0.00854***	0.0124***
		(4.64)	(4.61)	(5.41)
average_cont_RTA_A			-0.000808	-0.00106
			(-0.52)	(-0.59)
average_cont_RTA_B			0.000190	-0.0000967
			(0.10)	(-0.05)
vax_gdp_A				0.0153***
				(3.31)
vax_gdp_B				0.0120***
				(3.29)
vax_RTA_A				0.00192
				(0.38)
vax_RTA_B				0.000548
				(0.22)
_cons	4.233***	4.299***	4.299***	4.457***
	(51.34)	(50.80)	(50.72)	(53.16)
N	4900	4900	4900	4900

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4.3: Effects of containment measures on trade

Column 1 shows the results regarding a simple model in which the only used variables of interest are the number of vaccinated for hundred and the stringency measures. All the coefficients are statistically significant. The ones related to vaccines are still positive, instead the ones for containment are negative. This implies that the stronger a government's grip is, the lower will be the volume of trade. A possible explanation to this can be the fact that more workers are restrained at home and more firms are physically forced to close or voluntary decide to stop their activities for a lack of customers; this will generate a loss in production and in consumption's needs, producing consequently a fall in both economy and trade.

Column 2 describes what is achieved adding to the previous model terms which differentiate effects of goverenement's limitations based on income level. These differences are highlighted by the interaction terms added, among which only the

one related to the importer is significant. This means that developed countries' economy is more robust against sudden shocks in foreign supply of goods and services. Reason to this can be, again, the nature of rich countries' economies, which, focusing on services, achieves a higher grade of flexibility making workers, in a moderate range of cases, able to work even if forced to stay at home.
Column 3 represents the coefficients related to a model which has as main new feature the introduction of interaction terms with RTA. Both the two new factors' parameters are statistically insignificant meaning that stringency effects are not a function of their combination with the existence of regional agreements between countries. All the other factors maintain their characteristics and are practically unchanged.
Column 4 illustrates the final model including interaction terms for the people fully vaccinated. Changes from the previous column include the presence of three new significant coefficients: the two regarding the relation between vaccines and income level and, lastly, the one related to the link between income of the exporter and governments' constraints. Implications of the latter can be explained by similar reasons used to describe their importer counterpart previously; since a more robust economy can, not only limit provisions from foreign countries but even maintain more stable levels of production, less losses are described in exports and an overall more positive trade balance is recorded.
The following government's policy to analyze is the economic support devolved to households in the form of subsidies. These aids are measured by the variables *Support_A* and *Support_B*, and the estimations of the effects of the latter are collected in table **??**. The table still presents four columns, each of which is associated with a different regression model, and the variables deployed are the rows' entries.
Looking at column 1, a positive relationship is confirmed between vaccines and trade, and its sign is extended even to the correlation between bilateral flow and government's aids. All four coefficients are statistically significant. A possible justification for the last two coefficients is that, when countries sustain families, like in this case, covering partially or totally their main income's source, two goals are achieved: first, an increase of households' budget that improves or restore their consumption level; and second, more optimistic agents' expectations if subsidies are announced to be constant in the medium-term.
The new results obtained thanks to the addition of interaction terms, at first only with income and then even with RTA, are illustrated in columns 2 and 3. Only one of the new interaction terms is statistically significant in both models and it is the one which differentiates the effect of government's support according to the income level of the importer. Its related coefficients are both negative, implying how wage aids are less impactful in developed countries than in low-income ones. This is a result of two factors: rich countries' salary purchasing power which is far superior

than the average of rest of the world and to the benchmark level which suggests a respectable life; and secondly, the higher savings average level of households in high-income countries which makes families more prepared in cases of short-run economy's disruptions, leading to the existence of sufficient cushion sources and limiting imports. The other coefficients are insignificant, implying a homogeneity of aids' efficiency towards countries being part of RTA or not.
Lastly, according to the results of column 4, vaccines are confirmed to be less effective if country's GDP per capita is high for the reasons just cited; moreover, the fact that people will direct, in case of a sudden economy shock, their funds to the consumption of already existent products, explains the significant and positive coefficient of the interaction term from exporter's side between support and GDP.

	(1)	(2)	(3)	(4)
	log_exp	log_exp	log_exp	log_exp
vaxA	0.00973***	0.00963***	0.00944***	0.00637
	(4.39)	(4.30)	(4.27)	(1.64)
vaxB	0.0116***	0.0117***	0.0115***	0.0170***
	(9.95)	(9.95)	(9.83)	(5.32)
average_supportA	0.157***	0.161***	0.143***	0.143***
	(8.28)	(5.05)	(4.36)	(4.27)
average_supportB	0.113***	0.175***	0.155***	0.150***
	(5.45)	(4.27)	(3.54)	(3.37)
average_support_gdp_A		-0.00769	-0.0168	-0.0226
		(-0.21)	(-0.45)	(-0.59)
average_support_gdp_B		-0.0863**	-0.0953**	-0.0885**
		(-2.02)	(-2.28)	(-2.11)
average_support_RTA_A			0.0606	0.0766**
			(1.51)	(1.98)
average_support_RTA_B			0.0670*	0.0702*
			(1.80)	(1.74)
vax_gdp_A				0.00394
				(1.03)
vax_gdp_B				-0.00507*
				(-1.69)
vax_RTA_A				-0.000254
				(-0.05)
vax_RTA_B				-0.00316
				(-1.39)
_cons	2.776***	2.769***	2.775***	2.773***
	(103.64)	(100.46)	(100.89)	(101.52)
N	4900	4900	4900	4900

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Final instrument at government disposal regards the production side of the market and consists in direct aids to firms. It is represented by the variables

Debt_A and *Debt_B* which capture the size and specification of the debt reliefs lent by government to companies. To estimate their effects, 4 models have been built and the results obtained from them are captured by the the table 4.4 which uses models' indicators as columns and variables' codes as entries for the rows.

	(1)	(2)	(3)	(4)
	log_exp	log_exp	log_exp	log_exp
vaxA	0.0113***	0.0112***	0.0112***	0.00804**
	(5.33)	(5.29)	(5.31)	(2.12)
vaxB	0.0148***	0.0147***	0.0147***	0.0203***
	(12.25)	(12.18)	(12.14)	(6.38)
average_debtA	0.0548***	0.0956***	0.101***	0.0989***
	(3.16)	(3.22)	(3.26)	(3.24)
average_debtB	0.0949***	0.138***	0.135***	0.145***
	(4.98)	(4.16)	(3.92)	(4.17)
average_debt_gdp_A		-0.0636*	-0.0591	-0.0546
		(-1.72)	(-1.56)	(-1.45)
average_debt_gdp_B		-0.0671*	-0.0691*	-0.0844**
		(-1.68)	(-1.71)	(-2.07)
average_debt_RTA_A			-0.0216	-0.0245
			(-0.56)	(-0.67)
average_debt_RTA_B			0.00887	0.0198
			(0.22)	(0.49)
vax_gdp_A				0.00275
				(0.72)
vax_gdp_B				-0.00710**
				(-2.37)
vax_RTA_A				0.00163
				(0.36)
vax_RTA_B				0.000803
				(0.33)
_cons	2.922***	2.921***	2.921***	2.918***
	(106.32)	(106.56)	(106.50)	(107.07)
N	4900	4900	4900	4900

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4.4: Effects of debt reliefs on trade

The results offered by column 1 are pretty clear: the number of vaccinated is still significant and helps economy; the addition, in the first case, is represented by the coefficients correlated to the freeze of debts of which companies are grantee. These two coefficients are positive and statistically significant, even if lower in size in comparison with the ones capturing subsidies' effects. The reason is double: having their debt blocked, companies can bear all their costs and so their job places, thus they are able to maintain their production level and continue their possible

export activity; additionally, with lower interest expenses, if these conditions are held in the medium-run, expectations go up and firms become more trustworthy borrowers improving investments. Looking at columns 2 and 3, an heterogeneity of debt reliefs' effects in high-income countries arises, in the case of those being both importer and exporter. These government's actions are less effective in developed countries for reasons very similar to the subsidies' case: firms in these countries are usually characterized by a higher capital which can be used as a cushion against sudden turns of the economy, letting companies maintain their production and export levels and to not import any other source. Regarding the link between freezing of expenses and being part of an RTA, this does not seem to provide any additional effect due the insignificance of the respective coefficients.
Finally, column 4 shows how including interaction terms for the vaccines' variable confirms their heterogeneity towards the income-level of the importer, since among them the latter is the only one statistically significant.

4.3 Potential issues

It's fair to cite the main issues that could have affected the results presented above.
First, having based the model on the comparison of only two months distant one year, no matter how these months were the ones when the shock was at its peak and the variable used are yearly averages of the original indicators, this can lead to some errors in the estimation.
Second, the fact that some variables, like the one capturing GDP per capita, are binary makes them fail to measure and count in the process the monthly changes to which they could be subjected, causing some inaccuracies in the process.
Third, despite the indicators used are good proxies, they can eventually not be able to measure more general effects regarding the entire economic system.
Finally, even if the sample is based on a multitude of countries and one year as time span, many more countries can be involved and, when the data will be accessible, measures can be taken over a longer time horizon.

Chapter 5

Conclusion

In this study, light was shed on how the current Covid crisis legislation affects trade flows for the world economy during the first waves of the pandemic.
Using an augmented gravity model with fixed effects controlling factors like distance, income levels, regional trade agreements and other unobserved constant variables, some clear and interesting results have been generated.
Keys in international trade and global economy are trust and expectations; and the feature of the virus which could more undermine agents' previsions was its lethality. As proof of the fact that lethality was the main indicator for menace level of the virus and principal source of instability for people's expectations, it has been found a negative relationship between the mortality rate of Covid and volumes of bilateral trade flows. Another factor analyzed correlated both with deaths-cases ratio and expectations were vaccines. The results found in this analysis show how an increase in vaccinated people implies a percentage improvement in international trade. These findings confirm a positive effect of vaccines' efficacy and distribution on agents' previsions, thanks to them improving overall mobility and decreasing mortality rate.
Other main factors which affect trade are international supply and demand. In this analysis three tools in the hands of governments able to affect these trade decisors were observed.
First, after having analyzed the effects of what are called lockdown, namely diffuse closures and constraints on mobility, it has been found a negative relationship between the intensity of government's grip and the volumes of trade, with high-income countries being hit less by the containment. Possible reason to this is that, the more workers are at home, the more production and consumption are stressed since the main source of income lacks; developed countries can partially counter this phenomena trough the introduction of smart-working.
Second, the focus passed to the effects of direct aids provided by government, like subsidies to households. The higher was the size of these aids and the higher was

the increase in the volumes of trade flows from one year to the other, even if they were more effective in developing countries. Explanation to this is that if families' income tend to grow or be stable, the same feature is extended to consumption and investments, hence to trade and global economy; developed countries benefited less from these aids since their citizen had already enough savings to fill the income gaps created by Covid shocks.
Finally, this paper's analysis looks to the support of governments to the production and supply side of the economy. Support is represented by the debt relief granted to companies. Result of a higher freezing of debt expenses was the increase of international trade, with low-income countries exploiting more this opportunity. The principal cause to this outcome is the fact that the lower is debt's weight on firms' capital, in the medium-run, the more they can be seen as trustworthy borrowers boosting investments. In conclusion, factor which decreases the extent of this governments' action in developed countries is the average higher capital of their companies, which alone makes them more robust towards sudden economy's downturns.

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