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Distance Vs Digitalisation

The Effect on International Trade During Covid-19 Pandemic

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Table of Contents

1. INTRODUCTION

In the past year the world community has been hit by a totally unexpected event. Citizens all over the globe have found themselves fighting with an unknown enemy, Covid-19 virus.
A succession of cases, deaths, lockdown orders, restrictive measures have characterized the past months.
According to the sources, the first confirmed case with symptoms was recovered in Wuhan on the 1st of December 2019. From that moment onwards, the diffusion commenced, initially recording cases in the various Chinese provinces and shortly afterwards across the globe.

Asian countries, right after China, have been the first ones facing the pandemic and therefore implementing those restrictive measures that were initially misunderstood by the public opinion.
With the benefit of hindsight, those restrictions no longer seem so exaggerated. Indeed, countries such as Vietnam, Taiwan, or Singapore represent experiences of admirable responses to the pandemic in the sense that these countries succeeded in gradually recovering not only from a medical viewpoint but also economically.

The unpredictability and severity of the event has inevitably impacted the world economic system as it represented a tremendous shock simultaneously on the demand and supply side therefore affecting trade both within countries and internationally.

Events like these, albeit of different magnitudes, are often studied by economics researchers through the use of a model that is inspired by Newton's gravitational law, namely the gravity model of trade. These, starting from its first formulation by Tinbergen (1962), has found numerous applications in the study of the effect of particular factors and / or events that affect trade between countries.

Many studies deal with groups of countries, such as the one conducted by Nitsch (2000) in his investigation of the effect of natural borders on intra-European trade levels or the work by Wilson et al. (2003), differently focused on the APEC countries or again with that of Egger (2004), which studies the effect of trade blocks from 1986 to 1997 on the OECD countries.

More recently, the applications of the gravity model that took into account Asian countries have also increased, see Anamane Al-Kharusa (2003) for trade between Brunei and the EU, Filippini and Molini (2003) 's work dealing with east Asian trade flows, Robers (2004) on the FTA between China and ASEAN countries and Thorpe and Zhang (2005) focusing on East Asian economies intra-industry trade.

However, there are still few studies specific to individual Asian countries, despite the fact that today they represent perhaps the most suitable subjects for this type of analysis, especially if we consider the development that many of these have experienced in recent decades. As I explain in the dedicated section, Vietnam is certainly an exemplary country from this point of view, that in my opinion offers various points of analysis.

For this study, my intent was to focus on the progress of its bilateral exchanges over the past two years. The choice of this nation was prompted precisely by the fact that, even in the response to the virus, Vietnam, despite its proximity to China and therefore the greater risk of total disruption compared to other countries, stood out for its exemplary conduct, leading the population out of the state of emergency in a relatively very short time.

The remainder of the paper is structured as follows: Chapter 2 provides a literature overview on the theory of the gravity model of trade. Chapter 3 focuses on the issue of “Distance Puzzle” in gravity model applications and specifically on distance impact during the Era of Digitalization. Subsequently, in Chapter 4 I have attempted to provide a description of the dynamics of global trade during Covid-19 pandemic while Chapter 5 follows with an overview on Vietnam and an empirical analysis of the country’s trade flows during the period 2019-2020. Chapter 6 concludes the paper.

2. THE GRAVITY MODEL

The analysis and modelling of trade flows is a widely discussed subject in the field of international economics and insofar a whole literature providing insights on the topic has been produced.

2.1 Historical Background

Many years before the first mathematical formulation of the gravity model, different authors and scholars were already intuitively capturing and starting to describe the relationship of trade flows between distant locations and their "weight" in terms of development and production, as well as the negative contribution of distance to the efficiency of these trade flows. In 1885, Ravenstein, in explaining the phenomenon of migrations, stated that their driving factor was the "absorption of centers of commerce and industry" with distance representing the obstacle. (1885, pp. 198–99)

In the first half of the twentieth century, an additional contribution to the birth of the gravity equation of trade has to be attributed to those scholars such as Ohlin, Weber, Furlan, Engländer, Predöl and Lösch, that firstly challenged the established classic trade model. On the basis of their experience, Isard and Peck (1954) provided empirical proof to the increasingly popular belief of the negative impact of geographical distance to both domestic and international transports, although exploiting the similarity with the physics topic of electric potential instead of Newton's gravity equation.

Without obscuring the undeniable contribution of these previous pieces of literature, the paternity of the first mathematical formulation of the gravity model of trade is attributed to Jan Tinbergen, who firstly published a gravity model with empirical application in 1962 in his Shaping The World Economy (Tinbergen, 1962) while the 1966's PhD thesis of Linnemann, that he supervised, has become the main reference to the early version of the model (1966).
Working on an analysis of the global economy, Jan Tinbergen posed the question: "For which countries do we actually find much less trade than an optimum division of labour would suggest?"

However, in order to answer his question, it was necessary to solve an intermediate step. What can be identified as the right benchmark for "optimum" trade? Tinbergen argued that the most significant determinants of optimum trade were the size of the two countries forming each pair, and the geographic separation between them. (Tinbergen, 1962)

The economist borrowed Newton's Law of Universal Gravitation to explain the dynamics of trade among countries. As particles are attracted to each other thanks to a force that is directly proportional to the product of their masses and inversely to the square of their distance, countries trade depends on their respective market size and the level of proximity (Beverelli, 2017)

In economic terms, in the very early introduction of the model countries' GDPs are the counterpart of planets' sizes while proximity is identified as geographical distance. The farther the locations, the less the trade possibilities because of the increasing trade costs.

Although lacking of solid theoretical foundation, the adoption and analysis of the gravity model increased tremendously in the years after its first appearance, to the extent that it is now widely recognized as a significant development of previous trade models, which did not consider either the size of countries or the distance between them as crucial factors.

In particular, the Ricardian model, explaining trade flows dynamics in terms of differences in countries' technologies (Deardoff, 2007) and the Heckscher-Ohlin model, differently focused on the divergencies between countries with respect to factor endowments (Hechscher, Ohlin, Flam, Flanders, 1991).

Newton's Law of Universal Gravitation:

$$F_{ij} = \gamma W_i W_j d_{ij}^{-2},$$

where: F_{ij} is the force between objects i and j. W_i is the mass of object i. W_j is the mass of object j. d_{ij} is the distance between i and j. γ is the gravitational constant (= 6.647 × 10−11N · m2/kg 2).

Tinbergen's "Gravity Equation" in the basic form:

$$M_{ij} = \beta_0 Y_i^{\beta_1} \beta_1 Y_j^{\beta_2} d_{ij}^{\beta_3},$$

Where M_{ij} is the dollar value of trade flows between countries i and j. Y_i is the dollar value of GDP in country i. Y_j is the dollar value of GDP in country j. d_{ij} is the distance between i and j (capital cities, km). β_0, β_1, β_2, β_3 are unknown.
The unknown parameters are generally estimated using a least-squares regression:

$$ln\, M_{ij} = ln\beta_0 + \beta_1 ln\, Y_i + \beta_2 ln\, Y_j + \beta_3 lnd_{ij} + e_{ij}$$

As previously mentioned, in producing this equation, Tinbergen was arguing that the value of trade could be shaped by forces of supply, demand and barriers to international trade.

Indeed, his regression over a sample of 18 countries for the year 1958, supported his intuition. Specifically, the estimated value of coefficients showed that countries trade more with "larger" and closer destinations.

Despite the positive results of Tinbergen's regression and the subsequent attempts of Linnemann (1966), Pöyhönen (1963) and Pulliainen (1963) to provide micro-economic foundation to the model, the majority of academics, among whom Leamer and Levinsohn (1995), continued to consider it is a merely descriptive model of dubious theoretical solidity.
Furthermore, authors such as Deardoff (1998) were concerned by the fact that, paradoxically, the model was consistent with too many established models as mentioned above.

On the other hand, this compatibility with earlier trade models boosted its popularity among a group of academics in the years 1970s and 1980s, who found it convenient in terms of the theoretical limits of the scope of their works.

Beside the academic environment, the gravity method caught the interest of policy makers, particularly in the early and mid 1990s, when the model was widely adopted by policy institutions to analyse and understand the impact of substantial events on the dynamics of international trade.
In the last twenty years, the fundamental contributions by Anderson and Bergstrand in the attempt of enriching the model of theoretical basis and that will be analysed in the following chapter, has renewed the interest in the topic and further incremented its exploitation as analysis tool not only in economics but also for other research fields.

Figure 1. Comparison between Newton's Law of Gravitation and Gravity Trade Model.

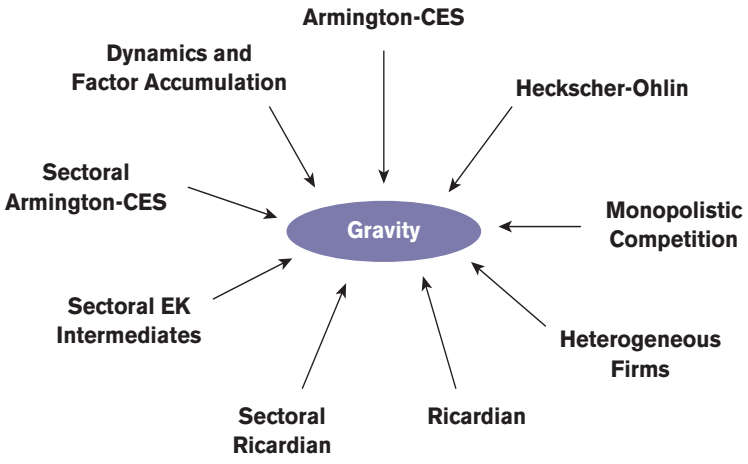
Newton's Law of Universal Gravitation	*Gravity Trade Model*
$F_{ij} = G\frac{M_i M_j}{D_{ij}^2}$	$X_{ij} = \tilde{G}\frac{Y_i E_j}{T_{ij}^{\theta}}$
where:	where:
– F_{ij}: gravitational force between objects *i* and *j* – G: gravitational constant – M_i: object *i*'s mass – M_j: object *j*'s mass – D_{ij}: distance between objects *i* and *j*	– X_{ij}: exports from countries *i* and *j* – $\tilde{G}$: inverse of world production $\tilde{G} \equiv 1/Y$ – Y_i: country *i*'s domestic production – E_j: country *j*'s aggregate expenditure – T_{ij}^{θ}: total trade costs between countries *i* and *j* $T_{ij}^{\theta} \equiv \left(t_{ij}/\left(\Pi_i P_j\right)\right)^{\sigma-1}$

Source: UNCTAD/WTO (2016)

2.2 Theoretical Foundation

The previous section suggested us that Tinbergen's intuition in exploiting existing and established physics laws as the Newton's law of gravity to explain economic phenomena, has found enormous interest among scholars. The increased popularity therefore led many academics to elaborate an adequate theoretical basis to the model, in order to recognize its significance and justify its many applications.

Figure 2. Theoretical Foundations for Gravity model.



Source: UNCTAD/WTO (2016)

The first relevant micro-foundation contribution was elaborated by Anderson (1979), who tried to fit gravity model within a cross-country utility maximization problem, where the share of income that each country spends on traded goods depends on income and population in each country. He indeed concluded that a country's imports from a partner country could be expressed as:

$T_{ij} = s_i a_j GDP_j$ with equilibrium condition implying $a_i GDP = s \sum_J a_j \times GDP_j$,

By substituting, the bilateral trade equation becomes $T_{ij} = a_i GDP_i a_j GDP_j / \sum_i \sum_j T_{ij}$

Where $\sum_i \sum_j T_{ij} = \sum_j a_j GDP_j$

However, Anderson did not take into account trade barriers, population differences in demand structures and price discrimination.

Deeper examinations were produced by Bergstrand (1985, 1989, 1990), who included importer and exporter countries' income as indicators for demand and supply conditions together with distance coefficient as a proxy for costs of transport as critical variables in the relationship between trade theory and bilateral trade.

Anyway, both authors' works contributed to the main reference in the gravity literature, represented by Anderson and van Wincoop (2003) paper, which introduced a method to deal with the challenging price index.

The method starts with a supply-demand setting that equates the value of country *i's* trade flow with the share of country *j's* expenditure in country *i*. It follows using a CES preferences demand function to derive an expression for share of imported goods in country *j* expenditure, which depends on the two countries' prices relative to a price index, associated with the CES demand structure. Subsequently, bilateral trade costs are included and, since the equation deals with total trade, all goods varieties are aggregated, which implies by budget constraint conditions that total production of country *i*, Y_i, equals the total amount of country *i* sales to all destination countries, including *i.*

The resulting gravity equation is of the form $T_{ij} = Y_i E_j \left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma}$ in the version given by the six steps revisited method by Baldwin and Taglioni (2006), which differs from Anderson and Wincoop (2003) in the price indices P and the multilateral resistance terms Π.

2.3 Main Challenges Of The Model

Van Bergeijk and Brakman (2010), in introducing their overview of the most relevant publications on the gravity model, identify four critical topics that cannot be neglected when conducting gravity empirical studies.

1. *Multilateral resistance terms* The difficulty lies in the fact that this factor depends both on trade costs and on multilateral resistance terms themselves, therefore causing a circular dependence in the estimation. The most relevant attempts of solutions in the literature suggest to include fixed effects as an approximation for multilateral resistance terms (Rose and van Wincoop, 2001), and convert the non-linear problem into a linearized model to solve analytically (Straathof, 2008)

2. *Zero bilateral trade flows* Missing observations, rounding errors or real zero bilateral trade flows can cause biases in the estimations, such as the ones discovered by Helpman et al. (2008) in observing a 50 per cent lack of trade among the 158 countries' sample. To counter the issue, the standard procedure introduced by Linnemann (1966) consists in the simple drop of all zeros or in the addition of a constant to all trade flows, a step that enables log-linear estimations. In the work of Santos Silva and Tenreyro (2006) both alternatives are applied. However, biases may persist when the zero values are not random. In these circumstances, Helpman et al. (2008) suggested a rationalization of the zero trade flows, adjusting for countries' probabilities to trade.

3. *Distance measurements* In the traditional form of the model, distance stands as the approximation for trade costs, together with additional dummies indicating common borders and other possible factors facilitating trade processes. However, researchers such as Combes and Lafourcade (2005) show the possible inadequacy of distance as measure of transport costs. The impact of distance on trade has been widely discussed to the extent that

a series of papers have started commenting on the *Distance Puzzle* (Buch, 2003) in particular after the publication by Disdier and Head (2008). In contrast to the widely shared opinion of a declining influence of the distance factor over time, the authors reported an increasing impact on international trade flows during the second half of the twentieth century. I will further examine the role of distance in the following section.

4. *Micro-data and product groups* the gravity model has hardly been applied at disaggregated level for many reasons, such as the limited availability of data. However, disaggregated analysis is recommended in terms of better clarifications of firms' conducts and adjustments to distance related measurement issues. Progresses in this way have been made since the turn of the century, for example with the analysis of international patterns of heterogeneous firms (Melitz, 2003). In addition, Buch et al. (2003) and Hilberry and Hummels (2008) both studied the negative relationship between distance and the number of products, firms and investment relations. Nevertheless, the application of disaggregated analysis requires deeper investigations.

2.4 Estimating The Gravity Equation

Now that the main challenges have been listed, the following step is to understand the methodology to estimate the gravity equation. We will see that the model has witnessed many adjustments, precisely because of the issues that might arise during the estimation phase.

First of all, in order to run a regression, growth accounting is applied to generate a log-linearized version, assuming validity of the equation over each period and adding error term at the end of the regression.

$$lnX_{ij,t} = lnE_{j,t} + lnY_{i,t} - lnY_t + (1-\sigma)lnt_{ij,t} - (1-\sigma)lnP_{j,t} - (1-\sigma)ln\Pi_{i,t} + \varepsilon_{ij,t}$$

This is the most popular specification for the empirical gravity equation because it allows to study the effects on trade of many factors - of course in addition to those essential ones that are countries' GDPs and geographical distance - at the same time, such as the presence of trade blocks, RTAs, exchange rates, population etc.

However, perhaps precisely because of the large variety of effects that researchers wished to study exploiting gravity method, quite a few estimation issues have arisen throughout the years, for each of which academics have proposed solutions that Yotov, Piermartini, Monteiro and Larch (2016) explains accurately and lists as the following:

1. The introduction of fixed effects estimation either directional for cross-section data (Hummels, 2001), or importer-time and exporter-time for panel data (Yotov, 2012) to avoid the *Gold Medal Mistake* (Baldwin and Taglioni, 2006), that is the lack of control for multilateral resistance term.

2. The application of Poisson Pseudo Maximum Likelihood (PPML) estimator to estimate the gravity model in multiplicative form to eliminate zero trade flows and heteroscedasticity of trade data, as advocated by Santos Silva and Tenreyro (2006).

3. To prefer panel data, whenever available, in order to apply pair-fixed-effects method and solve the issue of endogeneity of trade policy variables (Baier and Bergstrand, 2007).

4. To include both international and intra-national trade flows data in the estimation to better understand the impact of distance (Yotov, 2012), globalization and RTAs (Bergstrand et al., 2015) as well as bilateral (Dai et al., 2014) and non-discriminatory (Heid et al., 2015) trade policies on trade.

3. DISTANCE IN GRAVITY

Up until this point the main challenges posed by the gravity model have been presented. As anticipated in the introduction, this work will further investigate the theme of distance by firstly reviewing the most relevant papers that have treated the topic with their related conclusions and will follow with an empirical application of the model in the attempt of analysing the distance effect in a time of exceptional circumstances such as the ones caused by the Covid-19 pandemic.

3.1 The Distance Puzzle

In spite of its strength in terms of applicability which has brought many authors to adopt the model, outstanding questions regarding gravity capabilities to explain the effects of globalization on international trade have remained uncovered for long.

What economists have been trying to find evidence for so far is whether the negative effect of geographical separation has diminished over the years as a consequence of the advances in technology, experienced both in the communication and in the transportation sector. Indeed, recent improvements in world trade levels conventionally suggest that technological progress is likely to have led to a lower impact of distance costs.

Many empirical works, however, contrasted with this established assumption, insofar they show no changes in distance coefficients when dealing with cross-section estimates for different time periods.

This anomaly became known as the Distance Puzzle (Buch, Kleinert and Toubal, 2003).

Integration of the world economy has significantly boosted and this is confirmed by the increasing volumes of global trade and capital flows of the recent decades, for which factors such as the increased deregulation and technology advances have inevitably contributed positively. Accordingly, one would assume that to the same extent these factors would have reduced the impact of distance costs between trading partners.

On the contrary, in his empirical analysis on bilateral merchandise trade for the period 1965-1994, Frenkel (1995) found no tendency for the coefficients on distance to diminish over the years. In fact, his results would suggest an upward trend, confirmed by Boisso and Ferrantino (1996) gravity year-by-year estimation from 1950 to 1988, that goes against the expectation of decreasing transport costs, for which distance is taken as proxy,

Baier and Bergstrand (2001), by analyzing data from a sample of OECD countries between the late 1950s and the late 1980s, affirm that the effect of transports cost reductions on the growth of world trade is relatively low, around 8%, with respect to other factors e.g. tariff liberalization, and income convergence. Similarly, their analysis suggested an overall level of decrease in the cost of transportation not consistently relevant during the latest period of markets integration.

However, the authors that firstly pointed out the puzzling nature of the development of the distance effect were Disdier and Head in 2004. By carrying out a comprehensive and quantitative analysis of the importance of distance effect and by reviewing the results of previous applications of the gravity equation, the two authors underline how the negative impact of distance on international trade has not witnessed any decreasing trend. In fact, the effect persists even when interchanging the samples and including more recent data. In particular, the meta-regression carried out by Disdier and Head shows lower impact of geographical separation before 1970, declining between 1870 and 1950 and gradually rising thereinafter with an impediment to trade 37% higher since 1990 than the one from 1870 to 1969 and their findings are unexpectedly not affected by adjustments to the regression.

Rising distance coefficients after 1950s were likewise revealed by Combes, Mayer and Thisse (2008) in their year-by-year fixed effects estimation and previously by examinations conducted by Coe et al. (2002) and Brun et al. (2005).

In providing explanations for their result, the authors suggest that the impact of innovative communication technologies, as well as industry-level compositional changes (Berthelon and Freud, 2004) on the marginal cost of distance may not have been as effective. Additionally, the increasing importance given to time by consumers may have caused the distance factor to decrease less than expected (Hummels, 2007).

The persistence of distance effect is also confirmed by Céline Carrere, Jaime De Melo, John Wilson's (2011) estimations of trade elasticity to distance on a sample of 124 countries over the period 1970-2005. More specifically, here the authors conclude that the puzzle "only applies to poor countries" (Carrère, de Melo and Wilson, 2009, p.2) reflecting a greater marginalization. This discrepancy in the distance effect related to countries typologies were captured also by Brun et al. (2005), who recognized decreasing distance effect only when limiting the estimation to rich countries.

Accordingly, in reasoning that the negative estimate of geographical separation could be offset by the economic size of countries when evaluating trade levels through gravity models, Leamer and Levinsohn (1994) affirm that "the world is not getting dramatically smaller" (Leamer and Levinsohn, 1994: 46-47)

3.2 The death of Distance and a solution to the Distance Puzzle

In contrast to the above findings is the idea that the importance of distance in international trade flows is likely to become more and more irrelevant.

Cairncross (1997) promoted this line of thinking stressing the importance of the advances in communication speed. In her opinion, communication technologies are likely to revolutionize world dynamics and in particular weaken the impact of distance and location on trade activities in spite of the rising relevance of other factors such as customization, brand awareness, niches, mobility etc.

In support of "The death of distance" argument (Cairncross,1995: S5), Buch, Kleinert and Toubal (2003) studied how employing cross-section equations for different years may lead to misleading interpretation of distance costs. Additionally, Lin and Sim (2012) also contest the use of year-by-year regressions, providing insights on why the increase in distance coefficient may be an artifact of these. What the authors argued in their work was the misleading nature of the interpretation of distance coefficients as indicators of changes in distance costs throughout the years.

In particular, the authors conclude that "the problem with year-by-year regressions is that the steepening of the (conventional) distance coefficient does not convey a level effect at work, where trade is generally rising regardless of distance."(Lin and Sim, 2012: 228), thus suggesting a distance puzzle is observable despite Cairncross' correct supposition.

A credible solution to the distance puzzle was proposed by Yotov (2012), who studied a method capable to delete the persistent negative effect of geographical distance to international commerce.

In the opinion of the author the structural gravity model is only capable to cover relative trade costs. In fact, in the many applications of the model where only international trade data are used, the effects of globalization are not properly captured and, consequently, the distance puzzle persists.

Yotov (2012) therefore argues that the appropriate method consists in measuring the increase of international markets integration with respect to the integration of internal markets and, accordingly, compare the impacts of bilateral geographical separation and international trade costs to the ones of internal distance and internal trade costs. This methodology should not suffer from distance issues since international trade costs are likely to have decreased more than internal ones. This is assumed because, although technological advances have affected both internal and external costs, it is well

known that key institutional developments have been more significant in the context of external trade costs.

In order to provide evidence to his intuition, Y. Yotov has carried out a regression that reveals initially quite a constant impact of distance from 1965 to 2005. However, when adjusting the estimation to compare international with intra-national distance effects, the coefficient over the same period falls by 37.3% (Yotov, 2012), hence removing the puzzle.

Further support to Yotov's claim was provided by subsequent authors. In their "Advanced Guide to Trade Policy Analysis" (2016), the authors ran a fixed-effects PPML estimation of a gravity specification that takes into account both intra-national and international trade data and includes a variable for within-borders distance. First of all, their findings show how the impact of internal distance on domestic commerce is much lower than the effect of bilateral distance on international trade flows. Additionally and more importantly, the results reveal a statistically significant falling trend of the distance effect in the period 1986-2006, with a percentage decrease of -10.965 (Yotov, Piermartini, Monteiro and Larch, 2016:47).

From the evidence of the recent literature therefore it might be deduced that technological progress has in fact had an impact on the dynamics of international exchange, diminishing the importance of separation between countries.

3.3 Distance During The Era Of Digitalization

The whole string of technological development that have characterized the last decades has driven our community into a new era, shaped by the digital transformation.

Many are the changes digitalization has led us to adapt, among which digital trade is probably one of the most disruptive. The OECD does not provide a specific definition of this way of trading. Nevertheless, any "digitally-enabled transactions of trade in goods and services that can either be digitally or physically delivered, and that involve consumers, firms, and governments" (OECD.org) can be reconnected to digital trade.

The impact that digitalization has had on trade so far is undeniable to the point that, in this day and age, it is quite unconceivable to believe that geographical distance could still represent an important

obstacle to trade relationships. The role that Information and communication technology (ICT) play nowadays is so fundamental that the effect of previous decisive factors, such as geographical distance, is likely to be obscured and become more and more irrelevant.

Demirkan, Goul, Kauffman and Weber (2009) attempted to understand today's role of distance by examining the impact of information and telecommunication technology on trading costs between 175 separate and distant countries. More specifically, they tried to answer three main questions: "Does more ICT in a country support increased bilateral trade flows with its trade partners? Can we model ICT impacts as a gravitational force, to overcome the physical and cultural distances that constrain bilateral trade flows? Does ICT in larger economies have a greater effect on bilateral trade flows than in smaller economies? And does ICT have a greater effect on bilateral trade flows with distant or close countries?" (Demirkan, Goul, Kauffman and Weber, 2009: 3)

By using a conceptual gravity model that sees distance as a moderating variable in the relationship between trade flows and ICT penetration – measured with country's internet users per 100 population – three key facts could be acknowledged:

1) Not all ICT has substantial impact on trade as telecommunications are associated with less trade than internet use;

2) The ICT effect is bigger for smaller economies than for larger ones;

3) Trade between countries that are more far apart is more facilitated by ICT than trade between close countries. Hence, the greater the distance, the higher the impact of ICT.

These findings give more support to the idea of an increasing impact of ICT, regardless of its power over distance. ICT is indeed becoming more and more significant with respect to the past but since many other factors come into play as facilitators of trade, it "will never be able to fully mitigate the distance between trading partners" (Demirkan, Goul, Kauffman and Weber, 2009: 20)

The impact of digitalisation on trade is a particularly attractive topic because of its actuality and vagueness about its future prospects. Our world is witnessing an acceleration in this way, facilitated also by unexpected external factors such as a global pandemic can be.

Indeed Covid-19 has led to this. The attempts to escape the contagion by following strict lockdown orders, travel blocks and social distancing rules have brought us to a situation in which distance

between people and hence countries as trading partners has inevitably increased. However, in a digitalised world as it is the one we live in today, to what extent can this higher geographical separation really impact on global trade?

In the following chapters I will therefore try to assess what Covid-19 has meant in the general context of international economics and finally I will focus on the situation of one specific country to examine how the impact of digital trade can change in the setting of a global pandemic.

4. GLOBAL TRADE DURING COVID-19

4.1 The Outbreak Of The Pandemic

The unpredictable shock that has hit our world in the last year, commonly known as Covid-19 pandemic has inevitably affected the economic system as a whole, impacting societies and the economies of each country in far more ways than impacting the health of the affected.

To the direct and obvious effect on people's health that such a pandemic caused in terms of cases and deaths, the repercussions of the measures applied to contain the spread of the virus necessarily have to be included to understand the real impact of the Covid-19 crisis.

In the past year our world has gone through the largest global recession in history since the Great Recession, with more than a third of the global population at the time being placed on lockdown (Kaplan, McFall-Johnsen, 2020).

The first piece of information concerning cases of a 'viral pneumonia' in Wuhan was picked up by the World Health Organization Office in China on 31st December 2019 and on 5th January 2020 the first Disease Outbreak News Report was issued by the Organization, with details of the reported cases and their clinical status.

Once it was identified in a novel coronavirus the cause of the infection outbreak, on 11th January Chinese media communicated the first death. Consequently, with the aim of gathering more information about the response to the cluster of cases, the WHO sent the first research mission in Wuhan, with the outcome of the WHO Director-General declaring the novel coronavirus outbreak

a public health emergency of international concern (PHEIC), WHO's highest level of alarm, after having reported the detection of 98 cases in 18 countries outside China.

“This is the time for facts, not fear. This is the time for science, not rumours. This is the time for solidarity, not stigma.” (Adhanom, 2020)

On 24th February 2020, the team leaders of the WHO-China joint mission, deployed on 9th February, firstly warned about the necessity of planning a series of large scale non pharmaceutical public health measures such as detection, isolation and quarantine. The authorities continued to monitor the situation until the point when the general concern caused by the severity of the infection spread became so deep that it brought the WHO to officially assess Covid-19 as a global pandemic, specifically on 11th March 2020.

More than one year later, as of 23rd May 2021, the registered numbers of cases count for more than 166 million, while the confirmed deaths attributed to the virus have reached 3.45 million, making it one of the deadliest pandemics in history.

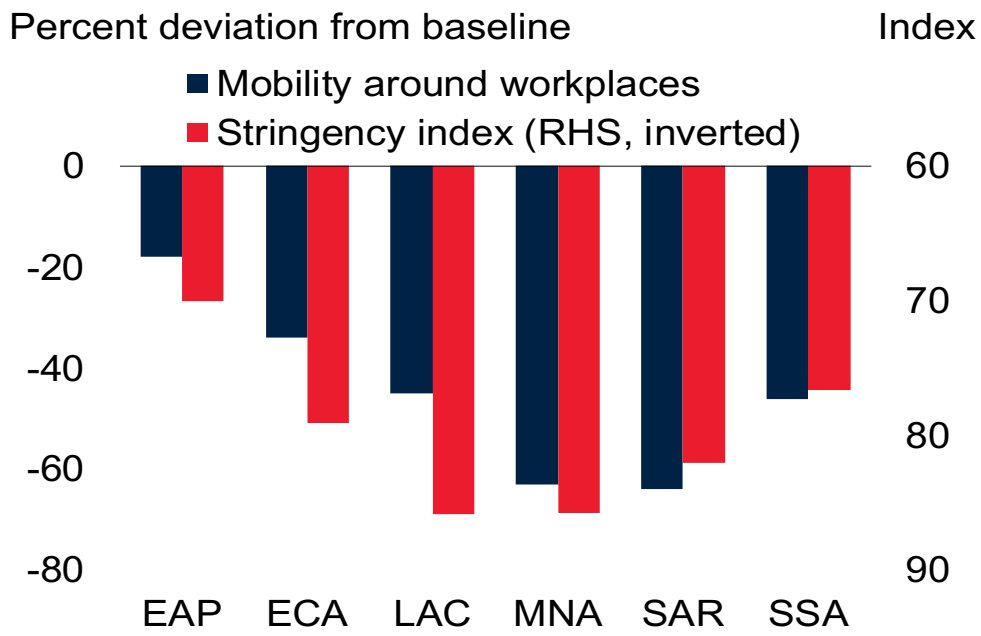
4.2 The Economic Impact

With respect to economic losses, the numbers are unsurprisingly less reassuring, with forecasts of global GDP falling by almost $22 trillions as of January 2021 (Welle, Deutsche, 2021).

In particular, international stock markets witnessed their worst decline since 1987 (Palumbo, 2020) while, during the first three month of 2020, G20 economies experienced a fall of 3.4% from the previous year (OECD, 2020). Furthermore, International Labour Organization have forecasted full time job losses for 400 million people between April and June (McKeever, 2020), with an global overall income fall of 10% in the first nine months (Financial Times, 2020).

However, it has not only been the disease itself to cause the recession. A significant contribution undeniably stems from the range of restrictions adopted with the aim of contrasting to the greatest extent possible the circulation of the virus such as the preparation of appropriate health facilities, the tracing methods, social distancing measures, the imposition of full lockdowns and closures of different level throughout the past months, not to mention the limitations to international travels.

Figure 3. Stringency of government response to COVID-19 and workplace mobility.



Source: Google Mobility Reports; Oxford University; World Bank.

The world system has been forced to a worldwide reorganization of all economic and non-economic activities: from the suspension to all in-person activities, to the transition to smart-working for a variety of companies and all physical events turned into online webinars. CEPR's Covid Economics, Vetted and Real-Time Papers, launched at the end of March 2020, provides research in real time on the scholarly work on Covid-19 that has quickly risen after the pandemic outbreak. The publication presents research papers concerning all the possible challenges that this event has posed on the different areas of economics including industrial organization, macroeconomics, finance, development, inequality, history and public finance.

The changes have been definitely substantial in terms of consumption habits and shifts in demand trends, witnessing an overall increase in the consumption of online goods and services accompanied by an obvious decrease in the demand for face to face services.

The impact and the effectiveness of the restrictions put in force by the governments are among the most debated topics. In their macroeconomic analysis, Krueger and Xie (2021) exploit a SIR epidemiological model to demonstrate that the Swedish laissez-faire approach against Covid-19 -

as opposed to the widespread trend of the enforcement of national lockdowns- together with an hypothetical sectoral reallocation to dictate consumption patterns would alleviate the economic crisis but at the expense of avoidable deaths.

The impact of social distancing on business that were based on face to face interaction between workers or, in general, that could not exist without physical proximity, was instead investigated by Koren and Peto (2020), who focused on US businesses finding that "when businesses are forced to reduce worker contacts by half, they need a 12% wage subsidy to compensate for the disruption in communication" (Koren and Peto, 2020: 1). Moreover, from their analysis it appears clear that the most affected sectors are in fact those of which people hear about the most on the news, such as restaurants, retail, arts and entertainment and education.

The issue of social distancing was also examined from a different perspective by Greenstone and Nigam (2020), who highlighted the positive effect of such a measure both in terms of lives saved and, surprisingly, also economically. They indeed constructed a method to "monetize" the impact of social distancing and concluded that the benefits of such preventive policies in terms of money account for about $60 000 per US household. Another core economic theme related to Covid-19 is the fast transition towards the smart-working, which involved many more companies than it probably would ever have done under normal circumstances, assuming that this way of working would still spread in the future, albeit at a different rate. The working-from-home method has been and still is a subject of debate, especially with a view to a return to normal life. in fact, it is difficult to understand if this accelerated digitalization in the workplace will be confirmed even once it will be again possible to return to the office or will remain only as a parenthesis characterizing a historical moment. There is probably no right or wrong answer on this, but it is possible that freedom of decisions and actions will be granted to individual companies.

However, working from home implies requirements that cannot be globally taken for granted such as the internet access at home. An interesting study conducted by Viollaz and Winkler (2020) indicated in fact how the possibility for traditional jobs to be converted in their smart version increases with the level of development of countries, both because jobs in poorer countries are more physical/manufacture intensive, but also because of less internet users and scarse connection from homes.

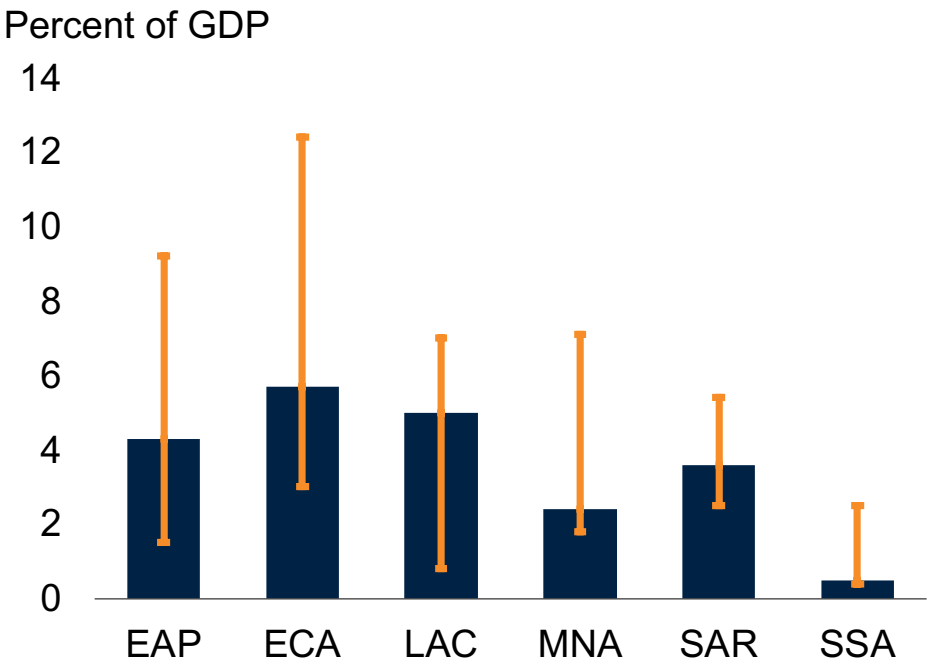
A broader but at the same time detailed vision of what has been by now the economic impact of such an event is the one proposed by Shang, Li and Ren Zhang (2020). In fact, the authors analyze

the devastating effect on global value chains caused by, for instance, the shortage in manufacturing supplies -particularly from China- or the market restrictions such as export bans, all of which in turn causing greater pressure on domestic value chains and a new trend towards de-globalization.

Furthermore, the consequences related to the world of finance are mentioned, where this general trend towards closure, together with reduced lending opportunities, and the consequent fall in the value of many local currencies, resulted in greater difficulty in settling dollar-denominated debts.

The authors also dedicate a few lines to highlight the difficulties that all national governments have had to face, not only from the point of view of health and preventive planning against the virus, but also of programming a series of economic measures aimed mainly at meeting the needs of the most affected categories such as freelancers, entrepreneurs of any sector, the unemployed, the poor and so on. All measures of expenditure for social protection which have weighed and will continue to weigh on the fiscal deficit of the various countries.

Figure 4. Fiscal support measures, by region.



Source: World Bank. Note: EAP = East Asia and Pacific, ECA = Europe and Central Asia, LAC = Latin America and the Caribbean, MNA = Middle East and North Africa, SAR = South Asia, SSA = Sub-Saharan Africa. Total measures either planned or under consideration as of May 29, 2020. Aggregates are calculated using 2019 nominal U.S. dollar GDP. Bars indicate medians. Orange vertical lines indicate interquartile range. Sample includes 29 EMDEs.

Eventually, a sort of comparison is also made with the previous epidemics we have experienced, as if to underline how the health and economic effects that we have to endure are common and should not shock. however, between the lines the authors actually offer a view that it is not so much these epidemics that put a strain on globalization, but rather it is the latter that allows viruses to still spread so widely today, despite advanced technologies in the pharmaceutical industry.

4.3 Digital Trade

As reported in the previous paragraph, the prevention measures such as social distancing and the various closures that governments have had to put into practice, have led people to look for new ways to entertain themselves from home and, similarly, companies to deal with smart-working. This has inevitably shifted the consumer's as well as the seller's attention to the digital world. In fact, not only digital shopping but also the demand for services of all kinds, such as online masters, has undergone an extraordinary increase.

Obviously, those already operating in digital or telecommunications areas have been spurred to improve their networking capabilities since the tremendous increase in the demand for their services have resulted in proportional amounts of data, responsible for the strains and network congestions that many e-companies had to deal with such as Netflix and Youtube. However, digital commerce has not been immune to the pandemic, as it is dependent on supply chains, manufacturing and distribution channels that have been severely constrained by the spread of the virus. Manufacturing production has undergone a huge decline also due to the lack or, in any case, decrease of operational workers; online purchases have experienced the same slowdowns as for physical retailers from a transport and therefore shipping point of view, since the new anti-covid rules have literally destroyed the usual methods of cargo transport, at least at the outbreak of the pandemic, hence customers have witnessed many unavoidable cancellations and delays of their ordered products.

Nevertheless, there has been a general effort in trying to facilitate e-commerce. Indeed, governments -in particular in developing countries- have adopted a proactive approach to speed up the digital transition, while developed countries have witnessed many businesses acting

autonomously to find solutions to make distribution smoother through independent delivery services. Banks have lowered fees on digital payments and mobile money transfers, mobile payments have been encouraged by the authorities of countries like Russian Federation or United Arab Emirates, where specific regulations are yet to be introduced and many other innovative actions have been adopted to encourage the trust on digital means and, hopefully, will be the starting point for a series of investments directed towards the digital transition, not only in developed countries but globally.

Hence, from a certain perspective, it might be agreed that the pandemic has led to an acceleration of digitalization, highlighting the cruciality of the online frontier for economic activities and, more importantly, the need of eliminating digital divisions both across and within countries.

Indeed, probably those experiencing the greater difficulties in exploiting the opportunities provided by the e-commerce have been the small and medium enterprises, in particular those located in the least developed countries. The common obstacles such as a reliable and strong internet connection, online visibility and attractiveness, access to e-payment methods as well as the cost of the increased cost of trading and shipping abroad and the cost of online ads have indeed been even less surmountable for these categories.

As a matter of fact, the discrepancies between and within countries in the possibility of access to ICTs and telecommunication devices are still too wide.

Consequently, the sped up digital transition caused by the pandemic must necessarily take into consideration this issue in the sense that authorities should commit themselves in regulating this process so as to make it as equitable and inclusive as possible and thus constitute, among other things, an opportunity for development.

To address these challenges, WTO has indeed responded promptly by enhancing and continuing to develop and implement the WTO Trade Facilitations Agreement, established in 2017. Among the solutions that the agreement provides to improve world trade openness it is worth mentioning the possibility to pay taxes, duties and fees through electronic means, the tax-exempt *de minimis* shipment value, the tool at traders' disposal, consisting in a single window that permits to both submit all the required documents and data and receive notifications regarding the release of goods from borders authorities.

Broadly speaking, the key objective of these facilitations is that of encouraging traders to increase their adoption of information technology and artificial intelligence in order to smooth all the processes that international commerce involve. (World Trade Organization, "E-commerce Trade And The Covid-19 Pandemic", Information Note, 2020)

There is undoubtedly still ample room for improvement in the facilitation of all international trade practices in a digital key. However, the event that has shaken the global community in the last year has already opened our eyes even more to how fundamental digital dimension is nowadays and, above all, how much it has been in this extremely challenging period.

In accordance with this view is the thought of Ciuriak (2020). In his G20's policy brief he underlines in fact how the year 2020 ushered in a new era of the global economy, thus constituting a point of no return, as the pre-pandemic production patterns will not be recovered, at least not completely, and international trade will eventually go through several adjustments particularly concerning consumer patterns, business strategies and technology-driven national contests for rent and power (Ciuriak, 2020).

Going slightly more in detail, the author writes for example how, since the pandemic arrived at a time when digital transformation was already taking place albeit at a shorter pace, all those practices that involve face-to-face interaction will be re-established only where they will be considered better, in terms of convenience, than the digital solutions introduced to face the new social distancing rules.

In addition, the pandemic has also had an impact on the business environment, bringing to light even further the gap between efficient companies, which therefore have been capable to reinvent themselves and embrace innovation and digitization and those who, on the contrary, have not been able to react and, in most cases, were forced to leave the market. Not to mention the discrepancies between countries in terms of national systems' robustness, organization and capacity to cope with an emergency that have surfaced since the outbreak of this disastrous event.

The author deepens his analysis even further by proposing five ways according to which, in his opinion, digital is transforming commerce. The first is represented by the so called "Internet Economy", comprising all digital transaction for which the digital service or product proceeds from wherever located servers. The second mode is the one of traditional e-commerce, which has highly increased mostly for grocery shopping during the pandemic, while the third is represented by the

sharing economy. The latter has initially been damaged by the various measures of social distancing and lockdowns but, with the ease of the restrictions, and by respecting the introduced health conditions such as sanitation protocols, is likely to rebound. The fourth way is instead the one of the gig economy at international level, for which an expansion is expected especially after the widespread diffusion of remote working. Several companies, mainly tech ones, are in fact willing to keep a large portion of their workforce remotely, arguing that the "office centricity" is now almost obsolete while digital work should become a default condition. Last but not least, we are moving towards the "data driven economy" or "DDE", meaning that the fifth way through which trade patterns are and will be affected is the capitalization of data, whose value is increasing in importance to the extent that Ciuriak defines it as "the new oil".

Thus, proper policies and agreements, both domestically and internationally, are ought to be developed to efficiently embrace these five main trade changes and handle the variety of new complexities related to all those delicate topics such as privacy, competition, culture etc., that will inevitably arise from in the prospected scenario.

Among these, there is the need to increase supply chains' robustness through improved networking activities, which have turned to be very promising in addressing the challenges posed by the virus. Furthermore, investments aimed at accelerating the integration between existing infrastructures and the novelties introduced by the digital era, such as 5G networks, are definitely crucial in this period, as indeed are the measures that will have to deal with the restructuring of supply chains, which, according to the author, will need redundancy rather than repatriation to better meet global demand needs, characterized by spikes.

To conclude, what Ciuriak (2020) wishes to underline is the fact that international organizations such as WTO or G20 and generally speaking governments and institutions will have to be ready to face these new challenges in order to be able to enter the new digital era in the best possible way, and to cope with the inefficiencies that are likely to arise as a result of such important revolutionary changes.

("Digital Trade in a Post-Pandemic Data-Driven Economy", G20 Policy Briefs, D. Ciuriak, 2020)

5. EMPIRICAL ANALYSIS

In the attempt to make a point on the work carried out up to this point, the analysis have firstly been focused on the presentation of the application of the gravity model to international trade, from its origins to the theoretical background. The attention was subsequently dedicated to the topic of distance, key issue of the aforementioned model, whose impact on international trade flows, often contrasting with the theory itself, is and continues to be the subject of studies and research by academics, who have repeatedly tried to find appropriate explanations for the differences emerged in the empirical applications of the model.

Going forward, the intent of my study was therefore to link the issue of distance to that of digitization, since, according to various analysis in recent years, the latter would contribute to reducing the importance of geographical distance in the development of exchange of goods and services between and within countries. Hence the idea of referring to the digital changes that global trade has undergone in an accelerated manner over the past year due to the pandemic.

The empirical application that I will therefore conduct in the following section aims to analyze both effects, distance and digitization, in the period that comprises the years 2019 and 2020, to observe the trends and hypothetical developments from one year to other and finally attempt to provide an interpretation.

For the aforementioned analysis my decision was to focus on Vietnam's bilateral trade flows, as it is among the exemplary countries in the response to the coronavirus pandemic, according to the Exemplars in Global Health (EGH) platform, since, as of December 31, 2020, the nation recorded 1465 cases and 35 deaths, therefore relatively low numbers.

5.1 The Case Of Vietnam

Vietnam is a Southeast Asia country, bordered to the north with China, to the west with Laos and Cambodia, to the north-east with the Gulf of Tonkin and to the east and south-east with the South China Sea and the Gulf of Thailand. Geographically, four macro-regions can be distinguished in the Vietnamese territory: North Vietnam, Central Vietnam, Southwestern Vietnam and Southeast

Vietnam, where the most populous city is located, Ho Chi Minh City, while the capital city, Hanoi, is located in the northern part of the country.

The country's population exceeds 90 million people and is characterized by a relatively low average age - about 40% under the age of fifteen - and various ethnic groups, among which the main one represents 86.2% of the total, and is that of Viet.

From the governmental point of view, Vietnam is a unicameral socialist constitutional republic, whose constitution entered into force in 1992. The only legally recognized party is the Communist Party and its affiliated organizations, while the main constitution body as well as the holder of legislative power is the National Assembly, by which the Prime Minister and the President of the Republic are elected.

As regards the country's economic performance, starting from the 80s and emulating the neighboring countries of Southeast Asia, the nation has embarked on a process of industrial development by significantly increasing production. This industrialization occurred mainly as a result of the increased openness to foreign markets, a factor that has actually facilitated foreign investment, also particularly attracted by the huge workforce of young people on which the country can count. In fact, the country, having emerged from the wars with a devastated and uneven economy, first attempted collectivization, which was soon abandoned, however, thanks to the adoption in 1986 of a series of economic reforms known as Doi Moi ("renewal") aimed precisely at liberalizing and integrating with the global economy and which have thus succeeded in transforming a centralized economy into a socialist-oriented market economy, putting Vietnam on the path to its current middle-income status (Treccani.it).

Vietnam’s Trade

Strategically located for foreign companies with operations throughout Southeast Asia, Vietnam is an ideal export hub for reaching other ASEAN markets. Compared to other developing markets in the region, Vietnam is emerging as the clear leader in low-cost manufacturing and sourcing, with the country's manufacturing sector accounting for 25% of Vietnam's total GDP in 2015 (Kyssha Mah, 2018).

In 2007, with the country's rise to the World Trade Organization (WTO), Vietnam took a significant step by integrating with world trade and subsequently entering into several free trade

agreements. In recent years, Vietnam has been active in signing bilateral trade agreements with countries around the world. Also, due to its membership in the Association of South East Asian Nations (ASEAN), Vietnam has become a party to several free trade agreements that the regional trading bloc has signed.

However, with recent trade agreements such as the Comprehensive and Progressive Trans-Pacific Partnership Agreement (CPTPP), the EU-Vietnam FTA (EVFTA), the UK-Vietnam FTA (UKVFTA) in place and the upcoming partnership Regional Global Economic (RCEP) - Vietnam appears to prioritize trading partners for integrating international trade outside ASEAN.

Country response to Covid-19

Vietnam has invested heavily in its healthcare system, with public health spending per capita increasing by an average rate of 9% per year between 2000 and 2016 (Teo, Bales, Bredenkamp, Cain, 2020). These investments have been paid off by rapidly improving health indicators, such as the reduction of more than half the levels of infant and maternal mortality from 1990 to 2018 (WHO, 2015).

With regards to the management of health emergencies, the country has shown itself capable of dealing with them seriously both during the SARS epidemic and in this last year hit by the pandemic. It was in fact the second country after China to face SARS and, after 63 cases and five deaths, it was the first country declared SARS-free by the World Health Organization (WHO, 2003). The success in the response to Covid-19 certainly depends on the experience acquired with SARS, experience not only of the national health system that has not allowed itself to be caught unprepared in putting into practice the right measures to contain the virus, but also of the population, certainly more willing to comply with a common unique response to the health restrictions (Our World In Data, 2021).

Despite its proximity to China, where the virus originated, Vietnam has incredibly fewer COVID-19 infections and deaths than other countries. In this, prompt political interventions have been among the determining factors in the country's successful response to the virus. The mentality of its leaders, who were able to recognize from the beginning the infectious and fatal risk of the disease, declaring that "chống dịchnhư chống giặc", that is, that they considered covid-19 as a real enemy to be defeated, was fundamental especially in shaping the perception of risk in the minds of citizens.

The technological and economic limits of the country have therefore not stopped the latter from implementing effective control and prevention measures since the outbreak of the pandemic. Among these, the blocking of international flights and travel bans introduced even before the first cases were confirmed in the country, especially the flights to and from China, canceled starting from February 1st, the tracking of contacts, encouraged also thanks to the introduction of the NCOVI application first and Bluezone later, quarantine and social distancing, without forgetting the national and zone lockdowns. In particular, the restrictions on movement and the various blockades appears to be responsible for the 55% reduction in new cases compared to the previous period (Quang Van Nguyen, Dung Anh Cao, Son Hong Nghiem, 2021).

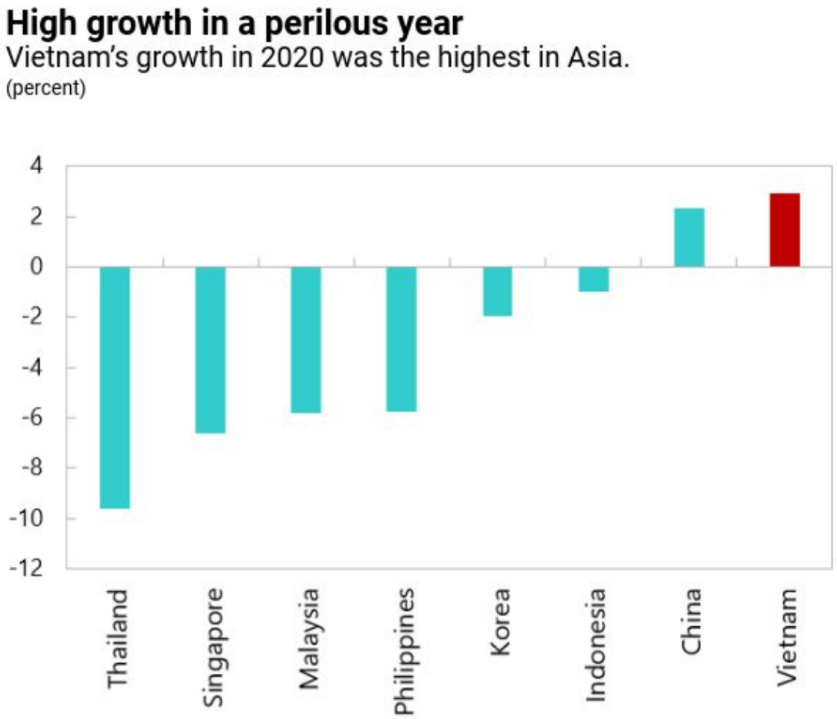
Economic Impact

The cost of the pandemic predicted by Prime Minister Nguyen Xuan Phuc will be around 200,000 billion dong ($ 9.4 billion) in revenue, with tourism being the most affected sector given the border closures. Fruit exports fell by more than half between April and June 2020, with transport costs instead quadrupled. (Dezan Shira & Associates, *Vietnam Business Operations and the Coronavirus: Updates,* 2021).

Overall, however, Vietnam is weathering the economic crisis better than many other countries. It is one of the few countries in the world that experienced a positive increase in GDP in 2020, registering growth of 2.9%, one of the highest in the world, supported since the first recovery movements in domestic activities and by a robust activity of export, especially of high-tech electronic products and services for the many people who have necessarily started to work from home. Among other things, according to the latest annual estimates by the IMF, the growth rate should reach 6.5% in 2021.

Clearly, Vietnam entered the pandemic with solid economic and political fundamentals, having made significant progress in consolidating public finances before COVID-19. Improving fiscal, external and financial reserves before the pandemic consequently made Vietnam more resilient to the shock (IMF, 2021).

Figure 5. Asian countries growth in 2020.



Source: IMF, World Economic Outlook Database

5.2 The Gravity Equation For Vietnam's Bilateral Flows

Once I have provided an overview of Vietnam, in particular focusing on its development in terms of industrialization and openness towards international markets over the last twenty years, and having summarized the conduct adopted in dealing with the pandemic emergency, as well as the impact in terms of GDP growth rates that the country has recorded in the last year, in this paragraph I will apply the gravity model of trade to analyze the trade flows between Vietnam and 66 trading partner countries during the two-year period 2019-2020.

The model is therefore the traditional one, proposed by Tinbergen (1962), however augmented in the number of involved variables, estimated through the use of a Random-effects GLS regression, which takes the following form:

$$\log (TRADE_{ij}) = \beta 0 + \beta 1 \log (GDPprod_{ij}) + \beta 2 \log (DISTANCE_{ij}) + \beta 3 \log (INTERNET_{i}) + \beta 4 \log (AFTA_{ij}) + \beta 5 \log (TPP_{ij}) + \beta 6 \log (COMMCOL_{ij}) + \beta 7 \log (COMBORDER_{ij}) + \log (\eta_{ij})$$

where

$i = 1$, and corresponds to Vietnam

$j = 1, 2, \ldots, 66$ Vietnam's trading partners

$TRADE_{ij}$ is the sum of exports and imports, measured in billion dollars, between Vietnam and partner country;

$GDPprod_{ij}$ is the product of Vietnam's and partner's nominal GDP, measured in current US billion dollars;

$DISTANCE_{ij}$ is the air travel (bird fly) shortest distance between Vietnam and partner's capital cities, measures in kilometres;

$INTERNET_{i}$ is a measure for internet users/ 100 population in Vietnam;

$AFTA_{ij}$ is a binary variable for the ASEAN Free Trade Area, takes either value 1 or 0;

TPP_{ij} is a binary variable for the Trans-Pacific Partnership Trade Agreement, takes either value 1 or 0;

$COMMCOL_{ij}$ is a binary variable for common historical colonial link, takes either value 1 or 0;

$COMBORDER_{ij}$ is a binary variable for shared geographical borders, takes either value 1 or 0.

Data on countries' levels of GDP for the chosen years are taken from the World Economic Outlook Database (2021), which is periodically published by International Monetary Fund website and are described in current US billion dollars. According to the theory, the product of GDP of Vietnam and its trading partners is used as a measure of economic size or "country masses", variable that in the model is considered to be directly proportional and significantly related to the level of bilateral trade. The larger the markets, the more opportunities for trading, hence this variable is expected to have a positive coefficient sign.

Distance is included in the model as an approximation of transport' costs, therefore the estimation should result in a negative coefficient for this variable. It is measured by the distance calculator website distancefromto.net in terms of kilometres' shortest air travel distances between countries.

Additionally, common colonial history as well as sharing geographical borders are added to the model above since many previous works have showed evidence for these elements to improve the explanation of trade flows dynamics. In fact, these dummy variables have been added to the model since the early applications such as in Rose (2000) analysis of common market effects on trade, where common border and colony are taken into account, or in the work developed by Glick and Rose (2002), where further attention is dedicated to the colony affect with the inclusion of dummy variables for both current and past common colonial ties.

The variable related to internet users is included to observe how ICT affects bilateral trade, assuming that it should result in a positive effect that contrast the cost of distance -and implicitly of transport- between countries. Specifically, these numbers are taken from the International Telecommunication Union (ITU) World Telecommunication/ICT Indicators Database, and represent the total internet users, no matter by which mean (personal computer, smartphone etc.). No other variables that could presumably contribute to the correctness and completeness of a "Digitization Factor" were included to avoid correlation. However, data related to the year 2020 are not yet available so I've been taking the values corresponding to 2019 for both periods, assuming no relevant changes in their levels from year to year. The inclusion of a variable explaining the impact of the level of internet connection of a country was previously analysed by Demirkan, Goul, Kauffman and Weber (2009), where the author in fact examined the hypothetical cost reduction benefit of ICT and its power of altering the impact of traditional variables, such geographical and cultural distance.

Finally, trade facilitation policies are included in the equation since many studies, among which the cross sectional analysis conducted by Soloaga and Winters (2001) on the effects of regionalism and trade agreements, the subsequent works by Cipollina and Selvatici (2006) and Grant and Lambert (2008) related to RTAs impact or the paper on the implications for the ASEAN Free Trade Area, written by Kien (2009), have proven the effectiveness of their supposed facilitating effect on international trade, inducing significant increases in trade opportunities for the countries involved.

5.3 About the Method

Moving from theory to practice, the application of the gravity model presents not a few uncertainties regarding the type of regression to be used.

Which estimator or econometric method to choose is and has in fact been a topic of discussion for many researchers. Despite the traditional Ordinary Least Square (OLS) estimator still finds application, especially with regard to the analysis of policies, the use of more advanced methods has been proposed by various academics as they viewed the traditional method as too little explanatory.

As mentioned in the first part of this study, some scholars have tried to solve the problem of multilateral resistance terms by opting for fixed effects regression (Anderson and Van Wincoop, 2001). An alternative that instead could represent a synthesis between the application of the OLS model and that of fixed effects was proposed by Baier and Bergstrand (2009). The same, subsequently, in an attempt to include the effect of FTAs in their analysis, proposed an estimation conducted with both fixed effects and random effects model (Baier and Bergstrad, 2007).

As Kepaptsoglou, Karlaftis and Tsamboulas (2010) highlight in their 10-year review of empirical applications of the Gravity Model, although OLS might be the simplest way to compute such a regression, the inclusion of interaction effects, whether with random or fixed effect model, is required to avoid biases and inconsistencies in the results.

Then, according to Egger (2004), the selection between the two methods depends on a series of factors such as the objective of the analysis and the consequent form of the data sample: cross-sectional if the analysis is intended in spatial dimension (i.e. across countries) and panel if instead it is temporal dimension based (i.e. over time). Moreover, the characteristics of the variables to be included in the regression indicate which is the proper method to use.

Indeed, fixed effects model is the correct choice whenever the objective of the analysis is to study the impact of factors that vary over time. A fundamental assumption of this model is that time-invariant features should not be correlated to other subjects' features, so if error terms result as

correlated in the estimation, it might be the case that alternative methods better fit the data, such as random effects.

"…the crucial distinction between fixed and random effects is whether the unobserved individual effect embodies elements that are correlated with the regressors in the model, not whether these effects are stochastic or not" (Greene, 2008: 183)

It is indeed reasonable to choose random effects specification whenever variations between entities are supposed to influence the dependent variable to some extent. Furthermore, this model allows to include time-invariant variables without the risk of incurring in biases, since its key assumption predicts no correlation between predictors and entity's error term. The model takes the following form:

$$Y_{it} = \beta X_{it} + \alpha + u_{it} + \varepsilon_{it}$$

Where

u_{it}= between-entity error

ε_{it}= within-entity error

(Torres-Reyna, 2007)

With regard to the object of this case analysis and considering the variables included, some of which not varying over time, it appears reasonable to opt for random effects specification. However, to precisely understand which methodology is the most correct, the first computation that will be reported in the following section is the Hausman test, which allows to observe whether the unique errors (u_{it}) are correlated with the regressors or not.

5.4 Estimation Results

The Hausman test poses as null hypothesis the fact that random effect should be preferred while the alternative hypothesis predicts the opposite.

The results of the test are reported as follows:

Hausman (1978) specification test

	Coef.
Chi-square test value	1.781
P-value	.182

A correct interpretation of the outcome would lead to opt for random effects model. It is indeed necessary to observe the value for "Prob>chi2". If the result is a number lower than 0.05 (i.e. significant) one might choose fixed effects. In the results above, the value is 0.1820, hence I suppose that random effects would fit the model more precisely. Thus, the estimation of Vietnam's bilateral trade for the period 2019-2020 has been conducted by applying the random effects specification. To efficiently assess the impact of ICT diffusion in the country, I have firstly run the regression without including the INTERNET*i* factor - log specified as LN_internet.

The outcome of the regression is shown below:

	(1)
VARIABLES	**Random Effects**
Ln_GDPprod	0.880***
	(0.0911)
LN_DISTANCE	-0.683**
	(0.310)
AFTA	0.308
	(0.747)
TPP	0.302
	(0.389)
COMMCOL	0.476
	(1.476)
COMMBORDER	0.563
	(1.185)
Constant	9.851***
	(3.118)
Observations	132
Number of Country1	66

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Subsequently, in the following regression the INTERNET*i* factor is included among the independent variables.

The second results are here summarized:

	(1)
VARIABLES	**Random Effects**
Ln_GDPprod	0.877***
	(0.0908)
LN_DISTANCE	-0.677**
	(0.309)
LN_internet	0.329
	(0.277)
AFTA	0.293
	(0.745)
TPP	0.367
	(0.391)
COMMCOL	0.649
	(1.478)
COMMBORDER	0.677
	(1.184)
Constant	7.038*
	(3.907)
Observations	132
Number of Country1	66

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

From the results above, firstly it is possible to observe the outcome for the R-squared, that is, the degree of response variable variations explained by the model. Random effects model takes into account both within and between information, therefore the attention should be focused on the average result, specified by the "overall R-sq", which in the regression above is equal to 0.7176. This is quite a high value, knowing that it ranges from 0 to 1, nevertheless additional factors should be observed to assess how well the model fits the data.

Consequently, the attention should be moved towards the estimates of the independent variables' coefficients. The outcomes under the Coefficients column give information

about the relationship between the independent variables and the dependent variable by specifying the amount of increase in trade between Vietnam and its trading partners that would be predicted by a 1 unit increase in each predictor.

By only looking at the coefficients' values, it can be observed how all independent variables, with the exception of distance, impact positively on the amounts of trade. Furthermore, when focusing on the predictors representing the level of internet diffusion in Vietnam, LN_internet, and on that accounting for distance, LN_DISTANCE, both representing the object of the focus of the aforementioned analysis, it is worth noting how the inclusion of the internet variable impacts, although to a small extent, the effect of distance on trade.

However, not all variables appear to have statistically significant coefficients. Indeed, only those related to the product of countries' GDPs and the geographical distance among Vietnam and its partners have p-values below 0.05, meaning that these variables have a significant influence on the levels of trade. This outcome is coherent with the theory of the gravity model, for which the key determinants of trade are in fact economic sizes of the targeted countries and the distance between them.

On the contrary, the effect of the included FTAs and the level of Vietnam's internet diffusion do not have influence on trade, or, if there exist, the effect is likely to be of negligible practical or theoretical significance.

This lack of significance is likely to be due to inaccuracies of the data, or other countries' aspects that have caused the results to turn out differently from the expectations. For example, there might have been additional factors for which the regression did not control that could possibly better explain the findings.

Estimation issues related to internet diffusion could be justified as well by the fact that the indicator used does not fully capture the digitalization level of a country since it only refers to the percentage of internet users among the population. Furthermore, as the data relating to the internet usage in Vietnam for 2020 have not yet been released, the indicator is assumed not to change from one year to the other. This could consequently represent an additional source of mistake.

The period on which the analysis is focused may in fact be considered too recent to provide totally correct results. It should not be neglected, among other things, that 2020 has suffered the impact of a global pandemic that has inevitably affected international trade, as explained in the previous section. Not having controlled for any effect given by the spread of covid 19 makes the rise of estimation issues even more reasonable.

6. CONCLUSION

The main purpose of this study was to deepen the gravity model of international trade, first proposing a revision of the theories that led to its formulation, therefore its historical background, and then proceeding with a purely theoretical analysis. The equation of the model was therefore presented with the description of the variables taken into consideration and with the listing of the numerous inconsistencies that emerged over the years in the various applications of the model with the related proposed solutions. The gravity equation of trade, thanks to its peculiar applicability, has been exploited by many researchers to study the effects of the most disparate events or factors that can hypothetically affect the level of international trade. This prompted me to propose an application of the model to evaluate, albeit in an analysis limited to the single country of Vietnam, the trend of international trade in the last two years, thus considering the economic shock caused by the pandemic.

Despite the problems of estimation and data collection issues that could affect the analysis, the results show how the distance effect still constitutes an important impediment, especially in view of a period that has seen the disruption of trade with closures that have indeed likely accentuated the effect of the geographical distance between countries.

Therefore, distance effect, together with the effect of countries' economic size in terms of GDP, are confirmed to be consistent with the theory in this analysis.

However, the study of the possible diminishing effect of digitization on distance did not lead to a statistically significant result despite the fact that the distance coefficient decreases once the variable relating to the level of digitization of Vietnam is included in the regression, whose coefficient, however, would suggest a positive impact on the country's level of bilateral trade. Perhaps, a more precise data collection, which takes into consideration all the possible factors omitted here, could lead to more significant results.

Therefore, this study proposes itself not only as a theoretical and literal revision of a model, but also as food for thought for future research on the issue of the effect of digitization on the development of international trade and, in particular, in reference to the very recent pandemic period.

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Thank you, Diana.

APPENDIX

Table A1: List of variables.

PARTNER	Vietnam's trading partners
YEAR	2019, 2020
AFTA	ASEAN Free Trade Area, dummy variable
TPP	Trans-Pacific Partnership, dummy variable
COMMCOL	Common colony history, dummy variable
COMMBORDER	Sharing border, dummy variable
LN_INTERNET	Natural logarithm of internet users/100 people in partner country
LN_TRADE	Natural logarithm of trade where TRADE = Imports + Exports
LN_DISTANCE	Natural logarithm of geographical distance between Vietnam and partner
LN_INTERNETviet	Natural logarithm Internet users/100 people in Vietnam
LN_GDPviet	Natural logarithm GDP Vietnam in current us billion dollars
LN_GDPpartner	Natural logarithm GDP of partner country in current US billion dollars
Ln_GDPprod	Natural logarithm GDP product
LN_internet	Natural logarithm product of internet users in Vietnam and in partner country

Table A2: Summary statistics.

Variable	Obs	Mean	Std.Dev.	Min	Max
LN_TRADE	132	14.14546	1.894703	10.09002	18.70655
LN_DISTANCE	132	8.752434	0.8407664	5.971262	9.871274
Ln_GDPprod	132	11.51754	1.644074	8.317597	15.78043
LN_internet	132	8.450497	0.499796	6.240569	8.826383