UNIVERSITAT JAUME I

The Macroeconomic Effects of COVID-19: a Critical Review

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MACROECONOMICS EFFECTS OF COVID-19: A CRITICAL REVIEW

ABSTRACT

The World Health Organization (WHO) declared on March 11, 2020 that Covid-19 had become a global pandemic. Although more than a year has passed, the world is still fighting to stop this pandemic. The cases, which originated in China, spread rapidly around the world, prompting world governments to put in place the necessary measures to isolate the cases and limit the transmission of the virus as much as possible. However, the adoption of these measures has been very damaging to the world's economies, as trade has been severely affected. With this brief presentation, this paper presents some articles on the macroeconomic effects of COVID-19 that I found most interesting. This paper presents the impact of COVID-19 from a more theoretical perspective by means of tables, graphs and policies adopted with the aim of slowing down the recession. We also present a series of articles which, using macroeconomic models, explain the behavior of the virus from different points of view.

Contents

1. INTRODUCTION.

The Covid19 pandemic that began in China at the end of 2019 and has spread to the rest of the world during 2020 has caused the largest recession since World War II (World Bank, 2021). Output in 2024 is expected to be still 3% below its pre-pandemic peak (World Bank, 2021).

Border closures, compulsory confinement and restriction of factor mobility, which affected the entire world, is an unprecedented event with an open end in terms of economic and health impact. For such an event, there are no models or theories that can offer a solution or answer solution (McKibbin and Fernando, 2020).

The International Labor Organization (2021) say that the pandemic has had a disproportionate impact on economic and health activities, with sectors experiencing steep declines (hotels and restaurants, arts and culture, retail trade, and construction) and others with significant growth (IT services, insurance, banking and communications). This divergence will tend to deepen income inequality within countries, especially in the less developed ones.

The strong processes of compulsory and social confinement were aimed at minimizing the spread of the virus, given the lack of knowledge of its biological behavior due to the absence of sanitary tools for its of sanitary tools for its elimination (vaccines, medicines, therapies, etc.). The most widely used argument was that in this way, restrictions on the mobility of people would reduce the number of deaths in the future.

This paper attempts to address the covid problem from a macroeconomic perspective. In this paper I am not going to propose a macroeconomic model in which to explain the development of COVID-19 in just over a year into the pandemic, but rather we have chosen a few macroeconomic articles related to this topic and have tried to give a more general perspective on them. In addition to explaining the articles in order to make them a little clearer, we have given them a more general analysis, which summarizes the factors, the main mechanisms that explain the macroeconomic effects of the pandemic from a more theoretical point of view.
The most important part of the paper is point 5, which has focused on analyzing three macroeconomic papers on COVID-19 at different stages of time. These articles propose macroeconomic models with which, given the information and data they had on the pandemic at that point in time, they propose solutions, macroeconomic policies that could be applied, etc. We thought that choosing articles about the virus at different points in time was a good idea for the simple fact that, as the pandemic has progressed, ideas have changed.

Commenting on the rest of the work, in the second point, I think it was necessary to tell a little about the history of the epidemics. As we will see later, although we are too young to have experienced a pandemic, there have been a few throughout history. There have been a few, but there will be 7 that we will tell in greater depth in this work. We will highlight the Spanish flu, AIDS and the Black Death, the latter being the deadliest to date. It should also be noted that there is little information on many of these diseases.

In point 3, I thought it would be useful to explain a little about the sectors most affected by a pandemic. As we will see in this work, although it is obvious, a global catastrophe such as a virus generates millions of losses, both monetary and human. We highlight sectors such as health or tourism, whose sectors have been severely damaged.

In point 4: The monetary policy response of the European Central Bank to the Covid-19 crisis. In this section we discuss the policies adopted by the EU and the significant role it has played for the euro zone countries. Thanks to the measures adopted, many of the countries have not been so damaged and with a deeper economic recession. The creation of the Pandemic emergency purchase program (PEPP) as a flagship non-standard monetary policy measure created to counteract the economic effects of covid-19.

Spain is within the EU. At this point I thought it was important to show graphs and tables on the main macroeconomic data of the European Union such as unemployment, GDP or inflation. Obviously, a global crisis generates poverty and serious problems, both health and economic. All the graphs we will see below follow a pattern, that of recession. Large declines in the graphs as we experienced, for example, in the 2008 crisis.

2. HISTORY OF EPIDEMICS

Disease is an intrinsic part of human history. We are currently suffering from the coronavirus, but since human beings began to organize themselves in society and to create nuclei of people living together in the same territorial space, contagious diseases took on a special role. As the world population grew, when a disease spread and affected several regions of the planet, becoming a threat to the population, the first pandemics began to be documented. These pandemics sometimes transformed the societies in which they appeared and, quite possibly, have decisively changed or influenced the course of history. We review those that put mankind in check:

1. Plague of Justinian

The Byzantine Empire was at one of its greatest moments of splendor when a plague epidemic appeared. It is the first plague epidemic on record. The disease - and with it fear and hysteria - spread through Constantinople, a city of nearly 800,000 inhabitants, at breakneck speed. And from there to the entire empire. Even Justinian himself fell victim to the plague, although he eventually recovered. By the end of the epidemic, the imperial capital had lost almost 40% of its population, and throughout the empire it had claimed the lives of 4 million people. The economic consequences were catastrophic, as there were times when the number of dead exceeded the number of living.

2. Black Death

The Black Death was already - and still is, as there are active outbreaks today - an old acquaintance when mankind experienced the worst outbreak of this disease in the middle of the 14th century. However, both its causes and its treatment were unknown. This, together with a great speed of spread, made it one of the greatest pandemics in history. It was not until five centuries later that its animal origin was discovered, in this

case rats, which during the Middle Ages coexisted in large cities with people and even traveled in the same transport - ships, for example - to distant cities, carrying the virus with them. The numbers left behind by this epidemic are shocking. For example, according to historians, the Iberian Peninsula would have lost between 60 and 65% of its population, and in the Italian region of Tuscany between 50 and 60%. The European population went from 80 to 30 million people.

3. Smallpox

The so-called variola virus, which has been known to affect humans for at least 10,000 years, is the cause of the disease known as smallpox. Its name refers to the pustules that appeared on the skin of the sufferer. It was a serious and extremely contagious disease that decimated the world's population from the time it appeared, with mortality rates of up to 30%. It spread massively in the New World when the conquistadors began to cross the ocean, terribly affecting a population with very low defenses against new diseases, and in Europe it had a period of dramatic expansion during the eighteenth century, infecting and disfiguring millions of people. Fortunately, it is one of the only two diseases that humans have managed to eradicate through vaccination. It was precisely in the fight against this disease that the first vaccine was discovered. First, Lady Montagu made some key observations in Turkey and, almost 100 years later, Edward Jenner scientifically proved its efficacy. The last case of infection with the virus, which has since been considered extinct, was recorded in 1977.

4. Spanish Influenza

In March 1918, during the last months of World War I (1914-1919), the first case of Spanish influenza was registered, paradoxically, in a hospital in the United States. It was so named because Spain remained neutral in the Great War and information about the pandemic circulated freely, unlike the other countries involved in the war, which tried to hide the data. This virulent strain of the influenza virus spread throughout the world at the same time as the troops were deployed on the European fronts. Health systems were overwhelmed and funeral homes could not cope. Recent studies have revealed more accurate data. It is estimated that the global mortality rate was between 10 and 20 percent of those infected, with between 20 and 50 million people dying worldwide. Some even dare to say that there could have been 100 million.

5. Asian flu

First recorded in China's Yunnan Peninsula, the avian influenza A virus (H2N2) appeared in 1957 and within a year had spread around the world. By then, the role of the World Health Organization (WHO), the medical arm of the UN created in 1948, was to design a vaccine each year to mitigate the effects of influenza mutations. Although medical advances in the Spanish flu pandemic helped to contain the spread of the virus much better, the pandemic resulted in one million deaths worldwide.

6. Hong Kong flu

Only ten years after overcoming the last great influenza pandemic, the so-called Hong Kong flu appeared again in Asia. A variation of the influenza A virus (H3N2) was recorded in this city in 1968 and spread throughout the world in a pattern very similar to that of the Asian flu. One million people were the victims of this new strain of influenza.

7. Acquired Immunodeficiency Virus (HIV)

One of the most serious and recent pandemics known to society today is that of the Acquired Immunodeficiency Virus, HIV, better known as AIDS (Acquired Immune Deficiency Syndrome). The first documented cases occurred in 1981, and since then it has spread throughout the world, concentrating much of the efforts of world health organizations. It is believed that its origin was animal, and its effects are something that could be described as the depletion of the immune system, so that the virus itself is not lethal, but its consequences are, as they leave the organism unprotected against other diseases. It is transmitted by contact with body fluids. Although these routes of transmission make it less contagious, a priori, than other viruses such as influenza, initial ignorance allowed it to spread very rapidly. It is estimated that HIV has caused around 25 million deaths worldwide.

3. Effects of pandemic outbreak on economies: evidence from business history context.

Although medical science has advanced greatly in recent years, the most common infectious diseases such as influenza and malaria still pose a threat to the world's population. While some are endemic in certain regions and do not spread elsewhere, other diseases can spread and become epidemics or pandemics (as in the case of COVID-19). While saving human lives is first and foremost important, the spread of a virus also means changes in terms of national or regional economies.

The data collected in this and many other studies indicate that pandemics have a negative impact on a country's economy through major sectors such as health, transportation, agriculture and tourism. At the same time, and as we have seen throughout this pandemic, trade has been severely affected, and therefore, commercial exchanges between countries have been affected.

These considerations, and factors such as international travel, climate change and rapid urbanization mean that outbreaks are worsening and are not a local phenomenon, but a global one, which means that countries must take measures to curb the pandemic. Throughout this year we have seen several measures adopted in all countries, such as curfews, the use of masks or simply investing in the creation of a vaccine against the virus. These measures have had to be taken in both developing and developed countries.

In the European Union (EU), health responsibilities lie with the Member States. Therefore, the EU's duty is to complement the decisions taken by each Member State in order to help meet the common challenge of a pandemic. In order to do this, member countries coordinate and share best practices together with health experts and with the help, of course, of research funding.

Due to the pandemic we are in, and where some sectors have been very critical of the level of reaction to the pandemic, the European Parliament has taken the opportunity to highlight the need for further action to be more prepared in case it happens again in the future.

A recent article estimates that the total value of losses (including income and high mortality) from a global pandemic could amount to more than $500 billion per year, or 0.6% of global income. The authors of the study estimate that these losses vary according to income groups, with developing countries being the most affected (1.6%) versus developed countries (0.3%). A 2019 report by the ONS and the World Bank estimates that the costs of a pandemic would be between 2.2 and 4.8% of global GDP ($3 trillion). Another article, this time from the International Monetary Fund, explains that the most vulnerable populations, the poorest, are the most adversely affected in a pandemic, for reasons such as having less access to healthcare or having fewer financial resources at their disposal.
Although at the national or regional level everything is negatively affected by a pandemic, some sectors are more affected than others.

Potentially impacted economic sectors

- Health sector and virus containment impacts.

The health sector is the first sector to be affected by a pandemic, both the public and private health system. An increase in hospital admissions causes a large amount of expenditure in a State.

While there are diseases that need less time to cure and have a short-term treatment, in the case of the pandemic in which we live, there are patients who are having a really bad time and need more time of care and even a fairly long stay in the hospital. The cost of the materials necessary for the treatment of this disease, such as masks, respirators, hospital beds, the hiring of more personnel, has been very high.

Another immediate effect observable in a pandemic is the measures that the governments of the countries have to take in order to stop the spread of the virus: in the case of Spain, closing schools, bars/restaurants, reducing the capacity of services such as transportation, etc. The closure of businesses and companies, whether by government obligation or by personal responsibility to ensure that their workers do not become infected, can have repercussions on consumer spending.

- Agricultural sector.

Since the beginning of the pandemic so far there have been no major disruptions in food supply. However, the situation could worsen as a result of logistical difficulties in supply chains, particularly due to movement restrictions between and within countries, and labor problems, especially if they persist over the long term. High-value products and especially perishables, such as fresh fruits and vegetables, meat, fish, milk and flowers, are likely to be particularly affected. In several countries, the health crisis has already claimed numerous jobs in sub-sectors such as floriculture. In addition, there is likely to be a further deterioration in the quality of jobs in the sector and job losses, especially at the bottom of the supply chain. Women and young people are expected to feel the greatest impact of the crisis, as they are particularly exposed to socioeconomic vulnerability.

Movement restrictions may also prevent farmers from accessing markets, resulting in food wastage. In many countries, farmers are currently unable to sell their produce either at local markets or to local schools, restaurants, bars, hotels and other

entertainment establishments due to temporary closures.

The pandemic may also have a strong impact on the production and processing of labor-intensive crops due to staff shortages and temporary cessation of production. Thus, the European agricultural sector is experiencing dramatic labor shortages as border closures prevent the arrival of hundreds of thousands of seasonal workers on farms in need of their services during the harvest season. The impact of the crisis on the sector is expected to be visible in the long term. Some of Europe's major agricultural producers, including France, Germany, Italy, Spain and Poland, are particularly vulnerable. According to Coldiretti, the Italian organization representing farmers, more than a quarter of the food produced in the country depends on approximately 370,000 seasonal migrant workers. However, it is estimated that some 100,000 agricultural workers will not make it to Italy this year, a figure that could be twice as high in France. In Germany, where around 286,000 seasonal migrants work each year in fruit, vegetable and wine production, the government is considering different options to mobilize the number of people needed for the harvest, such as organizing direct flights for agricultural workers and issuing permits for seasonal migrant workers.

- Tourism and travel

Tourism is one of the sectors most affected by the pandemic, especially in countries where tourism accounts for a high percentage of GDP. Governments in these countries have taken measures to mitigate the economic impact on households and businesses. In the long term, this sector will have to adapt to the new life after COVID-19.

Many tourists do not dare to take a plane right now. This is reflected in a report by the UNWTO (World Tourism Organization), in which it estimates that tourism will be reduced by 74% compared to 2019.

The pandemic has caused serious repercussions in countries dependent on tourism. Before the pandemic, tourism accounted for 10% of the world's GDP, a percentage that was higher in tourism-dependent countries.

- On the road to recovery

Sectors such as hospitality, commerce, tourism and automotive are reinventing themselves with new ideas based on digitalization and online sales to boost their businesses.

The large drop in foreign visitors, the loss of employment of thousands of people and local bars and restaurants forced to close because of the pandemic, is a situation in which we will not get out of easily.

The owners of these premises have been forced to innovate and have made use of tools that were already there before the outbreak of the pandemic, but had a low percentage of use: digitization and online sales.
Digitization should help the hotelier to achieve challenges such as being more efficient, improving revenues and helping to differentiate themselves from their competition.

This change has had to be made by retailers for several reasons. To recover lost sales in the physical channel, to reconvert stores into spaces of differentiation and added service and to promote an almost daily agility in online sales with prices, promotions, delivery

conditions, after-sales service and communication with customers.

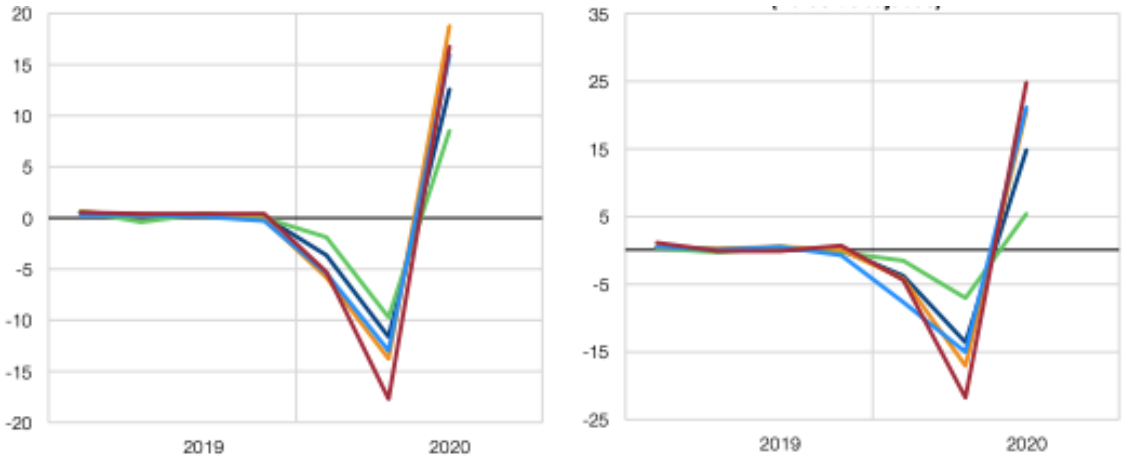
With all the above data and as the best solution to avoid the effects of the crisis, especially in the hospitality sector, there are some companies that have reinvented themselves and have decided to move forward with new proposals to revitalize the business.

This digital transformation process has also reached the tourism and automotive sectors. In the former, which "was little digitized and was very traditional".
The tourism strategy to reactivate itself once mobility is recovered involves using technology to unify the tourist offer and health data and to promote the marketing of the resources of an area on a single platform.
The former responds to a new need. Visitors now demand to know the health situation of the area they wish to visit and the level of preparation of hotels, restaurants, monuments and the rest of the offer.
The second is to take a step beyond the traditional tour operator. It means finding the entire offer of the destination in a single channel.

4. THE EUROPEAN CENTRAL BANK'S MONETARY POLICY RESPONSE TO THE COVID-19 CRISIS.

The year 2020 will be remembered as the year of COVID-19. The arrival of the virus triggered the biggest health and economic crisis in recent history. Its arrival at the end of February caused a sharp reduction in both the supply and demand for goods and services.

QUARTER-ON-QUARTER GDP GROWTH *QUARTER-ON-QUARTER GROWTH IN EMPLOYMENT*



Fuente: Eurostat

This situation has required economic policy actions throughout 2020. Therefore, the European Central Bank (ECB) has played a key role in taking measures to stabilize financial markets and ensure very loose financing conditions for governments, companies and households. These measures have prevented a major impact of the pandemic on the real economy and will also support the recovery.

- **The ECB's monetary policy decisions during 2020.**

The objective of the first economic policy shock measures adopted was to prevent the negative effects of the arrival of the virus from generating persistent effects over time. Fiscal policies were therefore adopted as a first line of defense.

In general, the response of European governments has been excellent against the pandemic and, on this occasion, has been supported by the EU. This support has been and will be essential for a faster recovery at a lower cost.

On the other hand, monetary policy has also acted decisively. COVID-19 broke into the euro area against a backdrop of low inflation and ample monetary stimulus, with benchmark interest rates at historic lows, net new asset purchases under the asset purchase program.

The economic disruption generated by the pandemic and the resulting containment measures was accompanied by a sharp tightening of financial conditions in the euro area. As governments announced plans to contain the disease, financial markets began to discount sharp falls in economic activity and increases in public and private indebtedness. This pushed up risk premiums, i.e. the compensation that bond investors demand for the probability of default by the borrower, with the consequent increase in the cost of financing for governments, households and companies, which would necessarily amplify the fall in aggregate demand and, therefore, inflation. Faced with this situation, the ECB Governing Council acted swiftly to avoid further economic contraction.

Another problem was that government financing conditions vary significantly. This affects the financing conditions of companies and banks. Therefore, in those countries where they have better prospects of repaying their debt, it will be easier to lend and, therefore, borrowing costs will be lower.

The first phase of the crisis affected European countries asymmetrically. Countries such as Spain and Italy, with high levels of public debt, were more affected. The consequence was a much more pronounced increase in financing costs in these countries.

In order to ease these situations, the ECB Governing Council introduced a package of measures in March aimed at asset purchases and liquidity operations. We move on to discuss these measures.

→ asset purchases:

Prior to the pandemic, the ECB already had an asset purchase plan in place. Therefore, a second bond purchase was made in March. With this purchase, and thanks to the great flexibility, the announcement of the creation of the PEPP served to reduce interest rates on sovereign debt.

In short, the PEPP succeeded in halting the deterioration of the euro area's financial markets and easing financing conditions. This relaxation gave the fiscal authorities room to act.

→ Liquidity-providing operations:
The ECB introduced a series of measures aimed at encouraging the provision of bank credit to the real economy of the COVID-19 crisis. Banks are the main source of financing for the population, so it was imperative to avoid a severe contraction in the flow of credit to the real economy. The risk of such a contraction derived from two factors: on the one hand, the possibility of a deterioration of the money markets, which could make it difficult for them to access them, and on the other hand, the distrust of the banks themselves to assume the risks involved in lending.

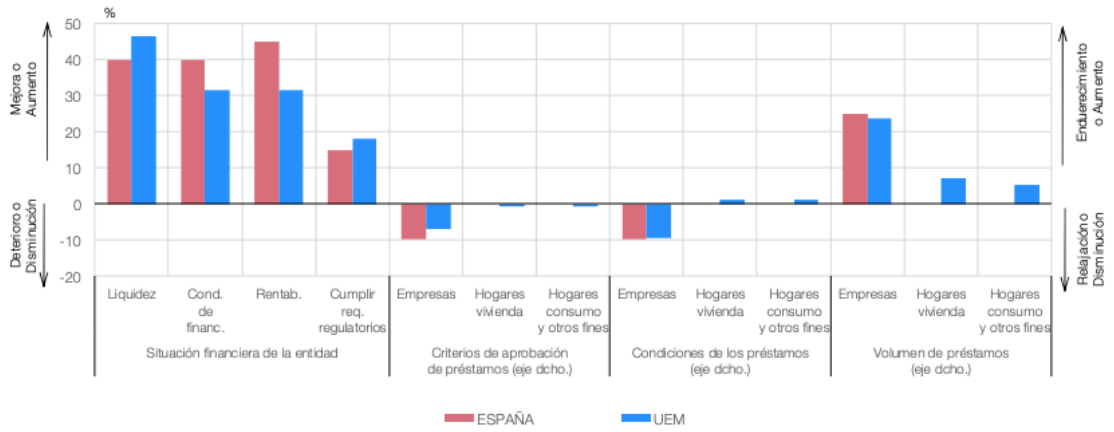
To address the first risk, the ECB introduced a line of longer-term refinancing operations. This measure helped to stabilize the funding costs of the banking sector in the initial phase of the pandemic.

As for the second risk, the ECB already had a tool to encourage banks to provide credit: targeted longer-term refinancing operations with never-before-seen advantageous conditions.

In order to obtain liquidity in Eurosystem refinancing operations, however, participating banks must provide collateral to protect the Eurosystem against possible bank failures. The ECB has therefore relaxed the conditions of its collateral framework to facilitate these measures.

In December 2020, in a context marked by the intensification of the pandemic in the euro area, we decided at the Governing Council to readjust some of these liquidity provision measures in at least three dimensions. First, we decided to recalibrate the conditions of the TLTROs, extending by twelve months, until June 2022, the period during which the subsidized interest rate will apply for banks that meet the lending target. Secondly, we decided to extend until June 2022 the duration of the easing measures of the collateral framework described above, with the aim of encouraging banks to continue participating in the Eurosystem's liquidity operations. And third, it was decided to offer four additional PELTRO operations in 2021, which will continue to provide liquidity support to banks.

The combination of these measures has proved to be a success. All these measures have played a key role in preserving the supply of bank credit in the euro area.



Fuente: Banco Central Europeo y Banco de España

The complementarity of these measures and those adopted by national governments has been decisive in facilitating the flow of financing to the economy during the crisis.

→ Macroeconomic effects of monetary policy measures

Beyond their impact on the financing conditions of companies, households and governments, it is necessary to assess whether all these measures have served their ultimate purpose, which is to support economic activity in the euro area and thus favor the adjustment of inflation towards its medium-term objective.

To assess the macroeconomic effectiveness of monetary policy measures, we can use various macroeconomic models. Estimates and studies suggest that the PEPP would have a positive impact on inflation and on the GDP rate.

However, it is difficult to predict what effects COVID-19 would have had on the economy in the absence of PEPP and the other measures.

On the other hand, the monetary policy decisions adopted by the ECB, and especially those related to the PEPP, are particularly relevant from the point of view of the budgetary policy of the euro area countries, given that they have given the fiscal authorities room to act, in order to maintain the measures to support the economy.

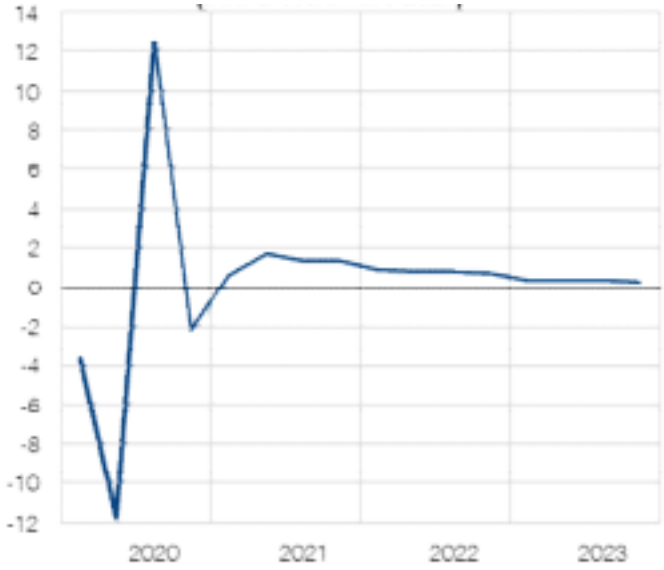
- **Short-term challenges for the euro area economy and the ECB's monetary policy.**

In any case, by mid-2021 it is clear that it is still too early to conclude the economic crisis resulting from COVID-19. While vaccinations are increasingly massive and reduce the likelihood of the most severe scenarios, there is still a long way to go to overcome this crisis.

It is true that economic activity has picked up since the beginning of the pandemic. However, this recovery, which is still partial, is highly heterogeneous, both by geographical area and by branch of activity. This can be seen in that the level of GDP in 2021 is lower than GDP in 2019 at this point in the year.

Moreover, the recovery is fragile. Activity indicators, such as the PMI or the European Commission's economic sentiment index, reflected a certain slowdown in activity, especially in the services sector. As a result, the recovery is uncertain.

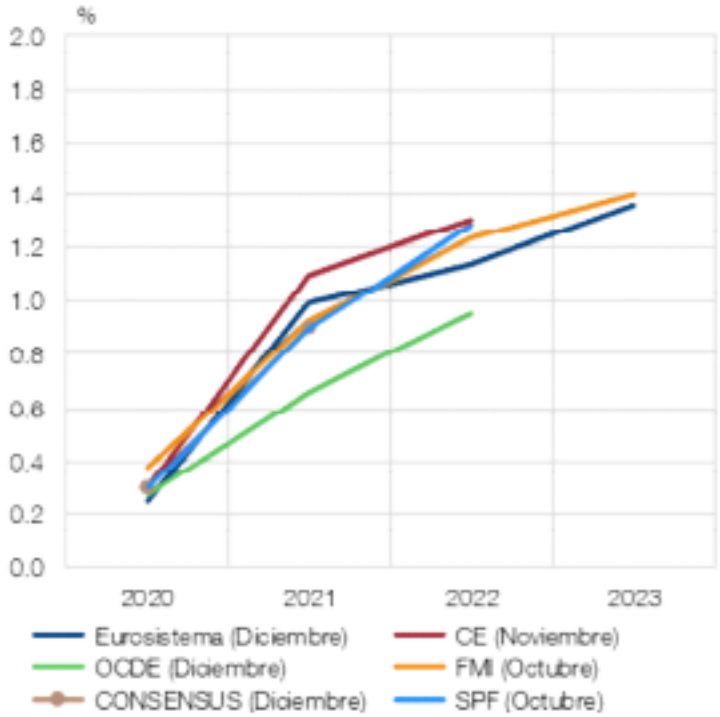
Graphic: EMU quarter-on-quarter growth projections



Fuente: Banco Central Europeo

Furthermore, the Eurosystem's projections show a worsening of growth expectations. Specifically, the pre-crisis GDP level will not be reached until the end of 2022.
As for inflation, they foresee an increase of only 1% in 2021. While forecasts point to a further acceleration of prices in 2022 (1.1%) and 2023 (1.4%), these rates would still remain far away from the ECB's medium-term objective of price stability.

Graphic: euro area inflation forecasts



Fuente: Thomson Reuters Datastream

The containment measures adopted in December 2020 were aimed at maintaining favorable financial conditions during the pandemic and avoiding the recurrence of financial fragmentation in the coming quarters, as well as continuing to preserve the provision of bank financing to businesses and households.

Looking ahead, the high uncertainty and fragility of the euro area recovery, medium-term inflation expectations that are well below our target, and nominal effective exchange rate developments that have offset much of our stimulus in recent months, suggest that there is no room for complacency on monetary policy.

In the case of the PEPP, the objective is to maintain favorable financing conditions during the extended period (see Figure 16), which implies that purchases will be made flexibly, in line with market conditions, and with a view to avoiding a tightening of financing conditions that would prevent counteracting the downward impact of the pandemic on the projected inflation path. Moreover, the flexibility of purchases will be maintained over time, across asset classes and jurisdictions, so as to ensure the smooth transmission of monetary policy and avoid problems of financial fragmentation.

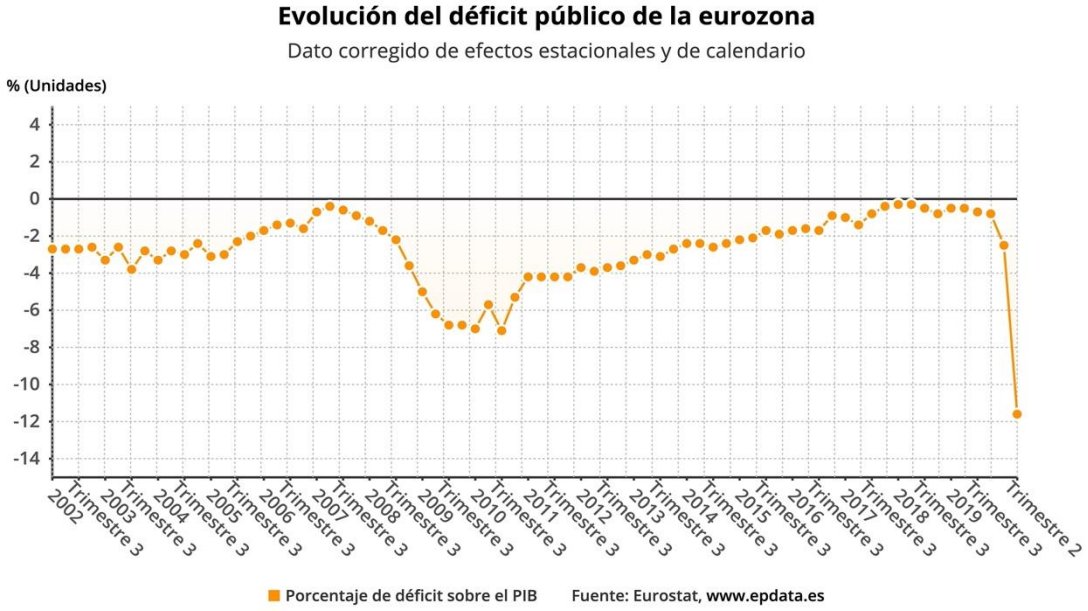
The expansion of PEPP purchases will allow for a continued presence in the market and a more durable support of monetary stimulus. Maintaining favorable financing conditions during the pandemic period will help reduce uncertainty and boost confidence, thereby stimulating consumer spending and business investment.

Finally, all other economic authorities, national and European, will need to understand that, even with mass vaccinations and lower levels of infection and deaths, there is no room for complacency. It is essential to respect the measures adopted by the governments of each country,

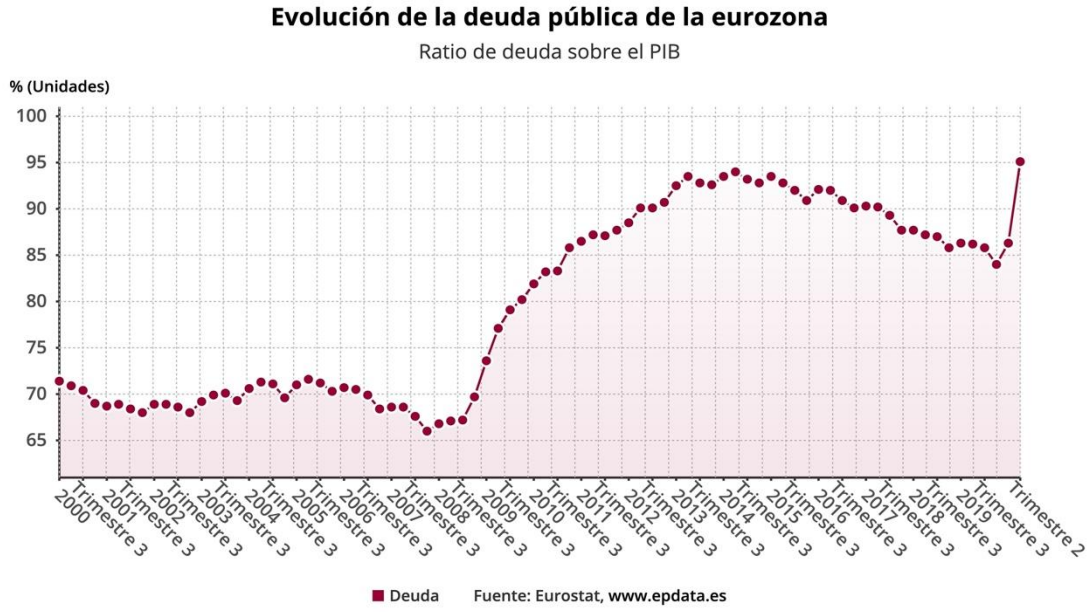
5. MACROECONOMIC DATA OF THE EUROPEAN UNION, IN GRAPHS AND CHARTS

Quarterly evolution of the eurozone deficit and debt

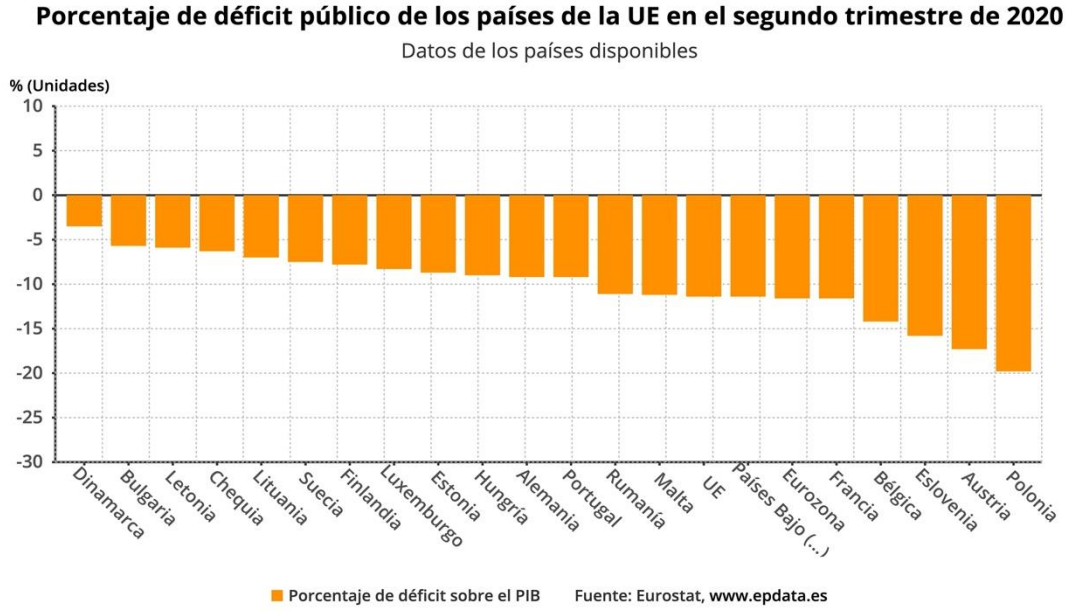
The economic impact of the coronavirus pandemic and of the containment measures implemented in the second quarter of 2020 triggered the euro zone's budget imbalance and public indebtedness, with the deficit reaching a record level of -11.6%, up from -2.5% in the first quarter.



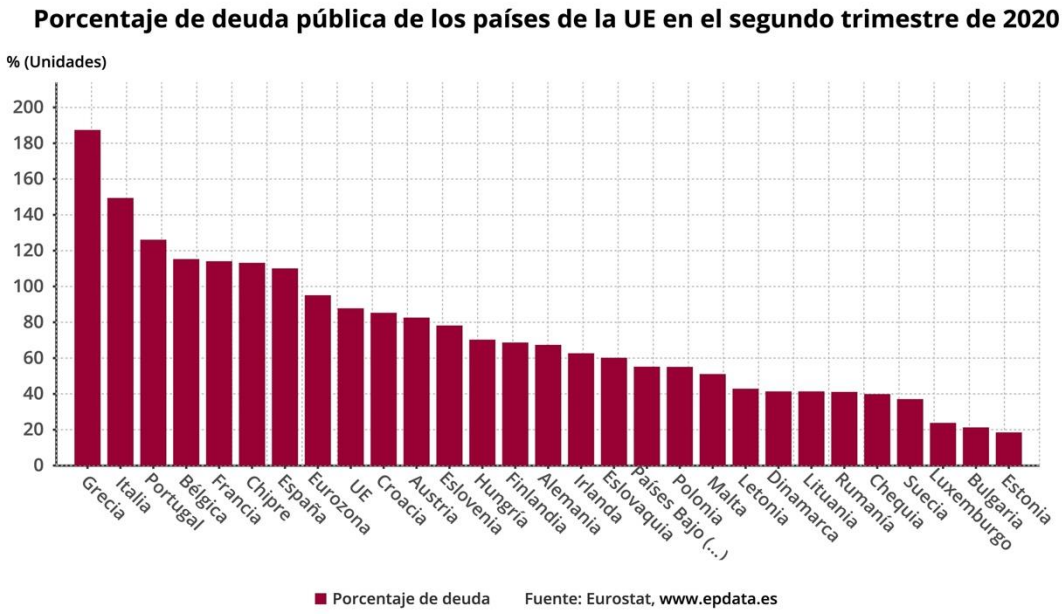
In addition, eurozone debt climbed to 95.1% of GDP from 86.3% in the previous three months, according to Eurostat data.



Among the EU countries, without publishing data for Spain, Italy, Greece or Ireland, the highest deficit ratios in the second quarter corresponded to Poland (-19.8%), Austria (-17.3%) and Slovenia (-15.8%). In the case of Germany, the deficit reached -9.2% from a surplus of 0.4% in the first quarter.



In the second quarter, the highest levels of public debt in the EU corresponded to Greece (187.4%), Italy (149.4%), Portugal (126.1%), Belgium (115.3%), France (114.1%), Cyprus (113.2%) and Spain (110.1%), all of them above 100% and above the Eurozone and EU average, while the lowest ratios were observed in Estonia (18.5%), Bulgaria (21.3%) and Luxembourg (23.8%).

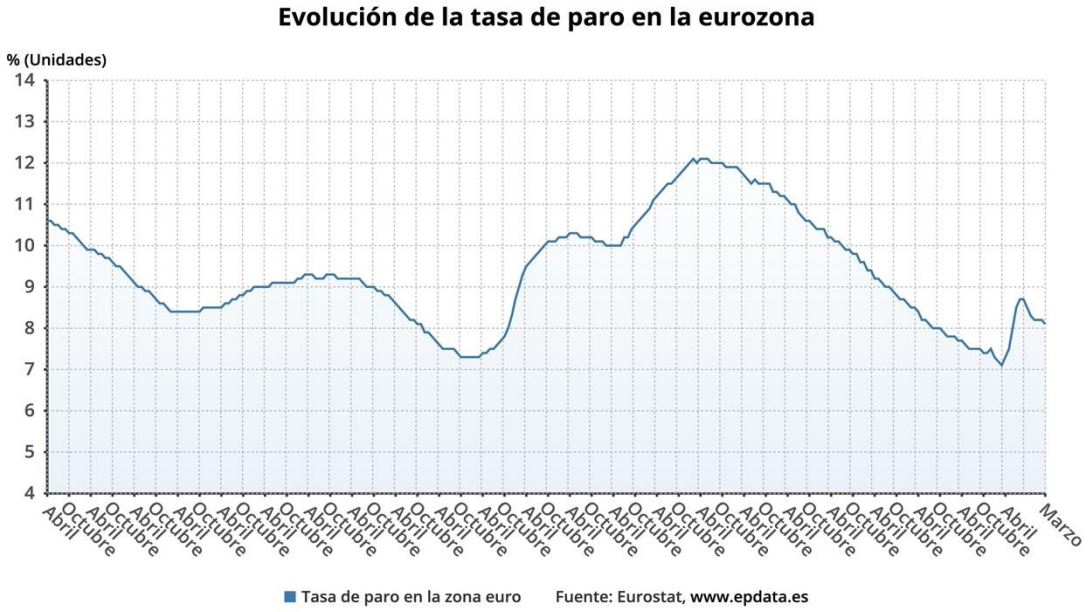


Inflation

The euro zone's year-on-year inflation rate stood at 1.6% in April, three tenths above the March reading, representing the biggest rise in prices in two years, according to the EU statistics office, Eurostat.

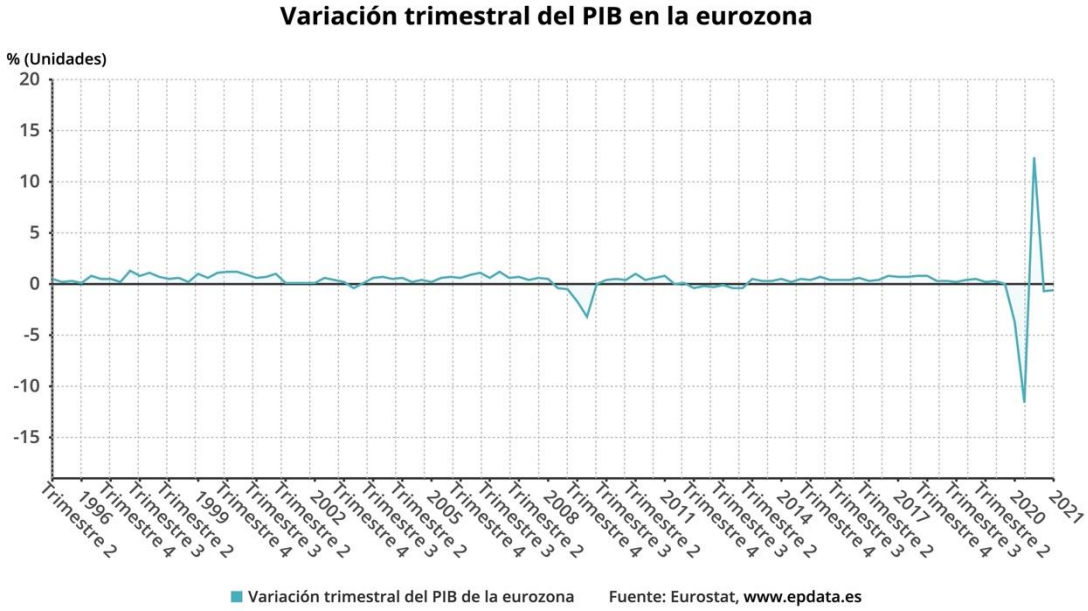
Unemployment

The eurozone's unemployment rate stood at 8.1% last March, down one tenth of a percentage point from the previous month, but up one percentage point from the same month in 2020, while in the EU as a whole it fell to 7.3% from 7.4%, according to the EU statistics office, Eurostat.

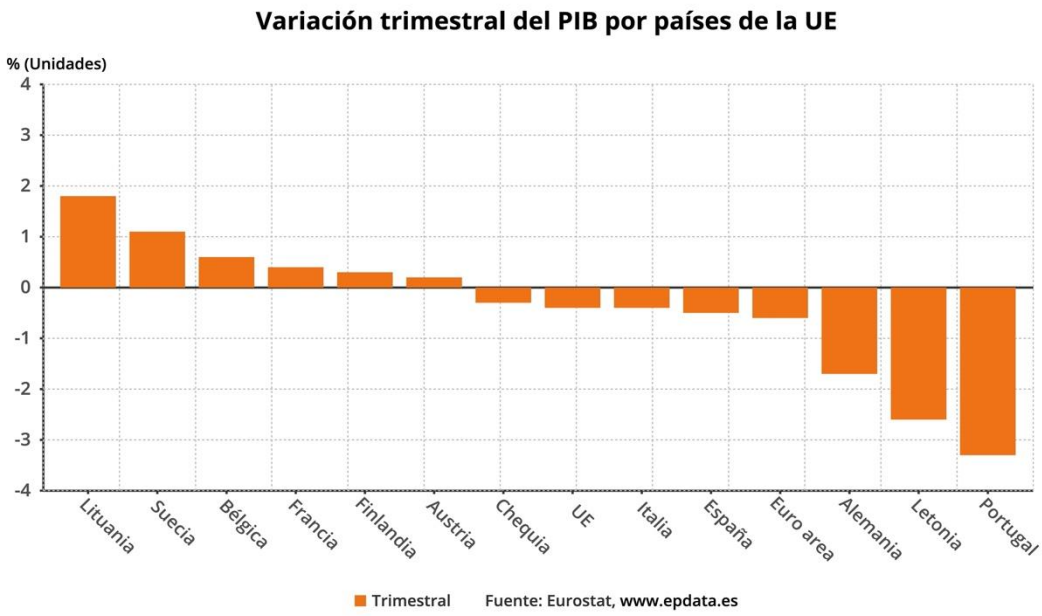


GDP

Eurozone gross domestic product (GDP) contracted by 0.7% in the fourth quarter of 2020 as a result of the impact of the second wave of the Covid-19 pandemic, after rebounding by 12.4% between July and September, leading the region's economy to register a contraction of 6.8% in 2020 as a whole, according to Eurostat's preliminary estimate.

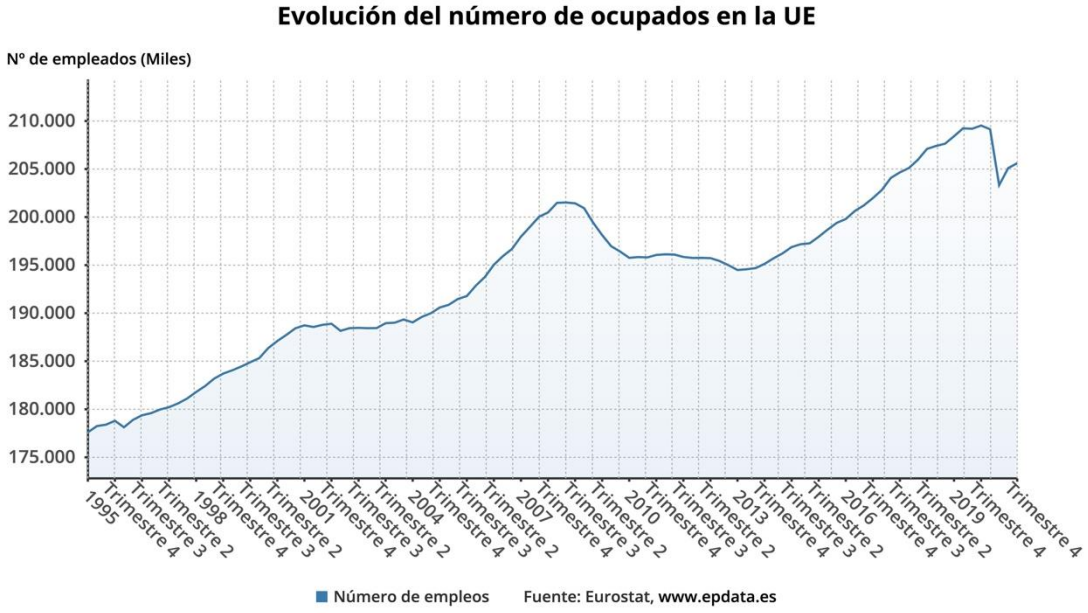


Among the EU countries for which data were available, the largest quarterly GDP declines were recorded in Austria (-4.3%), Italy (-2%) and France (-1.3%), while the most significant GDP increases were recorded in Lithuania (+1.2%) and Latvia (+1.1%).



Employment

The economic slump triggered by the Covid-19 crisis has resulted in the loss of almost four million jobs in the European Union in one year, according to seasonally adjusted data for the fourth quarter of 2020 published by Eurostat, which attributes more than three quarters of the job losses to the euro zone and up to 23% to Spain.



6. MACROECONOMIC EFFECTS OF PANDEMICS: A THEORETICAL PERSPECTIVE.

In this section I would like to explain/highlight some articles that I found curious on different COVID-19 topics.

➔ The first topic I would like to explain is: **Macroeconomic Implications of COVID-19: Can Negative Supply Shocks Cause Demand Shortages?** Veronica Guerrieri, Guido Lorenzoni, Ludwig Atraub, Iván Werning (2020)

This paper presents a theory based on supply shocks that have a greater impact on demand than shock prices. This type of shocks are known as Keynesian shocks.. When we speak of shocks, we refer to changes produced by the pandemic, such as closures, layoffs or firm exits. While in single-sector economies supply shocks can never be Keynesian, in multi-sector economies it is possible. A 50% shock affecting all sectors is not the same as a 100% shock affecting half of the economy. Incomplete markets increase the likelihood of Keynesian shocks and, together with the pandemic changes cited above that amplify the initial effect, exacerbate the recession. A standard fiscal policy may not have the expected effect as business closures mute the Keynesian feedback multiplier. A monetary policy, on the contrary, may have positive effects, preventing firm exits.

This paper argues that a supply shock, in this case a negative supply shock, can lead to demand that alters output and employment more than the supply shock itself would. Temporary negative supply shocks cause a decline in employment and output. An example of this is this pandemic, we know that it is temporary and that when this is over, in theory, everything will go back to the way it was before.
This paper states that supply and demand are intertwined: a supply shock affects demand, which is endogenous. For example, a loss of employment means a decrease in income, reducing spending and causing a contraction in demand.

- **Single Sector:** An infinite horizon model with a single good is shown. Competitive firms produce this good from labor.
In this model we assume that at t=0 employees cannot go to work either because their job requires attention to the public, by choice, of the firm or staff or because political measures prohibit it. In this period, agents cannot supply their work endowment.
At t=1, we assume that agents return to their jobs and can now supply their labor endowments.
We study this assumption separately, for two versions of the model: in an incomplete market and in a complete market. We look for two indicators: the interest rate response and the output response.

- **Complete markets:** We consider a single-sector model with a complete market, i.e., of a representative agent. The negative supply shock causes an increase in the interest rate. If this increase does not adjust, we would find excess demand in the labor market.

- **Incomplete markets:** single-sector model with incomplete markets. The negative supply shock, as before, increases the natural rate of interest. The result of this is an excess demand in the labor market to exactly the same extent as supply. Therefore, the interest rate is not affected, it remains constant.

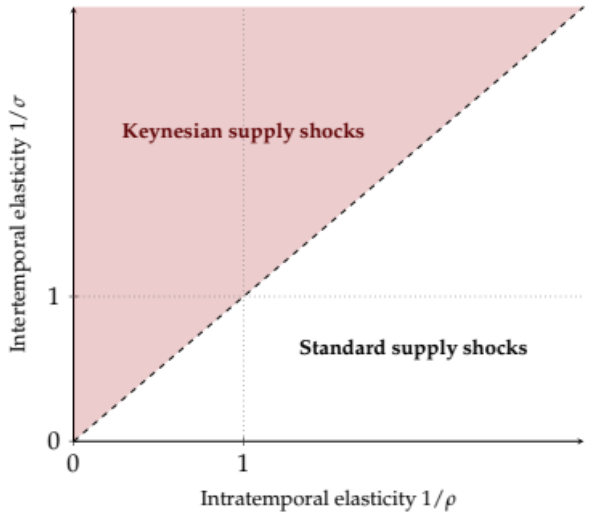
- **Multiple Sector:** We now add more than one sector in the model. The different containment measures against the pandemic have had different effects depending on the sector we are in. For example, the most adversely affected sector has been the service sector, because of the personal contact required.

  In this model, we will now assume that there are two sectors, 1 and 2. We will assume that workers are specialized in each sector. The supply shock in this example will affect sector 1 more, since production and consumption must necessarily require personal contact, something that does not happen in sector 2.

  As before, we will distinguish between complete markets and incomplete markets.

- **Complete markets:** As mentioned above, production in sector 1 stops.

Figure 2: When are supply shocks Keynesian with a representative agent?



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This negative supply shock will affect the natural rate of interest, decreasing it if and only if:

$$\frac{1}{\rho} < \frac{1}{\sigma}.$$

If this interpretation holds true, it means that the two goods are complementary, so that

a decrease in the production of good 1 would result in an increase in the marginal utility of good 2, and would result in a negative demand shock for good 2.
When the above interpretation holds, the central bank decides not to act (either because it is unwilling or unable) and keeps the interest rate at its initial value, then it would cause an inefficient recession in sector 2. When this happens, the economy presents two types of employment losses: the unavoidable ones, directly caused by the shock, and the inefficient ones, produced by insufficient demand in sector 2.
In the case that the interpretation does not hold, goods would be substitutable, so the recession in sector 1 causes a boom in demand in sector 2, wages rise and the central bank is obliged to act by increasing the nominal rate in order to avoid inflation.

- **Incomplete markets:** As in complete markets, in incomplete markets a negative supply shock would imply a decrease in the natural rate of interest if and only if:

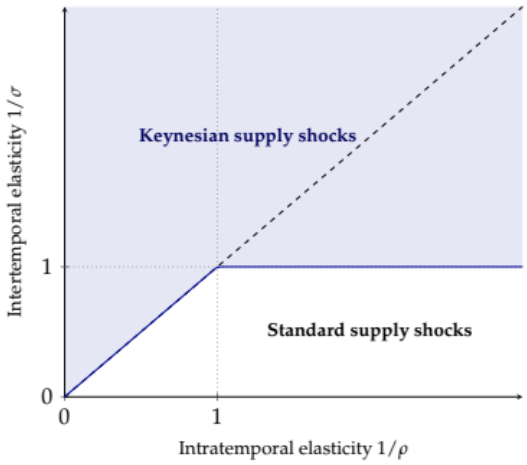
$$\frac{1}{\sigma} > \frac{1-\mu}{1-\phi\mu} \cdot \frac{1}{\rho} + \frac{\mu(1-\phi)}{1-\phi\mu}.$$

Source: pdf article

This expression is similar to the previous one. The only thing is that the incompleteness of the market relaxes the previous condition. In this case it is only required that 1/ σ is greater than the other combination, which usually tends to 1. Then:

$$\frac{1}{\sigma} > 1,$$

Figure 3: When are supply shocks Keynesian with incomplete markets?



Source: pdf article

In the above assumption, labor demand falls below labor supply and causes a recession in sector 2. This is caused because the supply shock has Keynesian effects. In the incomplete market situation aggregate demand is more likely to fall.

- **Fiscal policy in the incomplete market model:** Two possible stimulus policies: increased government spending or a transfer program.

  These policies are less effective than the model posited, since the

spending multiplier is 1 and the transfer multiplier is μ. This is because sector 1 is closed: there is no spending in this sector. Therefore, any spending, either by agents or by the government stays in the hands of workers in sector 2 and not to workers in sector 1.

- **Labor mobility:** In the previous models we have assumed that there was no mobility of workers between sectors. Now we will assume that there is such mobility.

  In the complete market: part of the workers in sector 1 move, temporarily, to sector 2. Expenditure in sector 2 increases and consumption of good 2 is decreasing over time, which requires a lower rate. It is still given that $\rho > \sigma$. However, total employment losses increase due to increased mobility.

  In the incomplete market: In this market there is less mobility than in the previous one. Labor mobility directly affects spending decisions since workers who move to the other sector do not lose their income. At a fixed interest rate, this lower mobility causes a greater recession due to higher income losses. The loss of employment in this case is smaller than in the case of complete markets, as the income effects on demand are weaker in the former.

➔ The second topic I would like to explain is called: **The Macroeconomics of Epidemics.** Martin S. Eichenbaum, Sergio Rebelo, Mathias Trabandt (2020

This paper studies, in general, how the economy changes during an epidemic. Specifically, this paper studies the interaction between economic and epidemic decisions. In the model presented, it is observed how the reduction of consumption and work by the population reduces the severity of the epidemic, in terms of human deaths. These decisions imply a recession of the economy.

The competitive equilibrium is not socially optimal. In the model presented, the optimal policy of containing the virus aggravates the economic recession, but would save half a million lives in the US.

As the virus spreads, more and more information about it becomes available and governments struggle to manage the pandemic. Epidemiological models are very useful in trying to predict the course of the pandemic, but they have an important shortcoming: there is no interaction between economics and infection rates.

In this paper we study the classic SIR model of Kernack and McKendrick, in a slightly more extended form, with the aim of studying the interaction between economic decisions and the course of the epidemic. In this model, it is shown that the reduction of work and consumption reduces the mortality rate, while at the same time aggravating the economic crisis.

In an epidemic, both aggregate demand and aggregate supply are affected. The effects on aggregate supply arise from the direct exposure of workers to the virus, which reduces their labor supply. The demand effect arises because the virus exposes people who consume goods and services and they react by reducing their consumption. Together, the demand and supply effects cause a large and persistent recession over time.

As discussed above, the competitive equilibrium is not Pareto optimal because people carrying the virus do not internalize the effect of their consumption and work decisions on the spread of the virus. This is known as market failure. This does not mean that these infected people have bad intentions or intent to infect the rest of the population, but reflects the fact that each person assumes the infection rates throughout the economy.

One of the most important questions that every economy in the world is asking is what policies the government should take in order to reduce the spread of the virus. Policies such as containment and reduction of working hours, for example, reduce economic interactions, increase economic recession, but increase the welfare of the population by reducing the number of deaths. This paper believes that it is optimal to introduce containment policies that sharply reduce aggregate output, which would save half a million lives in the United States.

With the support of a model that is really simple to understand, the results are really transparent. One problem with this model is that many pandemic-related policy issues cannot be studied. Policies such as those aimed at mitigating household hardship, such as fiscal transfers and the facilitation of lending to prevent many families from going bankrupt. Or policies aimed at maintaining the liquidity and health of financial markets.

Susceptible people.

$$U_t^s = u(c_t^s, n_t^s) + \beta \left[(1 - \tau_t) U_{t+1}^s + \tau_t U_{t+1}^i \right].$$

Source: pdf article

This model also abstracts from the short-term nominal rigidities of, for example, prices. If prices are rigid, the fall in demand would mean an even greater recession, although it would mitigate the spread of the pandemic. This paper does not address this issue. This paper, as stated above, attempts to address the inevitable trade-off between saving lives and a downturn in the economy.

As noted above, the SIR-macro model of Kermack and McKendrick (1927) is used. In this model the probability of transition between health states are exogenous values. This model is modified by assuming that the purchase of goods and work expose people to the virus. These types of activities increase the number of infections. We call the resulting framework the SIR-macro model.

First of all, we choose the parameters of this model with emphasis on Angela Merkel's speech on March 11, 2020. In this speech, the president of Germany said that 60% to 70% of the world's population will be infected if no action is taken. The application of

this speech in the case of the United States would be that some 215 million people would become infected and 2.2 million would die. Applying these data to the SIR model in a general equilibrium framework, the pandemic causes a very mild recession. Aggregate consumption falls by 2% about 29 weeks after the start of the pandemic. In the long run, population and real GDP fall by 0.65%.

The impact of economic activity in the SIR-macro model substantially changes the dynamics of the pandemic and the economic impact it would have. Compared to the SIR model, far more lives would be saved, at the cost of a larger economic recession. Aggregate consumption is reduced four times more than the SIR model (9.1 vs. 2). This greater decline in economic activity, in turn, reduces both the number of deaths (5.1 vs. 8.4%) and the number of infections (52.8 vs. 65%). Thus, the number of deaths in the United States is reduced from 2.2 to 1.7 million people.

An epidemic, in both the SIR and SIR-macro models, ends when, first, a vaccine is found, and second, when the majority of the population acquires immunity. In the absence of treatment or a vaccine, the only way to achieve this immunity is to become infected and recover. This would not be a good option as it would result in many deaths. Herd immunity serves as a backdrop for the debate on optimal policy.

Given the problems of consumption and labor, the optimal policy for the proposed model would be to reduce economic activity. In all the results obtained, the best thing governments should do is to avoid recurrent epidemics. Thus, in the absence of treatment or vaccination, the best option is for part of the population to become infected and recover. But what is the best way to achieve this optimal level?

This SIR-macro model makes it possible to prevent the spread of the virus by applying containment measures. The problem with this model is that it never reaches the level of herd immunity with the objective of extinguishing the virus. Obviously, these containment measures have to be relaxed, they cannot be forever, so the virus would spread again. Therefore, in this model, the optimal approach would be to increase the level of immunization, reducing consumption when the number of infected is large. This policy implies tightening containment measures when the number of cases of infection is high, and reducing them when the number of infections is lower.

Infected people

$$U_t^i = u(c_t^i, n_t^i) + \beta \left[(1 - \pi_r - \pi_d) U_{t+1}^i + \pi_r U_{t+1}^r + \pi_d \times 0 \right].$$

Source: pdf article

Recovered people.

$$U_t^r = u(c_t^r, n_t^r) + \beta U_{t+1}^r.$$

Source: pdf article

One concern in epidemics is the overflow of the health system due to the large number of infected. To analyze this concern, we add a version in which the mortality rate is an increasing function of the number of infected. In this model, in competitive equilibrium,

we find that the recession is greater as the population is more aware of the mortality of the virus. The population further reduces consumption and work in order not to become infected. As a result, in the competitive equilibrium, we find that less of the population is infected, but mortality is higher. Therefore, the policy response is much more aggressive as there is more death.

We assume that the mortality rate depends on the number of infected people, It.

$$\pi_{dt} = \pi_d + \kappa I_t^2.$$

Source: pdf article

If a vaccine is found, how do the results change in this model? First of all, vaccines do not cure the disease, but prevent people from becoming infected. On the contrary, step in a treatment, they cure the disease, but they do not prevent you from getting infected in the future. Treatment or vaccine are not very different in their competitive tradeoffs. Focusing on vaccines, the proposal of this study is the implementation of containment measures with the aim of minimizing deaths. As before, there would be a major economic recession, but by starting to vaccinate the population, this recession would be short term.

$$U_t^i = u(c_t^i, n_t^i) + (1-\delta)\left[(1-\pi_r-\pi_d)\,\beta U_{t+1}^i + \pi_r \beta U_{t+1}^r\right] + \beta\delta U_{t+1}^r.$$

Source: pdf article

The utility of an infected person before receiving treatment is shown. It is observed that with probability (1 - B) an infected person will remain infected at t +1. With probability B the person is treated and cured.

In the case of receiving a vaccine, as before, it is observed that with probability (1 - B) an infected person will continue to be infected at t +1. With probability B the person is vaccinated and gets immunity. Therefore, at time t + 1 this person is identical to a person recovered from the disease.

- ➔ The third topic I would like to explain is: **THE GREAT LOCKDOWN AND THE BIG STIMULUS: TRACING THE PANDEMIC POSSIBILITY FRONTIER FOR THE U.S.** Greg Kaplan, Benjamin Moll, Giovanni L. Violante (2020)

This paper studies a quantitative analysis of the trade-offs between the economic outcomes experienced by different policy responses to the COVID-19 pandemic and health outcomes. A SIR model of the spread of the virus has been developed with a macroeconomic model representing both the evolution of wealth and income, as well as occupational and sectoral heterogeneity. In this model, as in the data, the economy in the pandemic is correlated with financial vulnerability, which has led to very unequal losses in the population. The results obtained show the distribution of economic welfare

costs related to the mortality rate arising from fiscal and containment strategies. All combinations of health and economic policies have been exposed in this paper, we highlight the high and heterogeneous welfare costs. Therefore, we use this model to disprove the fact that it is only the lives that can be saved that matter, but also who can bear such high costs.

The number of deaths in the U.S. is in the thousands and, despite the enormous fiscal stimulus, the U.S. and all countries are in the midst of the largest economic recession in modern history. Given that the economy needs person-to-person contact to function, and that this virus spreads quite easily, both human deaths and economic losses are hardly inevitable.

Exposure and vulnerability of the pandemic: the first fact we can draw from the analysis is that the most financially exposed individuals, those with the lowest incomes, are the most financially exposed.

The key dimension of heterogeneity for financial exposure to the pandemic is occupation. Workers who require physical care and who have little flexibility in telecommuting are the most financially disadvantaged. In contrast, professional workers who produce goods and services that do not require physical attention and who have a high availability to work remotely have not been affected, economically speaking.

Comparing these two labor experiences, we realize the financial vulnerability of households. The three keys to this vulnerability are the size and composition of household balance sheets, eligibility for government assistance, and the ability to increase the supply of employment in order to compensate for the fall in income. These three concepts explain the extent to which pandemic losses result in a fall in consumption and economic welfare.

Earlier we noted that individuals working in occupations that require more social interaction have lower incomes, and that more flexible jobs that do not require social interaction and can be performed from home have higher incomes and wealth. This positive correlation between financial vulnerability and economic exposure to the pandemic tells us that the effect of the pandemic has been uneven across the population. Therefore, it is difficult to implement policies that both contain the virus and mitigate the economic losses of the most disadvantaged.

Integrated heterogeneous agent epidemiological and macroeconomic model: To evaluate all possibilities, a SIR model of virus spread has been integrated into a macroeconomic model of incomplete heterogeneous agent markets.

The epidemiological block of the model consists of a SEIR model a la Kermack and McKendrick (1927) with two features added by the authors: the first is a constraint on the capacity of the ICU, which implies an increase in the death rate; the second is that the rate of virus transmission depends on the choices made by each individual.

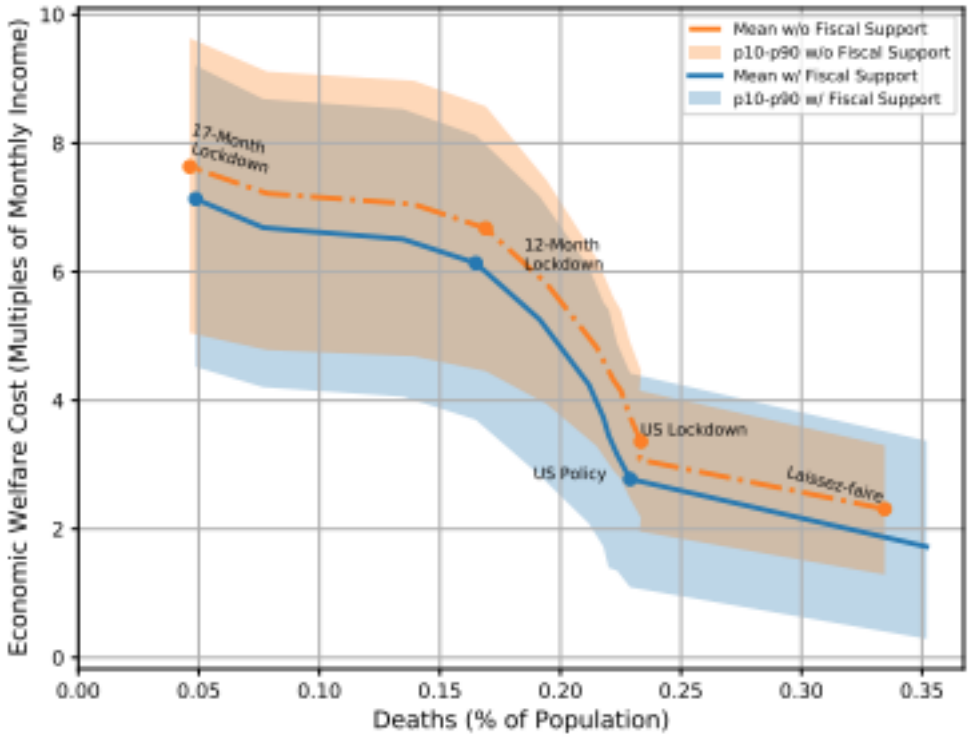
In addition to modeling income risk, individual and portfolio wealth, new values are introduced that, in his opinion, are very important for understanding the development of the pandemic:

- Three types of goods: ordinary, social and home-produced.
- Three types of work: on-site, remote and home-based.
- Work that differs in terms of flexibility for remote work, whether it produces ordinary goods or social goods, and how essential it is to produce necessities.

Finally, the utility or not of working at the workplace and its utility for consuming social goods depend on the duration of the virus. This characteristic indicates a drop in economic activity, even if the physical place of work has not closed.

Pandemic Possibility Frontier: In order to summarize the effects that the policies adopted would have on health and economic outcomes, a production possibility frontier has been used. It shows, for example, how we vary the duration of a block in the workplace and in the social sector, with and without fiscal support. Two different scenarios are shown: deaths from the virus (horizontal axis) and the costs to the living (vertical axis).

Most analyses relate only the welfare loss or the costs of a crisis to the decline in GDP or unemployment. However, this model allows us to look at the other side and see that the losses are unequally distributed among the population, calculating the welfare costs specific to each individual. We measure these costs as the change in each individual's wealth: we look at the change in each individual's wealth, before the pandemic, and during the pandemic, with the economic and health policies adopted. The PPF not only indicates the individual welfare cost, but also the dispersion of these costs. For example, in the image we can see the 10th and 90th percentiles of economic welfare costs, with and without fiscal support.



Source: pdf article

In this figure we find the Pandemic Possibility Frontier that summarizes the main results obtained. Laissez-faire: no blockade or fiscal support. U.S. block: no fiscal

policies. U.S. policies: block and fiscal stimulus. Each point corresponds to closures of different duration.

An advantage of this PPF is that it allows comparing different policy scenarios before and after adopting a measure, without taking the monetary value of life. Instead, it presents how the PPF would vary when applying an economic measure and, therefore, the best option for each moment. The aim is to make decisions that shift the curve inward, thus allowing the same number of deaths with lower economic costs.

Main conclusions: The first conclusion found is that, for any measure, whether economic or health, the costs are very high and heterogeneous. For example, the "U.S. block" item in the FPP shows that, with a 2-month shutdown, the economic welfare losses are higher than 3 months of income. Even in another scenario, "Laissez-Faire, with no standstill and no policy intervention, deaths are higher and the economic costs of the pandemic are at 2 months of income. This is because the public's knowledge of the high number of deaths causes social consumption and the supply of working hours to be reduced.

With or without a block, the highest welfare costs fall on households in the middle part of the income distribution. Households at the bottom are less affected because of their dependence on government transfers. Finally, households at the top work in more flexible jobs. In the Laissez-faire hypothesis only jobs that require physical contact are affected, whereas, with the labor block, these more flexible sectors are also affected.

The second conclusion is that the slope of the PPF varies greatly with the duration of the blockade. This second conclusion resolves the tension between the existence of a balance between lives and livelihoods, placing us at each moment where we are on the border. Two features are fundamental in explaining this nonlinearity: the aforementioned limitation of the ICU and the arrival of a vaccine. The two flatter parts of the border are due to the reduction of time in the ICU (right part) and the announcement of the imminent arrival of a vaccine (left part). The steep part is mainly due to longer ICU times.

The third conclusion found is that the fiscal policy response implemented by the U.S. government succeeded in mitigating economic welfare losses while keeping deaths stable. However, the distribution of welfare was very uneven. These measures redistributed welfare to poorer households, while middle-income households gained rather little. This redistribution, together with the large number of households we find at the bottom of the income distribution, affirms to us that the model works and that labor income has fallen more for poor households than for rich ones.

The fourth conclusion reached is that alternative policies offer better results than lock-ins. Letting workers go to work is shown to reduce welfare costs. One policy option would be to impose a tax on social consumption and those who do not work on the job, which would go to workers who are more rigidly and socially employed. These measures would flatten the PPF (greater trade-off between lives and livelihoods), but would entail a more unequal cost in terms of economic welfare losses, a problem that should be properly managed through good fiscal redistribution.

In drawing the US pandemic frontier of possibilities, we have only looked at the

economic and health measures, block policies and fiscal stimulus policies adopted by the US government. Different alternative policies, such as contact tracing, global PCRs, border closures, etc., have not been evaluated, as these measures have not been adopted at the time of the study. They are only useful for future studies on the evolution of the pandemic.

comments on the articles presented

In this last section of the paper, I would like to identify the common and most relevant elements of the articles presented above.

First of all, all three have developed their own macroeconomic-epidemiological model (SIR-macro model). One from the point of view of saving the economy, the other thinking more about human lives. What should be emphasized is that all the models take into account factors such as supply and demand, degree of exposure to the pandemic of the working population or the policies adopted by the governments of each country.

It is true that the three models proposed by the authors attempt to find an explanation and solution to the effects of the pandemic in different ways. The first one tries to explain the changes that the pandemic has produced in the labor markets, another one prioritizes human lives and the other one prioritizes the economy. But all of them try to explain the effects of the pandemic, they try to predict the future of the pandemic if it is decided to adopt such a measure and above all they study the best decisions that can be taken at each moment in time.

Obviously, they all agree that the most affected sector is the health sector.

All of them highlight the great impact that the virus has had on the population, both in terms of human health and the impact on their working lives.
Major impact of the virus on global production. All countries have seen a reduction in the production of goods and services due to the impossibility of physical contact at work.
Disruption of supply and distribution chains. Countries dependent on the export of products have been severely affected and, consequently, countries that need to import these products have also been affected, delaying and slowing down economic and productive activity.
Financial repercussions on companies and stock markets. The impact on the markets will materialize in negative valuations and an increase in risk. There is less security when taking on financing.

These three articles agree that the arrival of a vaccine would substantially improve their SIR-macro model. In all three articles, they modify their model by applying a variant with the advent of a vaccine. We can affirm that the arrival of the vaccine has been primordial and very important for the authors.

7. CONCLUSION

Covid-19 has been very hard, both at the population level (with all the deaths it has caused) and at the economic-political level.
Other different epidemics have been highlighted in the work, both "current" and older epidemics that had a great impact on the population. But undoubtedly, the COVID-19 pandemic has been the most catastrophic of modern life.

In one way or another, we have all been affected to a greater or lesser extent. For this reason, we have highlighted the most affected economic sectors, such as the health sector (collapse in the ICU, large number of infections and deaths, the need to find a vaccine, etc.), the tourism and hotel sector (fear of the population and governments to travel, pcr requirements before entering a country with the intention of controlling the spread of the virus, etc.) or food imports and exports (quarantines in countries for fear of the spread of the virus, production stoppage, etc.).

Before moving on to the more theoretical framework of the pandemic, I think it was appropriate to explain, above, some of the virus containment measures adopted by both countries (EU) and the European Union. To specify that from the beginning of the pandemic it is considered that the decisions of the European Union and the member countries (in general) have been adequate. The creation of the Pandemic emergency purchase program (PEPP) as a star measure against the spread of the virus should be highlighted.

The repercussions of the virus on the world and European economies can be seen in the graphs shown for GDP, unemployment and inflation. In all the graphs shown, we can observe a long decreasing line, wide recessions, since the arrival of COVID-19, at the beginning of March, and how it is recovering, although at a very slow pace, due to the fact that we have not yet come out of the crisis and the difficulties involved in returning to 2019 levels.

Finally, from a more theoretical framework, three articles have been presented. All of them, using an epidemiological-economic model, try to explain different situations that would provoke, for example, an economic policy or measures to contain the virus. In them, we have observed how: the first article creates a SIR-macro model that explains the changes that would be implied in the markets. In the second article, the SIR-macro model exposed gives more importance to the preservation of the economy than to saving human lives. The third article is the opposite of the second, it gives higher priority to human life and through the model proposes solutions and the negative impact it would have on the economy.

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