UNIVERSITÀ
DI PAVIA

DEPARTMENT OF ECONOMICS AND MANAGEMENT

MASTER PROGRAMME IN FINANCE

The impact of COVID-19 on financial markets

L'impatto del COVID-19 sui mercati finanziari

Supervisor: Prof. Patrizio Tirelli

Discussant: Prof. Xxxxxxx

Student: Martina Soresi

Identification number: 527323

Academic Year 2023-2024

To my family

ENGLISH ABSTRACT

This thesis investigates the reaction of financial markets to the COVID-19 pandemic, exploring its profound impact on global economic stability. The study primarily focuses on how financial markets, particularly equity and bond markets, responded to the unprecedented economic disruptions caused by the pandemic. By conducting a comprehensive literature review, this research synthesizes existing studies on the topic, providing an in-depth analysis of the financial and macroeconomic consequences of the pandemic, as well as the policy responses implemented by governments and Central Banks worldwide.

The methodology employed in this thesis involves a systematic review of academic literature, with the purpose of building a detailed understanding of the effects of the pandemic on financial markets. This approach also facilitated a comparative analysis with the 2008 Global Financial Crisis (GFC).

The results indicate that the COVID-19 pandemic caused strong volatility in financial markets, pushing investors to move towards safer assets. This phenomenon was particularly evident in European markets, where economic uncertainty was more marked than in the United States and Japan.

The role played by individual governments and major Central Banks proved crucial. The introduction of measures aimed at cutting interest rates and the adoption of asset purchase programs allowed markets to stabilize.

By comparing the COVID-19 pandemic and the 2008 Financial Crisis, it is possible to grasp the differences and similarities between the two events. Although both crises were characterized by considerable uncertainty, the pandemic, as an exogenous shock, caused a sharper decline in key economic indicators. Furthermore, the measures adopted to address the COVID-19 emergency have proven to be timelier than those adopted in 2008.

Ultimately, this thesis highlights the importance of adaptable and forward-looking economic policies in managing global financial crises and underscores the need for continued research to understand the long-term effects of such interventions on financial stability and economic inequality.

ITALIAN ABSTRACT

Questa tesi indaga la reazione dei mercati finanziari alla pandemia di COVID-19, esplorandone l'impatto sulla stabilità economica globale. Lo studio si concentra principalmente su come i mercati finanziari, in particolare i mercati azionari e obbligazionari, hanno risposto agli sconvolgimenti economici causati dalla pandemia. Attraverso una rassegna della letteratura, questa ricerca sintetizza gli studi esistenti sull'argomento, fornendo un'analisi approfondita delle conseguenze finanziarie e macroeconomiche della pandemia, nonché delle risposte politiche implementate dai governi e dalle Banche Centrali in tutto il mondo.

La metodologia impiegata in questa tesi prevede una revisione sistematica della letteratura accademica, con lo scopo di costruire una comprensione dettagliata degli effetti della pandemia sui mercati finanziari. Questo approccio ha anche facilitato un'analisi comparativa con la Crisi Finanziaria Globale (GFC) del 2008.

I risultati indicano che la pandemia di COVID-19 ha causato una forte volatilità nei mercati finanziari, spingendo gli investitori a spostarsi verso asset più sicuri. Questo fenomeno è stato particolarmente evidente nei mercati europei, dove l'incertezza economica era più marcata rispetto agli Stati Uniti e al Giappone.

Cruciale si è poi rivelato essere il ruolo svolto dai singoli governi e dalle principali Banche Centrali. L'introduzione di misure volte a tagliare i tassi di interesse e l'adozione di programmi di acquisto di asset hanno infatti permesso di stabilizzare i mercati.

Dal confronto tra la pandemia di COVID-19 e la Crisi Finanziaria del 2008 è possibile cogliere le differenze e le similitudini tra i due eventi. Sebbene entrambe le crisi siano state caratterizzate da una notevole incertezza, la pandemia, in quanto shock esogeno, ha causato un calo più brusco degli indicatori economici chiave. Inoltre, i provvedimenti adottati per far

fronte all'emergenza COVID-19 si sono rivelati essere più tempestivi ed efficaci rispetto a quelli adottati nel 2008.

In definitiva, questa tesi evidenzia l'importanza di politiche economiche adattabili e orientate al futuro nella gestione delle crisi finanziarie globali e sottolinea la necessità di una ricerca continua per comprendere gli effetti a lungo termine di tali interventi sulla stabilità finanziaria e sull'ineguaglianza economica.

INDEX

CONCLUSION

REFERENCES

INDEX OF FIGURES AND TABLES

CHAPTER 1

CHAPTER 2

CHAPTER 4

- Figure 39: *Currency swap lines between the Fed and other central banks*

INTRODUCTION

The COVID-19 pandemic, together with the 2008 Financial Crisis, has been one of the most destabilizing events for global financial markets in recent history.

Strong uncertainty about the global economic outlook has led to severe turbulence in stock markets which, globally, has contributed to increased volatility, reduced stock prices and structural changes in the way investors perceive risk and yield.

The impact that COVID-19 has had on global financial markets has not been the same for all countries: it depends in fact on a set of factors that determine its strength.

A first factor to consider is the economic sector of reference. As we well know, during the pandemic some economic sectors were hit harder than others: for example, the tourism sector recorded a drop in demand following the introduction of the lockdown.

Two further factors of interest are virus containment policies and fiscal and monetary stimuli. In particular, the first refers to the measures adopted by different countries to contain the virus (the faster they were taken, the less severe the economic impact), while the second refers to the fiscal and monetary policies introduced by governments and Central Banks in order to stimulate the recovery of the markets. This recovery was also made possible by the solidity of the financial sector.

We cannot forget investor sentiment: risk perception and investor expectations have caused strong market movements. Initial fear led to massive selling, while optimism about stimulus policies and vaccines aided the recovery.

Finally, the availability of liquidity played a crucial role in managing volatility: markets with high liquidity managed volatility better than those with less liquidity.

While both the COVID-19 pandemic and the 2008 Financial Crisis had devastating effects on global financial markets, there are some key differences between the two events. The 2008 crisis was triggered by structural problems in the financial sector, particularly related to subprime mortgages and the resulting liquidity crisis. In contrast, the COVID-19 crisis was an exogenous crisis, caused by a health event that had global economic repercussions.

Furthermore, the political response to the pandemic was much faster and more coordinated than in 2008. In 2008, it took time for governments and Central Banks to take significant stimulus measures. During the pandemic, however, the reaction was almost immediate, with expansionary monetary and fiscal policies implemented quickly to support the economy and financial markets.

Finally, the recovery of financial markets after the 2008 crisis was slow and gradual, with recovery taking several years. In contrast, after the initial collapse in March 2020, financial markets showed surprising resilience, recovering most of their losses by the end of the year thanks to support from fiscal and monetary policies and expectations of a rapid economic recovery with the arrival of vaccines.

The decision to write a thesis on the financial markets' reaction to COVID-19 is important for several reasons, ranging from increasing academic knowledge to providing valuable insights for the world of investments and public policies.

In particular, studying the economic impact of COVID-19 offers us the possibility to better understand global economic dynamics during the pandemic, highlighting the vulnerabilities and strengths of various economic sectors.

Furthermore, understanding how financial markets' reactions to the pandemic influence decisions in terms of monetary and fiscal policy helps us understand which measures, among

all those implemented to address the negative consequences of COVID-19, are the most appropriate and most effective in times of crisis.

In terms of risk management, the advent of COVID-19 has highlighted the importance of proper risk management in investment portfolios, offering important lessons for the future.

Finally, studying the behaviour that investors have assumed during the pandemic allows us to better understand the motivations behind investment choices, providing important lessons on how investors react in crisis situations.

In summary, analysing the financial markets' reaction to COVID-19 is essential to better understand the pandemic's impact on the global economy, improve risk management, inform economic policies, and prepare for future crises.

In this compilation thesis, I aim to carry out an in-depth review of the existing literature on the reactions of the financial markets to the COVID-19 pandemic and the consequent measures adopted to deal with it. The analysis will focus on how the pandemic has affected various aspects of global financial markets, highlighting their dynamics and vulnerabilities.

The thesis will be structured in four chapters.

In the first chapter I will briefly introduce the context of the COVID-19 pandemic, explaining its origin and the measures that have been taken to contain its spread.

Next, I will examine the reactions of global financial markets, as well as the impact on key macro-economic variables, with a focus on economic growth.

In the third chapter I will discuss the monetary and fiscal policy measures implemented by the government and the main Central Banks to mitigate the effects of the pandemic.

Finally, I will compare COVID-19 with the 2008 GFC highlighting similarities and differences.

Through this thesis, I hope to offer a comprehensive overview of the financial markets' reactions to COVID-19, providing a useful analytical tool to better understand the impact of global crises on markets and to develop more effective risk management strategies.

A BRIEF INTRODUCTION TO COVID-19

1.1 What is COVID-19

The Coronavirus (COVID-19) outbreak in December 2019 in China. More precisely the first city which was hit by the virus was Wuhan, a sub-provincial city of China and the most populous city of Hubei Province.

From China the virus has spread all over the world affecting more than 700 million people and causing the death of more than 7 million people.

The World Health Organisation (WHO) stated that COVID-19 is part of a large family of coronaviruses which cause respiratory infections ranging from the common cold to more severe illness such as the “Middle East Respiratory Sayndrome” (MERS) and the “Severe Acute Respiratory Syndrome” (SARS).

Coronavirus is an infectious disease caused by the SARS-CoV-2 virus. As we said before the virus affects people in different ways: most of them become mildly or moderately ill and heal without any special treatment, however others become seriously ill and require more specific medical care.

The most characteristic aspect of COVID-19 is that regardless the age anyone can get sick and die of that virus.

Coronavirus was declared a pandemic by the World Health Organisation (WHO) on 11th March 2020. By that time the virus had already affected more than 100.000 people all over the world, having killed thousands.

1.2 Measures to contain the spread of the virus

To contain the spread of the virus many countries all over the world have introduced several drastic measures including the social distancing, the ban on travel, and the closure of business and schools.

At the end of March 2020 more than 100 countries had already adopted lockdown restrictions, encouraging people to stay at home.

Further measures were, for example, the obligation to wear a mask outdoors and the obligation to quarantine in case of infection.

At the end of December 2020, the European Medicine Agency (EMA) authorized in Europe the administration of a vaccine against COVID-19. This discovery has contributed substantially to the end of the emergency and the consequent return to normality.

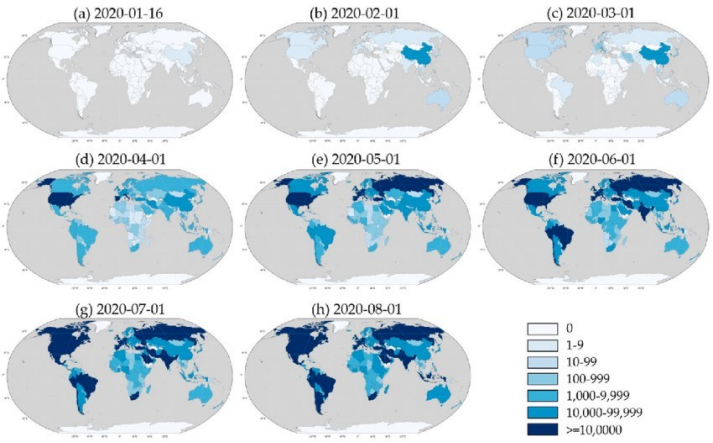

Fig. 1 The spread of COVID-19 across the world
Source: ResearchGate

THE REACTION OF FINANCIAL MARKETS TO COVID-19

In this second chapter I will analyse the reaction of financial markets to the pandemic. I will address in speech in 5 different sections, in which I will study the consequences and effects of COVID-19 on the global economy.

2.1 The impact of COVID-19 on the stock exchange market

Coronavirus is not only an unprecedented human and health crisis, but it is also one of the most economically costly pandemics in recent history.

Literature evidence the significant impact of COVID-19 on the global financial market. As a matter of fact, economists agree that the pandemic affected not only the social welfare, but also the financial market trading.

Using the yield curves of corporate bonds, McCulloch (2020) reach important conclusion about the impact of the pandemic. To do it, he proceeds with the analysis of the yield curves of corporate bonds of different maturities for Germany, France, Italy, and Spain putting them in relation with the progression of the pandemic. The considered sample of corporate bonds is large and can be considered representative for the euro area because the four countries we are considering represent the 80% of the euro area's population, economic activity, and financial markets.

Note that while for Germany and France most of the corporate bonds have low-risk ratings, the same cannot be said for Italy and Spain where, on average, corporate bonds are classified as risky bonds.

On 9th March 2020 , the date of the global stock market crash and of the announce of the lockdown in Italy, there is an acceleration in the growth in yields. Italy, seems to be the country most affected: the five-year yields almost triple over the following days.

Moreover, the pandemic seems to be influencing all maturities, particularly the long-run ones. As a matter of fact, since mid-March 2020 the five-year maturity bonds of all countries have increased significantly. This result allows us to state that the consequences of the COVID-19 are long lasting.

The lockdown of all business and organisations destroyed production, supply chain and financial market activities. The consequence is a fall on the share prices. In this regard, Daily FT (2020) stated that "The Dow Jones, and S&P both of which take into account the share prices of a variety of companies in the US, have dropped by over 20%."

Investors seem to be concerned about the spread of the virus and its impact on the global economy; as the literature suggests, the spread of Covid-19 has led to serious concerns and uncertainties in financial market investments. In fact, the performance of different world financial markets has become too volatile and share prices are falling significantly.

The increase of the number of people affected from COVID-19 as well as the rise of the death had a negative impact on markets. In effect, the spread of the pandemic is responsible to a decline of the stock market indexes and future prices, as well as an increasing in the option prices with a consequent increase in the volatility.

Stock markets started to decline on 20th February 2020. Over the following 4 weeks stock markets losses range between 30% and 40% of its value. They started to rise around the 23rd March 2020, which coincide with the stabilisation of the US dollar. This highlights the strong relationship between the financial markets and the volatility of currencies.

Indeed, currencies, including the dollar, began to lose value from the beginning of the year 2020. The situation then improved towards the end of March, as a consequence of the recovery of the markets.

However, the growing number of infected in Europe has resulted in a spillover of stock markets, with investors moving money away from stocks to safer assets like bonds.

The US and the Japanese stock markets performed much better than the Eurozone stock market. Among all European countries, UK was the one which did worse. The arrival of COVID-19 changed the mechanisms and the dynamics of the stock market in UK with industries which experienced huge financial losses.

Note that stock prices of large capitalized companies did better than mid capitalized firms and much better with respect to small capitalized ones.

The coronavirus crisis emphasizes the inferior position of emerging economies, which have performed much worse than developed economies.

Global investors have been adversely affected by the spread of the virus, so much so that they have decided to liquidate their financial positions, with consequent impact on global markets. In the late March 2020, the European and the US stock indices fell for more than 10%, causing the most widespread global and economic disruption since the Great Depression of the 1930s.

As expected, the stock prices show a downgrade trend with a negative peak in March 2020.

The credit default swaps (CDSs) were originally created for an insurance reason. As stated by Ito (2015) “The buyer of a CDSs makes a series of payments to the seller and, in exchange, receives a compensation payoff if there is a default, whereupon the seller retakes possession of the defaulting bond or loan.” The higher is the credit risk in a country, the higher is the CDS premium. As the pandemic arrived in Europe, the CDS premium growth exponentially in Italy, Spain, and Portugal.

The coronavirus has affected financial markets all over the world. It is responsible of the increasing in the risk level, which has led to huge losses for investors in a short period of time. The main stock market indexes in the US such as the Dow Jones Industrial Average (DJIA) and Standard and Poor's 500 (S&P 500) have dropped significantly.

Between 23rd January 2020 and 6th March 2020, the MSCI World Index, which includes stocks from 23 developed countries and 24 emerging, lost 10.7% of its value. In the same period, STOXX Europe 600 Index, which includes stocks of 600 companies from 17 European countries, recorded a fall of 12 percentage points. The same drop affected the Chinese stock market.

On 18th March 2020, the S&P 500 Index experienced a fall of 27 percentual point, whilst the Germany's DAX was down 38 percentual point, and the Japan's Nikkei was below 29 percentual points.

To study the impact of the pandemic on stock market returns Bahrini and Filfilan (2020) use a panel data regression. Indeed, this is an optimal choice because it allows us to consider both time and cases. Moreover, panel data models are better in capturing the heterogeneity of cases, in reducing estimation bias and multicollinearity.

They consider the following panel data model:

$$SMR_{i,t} = a_0 + a_1 COVID_{i,t-1} + \sum_{k=1}^{k} \beta_k X_{i,t-1}^{K} + u_{i,t} \qquad (1)$$

Where $SMR_{i,t}$ is the dependent variable. It represents the stock market return in country i on day t, which is measured as the daily change in the major stock market index of the country. a_0 is a constant term. The variable $COVID_{i,t-1}$ is computed by one of the four following variables:

1. TOTCC, the daily total confirmed cases per million of population

2. TOTCD, the daily total confirmed deaths per million of population
3. NEWCC, the daily new confirmed cases per million of population
4. NEWCD, the daily new confirmed deaths per million of population.

$X_{i,t-1}^{K}$ is a vector of control variables. It includes: the daily oil prices, the variation in percentage of the volatility in the oil market (measured by the Crude Oil Volatility Index, OVX), and two others factors which measure the global market systematic risk. The latter are the Dow Jones Global Index daily returns (DJGIR), and the S&P 500 volatility Index (VIX).

$u_{i,t}$ is the error term, which can be written as:

$$u_{i,t} = \mu_i + \gamma_t + \varepsilon_{i,t}$$

The latter equation shows that the error term in the panel model can be assumed to be divided into a pure disturbance term $\varepsilon_{i,t}$, and an error term due to other factors.

μ_i indicates the unobservable individual effects, while γ_t denotes the unobservable time effects. When the two terms are equal to zero, the stock market return equation is computed using the OLS method.

The following table (Table 1) presents the summary statistics of the variables just studied.

Table 1

Variable	Mean	Standard deviation	Minimum	Maximum	Observations
SMR	0.125	1.182	−3.830	6.380	315
TOTCC	4624.124	6710.722	37.598	31876.460	315
NEWCC	141.551	161.529	0.000	682.735	315
TOTCD	11.824	11.060	0.196	41.726	315
NEWCD	0.411	0.508	0.000	3.526	315
WTI	27.589	11.978	−37.630	40.460	315
OVX	−0.123	20.685	−46.330	135.770	315
DJGIR	0.263	1.619	−4.610	5.410	315
VIX	−0.462	9.017	−13.170	47.950	315

Note: The values of stock market returns (SMR and DJGIR) and volatility index's variations (OVX and VIX) are expressed in percentage.

Source: Bahrini and Filfilan (2020)

During the pandemic period the mean value of stock return is 0.125, which indicates that on average the GCC stock market shows a return close to zero percent. Focusing on the variable

TOTCC, it's possible to observe that its mean value is more than 4600, while its standard deviation is more than 6710. Finally, the values of the mean and the standard deviation related to the Dow Jones Global Index daily returns, and the S&P 500 volatility index imply that there is a great fluctuation of the global market systematic risks, highlighting the investor's sentiment of fear.

Table 2 displays that all variables Bahrini and Filfilan (2020) have used in their analysis are highly cross-correlated. It reveals also that the estimated correlation coefficient between certain variables is too high and statistically significant at 5%.

Table 2

	SMR	TOTCC	TOTCD	NEWCD	NEWCC	WTI	OVX	DJGIR	VIX
SMR	1.000								
TOTCC	−0.075	1.000							
TOTCD	−0.115*	0.825*	1.000						
NEWCD	−0.096	0.643*	0.531*	1.000					
NEWCC	−0.023	0.891*	0.604*	0.702*	1.000				
WTI	0.088	0.513*	0.565*	0.381*	0.356*	1.000			
OVX	−0.139*	−0.026	−0.020	−0.058	−0.008	−0.548*	1.000		
DJGIR	0.133*	−0.049	−0.056	0.058	−0.031	0.081	−0.189*	1.000	
VIX	−0.134*	0.121*	0.132*	0.013	0.078	−0.071	0.255*	−0.642*	1.000

Note: ** denotes statistical significance at 5% level.

Source: Bahrini and Filfilan (2020)

From the analysis of table 3 and table 4 the two economists put in evidence the fact that there is a negative relationship between GCC stock market returns and the variation in percentage on OVX index and on VIX, during the period of COVID-19 spread.

In table 3 it's possible to see that two different regression were obtained from Model 1 and Model 2. In each regression they add different control variables to avoid collinearity between highly cross-correlated variables. This table displays that all p-values of the F-test are less than the significance level (5%), which implies that regression models fit data better than models with no predictor variables. It also shows that all the results in Model 1 are statistically unsignificant when we are talking about the impact on TOTCC and on SMR.

Table 3

	(Model 1)		(Model 2)	
Variables	SMR	SMR	SMR	SMR
TOTCC	−0.1918 (0.1198)	−0.0871 (0.0643)		
TOTCD			−0.2671* (0.1373)	−0.1309 (0.1314)
WTI	0.0205*** (0.0075)		0.0231** (0.0075)	
VIX	−0.0118* (0.0060)		−0.0108* (0.0058)	
OVX		−0.0069*** (0.0016)		−0.0069** (0.0023)
DJGIR		0.0766 (0.0620)		0.0751 (0.0652)
Constant	0.9931 (0.5146)	0.7565 (0.4717)	−0.0118 (0.3326)	0.3509 (0.3523)
Prob > F	0.0012***	0.0054***	0.0007***	0.0046**
observations	315	315	315	315

Note: *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Robust standard errors are reported in parentheses.

Source: Bahrini and Filfilan (2020)

Table 4

	(Model 3)		(Model 4)	
Variables	SMR	SMR	SMR	SMR
NEWCC	−0.0966 (0.0904)	−0.0447 (0.0823)		
NEWCD			−0.2936** (0.1278)	−0.2785*** (0.0563)
WTI	0.0111** (0.0029)		0.0072 (0.0116)	
VIX	−0.0163* (0.0076)		−0.0168** (0.0068)	
OVX		−0.0066** (0.0015)		−0.0101*** (0.0011)
DJGIR		0.0785 (0.0657)		0.0343 (0.0533)
Constant	0.2281 (0.3309)	0.2970 (0.3537)	−0.2851 (0.4549)	−0.0568 (0.0438)
Prob > F	0.0107**	0.0024***	0.0406**	0.0000***
observations	315	315	315	315

Note: *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Robust standard errors are reported in parentheses.

Source: Bahrini and Filfilan (2020)

The main result they get from this analysis is that during the pandemic period the GCC stock markets responded in a negative way and significantly to the increase in COVID-19 confirmed deaths.

In addition, their analysis reveals that the negative association between investor's fear sentiment and GCC stock market return, implies that this latter declines in GCC countries (i.e. those countries which are oil-dependent economies) when the volatility rises. This means that there is a dependent relationship between the investor's fear sentiment and the GCC stock market.

Finally, they observe a positive relationship between the oil price and the GCC stock market returns, which appears to be dependent on the volatility of oil prices.

Equity markets in the European Union, in the United States, and in Japan fell by 30% of their value. To better understand this decline Gormsen and Koijen (2020) recall that the values of the stock market, S_t, is equal to the discounted value of all future dividends.

$$S_t = \sum_{n=1}^{\infty} \frac{E_t[D_{t+n}]}{1 + \mu_t^{(n)}}$$

Where $E_t[D_{t+n}]$ is the expected dividend in n years from today, conditional on the information available today. $\mu_t^{(n)}$ is the cumulative discount rate for that cash flow. If the stock market is expected to fall, then either future dividends falls or investors will discount future dividends at a higher rate, and so $\mu_t^{(n)}$ will rise.

Shiller (1981) and Campbell and Shiller (1988) show that "The most part of the variation in the value of the stock market is because there are changes in the in expected returns, $\mu_t^{(n)}$." The consequences are both good and bad: good because investors' expectation does not decline dramatically as we thought, bad because our knowledge about growth expectations is still small and circumscribed. On the contrary, our understanding about investors' changes in discounted rates is wide, and we know that it may be driven by shifts in risk aversion, sentiment, or uncertainty of the long-run growth.

Gormsen and Koijen (2020) continue with the analysis of the dividends, which allow them to estimate the growth expectations. As is known, future dividends are contracts that pay the dividends of the aggregate stock market in a certain year[1]. They convert the prices as follows:

[1] Van Binsbergen, and Koijen (2012), Van Binsbergen et al. (2013), Van Binsbergen and Koijen (2017) and Gormsen.

$$P_t^{(n)} = \frac{E_t[D_{t+n}]}{1 + \mu_t^{(n)}}$$

$P_t^{(n)}$ represents the price of the n-year dividend strip at time t. Summing all dividend strip prices, they add to the market: $S_t = \sum_{n=1}^{\infty} P_t^{(n)}$. Data on dividend strip prices appear to be crucial for two different reasons. First, Van Binsbergen et al. (2013) show that dividend band prices give good economic growth and dividend forecasts. Second, dividend bands are differentiated by maturity such as bonds. The latter is particularly useful when we want to estimate future growth and get a lower limit on the forward structure of growth expectations by maturity. Note that the lower limit is forward-looking, so it requires neither a forecasting model nor historical data, it is based only on the assumption that expected returns do not decrease.

Future dividends help us to understand the overall movements in the stock market. At the beginning of the crisis, the stock market drops more than 1-to-7-year dividend strips. This result means that the value of distant-future dividends must have fallen more than the value of near-future dividends. Thus, the prices on the market indicate that discount rates initially experienced a growth in the long-run.

On July 20, the S&P 500 trades at $3.251, which is lower than the peak of $3.386 reached on February 19. This drop can be explained by the fact that the first 10-years dividends have dropped down.

Future dividends must have the same value as before the crisis.

Remember that if long-term expected dividends are expected to be the same as before the crisis, long-term expected dividend returns must also be the same as before the crisis. However, as interest rates have fallen dramatically, the expected return in excess of interest rates is higher than before the crisis.

Figure 2 represents the cumulative return on the stock market in the Eurozone, in the US, and in Japan. Gormsen and Koijen (2020) use the S&P 500 Index as the representative stock index in the US, the Euro Stoxx 50 index in the EU, and the Nikkei 225 Index in Japan.

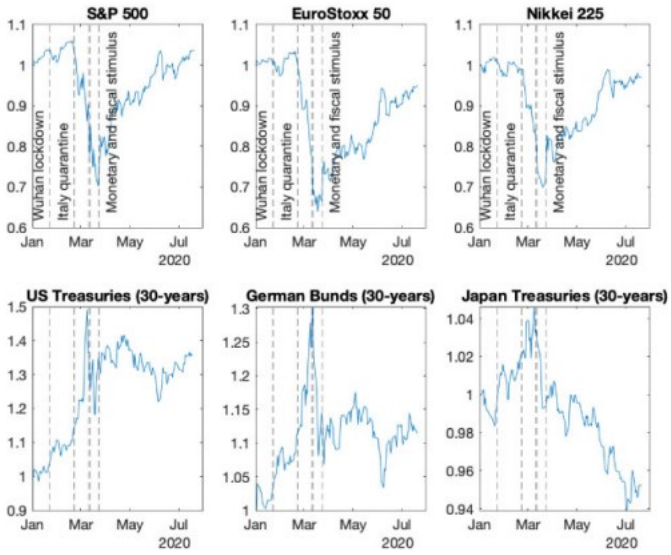

Fig. 2 Cumulative return on the stock market in the Eurozone, in the US, and in Japan
Source: S&P 500 Index, Euro Stoxx 50 index, Nikkei 225 Index, US Treasuries, German Bunds

The bottom panel show the cumulative return on 30-year nominal bonds in the US, Germany, and Japan. After the arrival of the COVID-19 in Europe, around February 29 stock market declined strongly. The situation became worst when on March 12 US government impose a ban on travel to Europe due to the spread of the virus. On that date, the stock market around the world decline by 10%. On March 18 stock market have dropped more than 30% from their peak.

Investors are increasingly looking for long-term government bonds issued by US, Germany, and Japan. In the same period the yield on 30-year US Treasury decreases by a percentage point. Something similar happened in Germany.

To better understand the impact of COVID-19 we must go back to the term structure of dividend prices. The equity term structure are prices of claims to the dividends of all firms in

an index in a certain year. Gormsen and Koijen (2020) rewrite the previous prices expression as follows:

$$P_t^{(n)} = D_t \frac{G_t^{(n)}}{1 + \mu_t^{(n)}}$$

Where $G_t^{(n)} = E_t \left[\frac{D_{t+n}}{D_t}\right]$ is the expected growth rate between years t and $t+n$. Note that we do not observe the dividend future price, which we called $F_t^{(n)}$. The two prices are strictly correlated by the no-arbitrage function: $F_t^{(n)} = P_t^{(n)}(1 + y_t^{(n)})$, which implies

$$F_t^{(n)} = D_t \frac{G_t^{(n)}}{1 + \theta_t^{(n)}}$$

Where $y_t^{(n)}$ is the cumulative $n - year$ risk free interest rate and $\theta_t^{(n)} = \frac{1+\mu_t^{(n)}}{1+y_t^{(n)}} - 1$ is the expected excess $n - period$ return on $n - period$ dividend risk.

Figure 3 shows how the prices on dividend future evolve between January 1 and July 20, 2020.

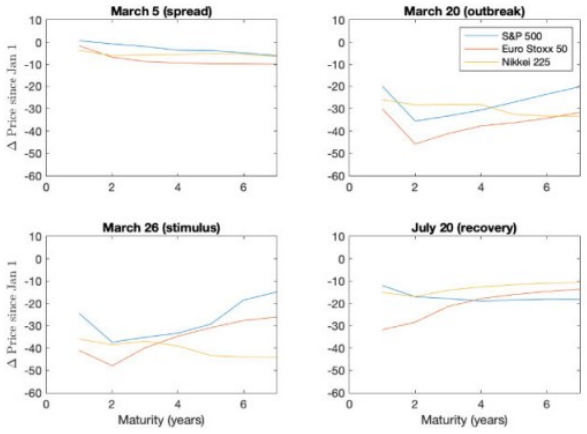

Fig. 3 Prices on dividend future evolve between January 1 and July 20, 2020
Source: S&P 500 Index, Euro Stoxx 50 index, Nikkei 225 Index

In the upper left corner, we can see the cumulative change in prices on 5th March 2020. Prices fell only in the beginning of the pandemic, from 1st January 2020 to 5th March 2020. The most significant collapse is recorded in the equity markets, which dropped by more than 10% in the same period. Dividends fall between 5th March 2020 and 20th March 2020.

The top-right corner displays the change in prices from 1st January 2020 to 5th March 2020. In this specific period, prices go down by more than 40% in the Euro Stoxx 50, and by more than 30% in the S&P 500.

The bottom left exhibits the prices trend from 1st January 2020 to 26th March 2020. Stock markets growth by approximately 10% from 20th March 2020 and 26th March 2020.

The last panel is the bottom right one. Here we can observe the prices from 1st January 2020 to 20th July 2020. Dividend prices rises between 26th March 2020 and 20th July 2020. Stock prices also increase over this period.

Huynh, Dao, and Nguyen (2021) posit that financial markets in countries with higher economic policy and financial uncertainty experience more chaos during the pandemic. Investors were significantly more sensitive to COVID-19 information in mostly wealthy countries as a result of their advances in information technology and communications.

The pandemic has worsened the level of uncertainty, investor confidence, and risk aversion. We want to investigate the effects of the uncertainty related to COVID-19 on financial markets 'volatility.

According to past empirical evidence, financial crisis is preceded by an increase in market volatility. Note that the financial volatility can have different sources, related to economic conditions, institutional issues, and market uncertainty.

Albulescu (2021) considers the financial crisis with a situation in which the S&P 500 daily volatility is higher than a given threshold between 15% and 20%. During the pandemic we assisted to an increase in volatility about 40%, with a peak of 85% on March 2020.

He discovers that both new infected cases and the fatality ratio positively influence financial markets 'volatility. He used the S&P 500 3-month realized volatility index to investigate the US financial markets 'volatility. The first step (Eq. 1) consisted in an implementation of a naïve estimation, while in the second passage (Eq. 2) he considers the US EPU as a control variable.

$$RV_t = c + aCOVID - 19_{t-1} + \varepsilon_t \qquad \textit{Eq. 1}$$

$$RV_t = c + aCOVID - 19_{t-1} + \beta EPU_{t-1} + \varepsilon_t \qquad \textit{Eq. 2}$$

With $\varepsilon_t \sim N(0, \sigma^2)$

Albulescu estimates two models: the first refers to global data, whilst the second refers to US ones. Then, he proceeds with the two types of analyses which investigate the impact of new cases announcement and the consequences of fatality ratio.

Table 5 shows the impact of announcements related to new infection cases.

Table 5

COVID-19 new case announcements and financial volatility.

OLS approach	Model 1 – Global		Model 2 – US	
	Naïve	Control	Naïve	Control
COVID-19$_{t-1}$	0.157***	0.158***	0.048***	0.048***
	[0.008]	[0.008]	[0.006]	[0.006]
EPU $_{t-1}$		0.026		−0.117
		[0.027]		[0.055]
c	2.337***	2.210***	3.591***	3.672***
	[0.093]	[0.165]	[0.064]	[0.261]
R^2	0.877	0.879	0.523	0.524

Notes: (i) 10%, 5% and 1% level of significance is denoted by *, ** and *** respectively; (ii) COVID-19 is associated with the new reported cases.

Source: Albulescu (2021)

Observing the table, it is possible to notice that the coronavirus positively influenced the financial volatility. Moreover, the researcher sees that markets are more sensitive to the COVID-19 spread at global level. Finally, he states that the figures reported at global level have a stronger impact on RV than those reported for the US.

Table 6 highlights the influence of the death rate on financial volatility. The results obtained appear to be in line with what was stated above, namely that COVID-19 had a positive and significant impact on financial volatility. Once again, the mortality rate reported at the global level has a greater influence on the realised volatility of S&P 500 than the US death rate.

Table 6

COVID-19 fatality ratio and financial volatility.

OLS approach	Model 1 – Global Naïve	Control	Model 2 – US Naïve	Control
$COVID\text{-}19_{t-1}$	0.088***	0.088***	0.030**	0.030**
	[0.010]	[0.010]	[0.011]	[0.012]
EPU_{t-1}		0.005		−0.009
		[0.051]		[0.074]
c	3.531***	3.503***	3.923***	3.967***
	[0.062]	[0.245]	[0.047]	[0.348]
R^2	0.595	0.596	0.127	0.128

Notes: (i) 10%, 5% and 1% level of significance is denoted by *, ** and *** respectively; (ii) COVID-19 is associated with the fatality ratio.

Source: Albulescu (2021)

Table 7 shows the impact that COVID-19 had on financial volatility. The results obtained are once again in line with what was previously stated. Note that the effect of the EPU is insignificant, while the figures reported globally have an impact on RV compared to those reported in the United States.

Table 7

COVID-19 new case announcements and financial volatility – robustness results.

RLS approach	Model 1 – Global Naïve	Control	Model 2 – US Naïve	Control
$COVID\text{-}19_{t-1}$	0.108***	0.108***	0.070***	0.070***
	[0.003]	[0.003]	[0.002]	[0.002]
EPU_{t-1}		0.003		0.011
		[0.012]		[0.018]
c	2.879***	2.860***	3.387***	3.325***
	[0.040]	[0.070]	[0.021]	[0.087]
R^2	0.564	0.578	0.372	0.373

Notes: (i) 10%, 5% and 1% level of significance is denoted by *, ** and *** respectively; (ii) COVID-19 is associated with the new reported cases.

Source: Albulescu (2021)

Finally, he makes an RLS estimate considering the impact of the fatality ratio which, even though the effect of fatality appears marginal, remains significant in all cases.

In conclusion, it is possible to say that the volatility linked to the spread of the virus has had consequences both at local (US level) and, above all, at global level.

To better understand the volatility of financial markets we can use the Exponential GARCH models. Yu and Hassan (2008), Rizvi et al. (2018) have relied on asymmetric GARCH model developed by Nelson (1991) suggesting a better adaptation of the EGARCH model for

volatilities. The EGARCH model enables more stable optimization of routines without parameter constraints:

$$ln\sigma_{j,t}^2 = \omega_t + \beta_j \ln(\sigma_{j,t-1})^2 + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right]$$

Where $\sigma_{j,t}^2$ indicates the conditional variance, while ω_t represents a conditional density function. The a symbolizes the symmetric effect of the model, β computes the perseverance in conditional volatility, and γ measures the leveraging effect.

The following table (Table 8) shows the returns and the volatility for the overall period.

Table 8

Statistics for returns and volatility for complete period.

	Daily return				EGARCH volatility			
	Mean	Standard dev	Min	Max	Mean	Standard dev	Min	Max
WRLD	−0.61%	2.73%	−10.44%	5.75%	0.07%	0.11%	0.00%	0.48%
EUR	−0.69%	2.46%	−14.06%	1.81%	39.23%	291.80%	0.00%	2203.55%
USA	−0.59%	3.34%	−12.92%	8.71%	0.11%	0.18%	0.00%	0.93%
ASIA	−0.49%	1.46%	−5.19%	2.75%	0.02%	0.02%	0.00%	0.09%
ITL	−0.77%	3.49%	−20.54%	6.60%	0.45%	1.96%	0.01%	13.21%
SPN	−0.74%	3.07%	−17.22%	5.32%	0.29%	1.24%	0.01%	8.87%
CHN	−0.29%	1.86%	−6.09%	3.79%	0.04%	0.04%	0.00%	0.18%
GER	−0.77%	2.67%	−15.09%	3.69%	0.06%	0.08%	0.00%	0.27%
FRA	−0.74%	2.78%	−14.90%	5.12%	0.07%	0.11%	0.00%	0.39%
KOR	−0.66%	2.97%	−11.00%	10.05%	0.08%	0.10%	0.01%	0.44%
SWZ	−0.38%	2.02%	−11.33%	3.91%	1.03%	5.27%	0.01%	32.17%
UK	−0.85%	2.52%	−14.21%	1.57%	0.05%	0.07%	0.00%	0.22%
BC	−0.31%	6.28%	−31.57%	15.83%	0.29%	0.37%	0.03%	1.53%
WTI	−1.48%	7.31%	−38.83%	21.36%	1.74%	8.19%	0.00%	62.11%
GLD	−0.04%	1.31%	−4.88%	2.59%	0.02%	0.01%	0.01%	0.09%
Trsry	0.12%	0.72%	−2.10%	1.82%	0.50%	0.74%	0.06%	2.95%
S&P	−0.17%	0.83%	−3.42%	0.81%	0.48%	0.97%	0.05%	5.10%

Source: Rizvi et al. (2018)

Analysing this table, we can clearly observe negative returns and higher volatility in all financial securities and commodities apart from the US treasury bonds. This result implies that the investor uncertainty sentiment due to the COVID-19 situation outbreaks.

Table 9 displays how the uncertainty affecting the global markets has increased after March 2020.

Statistics for returns and volatility for epidemic and pandemic times. The Coronavirus (COVID-19) has been classified as an epidemic from its emergence to March 10, 2020. Post-March 10, 2020 it has been classified as Pandemic by as per the World Health Organization.

		Daily return				EGARCH volatility			
		Mean	Standard dev	Min	Max	Mean	Standard dev	Min	Max
EPIDEMIC	WRLD	−0.28%	1.66%	−7.44%	3.27%	0.04%	0.07%	0.00%	0.29%
	EUR	−0.41%	1.49%	−6.92%	1.64%	0.49%	2.30%	0.00%	15.51%
	USA	−0.23%	2.04%	−7.99%	4.77%	0.06%	0.11%	0.00%	0.57%
	ASIA	−0.23%	1.07%	−4.17%	1.90%	0.01%	0.02%	0.00%	0.06%
	ITL	−0.53%	2.09%	−11.01%	2.41%	0.48%	2.10%	0.01%	13.21%
	SPN	−0.47%	1.70%	−7.88%	1.76%	0.29%	1.33%	0.01%	8.87%
	CHN	−0.08%	1.47%	−4.44%	2.81%	0.04%	0.04%	0.00%	0.18%
	GER	−0.44%	1.53%	−7.15%	1.49%	0.04%	0.06%	0.00%	0.19%
	FRA	−0.46%	1.57%	−7.52%	1.69%	0.03%	0.04%	0.00%	0.16%
	KOR	−0.25%	2.02%	−5.61%	3.83%	0.05%	0.04%	0.01%	0.15%
	SWZ	−0.20%	1.29%	−4.58%	2.08%	0.53%	3.43%	0.01%	24.03%
	UK	−0.52%	1.58%	−7.60%	1.57%	0.04%	0.05%	0.00%	0.21%
	BC	0.22%	3.84%	−15.07%	6.96%	0.19%	0.26%	0.03%	1.07%
	WTI	−1.15%	5.89%	−38.83%	9.87%	1.75%	8.81%	0.00%	62.11%
	GLD	0.17%	0.95%	−3.78%	2.59%	0.02%	0.01%	0.01%	0.04%
	Trsry	0.16%	0.54%	−2.05%	1.82%	0.26%	0.44%	0.06%	2.36%
	S&P	0.08%	0.36%	−1.74%	0.81%	0.15%	0.17%	0.05%	0.86%
		Daily return				EGARCH volatility			
		Mean	Standard dev	Min	Max	Mean	Standard dev	Min	Max
PANDEMIC	WRLD	−2.72%	5.97%	−10.44%	5.75%	0.29%	0.10%	0.18%	0.48%
	EUR	−2.42%	5.44%	−14.06%	1.81%	276.49%	778.65%	0.06%	2203.55%
	USA	−2.83%	7.43%	−12.92%	8.71%	0.41%	0.26%	0.21%	0.93%
	ASIA	−2.11%	2.40%	−5.19%	2.75%	0.07%	0.02%	0.05%	0.09%
	ITL	−2.27%	8.13%	−20.54%	6.60%	0.26%	0.54%	0.01%	1.58%
	SPN	−2.41%	7.26%	−17.22%	5.32%	0.25%	0.35%	0.01%	1.03%
	CHN	−1.54%	3.33%	−6.09%	3.79%	0.05%	0.04%	0.01%	0.10%
	GER	−2.85%	5.98%	−15.09%	3.69%	0.20%	0.04%	0.14%	0.27%
	FRA	−2.48%	6.44%	−14.90%	5.12%	0.30%	0.06%	0.21%	0.39%
	KOR	−3.18%	5.90%	−11.00%	10.05%	0.28%	0.11%	0.14%	0.44%
	SWZ	−1.50%	4.46%	−11.33%	3.91%	4.12%	11.34%	0.01%	32.17%
	UK	−2.90%	5.35%	−14.21%	1.26%	0.16%	0.04%	0.11%	0.22%
	BC	−3.66%	14.25%	−31.57%	15.83%	0.19%	0.26%	0.03%	1.07%
	WTI	−3.53%	13.69%	−27.99%	21.36%	1.75%	8.81%	0.00%	62.11%
	GLD	−1.34%	2.32%	−4.88%	2.45%	0.02%	0.01%	0.01%	0.04%
	Trsry	−0.14%	1.41%	−2.10%	1.74%	0.26%	0.44%	0.06%	2.36%
	S&P	−1.70%	1.20%	−3.42%	0.73%	0.15%	0.17%	0.05%	0.86%

Table 9

Source: Rizvi et al. (2018)

European markets appear to be deeply affected by the crisis, with negative returns higher than in other markets. A possible explanation can be sought in the impact that the pandemic has had on sentiment, which caused a delinquency of the markets and increased volatility (Engelberg and Parsons, 2011; Peress, 2014; Donadelli, 2015). Another possible reason for this sudden fall could be that most European countries have announced the closure of all non-existent economic activities, with a negative effect on the markets.

In terms of regional indices (Figure 4), Asia recorded the lowest volatility, on the contrary Europe displays the highest volatility.

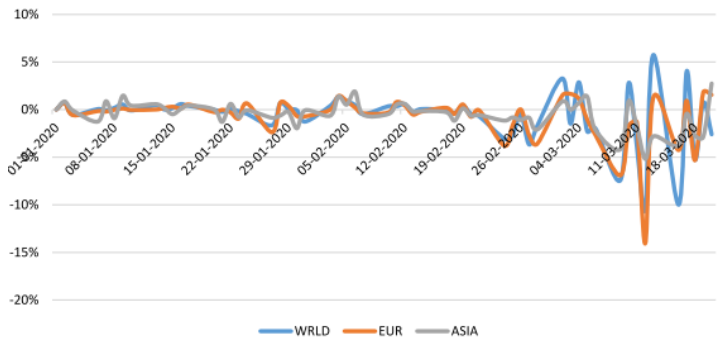

Fig. 4 Market volatility
Source: Rizvi et al. (2018)

In the last table (Table 10) it is possible to see a strong correlation between bond yields and COVID-19 deaths. The fact that stock volatility is positively dependent on deaths means that stocks become more volatile the more people have died as a result of COVID-19.

Bivariate regression (Independent variable: Covid19 deaths). This table shows the bivariate relationship between returns and volatility of different financial securities and Covid19 deaths.

Bivariate regression (Independent variable: Covid19 deaths)				
Dependent variable	Returns		Volatility	
	Coef.	t-stats	Coef.	t-stats
WRLD	−0.0017557*	−1.85	0.0001745***	5.19
EUR	−0.001646*	−1.93	0.001327*	1.61
ASIA	−0.001273**	−2.59	0.0000416***	6.04
ITL	−0.0018846	−1.54	0.0010003	1.44
SPN	−0.0017041	−1.59	0.0006576	1.49
CHN	−0.0009452	−1.45	−5.89E−06	−0.43
GER	−0.0018756**	−2.04	0.0001397***	6.76
FRA	−0.0016853*	−1.74	0.0001647***	5.32
KOR	−0.0018842*	−1.83	0.0001531***	5.24
SWZ	−0.0011381	−1.61	0.002421	1.29
UK	−0.0018748**	−2.17	0.0001209***	6.79
USA	−0.0018173	−1.55	0.000244***	4.2
BC	−0.0035129	−1.6	0.000511***	4.45
WTI	−0.0025533	−0.98	0.0034437	1.18
GLD	−0.000548	−1.18	4.29E−06	1.01
Trsry	6.65E−06	0.03	0.0010561***	4.75
S&P	−0.0007713***	−2.76	0.0011414***	3.69

*p < 0.1.
**p < 0.05.
***p < 0.01.

Source: Rizvi et al. (2018)

Table 10

Diebold and Yilmaz (2015) show that "An increase in market volatility is a reflection of an increase in connectedness across different assets."

Between January and March 2020, the energy sector is one of the most affected by the crisis caused by the advent and spread of COVID-19. Energy prices have suffered particularly during this period and these negative shocks have spread further to other sectors of the economy.

The energy sector presents itself as a potential multiplier of shocks due to the links between oil prices and the rest of the economic sectors. The impact of the energy sector on other economic sectors depends largely on their dependence on energy consumption. For example, a positive oil supply shock negatively affects sectors that are more dependent on oil, such as the transport sector. By contrast, industries that obtain a significant share of their revenues from oil products such as oil and gas usually present a positive exposure of the oil price.

Another consequence of interconnectivity between economic sectors is equity valuation. Through the spillover mechanism, large idiosyncratic shocks by a leading sector are likely to

affect not only the volatility of equity valuation in that sector, but also the volatility of equity valuation in other sectors. Links between economic sectors also affect portfolio allocation due to the presence of asymmetric propagation structures, which influence the effectiveness of portfolio diversification (Zareii, 2019).

Table 11 allows the researchers to have a wider overview of the volatility in each economic sector. What emerges is that the most affected by the pandemic are the Banking-Insurance, and energy sectors.

Secondly, the Health Care and Pharmaceuticals sectors exhibit volatility that is, on average, lower than for the other sectors. This is easily explained by the fact that these sectors are usually anti-cyclical and, consequently, more stable under the market turmoil. Finally, as regards the biotechnology sector, volatility remains high throughout the period (from 2003 to 2020).

Table 11

Summary statistics: Log of annualized asset return volatilities by sector of economic activity.

	Health Care	Pharmaceuticals	Biotechnology	Banking & Insurance	Cyclical sectors	Technology	Energy
Mean	1.20	1.24	1.40	1.29	1.33	1.31	1.49
Median	1.17	1.23	1.39	1.23	1.28	1.28	1.45
Maximum	1.98	1.93	1.99	2.09	2.05	2.01	2.20
Minimum	0.73	0.67	1.05	0.85	0.96	0.95	1.09
Standard Deviation	0.17	0.18	0.16	0.24	0.18	0.17	0.18
Skewness	1.36	0.53	0.42	1.21	1.20	1.04	1.09
Kurtosis	2.72	0.87	0.20	1.20	1.32	1.57	1.93

Source: S&P 500 Index

The following graph (Figure 5) shows what has just been described.

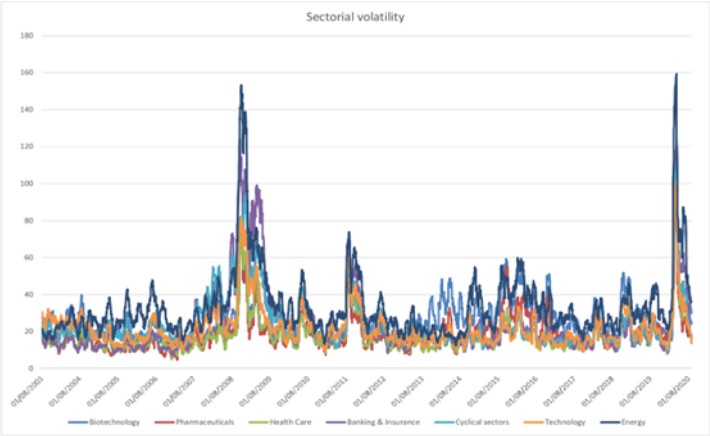

Fig. 5 Sectorial volatility
Source: S&P 500 Index

2.2 The consequences of COVID-19 on economic growth

Despite the crucial role of lockdown in containing COVID-19, we cannot fail to consider the negative effects of this measure. As a matter of fact, if on the one hand containment measures save lives, on the other hand they impose constraints on crucial economic sectors. The closure of commercial activities has led to the dismissal of many people, who from one day with the other have found themselves without the necessary income to live and to afford subsistence consumption. This allows us to state that optimal containment measures depend on the country characteristics, in particular the income level and the poverty rates, that affect the fraction of population made of poor people.

It is possible to conduct an analysis of economic tip in which we consider the trade-off between the lifesaving measures and their repercussions on the economy. In proceeding with this analysis, Bloom, Kuhn, and Prettner (2020) use a metric variable called VLS (Value of a Statistical Life), which however highlights some incompatibilities with the values and ethics that society imposes. In particular, the VLS declines with age and increase with income, so a disease that kills mainly older people or poor ones would be associated with comparatively low losses in term of VLS. This highlights the limits of the economic analysis when it comes to social rules and to ethical responsibilities that provide an adequate protection for the most vulnerable part of the society.

To better understand the consequences of COVID-19 on economic growth and prosperity is important to bear in mind the ways by which health affects the economy taking into consideration the possible difference that can be between a rich country and a poor one.

Generally, a better health system implies:

1. A greater supply of productive labour and so higher incomes;

2. Higher life expectation and lower morbidity, which tend to increase schooling and human capital;
3. Higher saving and level of investment, due to a longer expectation of life;
4. Lower fertility.

In low-income countries, a lack of access to health care contributes to the spread of the pandemic. These countries face the risk of remain in a vicious circle that link low income, the absence of investment in schooling and health system, and high fertility. This shows the importance of investment in health: thought such investments low-income countries can promote and support the economic development.

Generally, it is possible to affirm that countries with a poor health care system are trapped in a "Malthusian stagnation equilibrium." In such a setting, negative health care system can have a massive negative effect on economic growth by either perpetuating the stagnation, or by pushing the economy back to a poverty level[2].

In high-income countries, a full access to a good health care system can mitigate the negative health socks. Indeed, if we think about COVID-19 we can say without any doubt that the use of specific machines such as the mechanical ventilator have proved to be essential for the survival of many patients. The availability of this type of medical equipment is higher in wealthy countries whose economic availability is higher; these machines are in fact very expensive.

Summing up, Bloom et al. (2020) state with certainty that high-income countries show a large wiliness to pay for a better health care system, albeit expensive, to contain the mortality and

[2] Lagerlöf, 2003; Momots et al., 2005; Chakraborty et al., 2010

thus the spread of the virus. Recent studies had demonstrated that this wiliness to pay a higher price for the best health care is totally justified in terms of social welfare[3].

There are two main approaches to estimate the direct consequences of health on the economic growth from an empirical perspective. The first method is called "Micro-based approach," which use a well-identifies wage regression to isolate the effects of health on individual earnings. The results are then aggregated over the whole population to understand the effect of health on macroeconomic performance. The second method is called "Macro-based approach" which utilizes conditional convergence regressions to estimate the impact of a better health on the growth rate of economy. Comparing the two methods we can surely affirm that in the "Macro-based approach" the effect of health on the economy are greater with respect to the "Micro-based approach." The explanation is simple: while macro-based estimates show a propensity to include indirect effects of health on schooling and saving, micro-based estimates do not consider them by construction.

Bloom et al (2020) estimate that "macro-based estimates imply that a 10-percentage-point increase in adult survival rates leads to a 9.1% increase in aggregate labour productivity."

Several are the approaches and the methods which can be implemented to evaluate the economic burden of illness:

a) The "Cost-of-illness approach" (COI) considers the economic burden of a disease by taking into account all direct and indirect costs caused by the disease over a well-defined time period. Personal medical and non-medical costs and non-medical care costs are embedded between the direct costs, while the loss of income of infected individual is included between the indirect costs. This approach is a very simple one

[3] Hall and Jones, 2007; Jones, 2016; Kunh and Prettner, 2016; Frankovic and Kuhn, 2018; Fonseca et al., 2020; Frankovic et al., 2020

and helps us in our cost-benefit analysis. However, this method is a mechanical one which does not consider general equilibrium adjustment mechanisms at the macroeconomic level, as well as the individual behaviour changes and policy measures implemented to contain the spread of the virus.

b) The already known "VLS approach" which refers to the value that people attach to their lives by estimating their intention to take risks in wage regression or, alternatively, their wiliness to pay to decrease the level of risk[4]. As the previous methos, also the VLS one does not embed the general equilibrium repercussions and behavioural changes.

c) A method which considers the macroeconomics adjustment is the one based on convergence regressions. In this approach, economic growth is regressed taking into account the disease of interest and many relevant variables[5]. However, this method has some negative aspects that cannot be left out, among the many, we remember for example the huge number of data that we need, and the fact that it is a method usable only for serious diseases (such as COVID-19) with large-scale effects.

d) Bloom et al. (2020) propose another different approach based on the calibration of the human capital augmented production function considering specific data of mortality and morbidity of the disease under study.

[4] Viscusi and Aldy, 2003; Murphy and Topei, 2006
[5] Durlauf et al., 2005; Eberhardt and Teal, 2011

2.3 The impact of COVID-19 on education, productivity, capital accumulation

Infectious illnesses, such as COVID-19, can impact on human capital accumulation in a variety of ways including the school closure, the impossibility of access to medical treatment and the changes in the expected benefits of going to school. Because of their long-term nature, investments in human capital are the less influenced by infectious diseases.

Bloom, Kuhn, and Prettner (2020) hypothesize that at time t individuals can invest an amount e_t into education facing a cost $k_t > 0$, the human capital will be $h_t = \theta^i f(e_t)$ with $f' > 0$. Remember that θ^i with $\theta^I \leq \theta^S = 1$ emphasizes the strong relationship between education and health.

The first-order condition for the choice of e_t is given by the following function:

$$\rho(1-\mu_t)[\alpha_t I_t \ \varphi^I \ w_{t+1} \ \lambda^I_{t+1} + (1-\alpha_t I_t) w_{t+1} \lambda^S_{t+1}] f' - k_t \lambda^S_t = 0$$

Optimally, the expected return to education must be equal to the cost-weighted current value of wealth. In this specific case, the expected return increases with general survival and it is subject to the probability of contracting the virus.

When $\varphi^I \ll 1$ implies a drag on the returns to education and so the accumulation of human capital, a drag that increases if the probability of contracting the virus is greater. When $\lambda^I_{t+1} \gg \lambda^S_{t+1}$ the infection becomes an incentive to invest in education.

Finally, it is possible to note that infectious diseases, such as COVID-19, may raise the cost of education.

For an individual who is already infected, the first order condition is the following:

$$\rho(1-\mu_t)(1-\mu^I_t)[(1-y_t)\varphi^I w_{t+1}\lambda^I_{t+1} + y_{t+1} w_{t+1} \lambda^R_{t+1}]\theta^I f' - \lambda^I_t = 0$$

This function implies that the return to education and the incentive may decrease if the morbidity lowers the education, $\theta^I < 1$.

The production function is just a function according to which the inputs aggregate physical capital (K_t) and aggregate human capital (H_t) combine to produce aggregate output (Y_t).

$$Y_t = F(K_t, H_t)$$

The aggregate human capital is the product between the aggregate labour supply (L_t), the average human capital (h_t) and the average disease-specific productivity (φ_t), such that:

$$H_t = h_t \varphi_t L_t$$

Average human capital is calculated by the quantity and the quality of schooling and work experience.

If we assume to be in a closed economy (i.e. an economy that does not participate in international trade) the aggregate output equals the aggregate income. The three researchers exhibit that the aggregate output/income can be save or consume such that the aggregate capital accumulation is given by:

$$K_{t+1} = Y_t - C_t - G_t + (1 - \delta)K_t$$

Where C_t is the aggregate private consumption, G_t is the aggregate private or public resources use for education or health, and δ is the depreciation of physical capital.

Pandemic influences directly human capital, and indirectly the labour supply and the education level. Has been demonstrated by Bloom at al. (2020) that the mortality rate of a disease reduces human capital and the output level in the short run. The extend to which human capital is reduced depends on the mortality, the incidence, and the morbidity of the pandemic.

To be affected directly by the mortality rate is also the aggregate consumption. The extend to which the aggregate consumption is reduced depends on the relationships between mortality and the age structure of consumption[6].

[6] Kunh and Prettner, 2018

2.4 The effects of the pandemic on key macro-variables

Beland et al. (2020) studied the short-term effects of COVID-19 on employment and wages in the US. Their discoveries highlight that the pandemic increased the unemployment rate, and decreased both the hours of work and the labour force.

In particular, the unemployment rate peaks in April 2020 at 16%. At this point the economy is experiment a deep recession phase, which intensifies itself reaching a 20% output loss relative to pre-shock level. The situation became critical up to the point where in ten weeks from mid-March to the end of May 2020, the US government has received more than 40 million applications for unemployment benefits (Figure 6). It is a worrying figure if we think that in the pre-covid period the requests were "only" 250 thousand.

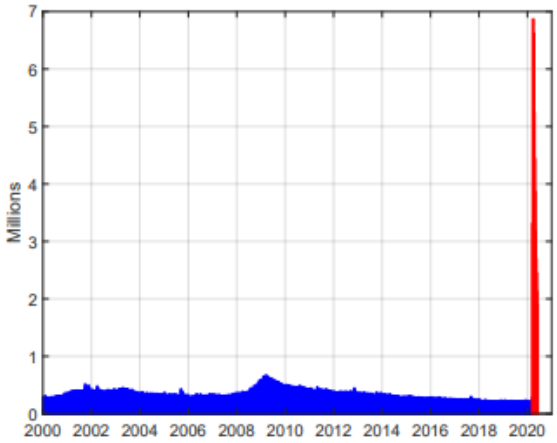

Fig. 6 Unemployment benefit claims in the period from 2000 to 2020
Source: FRED Economic Dats, St. Louis Fed

Similar results have been found for Europe. According to Pouliakas and Branka (2020) and Fana et al. (2020), the negative effects of COVID-19 have particularly affected that fraction of workers considered most vulnerable. Women, workers on fixed-term contracts, and those with a low level of schooling were particularly affected.

Barrot et al. (2020), considering the case of France, display that the collapse in employment is particularly high in those areas where contact with people is a fundamental part of the work

itself (ex. hotel, restaurant, service activities, etc). Fana et al (2020), showed that "The rate of employment in sectors that were forcefully closed by confinement measures (…) is highest in some Mediterranean countries (Malta, Spain, Italy, Greece and Cyprus) and Ireland, while the proportion is below average in most Nordic, Easter, and central Europe."

In order to mitigate the negative effects of the pandemic on employment, efforts were made to find solutions that would allow as many people as possible to continue working. One of these solutions is smart-working, which allows people to perform their professional activity remotely from home.

However, these measures have proved inadequate because, as we all know, not all work can be done from home. This has led to the decision of many companies to lay off their employees, who found themselves without any source of income. So, as Palomino et al. (2020) have demonstrated, the coronavirus crisis is responsible to the growth of poverty all around the world.

Moreover, capital and goods of some sectors also become temporally unavailable for production and consumption. Bayer, Born, Luetticke, and Müller (2020) refer to this scenario as the "Quarantine shock" or "Q-shock."

This shock has had multiple consequences that have involved not only a decrease in production potential of the aggregate economy, but also an increase in income risk at the household level, resulting in increased savings. As a result, expenditures declined and the economic activity cessation.

In this regard data on the US personal savings rate point out an increasing in the personal savings rate from 7.9% to 33% in the first months of the pandemic[7]. The growth is due to an

[7] Trading Economics, 2020

increase in the demand for precautionary savings with the aim of purchasing items in the future.

Bayer et al. (2020) proposed a model which goal was to capture the economic fallout of the pandemic. They model an economy made of three sectors: the firm sector, the household sector, and the government sector. The main difference between these sectors is that some of them are put under quarantine in response to "Q-shock" and others are not.

We proceed with the analysis of the first sector, the household sector. This sector is divided into two types of agents: workers and entrepreneurs. Both rent out physical capital, but only workers supply labour. The efficiency of workers' labour exposes household to labour-income risk.

Households have a time-separable preferences with time-discount factor β, and derive felicity from consumption c_{it} and leisure. They obtain income from four distinct sources: the labour supply (n_{it}), the rent of capital (k_{it}), the interests on bonds (b_{it}), and profits. Note that the households pay taxes on labour and profit income.

A household's labour income $w_t n_{it} h_{it}$ is made of three components: the aggregate wage rate on raw labour (w_t), the household's worked hours (n_{it}), and the labour productivity (h_{it}). We assume that the productivity component evolves according to the following expression:

$$\tilde{h}_{it} = \begin{cases} \exp\left(\rho_h \log \tilde{h}_{it-1} + \epsilon_{it}^h\right) & \text{with probability } 1-\zeta \text{ if } h_{it-1} \neq 0, \\ 1 & \text{with probability } \iota \text{ if } h_{it-1} = 0, \\ 0 & \text{else,} \end{cases}$$

Where the variable Q_{it} refers to the household when it is quarantined. Thus, when $Q_{it} = 1$ the household is not able to work.

With respect to leisure and consumption, household have preferences and maximize the discounted sum of felicity:

$$\mathbb{E}_0 \max_{\{c_{it}, n_{it}\}} \sum_{t=0}^{\infty} \beta^t u\left[c_{it} - G(h_{it}, n_{it})\right]$$

The felicity function u shows a constant risk aversion. The risk aversion parameter is indicated with the letter ξ. When $\xi > 0$ we obtain:

$$u(x_{it}) = \frac{1}{1-\xi} x_{it}^{1-\xi}$$

Where $x_{it} = c_{it} - G(h_{it}, n_{it})$ is the demand for goods consumption c_{it} and leisure. G is a measure of the disutility from work.

Given the labour income we proceed with the optimization of the household's budget constraint:

$$\begin{aligned} c_{it} + b_{it+1} + q_t k_{it+1} \;=\; & b_{it} \tfrac{R(b_{it}, R_t^b)}{\pi_t} + (q_t + r_t) k_{it} + \mathcal{T}_t(h) \\ & + (1-\tau_t)[(1-Q_{it}) h_{it} w_t N_t + \mathcal{R}(h) Q_{it} h_{it} w_t N_t + \mathbb{I}_{h_{it} \neq 0} \Pi_t^U + \mathbb{I}_{h_{it}=0} \Pi_t^F], \\ & k_{it+1} \geq 0, \quad b_{it+1} \geq \underline{B}\ , \end{aligned}$$

Where Π_t^U is union profits, Π_t^F is firm profits, b_{it} is the real bond holdings, k_{it} is the amount of illiquid assets, q_{it} is the price of the assets, r_t is their dividend, $\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}}$ is the inflation, and R is the nominal interest rate on bonds. Depending on their income level, households receive a lump-sum transfer $T_t(h)$.

The second sector is the firm sector. It consists of four sub-sectors:

1. A labour sector composed of "unions" that differentiate raw labour and labours packers, who buy differentiated labour and sell labour services to intermediate goods producers;

2. Intermediate goods producers who buy labour services and rent out capital;
3. Final goods producers who sell to goods bundlers the intermediate goods, which are sell as consumption goods to household;
4. Capital goods producers who transform final goods into capital goods.

In the first sub-sector the worker household sell their labour services to "unions" (indexed by j) which hold a variety of labour that offer to labour packers who then provide labour services to goods producers. Labour packers produce final labour according to the following production function:

$$N_t = \left(\int \hat{n}_{jt}^{\frac{\zeta-1}{\zeta}} dj \right)^{\frac{\zeta}{\zeta-1}}$$

Cost minimization determines that each variety of labour face a downward demand curve:

$$\hat{n}_{jt} = \left(\frac{W_{jt}}{W_t^F} \right)^{-\zeta} N_t$$

Where W_{it} is the nominal wage set by union j and W_t^F is the nominal wage at which labour packers sell labour services to goods producers. Given both nominal wage we can state that unions try to maximize their discounted profits. They maximize:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \lambda_w^t \frac{W_t^F}{P_t} N_t H_t \left\{ \left(\frac{W_{jt} \bar{\pi}_W^t}{W_t^F} - \frac{W_t}{W_t^F} \right) \left(\frac{W_{jt} \bar{\pi}_W^t}{W_t^F} \right)^{-\zeta} \right\}$$

The second sub-sector is made of intermediate goods producers who produce goods with a constant return to scale production function:

$$Y_t^F = (H_t N_t)^{\alpha} (H_t u_t K_t)^{(1-\alpha)}$$

Where H_t is the labour fraction, and $u_t K_t$ is the effective capital stock considering the utilization u_t. If we use a fraction of capital which is higher than normal results what we obtain is a depreciation of capital. As a matter of fact, capital will depreciate according to:

$$\delta(u_t) = \delta_0 + \delta_1(u_t - 1) + \delta_2/2(u_t - 1)^2$$

The intermediate goods producer works in a perfectly competitive markets and maximizes profits:

$$mc_t Y_t^F - H_t w_t^F N_t - H_t [r_t + q_t \delta(u_t)] K_t$$

Here r_t^F and q_t are the rental rate of firms and the price of capital goods, respectively.

Bloom et al. (2020) assume that utilization is decided by who holds capital goods, considering aggregate supply of capital services as given. The total production reflects the loss in varieties because of a decrease in productivity due to the pandemic.

The third bus-sector we are going to analyse is the one regarding the final goods producers. Here each reseller j in sector k faces a downward demand curve:

$$y_{jt} = \psi_{kt} (p_{jt}/P_{kt})^{-\eta_F} Y_{kt}$$

and buys the intermediate goods at the nominal price MC_t. As we have seen before, even in this case firms want to maximize their profits. They do that with a constant discount factor, where $1 - \lambda_Y$ is the probability of price adjustment and $\bar{\pi}$ is the steady state inflation rate.

In the last sub-sector, the capital goods producers take the price of capital goods as given, and maximize:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t I_t \left\{ q_t \left[1 - \frac{\phi}{2} \left(\log \frac{I_t}{I_{t-1}} \right)^2 \right] - 1 \right\}$$

Since all capital goods producers are symmetric, the following expression is what we get as the law of motion for the aggregate capital:

$$K_t - (1 - \delta(u_t))\, K_{t-1} = \left[1 - \frac{\phi}{2}\left(\log \frac{I_t}{I_{t-1}}\right)^2\right] I_t$$

The functional form assumption implies that investment adjustment costs are minimized and equal to 0 in the steady state.

The last one sector is the government sector who operates as a monetary and fiscal authority. The monetary authority controls the nominal interest rate on liquid asset, whilst the fiscal one issues government bonds, chooses the average tax rate in the economy, and adjusts expenditures to stabilize the debt.

Bloom et al. (2020) assume that monetary policy follows a Taylor-type rule with interest rate smoothing:

$$\frac{R^b_{t+1}}{\bar{R}^b} = \left(\frac{R^b_t}{\bar{R}^b}\right)^{\rho_R} \left(\frac{\pi^F_t}{\bar{\pi}}\right)^{(1-\rho_R)\theta_\pi}$$

The coefficient $\bar{R}^b \geq 0$ implies that the nominal interest rate is in the steady state, while the coefficient $\theta_\pi \geq 0$ refers to the extent to which the Central Bank tries to stabilize inflation. The parameter $\rho_R \geq 0$ shows the interest rate smoothing.

Regarding fiscal policy, it is possible to say that it follows two simple rules for spending and taxes, which react to any deviations of government debt from its long-run target:

$$\frac{G_t}{\bar{G}} = \left(\frac{G_t}{\bar{G}}\right)^{\rho_G} \left(\frac{B_t}{\bar{B}}\right)^{(1-\rho_G)\gamma^G_B},$$
$$\frac{\tau_t}{\bar{\tau}} = \left(\frac{\tau_t}{\bar{\tau}}\right)^{\rho_\tau} \left(\frac{B_t}{\bar{B}}\right)^{(1-\rho_\tau)\gamma^\tau_B}.$$

The coefficients γ_B^G and γ_B^γ determine the speed at which the government debt is restored to its optimal level. Total taxes and the government budget constraint establish the residual government debt:

$$B_{t+1} = R_t^b/\pi_t B_t + G_t - T_t + \int \mathcal{T}(h_i)di + w_t N_t(1 - H_t) \int \mathcal{R}(h_i)h_i di.$$

The adjustment of the economy to the "Q-shock" over time are represented in the following figure (Figure 7). Panel A shows a fall in output of 1%, while consumption is pretty stable (Panel B) and investment decreased by more than 5% (Panel C). All these variables are computed considering the actual price index and not the ideal price index.

The effective capital exhibits a fall (Panel D), as well as the hours worked (Panel E). This is just the consequence to the decline in the aggregate demand. Finally, Panel F represents the adjustment of the labour-intensive margin, which on impact falls sharply.

The shock impact becomes stronger and stronger, up to the point where output, consumption, and investment start to decline more rapidly. As a matter of fact, the output losses reach almost the 20%, whilst the investment losses more than 30%.

Despite the recession period, the economy recovered quickly, so much so that only after 18 months the output returned to its pre-Coronavirus level.

Summing up, it is possible to affirm that the "Q-shock" played an important role in the reduction of the effective labour force and on the effective capital stock. It also negatively impacted on the aggregate demand.

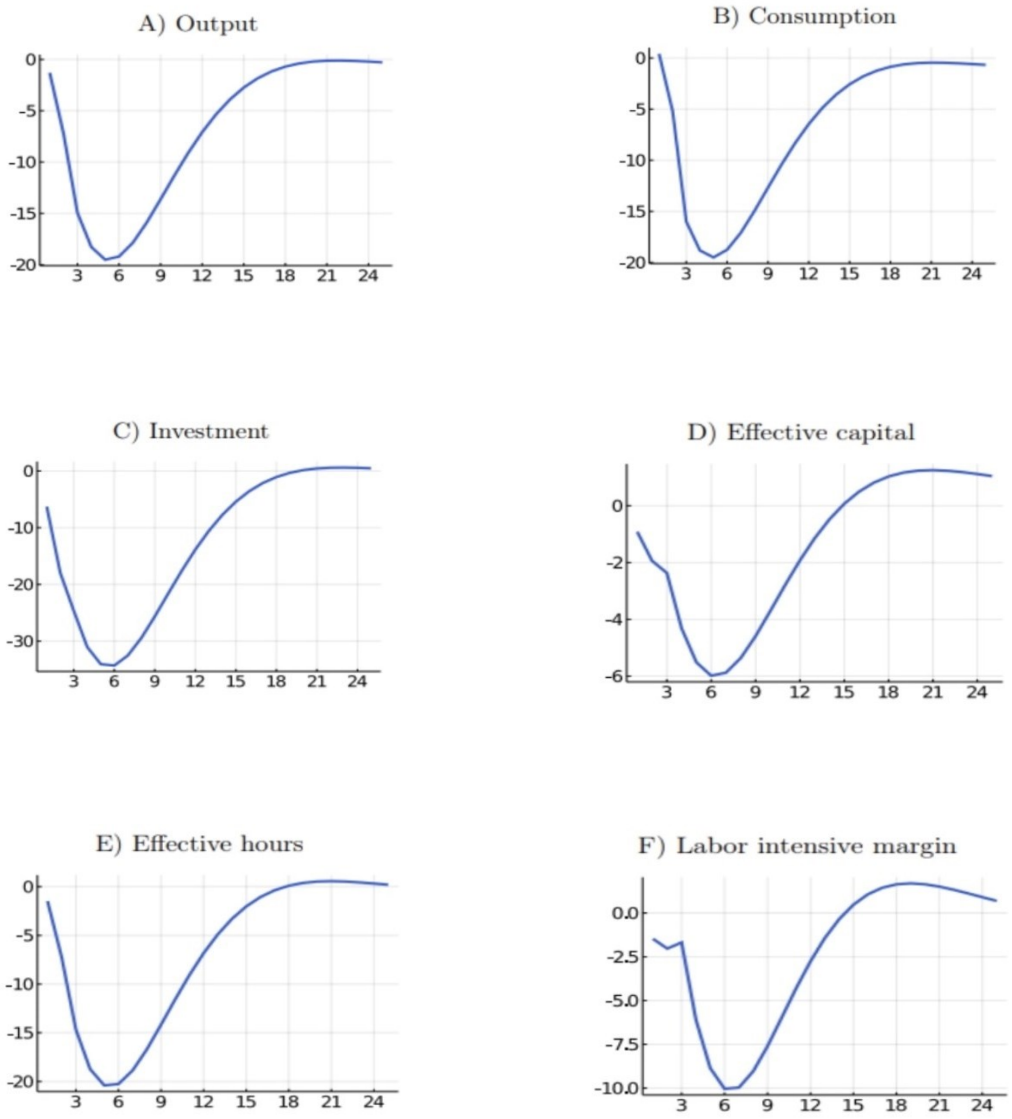

Fig. 7 Adjustment of the economy to the "Q-shock" over time
Source: Bayer, Born, Luetticke, and Müller (2020)

Several researchers, among whom we remember Guerrieri et al. (2020), point out that the economic collapse affects not only the supply, but also the demand. Eichenbaum et al. (2020) argue that the COVID-19 pandemic affected not only the demand for consumption goods, but also the labour supply.

The supply and the demand effect arise because workers are exposed to the risk of becoming infected by the virus. Thus, they react by reducing the labour supply and their consumption level. The consequence is a huge and lingering recession (Figure 8).

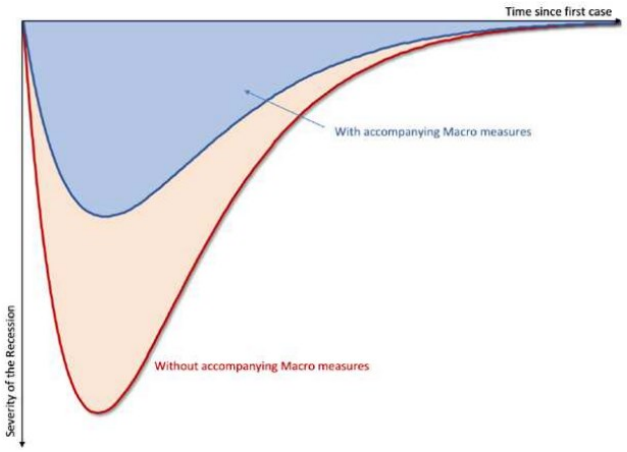

Fig. 8 Flattening the Recession Curve
Source: Gourrinchas (2020)

The global recession appears to be worse than the one during the Great Financial Crisis (2008), and even deeper and faster than the one during the Great Depression of the 1930s. As a matter of fact, the coronavirus recession was very large and it was characterized by large drops in consumption and investment.

In this regard Eichenbaum, Rebelo, and Trabandt (2021) introduce a new model which is called the "New Keynesian model." It reflects the negative impact of COVID-19 on consumption demand and labour supply.

The New Keynesian model assumes that the economy is initially in the steady state where all people are identical. The population is divided into four different groups: susceptible (S_t), infected (I_t), recovered (R_t), and deceased (D_t). The variable T_t denotes the new infected.

As in Eichenbaum et al. (2021), we hypothesize that susceptible people can become infected in three ways: purchasing consumers goods, working, and through the interaction with infected people. The number of the new infected people is given by the following expression:

$$T_t = \pi_1(S_t C_t^s)\left(I_t C_t^i\right) + \pi_2(S_t N_t^s)\left(I_t N_t^i\right) + \pi_3 S_t I_t$$

Note that:

- $(S_t C_t^s)(I_t C_t^i)$ indicates the number of new infected people due to consumption reasons;
- $(S_t N_t^s)(I_t N_t^i)$ indicates the number of new infected people due to work;
- $S_t I_t$ indicates the number of new infected people due to something which is not related to consumption and work.

The variables C_t^s and C_t^i represent the consumption of a susceptible and infected people, respectively. The variables N_t^s, N_t^i, $I_t N_t^i$, and $S_t N_t^s$ represents the hours of work of susceptible and infected people, whilst the terms $S_t C_t^s$ and $I_t C_t^i$ represent the total consumption of susceptible and infected people.

The parameter $\pi_1$is the measure of both the amount of time spent in consumption activities and the probability of becoming infected, while π_2 reflects the probability of becoming infected due to work reasons. To isolate the effect of the pandemic on the consumption demand we set π_2 to zero, so that the hours of work do not affect the probability of people to become infected.

Figure 9 displays the impact of COVID-19 on key macro-variables. As we can see we are in a recession phase, where the GDP and the worked hours start falling reaching 0.4 and 0.6 respectively. In addition, consumption declines, whilst investment rises.

Through the image it's easy to understand that the household utilizes a large part of savings for the purpose of financing the growth in investment. Investment plays a crucial role: it allows the household to smooth consumption and worked hours. Since the household wants to lower its level of consumption, the return to work must fall. The consequence is an initial reduction of worked hours, which then start to increase again.

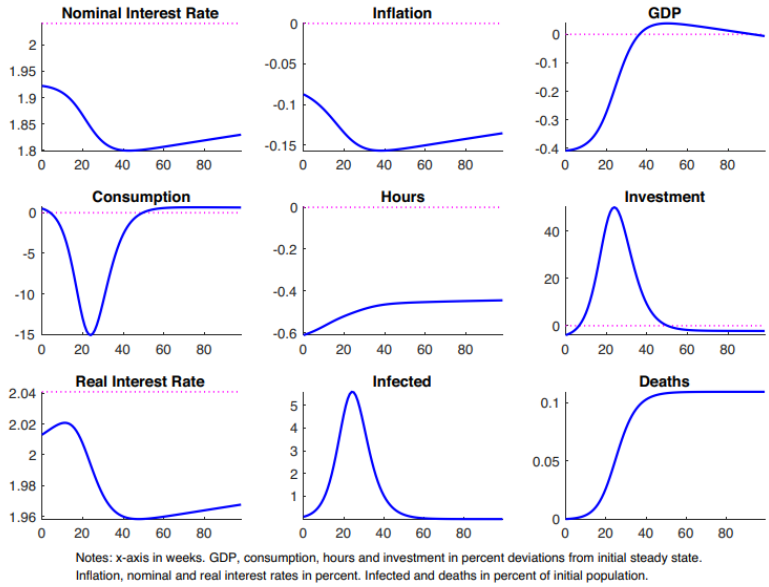

Fig. 9 Impact of COVID-19 on key macro-variables
Source: Eichenbaum, Rebelo, and Trabandt (2021)

Figure 10 represents the consumption and the worked hours for susceptible, infected, and recovered people. From the graph we can see a huge decline in consumption of susceptible individuals. The falling highlights people's intention to smooth the probability of becoming infected.

If we observe the consumption relatively to infected and recovered people, we can see a small increase. On the other hand, worked hours remain stable in all three cases.

Figure 9 and figure 10 display import results. The intuition is that the virus behaves as a negative shock to susceptible people's demand for consumption. The household reduces their consumption with the goal of smoothing the probability of contracting the disease. On the contrary, the consumption for infected and recovered people does not shift down.

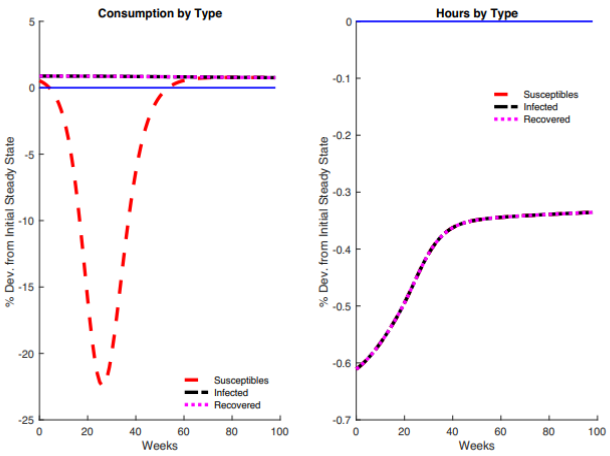

Fig. 10 Consumption and the worked hours for susceptible, infected, and recovered people
Source: Eichenbaum, Rebelo, and Trabandt (2021)

The image exhibits the consequences of the epidemic. The figure 11 shows a large recession with GDP and worked hours falling up to 15% and 22% respectively. A decrease is recorded also in the level of consumption and investment.

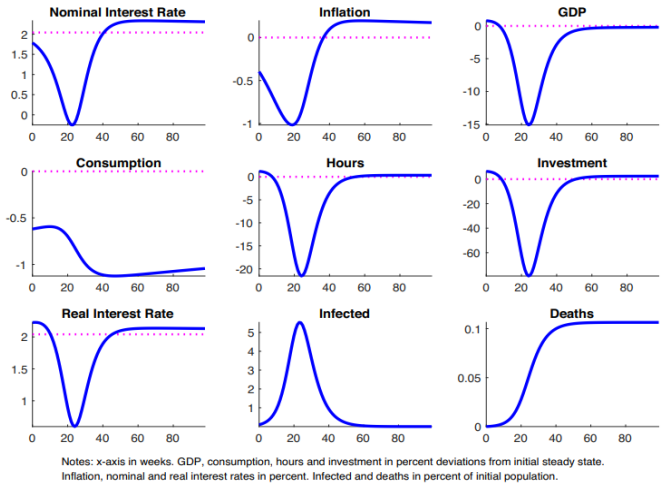

Fig. 11 Impact of COVID-19 on key macro-variables
Source: Eichenbaum, Rebelo, and Trabandt (2021)

In the figure 12 the consumption for susceptible, infected, and recovered people declines for a small amount. Also worked hours experiment a fall. However, the decrease is strictly correlated to the fact that the individual is either susceptible or infected or recovered. In the first case the drop is about 34%, while in the other two cases is about 6%.

Household prefers to lower the level of consumption because it does not affect anyone's probability of becoming infected.

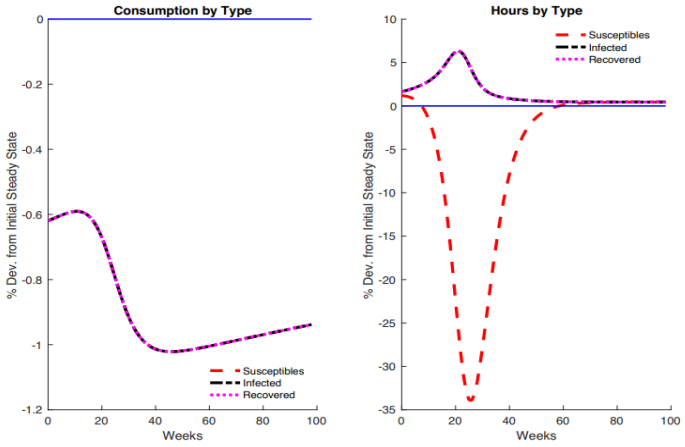

Fig. 12 Consumption for susceptible, infected, and recovered people
Source: Eichenbaum, Rebelo, and Trabandt (2021)

Figure 13 shows a large drop in GDP, consumption, investment and worked hours. The fall in consumption (9%) points out a fall in consumption demand by susceptible people. The huge decrease in investment (12%) reflects the relevance of labour supply shock.

Between the two models (New Keynesian model and model with flexible prices) the difference is only about the level of inflation. As a matter of fact, in the New Keynesian model (sticky prices) the drop of prices is lower than in the model with flexible prices.

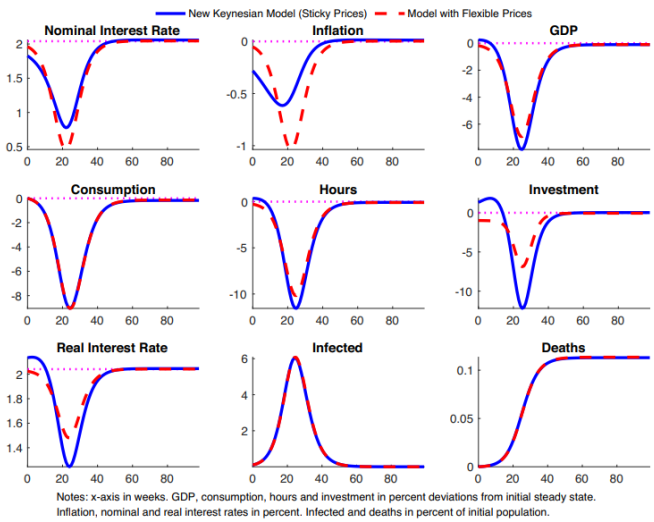

Fig. 13 Impact of COVID-19 on key macro-variables
Source: Eichenbaum, Rebelo, and Trabandt (2021)

Figure 14 illustrates the response of consumption and worked hours for susceptible, infected, and recovered people. Susceptible individuals show a tendency to lower their consumption and worked hours to diminish the probability of contracting the virus. Even their income drops down, with the consequence of getting negative savings.

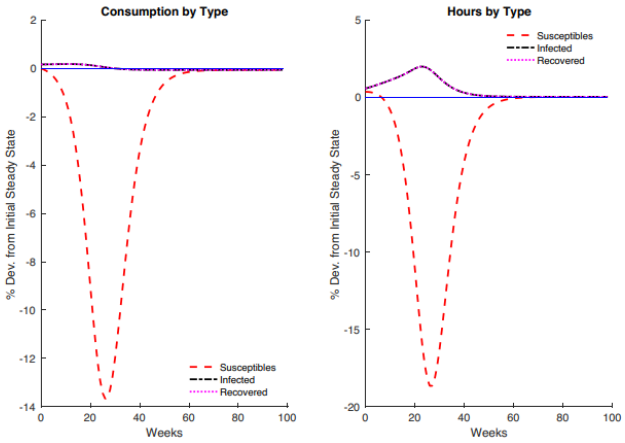

Fig. 14 Consumption and worked hours for susceptible, infected, and recovered people
Source: Eichenbaum, Rebelo, and Trabandt (2021)

2.5 The consequences of the pandemic on the global GDP

GDP (Gross Domestic Product) is one of the most significant macroeconomic variables used to assess the economic performance of a specific country. In particular, GDP per capita tells us how the economy of a state is correlated with the provided level of welfare. For example, if a particular country has a downward trend in the GDP per capita it means that its economy is not doing so well, as well as its level of welfare.

COVID-19 hit the global economy causing, as already seen, a decrease in consumption resulting in a decrease in demand, and therefore in production, but also a collapse in GDP.

Data on the first quarter 2020 GDP performance of major economies has shown how strong and extensive was the impact of COVID-19 on the economy. In that regard, the net US GDP losses from COVID-19 are estimated to range from $3.2 trillion to $4.8 trillion. In percentual terms these GDP losses are around 4.8% for the first quarter of 2020, whilst in the Eurozone, for the same period, the contraction of GDP is about 14.4%. This big difference in terms of GDP losses is because Europe and the United States were affected by COVID-19 with different timing: initially to be affected was Europe, in particular Italy, and only later the coronavirus expanded hitting also the US.

If we look at the global GDP, we cannot fail to consider the different impact that COVID-19 has had on different countries depending on whether they are emerging countries or well-established economies. As a matter of fact, the global GDP is expected to decrease by 2.1%, which is an average between the expected loss for developing countries 'GDP (2.5%) and the high-income countries expected fall (1.9%).

These losses are partly justified by the virus containment measures taken by individual countries, which included, among other things, a ban on displacements, with the consequent stop to tourism. In this regard, on March 2020 the United Nations World Tourism

Organisation (UNWTO) has estimated a decline between 20% and 30% of international tourist arrivals compared to 2019. This turns into a loss of international tourism between $300 and $450 billion.

The pandemic has devasted the travel and tourism sector up to the point where countries whose GDP relies largely on the tourism sector and everything related to it (ex. restaurants, hotels, etc.) have found themselves in serious difficulties. Precisely, to have been found in this situation are Spain and Italy where tourism contributes to the national GDP for 14.3% and 13% respectively (Figure 15).

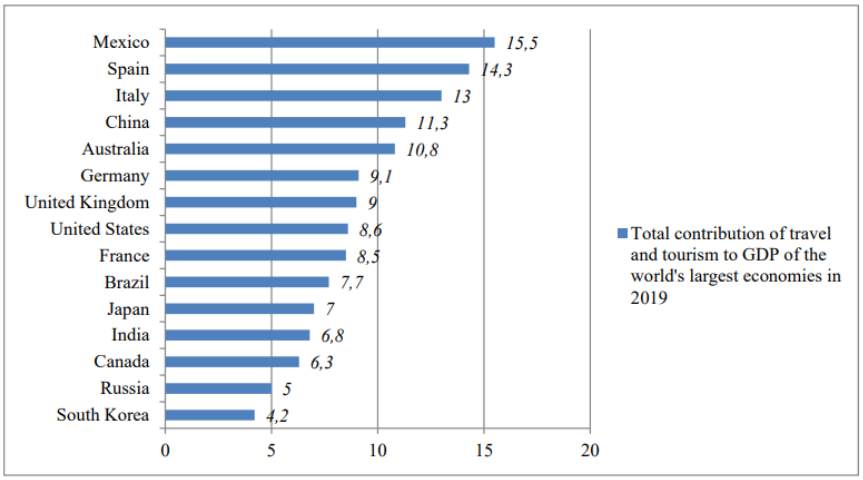

Fig. 15 Total contribution of travel and tourism to GDP of the world's largest economies in 2019
Source: Richter (2020)

According to the World Travel and Tourism Council (WTTC), in 2019 the travel and tourism sector contributed for the 10.3% of the global GDP.

However, Italy and Spain are not the only European countries that have experienced the negative consequences of COVID, in fact even Germany, despite not being a country particularly dependent on the tourism sector, has recorded a decrease in GDP of 2.2%.

The spread of the virus has affected the GDP per capita in the Eurozone. Zagurska-Antoniuk, Suprunova, and Zavalii (2020) study it using a multiple regression model, in which they

examine the relationship between the GDP (dependent variable, y) and five independent variables (x_1, x_2, x_3, x_4, x_5). These five independent variables are:

1. Total confirmed cases per capita (x_1);
2. Total confirmed deaths per capita (x_2);
3. Percentage of recovered in the total confirmed cases on July 2020 (x_3);
4. Total test per capita (x_4);
5. Percentage of days from the beginning of the spread of COVID-19 in the total number of days in the first half of 2020 (x_5).

Table 12 shows the results that we have obtained using the Ordinary Least Squared (OLS) method. Here, we can see the extent to which the independent variables affected the dependent variable.

Table 12

OLS, using the observations 1–33 (Dependent variable – GDP per capita (IMF forecast))

	Coefficient	*Standard error*	*T-statistics*	*P-value*	*Significance by t-statistics*
const	−8191,23	16556.4	−0,4947	0,6248	
TC per capita	−188462	1,04995e+06	−0,1795	0,8589	
TD per capita	2,56770e+07	1,11965e+07	2,293	0,0298	**
% recovered	283,606	88,2650	3,213	0,0034	***
TT per capita	53033	28538,9	1,858	0,0741	*
% days	15,0524	239,190	0,06293	0,9503	

Source: Zagurska-Antoniuk, Suprunova, and Zavalii (2020)

The model is represented by the following expression:

$$\hat{y} = -8191 - 188462x_1 + (2.56770e + 07)x_2 + 284x_3 + 53033x_4 + 15x_5$$

Where:

- x_1 represents the total confirmed cases per capita (TC per capita);
- x_2 represents the total confirmed deaths per capita (TD per capita);
- x_3 represents the percentage of recovered in the total confirmed cases on July 2020:
- x_4 represents the total test per capita (TT per capita);

- x_5 represents the percentage of days from the beginning of the spread of COVID-19 in the total number of days in the first half of 2020.

According to the p-value, the variable x_5 is known to be the most important and crucial variable in the equation. The second significant variable is x_1.

Remember that, if between the variable x_5 and y there is a positive correlation, then it means that between x_1 and y there is a negative one. The positive correlation implies that an increase in x_5 will increase y, whilst the negative correlation means that an increase in x_1 will decrease y.

The p-value of x_2, x_3, and x_4 is less than one, meaning that these variables may not be considered due to their low impact in the equation.

According to the t-test, three coefficients of the regression equation are considered to be important, namely those marked with the asterisk symbol.

The statistical characteristics of the five independent variables are grouped together in the following table (Table 13).

Table 13

Variable	*Mean*	*Median*	*Standard Deviation*	*Min*	*Max*
GDP per capita	20965	19161	10997	4080	56022
TC per capita	0,00243	0,00164	0,00192	0,000309	0,00694
TD per capita	0,000127	0,000057	0,000182	0,000005	0,000842
% recovered	73,8	79,3	19,8	27,7	98,7
TT per capita	0,0822	0,0625	0,0700	0,0152	0,305
% days	70,2	68,1	7,10	63,2	87,4

Source: Zagurska-Antoniuk, Suprunova, and Zavalii (2020)

For example, if we consider the TC per capita, we can observe that its maximum value is 0.00694 (Luxemburg), while its lowest is 0.000309 (Slovakia). The standard deviation is 0.00192, the average value is 0.00243, and the median is 0.00164.

The coefficient of determination of the model (R^2) is 0.56, which allows to determine the impact of the pandemic on GDP per capita in Europe with a 56% probability. The regression

of 56% explains the changes in y, whilst the remaining 44% of the changes are due to other factors which are not included in our model.

Table 14 displays the correlation coefficients for the independent variables.

Table 14

TC per capita	*TD per capita*	*% recovered*	*TT per capita*	*% days*	*Variables*
1,0000	0,4858	0,0457	0,5538	0,2432	*TC per capita*
	1,0000	–0,3287	0,0546	0,5517	*TD per capita*
		1,0000	0,4639	–0,0954	*% recovered*
			1,0000	–0,0131	*TT per capita*
				1,0000	*% days*

Source: Zagurska-Antoniuk, Suprunova, and Zavalii (2020)

The most significant correlations between independent variables are 0.5538 (between TT per capita and TC per capita) and 0.5517 (between TD per capita and the percentage of days from the beginning of the spread of COVID-19 in the total number of days in the first half of 2020).

At this point we can discuss about four possible scenarios regarding the evolution of GDP taken from Sheiner and Yilla (2020).

The most optimistic scenario is the V-shaped recovery (Figure 17). Here the economy, after a challenging time due to the spread of the virus, returns to its previous conditions. The loss of GDP during the period of restrictions, due to both demand and supply shock, is definitive. However, everything will return to normality at the end of the pandemic.

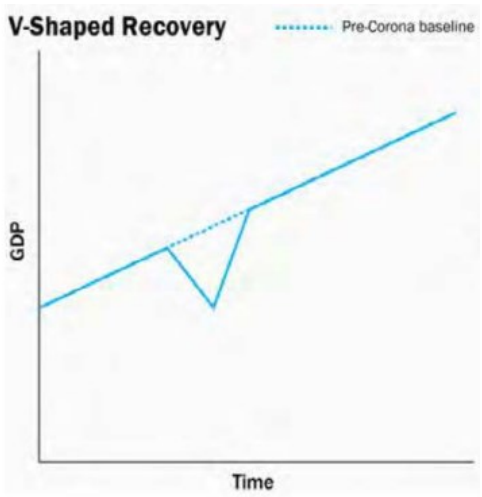

Fig. 17 V-shaped recovery
Source: Louise Sheiner and kadija Yilla, The ABCs of the post-COVID economic recovery, Hutchins Center on Fiscal & Monetary Policy, The Brookings Institution, May 4, 2020

The less optimistic scenario is the U-shaped setting (Figure 18). In this case, the impact of the COVID-19 persists: even if the emergency was over, consumers and companies hesitate before return to consume and invest.

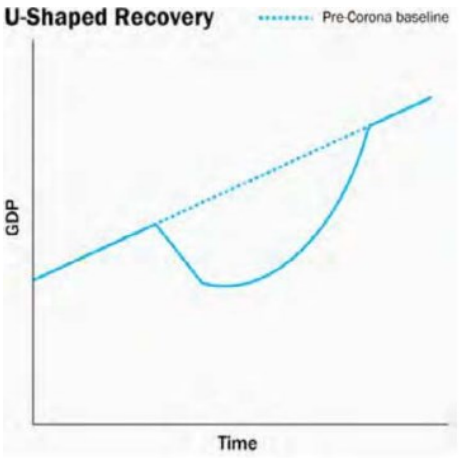

Fig. 18 U-shaped setting
Source: Louise Sheiner and kadija Yilla, The ABCs of the post-COVID economic recovery, Hutchins Center on Fiscal & Monetary Policy, The Brookings Institution, May 4, 2020

The third possible scenario is a pessimist scenario, and it is called the W-shaped recovery (Figure 19). In this setting after a relaxation of the virus containment measures, COVID-19 will return stronger than ever, resulting in the implementation of new rules.

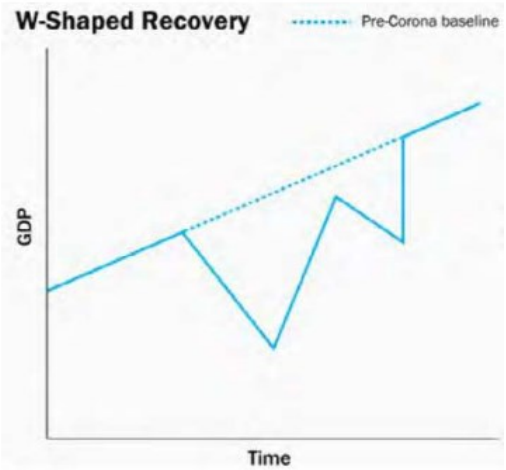

Fig. 19 W-shaped recovery
Source: Louise Sheiner and kadija Yilla, The ABCs of the post-COVID economic recovery, Hutchins Center on Fiscal & Monetary Policy, The Brookings Institution, May 4, 2020

Finally, the last scenario is the L-shaped recovery. In this setting the damage of coronavirus is permanent, the economy will growth again, but at a lower value of GDP.

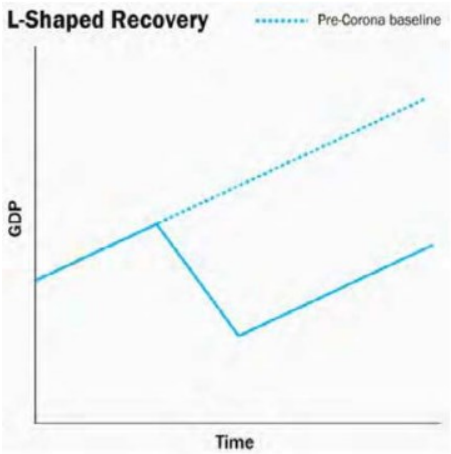

Fig. 20 L-shaped recovery
Source: Louise Sheiner and kadija Yilla, The ABCs of the post-COVID economic recovery, Hutchins Center on Fiscal & Monetary Policy, The Brookings Institution, May 4, 2020

The shape of the recovery will depend on the quality of the measure implemented to contain the pandemic. It also depends on the previous fiscal and financial weaknesses.

At the end of this second chapter, I can say that COVID-19 has had a negative impact on global stock markets, causing stocks to collapse. Investors are visibly concerned about the long-term impact of the virus.

The spread of the virus has negatively affected Europe and the United States, causing a collapse of bankruptcy, supply chain and financial activities.

Economic growth has come to a halt, while unemployment has not slowed down. Just think that in April 2020 it reached a 16% peak in the United States, with a consequent increase in the demand for economic aid from the government.

COVID-19 has strongly affected all sectors of the global economy. The recession experienced during the pandemic has far outweighed that experienced during the Great Recession of the 1930s.

Finally, global GDP collapsed by 2.1% due not only to the pandemic itself, but also to the initiatives put in place by the various governments to contain the spread of the virus (e.g. Lockdown).

THE RESPONSE OF PUBLIC AUTHORITIES TO THE PANDEMIC

In this third chapter I will analyse the measures taken by public authorities (Central Banks and governments) to remedy the situation of great economic and financial uncertainty caused by the pandemic. In particular, I will structure my work into three sections, in which I will first give a general and global view (section 3.1), and then focus on the measures taken at European (section 3.2) and US (section 3.3) level.

3.1 A macro view of the measures taken to deal with the consequences of COVID-19

The International Labour Organization (ILO, 2020) had expressed itself negatively about the effects that the spread of the virus was having on the markets. As a matter of fact, it was concerned that the coronavirus crisis could turn into an economic and labour market crisis. Supporting this are the worrying numbers about the unemployment rate in America that appear to be even higher than those related to the period of the Great Depression that struck the United States in the 1930s.

As of March 2020, global financial market conditions have plummeted rapidly. The prices of risk assets fell precipitously, as did the volatility that contributed to the increase in macroeconomic uncertainty and expectations of widespread corporate defaults. Equity markets, for example, have experienced one of the most dramatic collapses ever recorded with the S&P 500 Index, which has lost 34 percentage points since mid-February 2020. A decline of this magnitude can only be compared to the eight months following the onset of the Global Financial Crisis.

In response to the critical situation in the global financial market, the major Central Banks have joined together by taking decisive steps to: 1. Reduce policy rates, 2. Introduce new asset purchase programs, 3. Provide liquidity support, 4. Introduce several emergency facilities to sustain the flow of credit to the real economy. The magnitude and importance in economic terms of this initiative are unprecedented in history: in just months from the start of the pandemic, Central Banks assets have grown by 6 trillion dollars, more than double what was recorded in the two years following the start of the Global Financial Crisis.

In addition, many Central Banks in emerging economies have put in place monetary support programs that involved the purchase of assets including government bonds, corporate bonds, state-guaranteed bonds, and mortgage-backed securities.

The measures taken by the main Central Banks were also supported by the strong monetary and financial frameworks already existing before COVID-19. In this regard, there are three factors that have proved to be of fundamental importance: the soundness of domestic banking sectors, policy credibility, and external buffers. Banks entered the COVID era with much more capital and much more liquidity than they had on the eve of the Global Financial Crisis. These buffers have proved to be crucial in resisting the pandemic preventing the occurrence of a macro-financial doom loop.

Major Central Banks can play the role of lenders, thanks to the credibility gained over the years. The importance of credibility is therefore crucial in providing long-term support for international monetary policy, which may also involve the use of methods that are not strictly conventional.

Finally, emerging markets had large external reserves in the form of foreign exchange reserves in the run-up to the pandemic, which, in most cases, were higher than their stock of reserves on the eve of the Global Financial Crisis. Exchange rate flexibility has helped to limit

the impact of the shock, while sufficient supply of foreign exchange reserves has allowed intervention in the foreign exchange markets to mitigate the strong depreciation of the currency against large capital outflows, reducing financial stability risks arising from undefined foreign currency exposures.

The combination of these three factors has contributed significantly to supporting the macro-financial policies implemented during the pandemic.

The advent of the pandemic has made clear the importance of policies to prevent and limit possible calamitous financial outcome. Moreover, it has contributed to the understanding of the influence of certain policies in determining future financial stability.

Monetary easing and large-scale liquidity provision by Central Banks have increased investor risk appetite, resulting in asset price misalignments and an increase in the leverage of the non-financial sector.

A clear example of this was in the United States, where following the Fed's announcement to establish credit lines, there was a stock market recovery, with the S&P 500 rising by more than 100% during this period. This growth ceased only after the Fed declared its intention to accelerate the decline in asset purchases in December 2021.

The price misalignments, that have been created as a result of the behaviour of investors, have turned out to be so important in terms of size as to be comparable only to those that occurred during the 1990s following the dotcom bubble.

Monetary authorities are now facing a major dilemma: on the one hand, providing monetary support to stimulate economic growth in markets, and on the other hand ensuring macro-financial resilience in the long term.

An unexpected outcome of the pandemic was high and persistent inflation.

In the face of rising inflation, Central Banks in emerging markets have started to raise rates to avoid a loosening of inflationary expectations. By contrast, the Central Banks of major advanced economies pursued an accommodative position until 2021.

As an example, we can cite the case of the United States where, the annual inflation rate was close to 5% in the second quarter of 2021. However, the Fed decided not to intervene, preferring to keep a softer line, at least until December 2021, when annual inflation approached 7%, the highest level in 40 years.

Other major Central Banks in advanced economies such as Canada and the United Kingdom also did not react to rising inflationary pressures until the end of 2021. The European Central Bank (ECB) increased the reference rate in July 2022.

The experience of the pandemic teaches us that not reacting to inflationary pressures when uncertainty about the source of the shocks is high or, when the economy is under pressure, can entail significant risks in the form of entrenched inflation (Gopinath 2022). To address this scenario, Central Banks may need to aggressively tighten monetary policy which, as history has repeatedly shown, could generate another recession and impose high economic costs (Edge and Levy, 2022).

The COVID-19 pandemic has put a strain on the global economic and financial system. However, it has given us many foods for thought and taught us important lessons in terms of policies to be adopted to ensure long-term financial stability.

In particular, the crisis highlighted the importance of a sound and adequate monetary policy that Central Banks must implement to restore confidence and stabilise markets in the face of extreme macro-financial shocks.

However, as we have seen, the advent of COVID-19 has helped to reinforce the negative effects of prolonged support for global monetary policy.

Indeed, a milder and more permissive monetary policy on the one hand allows for the easing of financial conditions to stimulate economic growth in the short term, on the other hand could lead to an accumulation of financial vulnerabilities, threaten macro-financial stability in the future.

Finally, loose monetary policies in advanced economies may also have negative cross-border effects, leading to increased volatility of emerging-market capital flows that could potentially threaten the stability of the international monetary and financial system.

The advent of COVID-19 has shown that the measures that have been put in place to cope with the crisis have positively affected banking systems making them generally safer. However, this has not happened in non-banking financial intermediation where major vulnerabilities have emerged.

Based on this experience, we see four key priority areas to further strengthen the resilience of the global financial system:

- Mitigate inter-temporal policy compromises → In a context where accommodative monetary policies are needed to foster economic growth, monetary and financial authorities must monitor financial vulnerabilities to preserve financial stability.
- Ensure sound monetary policy frameworks → Central Banks must be resolute in addressing inflationary pressures and maintaining their credibility by maintaining price stability and ensuring that the monetary policy adopted is sound to cope with both an increase and a reduction of inflation.
- Manage the volatility of capital flows → To mitigate the consequences of monetary policies pursued by advanced economies, emerging economies must manage the volatility of capital flows using macroeconomic and prudential policies, as well as foreign exchange interventions and capital controls.

- Address systemic risks in non-banking financial intermediation → Given the increasing importance of non-banking financial intermediation, it is essential that the systemic risks posed by such institutions are better understood and addressed. Moreover, the regulation and supervision of the sector must be strengthened and commensurate with the risks of financial stability it entails.

Governments around the world are mobilizing to take all the necessary measures to cope with the COVID-19 crisis. These measures include structured programmes aimed at providing practical help to all businesses and those who are most affected by the pandemic.

The global distribution of the economic policy response to COVID-19 across 166 countries is shown in figure 21. The overall average economic policy response to COVID-19 reported in the figure 21 places the US in first place, closely followed by Sweden, the UK, Oman and, New Zealand. Countries with a limited or non-existent economic policy include Kazakhstan, Kyrgyzstan, Denmark, Belarus, Ukraine, Turkmenistan, Yemen, Liberia, Guinea and, Laos.

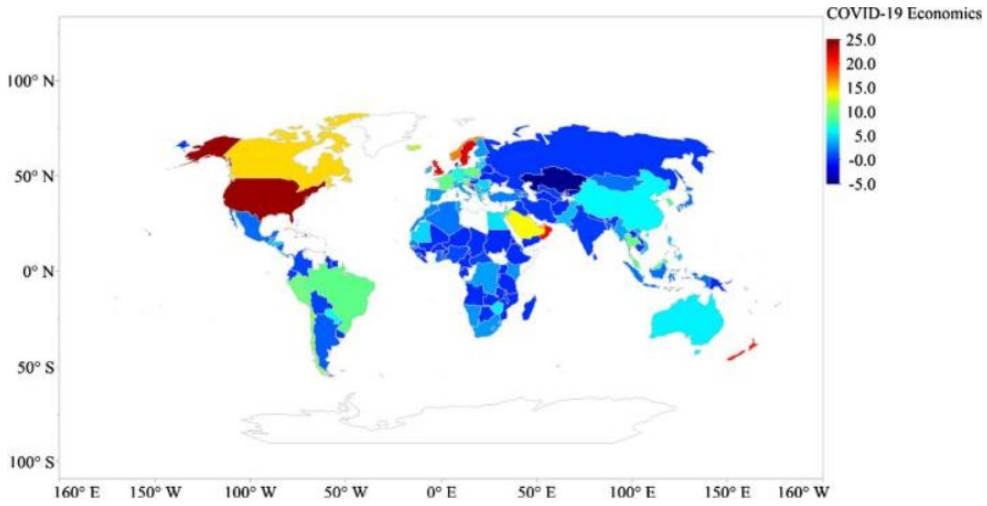

Fig. 21 The Global average distribution of economic policy response to COVID-19 (% of GDP)
Source: Samuel Asumadu Sarkodie and Phebe Asantewaa Owusu

In OECD countries, economic policy responses to COVID-19 under containment measures include 100% financial support to affected local businesses, about 94% income support for the self-employed and residents with job or income loss, about 80% financial assistance to

pay rent, mortgages or utilities and income support ranging from about 47 to 67% for workers in quarantine and sick (OECD 2020).

Let us now examine in detail some of the measures taken by individual countries. In Austria, for example, some EUR 38 billion has been allocated as emergency funds to amortize industries affected by COVID-19 (IMF 2020). The Norwegian Government has announced a NOK 174 billion loan programme for the aviation industry, companies, students, and vulnerable groups (OECD 2020). In Russia the government has allocated 6.11 billion dollars to amortize regional budgets, businesses, and households (OECD 2020). Finally, in the United States, an additional $2 trillion has been allocated, adding to previous allocations (Heritage 2020; OECD 2020).

When an economy is in a stressful situation, due to slower growth, rising unemployment, a financial crisis or a pandemic, governments can respond to this situation by choosing from a variety of tools. Among the measures that can be implemented is a combination of: fiscal policy, monetary policy, foreign exchange intervention (FX), and adjustments to macroprudential regulations and/or capital controls.

Thanks to the analysis conducted by Bergant and Forbes (2023), we obtain important results about the way in which different countries have responded to the advent of COVID-19.

To better understand this variation, it is necessary to analyse the three factors that play a crucial role in determining a country's political response to the pandemic crisis: policy space, extent of economic stress, financial and health during the early stages of the pandemi, and other features of the country.

As can be seen, the pre-existing policy space exerts a great influence on a country's ability to announce and use useful tools in times of stress.

In more detail, the policy space has proved to be a crucial element in determining the extent to which countries have used exchange rate intervention, lowered interest rates and relaxed

macroprudential policy to support their economies during the pandemic. Policy space has influenced not only the extent of the adjustment, but also its form. Monetary easing, in fact, can be pursued in many ways: through reductions in interest rates, through purchases of assets, through fiscal measures or "below line" measures (such as loans, equity, and credit guarantees).

The analysis shows that countries with a higher interest rate before the pandemic lowered it, relying less on other forms of monetary stimulus, such as asset purchases and the provision of liquidity to banks. Countries with a more restrictive macro-prudential orientation have been more likely to soften macroprudential regulation. In contrast, countries with larger reserves preferred to rely on forex interventions.

As the pandemic worsens, governments around the world were faced with assessing how to sustain and preserve their economies while minimizing the damage to health, employment, and incomes.

A first, and widely used, response to the pandemic was fiscal policy.

As reported by Bergant and Forbes (2023): “Most countries announced a large fiscal stimulus, with an average size of 11% of GDP in the sample. Seventeen countries provided stimulus of more than 10% of GDP and five provided stimuluses of at least 20% of GDP. On average, countries divide this stimulus almost equally between "above-the-line" and "below-the-line" measures. However, there is great variance in each of these measures, with the overall stimulus ranging from just 1% of GDP (for Mexico) to 37% of GDP (for Germany), and the stimulus share being above the line ranging from just 3% (for Turkey) to 100% (for Georgia).”

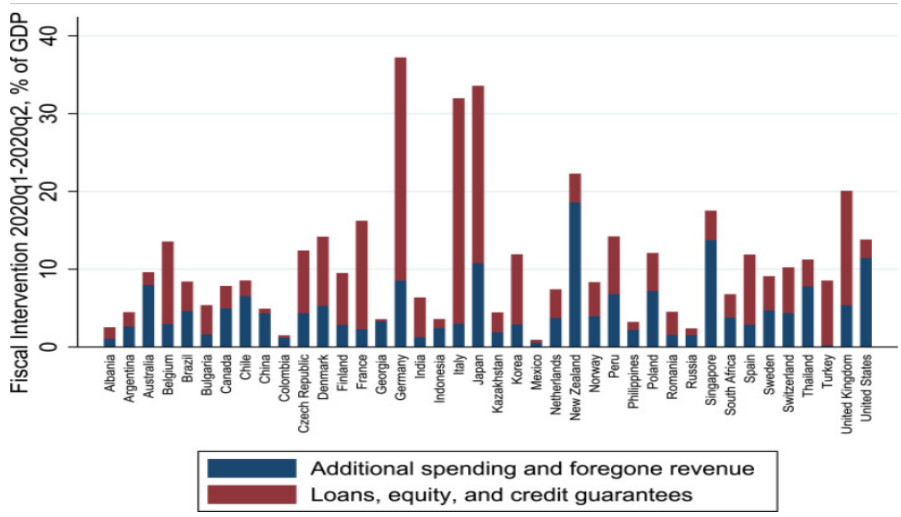

Fig. 22 Tax response to COVID-19 as a percentage of GDP
Source: Based on data from the IMF's Fiscal Monitor Database of Country Fiscal Measures in Response to the Covid-19 Pandemic

The second measure implemented by governments around the world concerned monetary policy, both with "conventional" changes in official interest rates and with different forms of "unconventional" policy.

Figure 23 shows changes in official interest rates. Most countries have lowered the reference rate, except for Sweden and Kazakhstan (which have increased rates by 25 basis points) and six other countries that have not made changes.

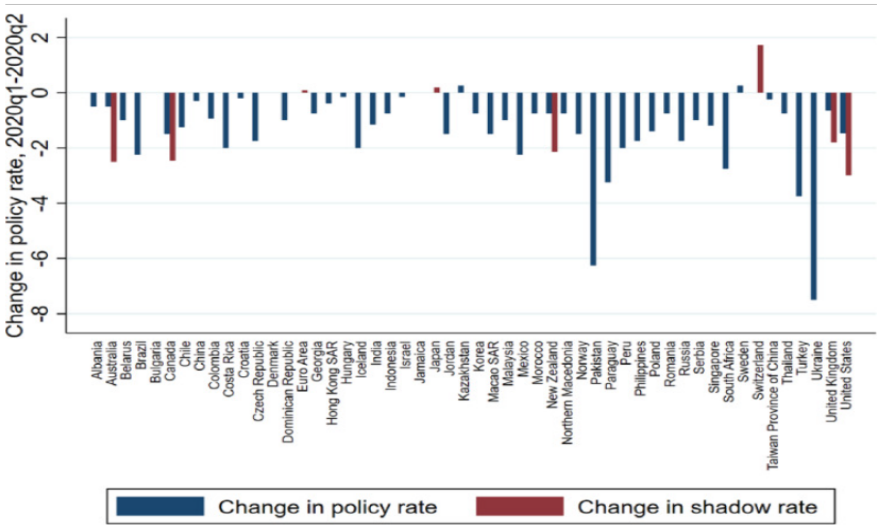

Fig. 23 Interest rate response to COVID-19
Source: Policy interest rates from Haver and shadow interest rates from Leo Krippner's website, based on calculation in Krippner (2015)

Figure 24 provides information on "unconventional" monetary responses. It shows the share of countries that have implemented non-conventional monetary policy, dividing them into advanced economies (AEs) and emerging markets (EMs). Looking at the figure, more than 80% of AEs and EMs have decided to introduce liquidity support measures for banks. In addition, AEs have also made widespread use of asset purchases (61%) and swap lines (71%).

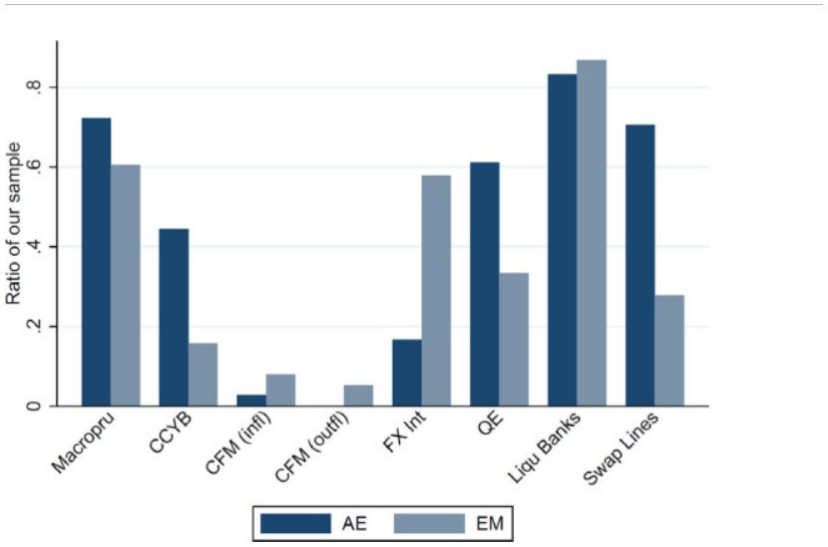

Fig. 24 Changes in macroprudential policy, foreign exchange intervention, capital controls and unconventional monetary policy in response to COVID-19
Source: Based on scrapped data from the IMF's Policy Tracker

A third policy response is intervention on forex aimed at moderating sharp currency movements.

Figure 25 highlights the extent of changes in foreign exchange reserves according to Adler et al. (2021). Figure 24 shows the share of the sample reporting any forex intervention according to the IMF Tracker. Although only Iceland, Israel, and Switzerland claim to have made direct interventions on forex during the first half of 2020, most EM reported that they had undertaken some kind of intervention on forex.

According to Adler et al. (2021): "Currency intervention was more widespread than reported in the IMF Policy Tracker, and that the directions and extent of this intervention varied substantially from one country to another."

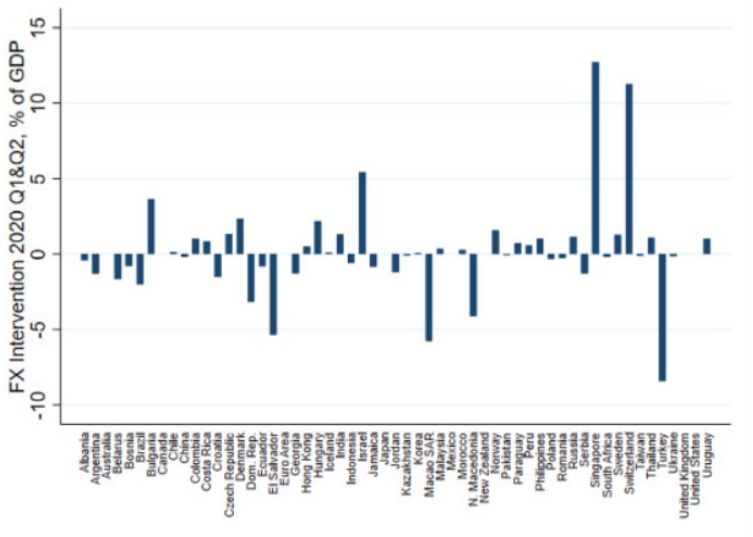

Fig. 25 Forex interventions during COVID-19 as a percentage of GDP
Source: Based on data from Adler et al. (2021)

A fourth policy response includes the use and the adjustment of macroprudential regulations. Figure 24 highlights the share of countries that claim to have made any adjustments in macroprudential policy. Analysing the figure in detail, we can see that a large percentage of countries report an adjustment of macroprudential policy (72% of AE and 61% of EM).

The last policy consists of adjusting capital controls. More specifically, we focus on two types of capital flow measures (CFM) that aim to reduce net capital outflows and the corresponding pressure for currency depreciation. Figure 24 highlights the small number of countries reporting changes in capital controls: only 8% of emerging markets have reduced capital inflow controls (Peru, India, and China) and 5% tightened controls on capital inflows. The only Asian country that reported changing its capital flow measures is Korea, which has adjusted capital inflow controls.

To better understand the choice of pursuing one policy rather than another, Bergant and Forbes (2023) proceed to the estimation of the use of each political instrument (PT) for each country i in function of three variables: pre-existing policy space (PS), country-specific stress (ST), and other country-specific characteristics (CC):

$$PT_{i,t} = \alpha + \beta * PS_{i,t} + \gamma * ST_{i,t} + \delta * CC_{i,t-1} + \varepsilon_{i,t}$$

Unlike the political instrument and the variables of stress that are measured in the early stages of the pandemic, the policy space and other characteristics inherent in the country are calculated before the pandemic begins.

The above equation is estimated using OLS when the policy tool is a continuous variable, or as a probit when it is a fictional variable. All regressions include robust standard errors.

The measurement of policy space in each regression varies depending on the policy instrument used:

- For tax stimulus regressions → the policy is computed space as general government gross debt in relation to GDP;
- For regressions requiring the use of monetary stimuli → the policy space is measured using the level of the official interest rate;
- For regressions involving foreign exchange intervention → the policy space is calculated as the level of foreign reserves as a percentage of GDP;
- For regressions involving the use of macroprudential tools → the policy space is measured as an index of three popular macroprudential tools (the level of the CCyB, the level of the LTV ratio, and an index of foreign exchange regulations);
- For regressions that predict changes in CCyB → the policy space is computed from the initial level of CCyB;
- For regressions requiring adjustments in controls on capital inflows or outflows → the policy space is measured using an index of controls on inflows or outflows, respectively, by Fernández et al. (2016);

- For regressions involving the use of containment tools → we use the output gap to capture the stage of the business cycle we are in, in order to understand whether the economy started from a stronger position to absorb any containment in activity.

In each of these measures a positive value is synonymous with a greater policy space (i.e., lower debt ratios, higher interest rates, higher foreign exchange reserves, macroprudential regulation or tighter capital controls and a smaller output gap).

With the second set of variables, it is possible to measure the level of stress (ST) caused by COVID-19 on financial markets, economic activities, and health.

Bergant and Forbes (2023) measure financial stress based on the percentage changes from the end of 2019 to the date of the "stress peak" for each country. Economic stress is calculated as the change in GDP growth forecasts for each country in the first six months of 2020. Finally, they measure health stress as the number of reported cases of COVID-19 on the total population of each country.

It is important to note that a high value indicates increased stress (i.e., greater increase in financial market spreads, greater reduction in projected GDP growth, or greater incidence of COVID-19 cases).

Policy space also proves to be a useful tool when there is a need to understand how different policies (e.g. fiscal policy) have been implemented.

As far as fiscal policy is concerned, it is possible to state that AEs with higher pre-pandemic debt levels preferred a strategy of using stimulus in the form of loans, shares, and credit guarantees, rather than a strategy based more on traditional budgetary expenditure increases and revenue losses.

Compared to monetary policy, countries with higher pre-pandemia official interest rates appear more likely to lower these rates, without implementing monetary policies called “non-conventional.” More specifically, these countries are less tempted to purchase assets and implement programs that provide liquidity to banks.

Countries may also decide to use certain policies as substitutes for others.

In more detail, it may happen that a country must use other instruments than the one already in use to provide new stimuli. Or, it could happen that a country cannot resort to the use of the instrument it had set out to use, it is forced to use alternative instruments. Finally, if a country does not have the necessary reserves to counter depreciation, it must rely on other instruments such as adjustment of macroprudential policy or capital controls.

In conclusion, the decision to use certain policies could be influenced by iterations with other ones. For all these reasons, the policy space could influence a country's decision to use other instruments.

From the analysis of Table 15, all the countries in the reference sample used at least two categories of instruments: fiscal stimulus and containment measures.

On average, all countries have used at least four of the six categories of instruments to stimulate their economies. In particular, thirteen countries used instruments belonging to five categories and two (China and Turkey) used instruments belonging to all six categories.

Noteworthy is the incidence of countries that decided not to use popular policies, or that resorted to instruments that pushed in different directions. For example, although all countries have used some form of monetary policy to provide stimulus and/or loosen financial conditions, about a third of these countries have not relaxed macroprudential regulations. In addition, about a third of the countries that provided some form of monetary stimulus simultaneously purchased foreign exchange reserves to slow down the appreciation of their

currencies. At the same time, of the 25 countries that use forex intervention to slow the depreciation of their currencies, only two (China and Turkey) have tightened controls on capital outflows or relaxed controls on capital inflows.

Table 15

	Fiscal		Monetary				FX	Macroprudential		CFMs		Contain-	Total by Groups		Total by Tools	
Country	ATL	BTL	Δ Rate	APP	Liquidity	Swaps	Purchases	Overall	CCYB	Inflows	Outflows	ment	Stimulus	Any Form	Stimulus	Any Form
Albania													4	4	6	6
Argentina													5	5	7	7
Australia													3	3	7	7
Austria													3	3	5	5
Belarus													4	4	4	4
Belgium													4	4	8	8
Bosnia and Herzegovina													2	2	2	2
Brazil													5	5	8	8
Bulgaria													4	5	6	7
Canada													4	4	8	8
Chile													3	4	6	7
China													6	6	8	8
Colombia													3	4	8	9
Costa Rica													4	5	6	7
Croatia													4	4	7	7
Cyprus													4	4	6	6
Czech Republic													4	5	6	7
Denmark													4	5	7	8
Dominican Republic													4	4	6	6
Ecuador													3	3	3	3
El Salvador													4	4	4	4
Estonia													4	4	7	7
Finland													4	4	7	7
France													4	4	8	8
Georgia													5	5	6	6
Germany													4	4	8	8
Greece													4	4	6	6
Hong Kong SAR													4	5	7	8
Hungary													2	3	5	6
Iceland													4	5	6	7
India													5	6	8	9
Indonesia													5	5	7	7
Ireland													4	4	7	7
Israel													4	5	8	9
Italy													3	3	6	6
Jamaica													4	4	5	5
Japan													3	3	6	6
Jordan													4	4	5	5
Kazakhstan													5	5	7	8
Korea													5	6	8	9
Latvia													3	3	6	6
Lithuania													4	4	8	8
Luxembourg													3	3	5	5
Macao SAR													4	4	4	4
Malaysia													3	4	4	5
Malta													3	3	6	6
Mexico													3	3	6	6
Morocco													4	5	6	7
Netherlands													3	3	8	8
New Zealand													4	4	7	7
Northern Macedonia													5	5	6	6
Norway													4	5	9	10
Pakistan													5	5	8	8
Paraguay													4	5	5	6
Peru													4	5	6	7
Philippines													3	4	6	7
Poland													5	5	8	8
Portugal													4	4	6	6
Romania													4	4	8	8
Russia													4	5	6	7
Serbia													5	5	6	6
Singapore													4	5	7	8
Slovak Republic													4	4	7	7
Slovenia													4	4	6	6
South Africa													5	5	7	7
Spain													3	3	6	6
Sweden													4	5	8	10
Switzerland													4	5	7	8
Taiwan Province of China													3	3	3	3
Thailand													4	5	7	8
Turkey													6	6	10	10
Ukraine													5	5	6	6
United Kingdom													4	4	8	8
United States													3	3	7	7
Uruguay													4	5	4	5

Green indicates that the country used the policy instrument to provide stimulus/ease financial conditions; red indicates that the instrument has not been used; yellow indicates that the instrument has been used in a direction that does not provide stimulus/easing to financial conditions; and white indicates that no data were available or that the instrument is not available in the country.
Source: Data from the IMF's Covid-19 Policy Tracker

To conclude, the results of the analysis conducted by Bergen and Forbes (2023) suggest the crucial importance of the policy space as a determining factor to understand clearly how a certain country responds to a shock.

As stated by Bergene and Forbes (2023) themselves: “Policy space is a determining factor for a country’s ability to: provide monetary stimuli by lowering interest rates, engage in interventions on forex to support the exchange rate, and loosen macroprudential reserves (including CCyB) to support lending and access to credit.”

3.2 Focus on measures to tackle the crisis at European level

Only a decade after the sovereign debt crisis that hit the eurozone, and which almost led to the disintegration of the European Union's monetary system, the eurozone is once again facing a crisis that appears far worse than the previous one.

European states immediately activated fiscal and monetary responses to face the crisis. The same was done by the European Central Bank (ECB).

In terms of monetary policy, the European Central Bank (ECB) announced on 18 March 2020 the so-called "Emergency Purchase Programme (PEPP)." Through the introduction of this programme, the ECB aims to increase temporarily their purchases of goods of 30%.

As regards fiscal policy, each country has announced its own bailout package. In the case of Italy, a 25-billion-euro rescue package was announced on 10 March 2020 to address the emergency. Only three days later Germany also presented its package called "bazooka" worth 550 billion euros. Following this, France and Spain introduced their rescue packages worth 345 billion and 200 billion euros respectively.

Finally, it is worth mentioning the rescue package approved at the G7 meeting on 24 March 2020 to the value of EUR 540 billion.

Figure 26 shows the performance of five-year yields against the PEPP. Interestingly, monetary policy intervention coincides with a decrease in financial risk in all four countries and for all sectors. This means that the intervention promoted by the ECB seems to have been useful and effective.

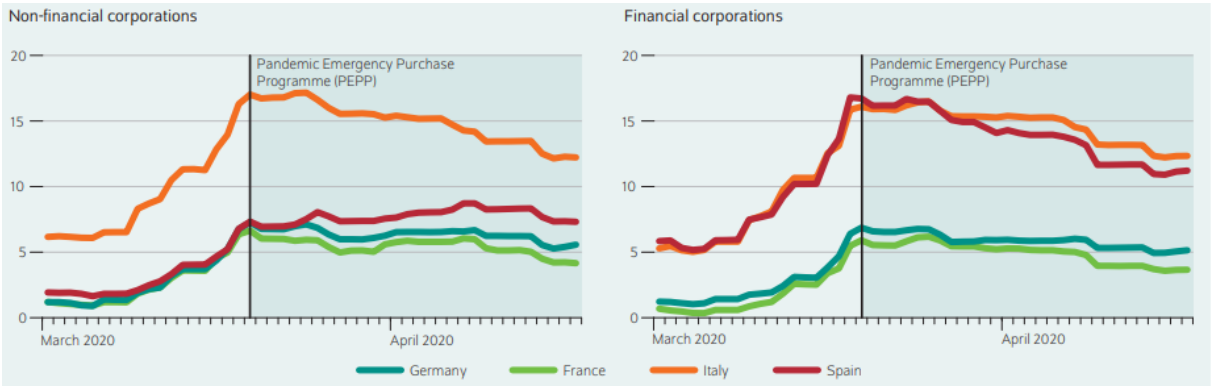

Fig. 26 Monetary policy interventions of the ECB.
Yields on bonds issued by non-financial corporations and financial corporations, five-year maturities, in percent.
Source: Bloomberg and calculations by Ettmeir, Kim and Kriwoluzky

Figure 27 summarizes fiscal policy interventions. In general, they do not seem to coincide with a change in five-year returns for either the financial or non-financial sectors. However, Germany is an exception: the introduction of the "bazooka" coincides with a temporary stabilization of financial market participants' expectations about the negative economic consequences of the pandemic.

It is interesting to note the positive relationship that seems to exist between the German rescue package and the returns of France, Italy, and Spain; in fact, looking at the graph you can see how the introduction of the "bazooka" stabilized the yields of the three countries mentioned above.

Finally, with regard to the aid package promoted by the EU finance ministers, it is possible to observe a decrease in the yields of the countries concerned (Germany, France, Spain, and Italy). This decline in returns reflects the confidence of financial investors in European measures.

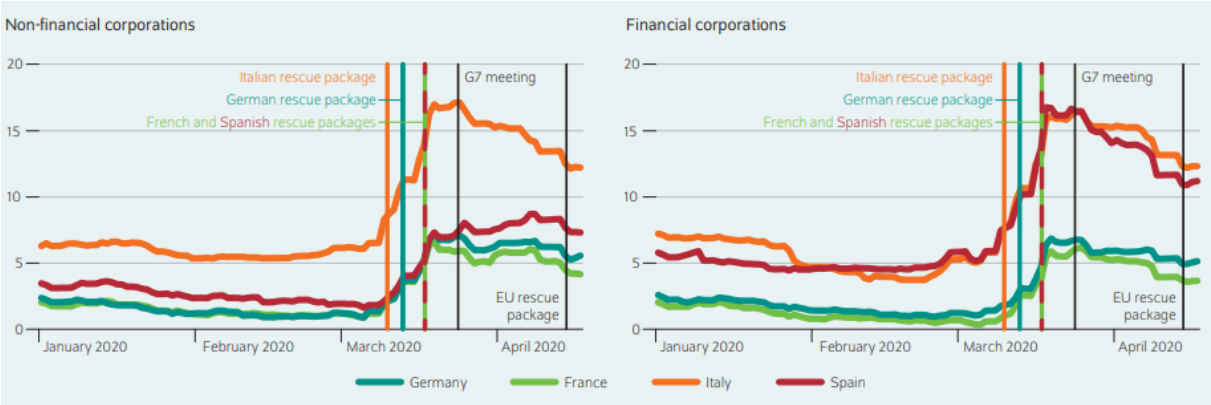

Fig. 27 Monetary policy interventions in the euro area.
Bond yields of non-financial corporations and of financial corporations with a five-year yield curve in percent.
Source: Bloomberg and calculations by Ettmeir, Kim and Kriwoluzky

Another tool that has been used to address the crisis resulting from the spread of COVID-19 is the "ESM". The "ESM" or "European Stability Mechanism" is a mechanism that was established in 2012 to provide financial assistance to euro area countries facing market tensions.

Initially, it seemed that the use of ESM was the easiest way to provide support to Member States. Indeed, loans provided through this instrument are repaid at lower than market interest rates. However, in order to use the funds made available to the ESM, countries need to participate in macroeconomic adjustment programmes, combining economic reforms and fiscal consolidation measures.

On 9th April 2020, euro area finance ministers agreed to develop a specific ESM credit line with limited conditionality. This new credit line (which is called "PCS") allows the euro area countries to borrow up to 2% of their GDP, without implementing any kind of macroeconomic change.

In addition to this new ESM credit line, euro area finance ministers have decided to create a new temporary EU instrument, called "Support to mitigate Emergency Unemployment Risks" (SURE).

This instrument is nothing more than an additional loan with a maximum value of EUR 100 billion that can be requested by Member States to cover any short-term expenses.

However, the implementation of these two instruments (ESM and SURE) has not convinced financial investors who have been rather sceptical about the ability to improve the monetary resilience.

As demonstrated by Delatte and Guillaume (2020), markets were disappointed by the measures taken by Europe. Investors know that providing debt to countries with a fragile economy is not the best option if the monetary gap between European countries is to be reduced.

Creel et al. (2020) calculated that Italy's use of the ESM and PCS would allow the country to save about 0.04% of GDP on interest rates. However, it should be stressed that participation in the ESM programme could have negative effects: indeed, participation in the ESM programme could be interpreted by the markets as a sign of weakness, which could then result in higher interest rates being demanded when these countries issue new bonds.

Precisely because of this negative aspect, European countries have been reluctant to use both PCS and MES, while they have been more inclined to use SURE. In fact, 15 countries have asked to use the SURE for a total of 81.4 billion euros (European Commission, 2020).

The introduction of all these instruments has meant that the ECB has been the main European institution to provide concrete aid to individual Member States.

However, some Member States have criticised these programmes. In particular, Germany challenged the PEPP, arguing that: "Asset purchase programs have blurred the line between monetary and fiscal policy." This dispute was resolved during the summer of 2020 by a vote of the German Parliament in support of the ECB.

Among the many initiatives promoted to tackle the crisis, it is worth mentioning that of France and Germany. They called for the development of a European fund worth EUR 500 billion, which should then be distributed to the governments of the most affected countries in the form of transfers financed by long-term debt issues.

Despite strong opposition from Austria, Denmark, the Netherlands, and Sweden to debt-financed transfers, on 21st July 2020 the European Commission announced the creation of a recovery fund called "NextGeneration EU".

This fund (worth 750 billion) will be used to finance major investments and reforms in all Member States. Italy and Spain will benefit from this fund in terms of value under the programme, while Bulgaria, Greece and Croatia will benefit in terms of their share of Gross National Income (GNI).

The announcement of the creation of the fund "NextGeneration EU" was welcomed by the financial markets with an additional fall in sovereign spreads.

The creation of this fund demonstrates once again that even in a situation of great economic crisis Europe has managed to renew its internal political dynamics, thus managing to give a clear and strong response to all Member States.

So far, we have talked about how Europe and the European Union have responded to the economic and financial crisis generated by COVID-19. Let us now focus on Italy to understand how the Italian government has faced this very critical situation.

Data from March 2020 confirm Italy as the epicentre of coronavirus at European level, representing 60% of confirmed cases and 90% of deaths in the EU.

To cope with the spread of the virus, the Italian government has taken important measures including declaring a lockdown on a national basis by closing schools, universities, and economic activities deemed unnecessary.

On the socio-economic front, Italy has adopted a series of measures to help families and businesses. In particular, the government has:

- Provided new funds to the “Cassa Integrazione Guadagni” to help companies pay workers' salaries and thus avoid dismissal;
- Provided economic aid of EUR 500 per month for workers with VAT;
- Provided new funds for SMEs;
- Suspended mortgage payments, tax payments, and social security contributions;
- Provided tax credits for companies that have recorded a decrease in turnover of at least 25%;
- Provided support for parents with school-age children (parental leave and babysitting vouchers).

For financing these measures, the Italian government has provided an initial budget of 900 million euros, to which were later added a further 25 billion (1.1% of national GDP).

3.3 Focus on measures to tackle the crisis at USA level

The US Treasury Security Markets, normally considered a safe haven during times of financial uncertainty, has experienced a notable deterioration in liquidity (Fleming and Ruela 2020).

As a result of the measures introduced to cope with the crisis, risk asset prices rose sharply while interest rates fell. This has resulted in a general improvement in non-global financial conditions.

To address the strain in offshore US dollar funding markets, the Fed increased liquidity by strengthening existing swap lines with five Central Banks (Bank of Canada, Bank of England, Bank of Japan, European Central Bank, and Switzerland National Bank), and it created new swap lines with nine others (Australia, Brazil, Denmark, Korea, Mexico, New Zealand, Norway, Singapore, and Sweden). As described by Barajas et al. (2020) and Eren, Schrimpf and Sushko (2020): "These swap lines had a significant impact and their announcements were associated with a significant narrowing of the cross-currency base for swap currencies."

On 15th March 2020, the Fed cut interest rates to zero and offered to buy $700 billion of assets from banks. A few days later, on 23rd March 2020, for the first time in its history, the Fed offered to buy corporate bonds. This coincided with the beginning of the stock market recovery and the end of the flight to the US dollar.

The "Coronavirus Aid, Relief, and Economic Security Act", better known as the "CARES Act", is a $2.2 trillion economic bill passed by the 116th United States Congress and enacted by President Donald Trump on 27th March 2020.

Unprecedented in size and scope (the planned cash allocation corresponds to about 10% of US GDP), this law was intended to provide a response to the economic crisis resulting from the spread of COVID-19.

In particular, of the 2.2 trillion dollars allocated, 300 billion went to the aid of the people and families who were most in difficulty, 260 billion were spent on increasing unemployment benefit and creating a "Salary Protection Program" that provides non-repayable loans to small businesses (for the latter project a further 669 billion dollars have been allocated), $500 billion was lent to corporations, and the remaining $339.8 billion to state and local governments. In addition, the law provides for the allocation of 100 billion dollars to hospital facilities.

On 21st December 2020, through the Consolidated Appropriations Act, the US government allocated an additional $900 billion to extend certain provisions of the CARES Act.

Let us now focus on Figure 28, which shows the adjustment of the economy to the "Quarantine shock" with and without the provisions of the CARES Act.

In particular, the blue lines reflect the adjustments of the economy without the CARES Act, while the red lines show the adjustments of the economy in presence of the CARES Act.

Looking at Graph A you can see that the presence of the CARES Act decreases production by 15% instead of 20%. This is due to the stabilisation of consumption (Figure B).

The transfer of resources to households also implies a realignment of the negative effects on investment (Figure D).

Finally, in the case of transfers, inflation rises gradually by about 2% above its stationary level. This implies a gradual increase in the reference rate.

Let us now examine the response of public debt. Graph F shows the development of the debt-output ratio at the Quarantine shock (or simply Q-shock) in the presence and absence of resource transfers. The presence of transfers implies that, at the end of the period considered, the ratio between the two variables is about 5 percentage points higher. This is easily explained if we assume that debt is slowly returning to its pre-pandemic value, while taxes and government spending are adjusting to stabilize debt.

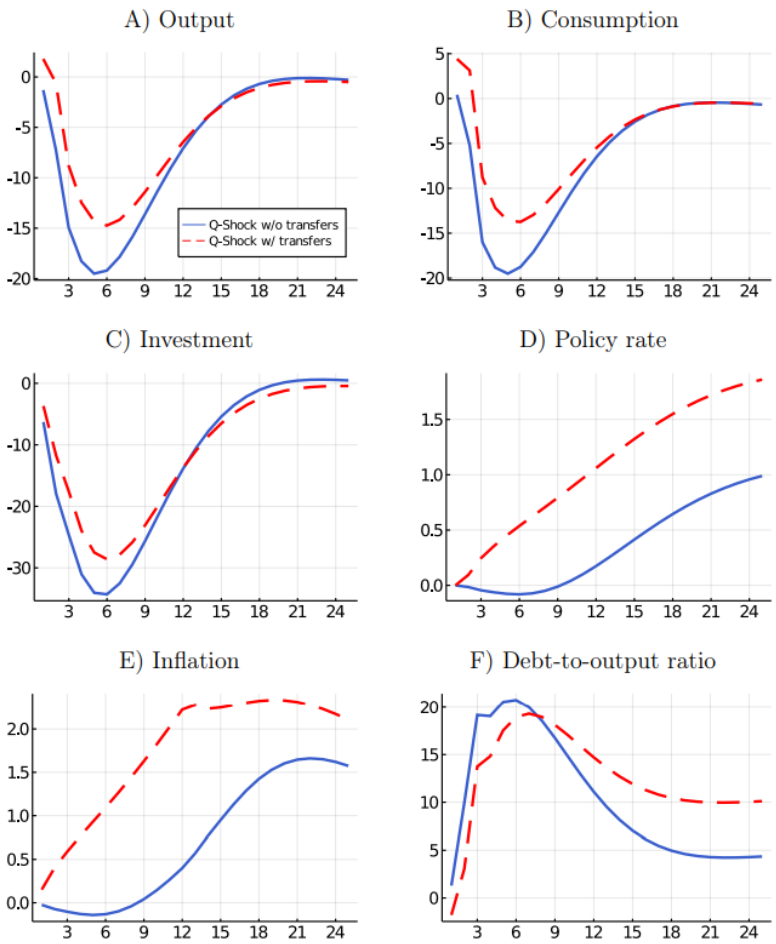

Fig. 28 Dynamic adjustment to Q-shock with and without fiscal transfers
Source: Bayer, Born, Luetticke and Müller

As highlighted by Cachanosky et al. (2021), the pandemic and the resulting lockdown have led to a significant decrease in total factor production. However, if nominal expenditure is not stabilised, this situation could degenerate into a decline in aggregate demand.

A decline in aggregate demand depends on a multitude of factors: either a flight to assets considered to be more liquid, a collapse in consumer confidence, or even a reduction in investment spending. If there were to be a fall in aggregate demand, real output would fall and the economy would therefore produce less of its potential.

To avert this scenario, intervention by the Fed is needed to provide monetary stability.

As of March 2020, the Fed has introduced measures to address the damage to the economy caused by COVID-19.

The measures taken by the Fed can be divided into two categories: monetary policy and emergency lending policy. When we talk about monetary policy, we refer to all those measures that have been implemented with the aim of influencing the yield curve and lifting the economy. On the contrary, the term “emergency lending policy” refers to the series of measures introduced with the aim of extending credit to banks, businesses, or other sectors of the economy.

As for monetary policy, the Fed’s first step was to lower interest rates to meet the growing demand for liquidity. It also took several measures to ensure that banks could continue lending money to households and businesses.

It is important to remember that the Fed has been operating in a floored system since October 2008, and its main monetary policy instrument is the IOR. By increasing and reducing the IOR, the Fed can discourage or favour monetary lending by banks, respectively.

As shown in Figure 29, the Fed began reducing its IOR from May 2019.

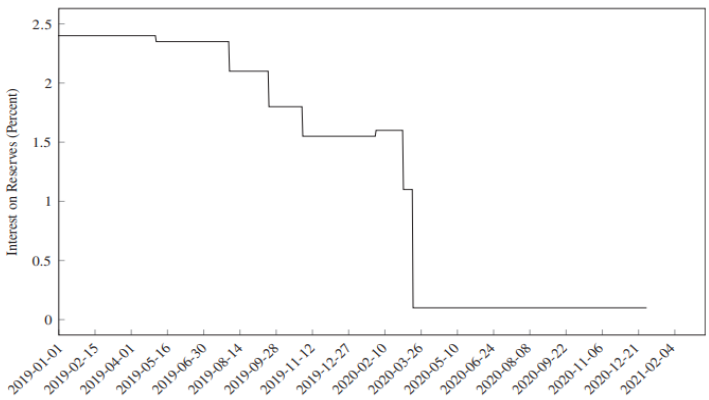

Fig. 29 Interest rate paid on reserves
Source: Board of Governors of the Federal Reserve System

Finally, in accordance with the operation of a floor system, the Fed reduced its FFR and it has expanded its repurchase operations.

To encourage banks to continue lending, the Fed has made two major changes to current legislation: it has removed reserve requirements and temporarily relaxed the rules governing bank capital and liquidity.

Finally, at the end of August 2020, the Federal Reserve revised its long-term goals and monetary policy strategy by declaring that the main goal is to achieve 2% inflation over time.

To extend credit to specific banks, businesses, municipalities, states or other sectors of the economy, the Fed has relied on several credit lines. On 17th March 2020, the Fed re-released its CPFF and PDCF. In particular, the CPFF was created with the aim of providing liquidity to the commercial card market. Instead, as regards PDCF it is only available to primary resellers, and is used to provide liquidity to the repo market.

On 18th March 2020, through the $10 billion support provided by the Treasury, the Fed established the MMLF. It is an updated and a more modern version of the "Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility" (AMLF), effective from 2008 to 2010. The main purpose for which the MMLF was introduced is the help and support that this tool could give to the MMF to meet repayment requests by making loans to U.S.

deposit institutions and bank holding companies that purchase high-end assets quality from MMF.

Only 5 days later, on 23rd March 2020, Federal Reserve relaunched its TALF with the aim of providing liquidity to the credit market used by consumers and businesses.

To provide credit to large corporations, the Fed authorized the PMCCF and SMCCF. Both are administered by the Federal Reserve Bank of New York, and boast a combined capacity of $750 billion.

Finally, the Fed's last emergency credit policy measure dates back to 8th April 2020 with the introduction of the PPPLF. It was intended to provide liquidity to financial institutions providing PPP loans.

In conclusion, we can say that the Fed has succeeded in promoting monetary stability. As Figure 30 suggests, aggregate demand grew rapidly, while the spread stood at 1.95%. This indicates that markets are confident that Federal Resources can reach the 2% inflation target within the next 5 years.

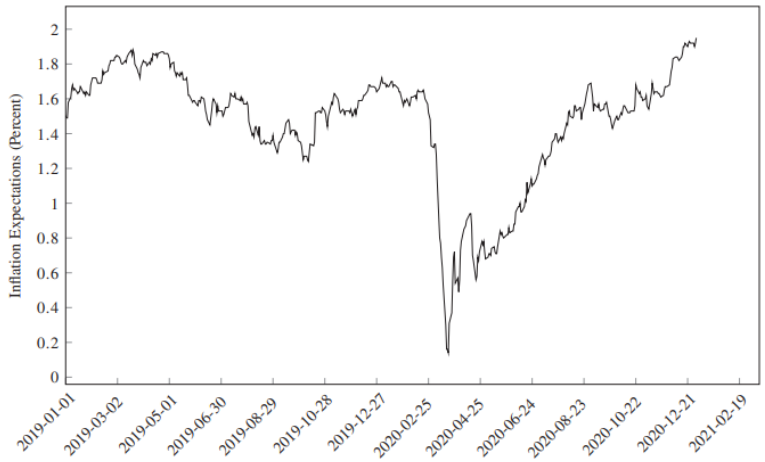

Fig. 30 Five-year TIPS spread
Source: Board of Governors of the Federal Reserve System

However, nominal spending continues to be below trend. This means that the Fed has failed to stabilize it.

Finally, it should be noted that Section 13 of the Federal Reserve Act authorizes the Fed to "lend to individuals, corporations and corporations in unusual and demanding circumstances, but only in a way that is broad and only for the purpose of providing liquidity to the financial system." Put another way, the Fed is allowed to lend to individuals and corporations for the sole purpose of promoting monetary stability.

Some of the Fed's credit lines (for example: CPFF, MMLF, PDCF, TALF) were introduced with the aim of ensuring liquidity, while others (for example: MLF, MSLP, PMCCF, PPPLF, SMCCF) are more of allocations of credit. They are unjustified: they are not useful to promote monetary stability.

Interestingly, Congress has not made any changes to the Federal Reserve Act to authorize the use of these instruments. Rather, it bypassed the law by justifying the introduction of these programs "in order to provide liquidity to the financial system that supports loans to eligible businesses, states or municipalities." In other words, Congress authorized the Fed to use such programs as if they were intended to provide liquidity to the financial system, even if they were not.

Everything I wrote in chapter 3 can be summarized as follows.

On a global level, the major Central Banks found themselves having to cooperate to face together a crisis whose scale far exceeded that experienced during the Great Depression. Among the measures adopted we recall: a reduction in interest rates, provision of liquidity, introduction of new credit lines and asset purchase programs. All these measures have been made possible by a very strong pre-pandemic monetary and financial environment.

To the action of the Central Banks is added the action of the governments of individual countries. They have in fact mobilized, taking all the necessary measures, to face the consequences of COVID-19. In particular, each government has drawn up precise and well-designed plans for, on the one hand, providing social assistance (for example, funds for the unemployed, funds for families in difficulty, funds for the redundancy fund), on the other hand to provide concrete aid to businesses and all economic activities in difficulty. The implementation of these assistance programmes was made possible by a planned monetary and fiscal policy action.

At European level, the European Central Bank has reacted strongly and decisively by providing timely and adequate solutions to tackle the crisis. Among the measures promoted by the ECB I cannot fail to mention the PEPP (Emergency Purchase Programme), with which the ECB intended to increase its purchases of goods by 30%, the ESM (European Stability Mechanism) which was used to provide assistance to eurozone countries in difficulty, and the "NextGeneration EU", a recovery fund designed to support investment and reform in all Member States.

Finally, at the US level, the US government enacted a law called the "CARES Act," in which $2.2 trillion was earmarked to stem the difficult social and economic situation facing the US.

An important contribution was also made by the Fed, which undertook, with a whole series of measures (for example: credit lines and monetary policy actions), to ensure economic stability in the country.

COMPARISON BETWEEN THE CORONAVIRUS AND THE GLOBAL FINANCIAL CRISIS OF 2008

In this fourth and final chapter I will compare the financial crisis of 2008 with that resulting from the pandemic.

In particular, in the first section (section 4.1) I will briefly introduce the GFC and explain its origin and consequences. In the second section (section 4.2) I will analyse the similarities and differences between the two crises. Next, in section 4.3, I will examine the reaction of macroeconomic variables to the crisis of 2008 and to the crisis of 2020. Finally, in the last section (section 4.4.) I will compare the measures taken by the main Central Banks to face and remedy the economic and financial consequences of the two crises.

4.1 Introduction to the Global Financial Crisis

The financial crisis of 2007-2010 has been one of the most severe financial crises since the Great Depression of the 1930s. The three-year period 2007-2010 is also known as the "Great Recession", a word coined by the economist Peter Morici (2008). This term well describes the extent and severity of the crisis that led to the failure of economic activities, as well as the decline of financial wealth and the contraction of the global economy (Baily and Elliot, 2009).

Figure 31 shows the financial stress index produced by the Federal Reserve Bank of St. Louis. It is constructed considering 18 variables including: bond indices, interest rates and spread levels. Through the analysis of this index, it is possible to understand the beginning of the crisis period, as well as its severity. Bearing in mind that: "The higher the index, the higher the level of stress," it can be noted that in 2006 the index was negative, meaning that the financial market was in a quiet stress-free situation. Things started to change from 2007, only to worsen in 2009 when the index peaked.

Fig. 31 Financial Stress Index
Source: Federal Reserve Bank of St. Louis

The event that led to the crisis was the overvaluation, and the subsequent collapse, of the US real estate market in 2006.

Until 2006, American house prices were rising sharply, partly due to the ease with which mortgages could be accessed, and partly due to low initial floating rate (ARM) interest rates.

After 2006, house prices began to fall, resulting in higher interest rates.

This was followed by a rapid increase in default assets, and mortgages were no longer able to refinance themselves on expiry of the initial "teaser" ARM rates that were reset to higher rates.

The collapse of house prices has led to serious economic and financial losses amounting to a few trillions of dollars.

During the housing bubble, house price growth had far exceeded income growth: in 2006 the average price of an American house had risen 124%, about 4.6 times the income of an average family.

Figure 32 shows the S&P Case-Shiller 10-city house price index. As you can see from the chart, in 2006 the index reaches its peak of 220. Following the bursting of the real estate bubble, the index started to fall to 151.19 in May 2009. There was a small rebound in 2010, and then rolled back to 151.66 in 2011.

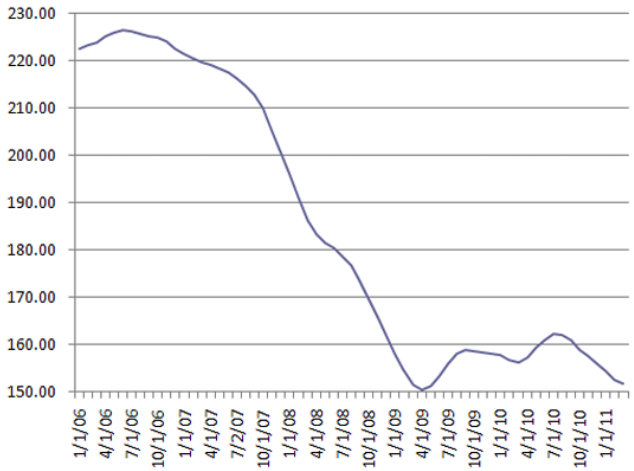

Fig. 32 S&P Case-Shiller 10-city home price index
Source: ALFRED, St. Louis Fed

As mentioned above, the financial crisis was partly caused by low interest rates.

In this regard, Bernanke (2005) argued that: "Further downward pressure on rates came with the large US current account deficit. The resulting strong international demand for US financial assets pushed up bond prices and thus brought yields down." To finance the increase in the US current account deficit, the USA was forced to borrow money from abroad. This large inflow of capital has increased demand for US financial assets. For these reasons Bernanke (2005) argues that: "One engine of the crisis was a foreign "saving excess"."

In the years leading up to the financial crisis, American households and financial institutions were increasingly in debt; which contributed to increasing their vulnerability and worsening the economic crisis. The key statistics include:

1. In 2007, the debt of American households was 127%, compared with 77% in 1990;
2. The value of loans granted for the purchase of a house was 1.428 billion dollars in 2005, compared with 625 billion in 2001;
3. US private debt rose from 123% of GDP in 1981 to 290% of GDP in 2008;
4. Major US banks report worrying debt levels: about $4.1 trillion in 2007 alone, equivalent to 30% of US GDP.

The International Monetary Fund (IMF) has periodically estimated the global losses of this financial crisis.

In April 2009, it estimated the value of losses on loans and financial assets to be $4.1 trillion, about double the January 2009 estimate.

The IMF also estimated that the total write-downs of US assets (which included both bank and equity assets and pension funds) reached $2.7 trillion, against the $2.1 trillion forecasts by previous estimates made in January of that year.

As has already been said, credit institutions were also affected by this financial crisis. Large US banks suffered losses of $2.8 trillion from 2007 to 2010.

The US economy has suffered greatly from the financial crisis. American families have also been hit by the crisis, losing about 25% of their net worth from June 2007 to November 2008.

Savings and pensions also fell by $1.3 trillion and $1.2 trillion respectively. In contrast, the unemployment rate rose from 5% in 2007 to 10% in 2009.

Finally, US GDP contracted sharply in 2008-2009 (Figure 33).

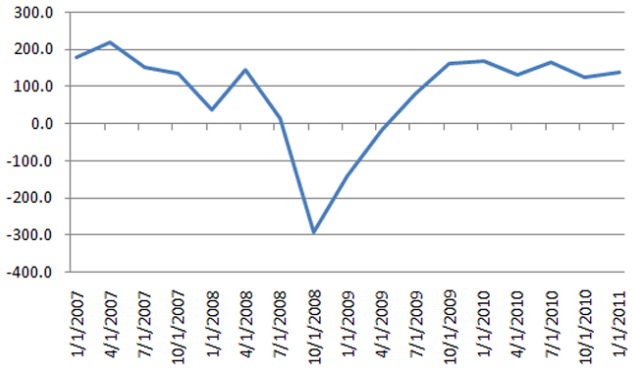

Fig. 33 Changes in the US GDP
Source: Federal Reserve Bank of St. Louis

After the outbreak in the US, the financial crisis quickly spread around the world, causing, among other things, the bankruptcy of many credit institutions, the collapse of stock indices and the decrease in the market value of stocks and commodities.

As regards GDP, there was a global decline: during the first quarter of 2009 in the euro area the decline in GDP was 9.8%, in Japan of 15.2%, while in Mexico of 21.5%.

The Fed, the ECB and other major Central Banks took immediate action to provide a timely and adequate response to the crisis. In the last quarter of 2008, Central Banks purchased $2.5 trillion in public debt and assets from banks. This is one of the largest international monetary policy operations ever.

Important was the action of the US government that has allocated 3 trillion dollars to implement a series of rescue programs. Among the various aid packages, we mention:

1. On 3rd October 2008, President-in-Office George W. Bush signed a programme called "TARP", which was used to purchase assets deemed problematic in the possession of financial institutions;
2. A programme, the American Recovery and Reinvestment Act was drawn up in 2009, which included, among other things, a tax cut for American households.

4.2 Differences and similarities between the COVID-19 pandemic and the Global Financial Crisis

According to the economist Marc-Olivier Strauss-Kahn (2020), the two crises are joined by three important factors:

1. The uncertainty;
2. The collapse;
3. The reaction.

As regards the "uncertainty" factor, it can be defined as a non-quantifiable risk (Frank Knight, 1921). This risk is not easily traceable, the probability of occurrence and its impact are unpredictable.

Both crises (COVID-19 and Global Financial Crisis) are associated with this factor. Indeed, as far as the Global Financial Crisis is concerned, the element of uncertainty is the sub-prime loans that were granted to the Americans, which were not aware of the risk associated with such loans because they were well hidden and transferred through apparently sound financial assets and vehicles. This has led to a peak of unprecedented economic and financial uncertainty.

Similarly, the COVID-19 brought with it great uncertainty: at the end of April 2020 the index of uncertainty related to global economic policy records its maximum. This is partly due to the blocking of economic and commercial activities worldwide.

Regarding the collapse we can say that the decreases in the stock exchanges of the main countries are similar to the two crises.

Chart 1 shows the evolution of the S&P 500 index from 2008 to 2020. In particular, it provides two important focuses: the first on the six months following the disaster of

Lehman Brother, while the second about two and a half months after the start of the pandemic.

Chart 1 US Stock Exchange 2008-2020 with 2 Focus just after Sept. 2008 & Feb. 2020
Source: Marc-Olivier Strauss-Kahn (2020)

In both cases, the index appears to be overvalued: in September 2008, the previous peak had already undergone a partial correction, while in February 2020 a new historical peak was recorded, well after the arrival of the virus in the USA.

According to Robert J. Shiller (2020), the Price/Gain ratio, calculated using the S&P Index, was over thirty in early 2020, which led to stock prices rising. The same scenario occurred in 2008.

As for the "year-on-year" forecasts, the International Monetary Fund assumes a rapid recovery of the markets, preceded however by a period of sharp decline in growth. As shown in chart 2, in 2020 the IMF assumes a decline in growth ranging between -6% in the United States and -8% in the euro area. This decline appears to be more serious than that experienced in 2009, where the only country to have recorded such a sharp contraction in growth was Japan (-7% growth).

Chart 2 Real Growth Forecast for 2020
Source: IMF World Economic Outlook, April 2020

Finally, as regards the reactions, namely the measures taken to limit these shocks, they appear similar: in both cases, economic and financial aid has been provided to address these situations of uncertainty. It is important to remember that, in both crises, the difference was made by the public authority, which was able to provide effective and timely responses.

So far, we have limited ourselves to examining the similarities between COVID-19 and the Global Financial Crisis. However, they also have important differences. In particular, Marc-Olivier Strauss-Kahn (2020) identifies four:

1. The process;
2. The speed and the shape;
3. The policies;
4. The multilateralism.

The first factor that Marc-Olivier Strauss-Kahn (2020) analyses is the process.

Looking at what happened in 2020, it is impossible not to notice the speed with which the virus spread across the world. This appears to be partly due to the high integration of supply chains and, in part, to the contagious nature of the virus. The health emergency hit the supply side first and then hit the demand side (tourism, trade, etc.).

The supply shock has consequently negatively affected the financial sector.

To minimize the damage, early intervention was necessary to ensure that programs were implemented to minimize capital losses and corporate bankruptcies.

On the contrary, in 2008 the financial shock caused the bursting of the real estate bubble in the USA and, consequently, of the demand. Both then affected the national and international financial markets, leading to a global recession.

To remedy this situation, several initiatives have been taken with the aim of relaunching the global economy and financial markets.

The second factor under exam is the speed and the shape. As analysed in Chapter 2, there are four possible scenarios that depict the evolution of GDP.

As we well know, the "V-shaped" shock is the most optimistic. It appears as the most intense, but at the same time as the shortest. This would allow real GDP to return to its initial value, in stark contrast to what happens when the shock is "U-shaped" like that of the GFC.

Indeed, the recovery following the Global Financial Crisis was rather slow and tortuous, interrupted by further crises such as the one that broke out in Greece or Italy.

Therefore, if confirmed, the "V" shock would allow a rapid recovery (both economic and financial) from the pandemic.

As regards the policies put in place to tackle the two crises, we can say that in 2020, unlike 2008, public authorities seem to have a smaller margin of reaction. As highlighted by Marc-Olivier Strauss-Kahn (2020): "This would apply to fiscal policies, given the high debt ratio, in most mature economies. However, the magnitude and speed of the reactions were unprecedented."

Chart 3 compares the fiscal support provided to different countries. In particular, the United States seems to receive more fiscal support, compared to the euro area. However, the euro area benefits from more government guarantees in terms of lending money.

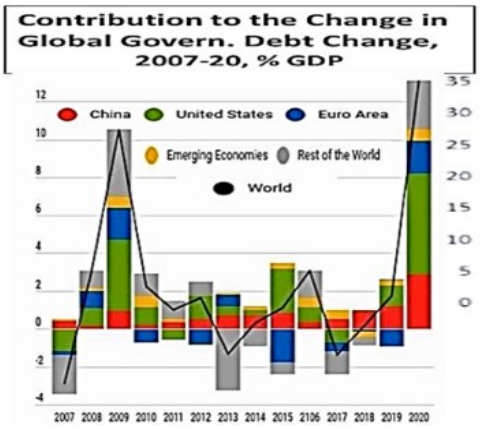

Chart 3 Fiscal support in the main countries
Source: National authorities and IMF

Finally, the last factor that Marc-Olivier Strauss-Kahn (2020) examines is multilateralism.

Unlike what happened during the Global Financial Crisis, cooperation between governments was not particularly significant during the pandemic. Indeed, while there are many examples of international cooperation and coordination between credit institutions (e.g. swap agreements), there are fewer among governments globally.

In particular, at the European level, it is worth remembering the difficulties that European leaders experienced in finding a univocal agreement on the recovery fund "NextGeneration EU."

We can therefore conclude that, from the analysis carried out by the economist Marc-Olivier Strauss-Kahn (2020), it is clear that the differences outweigh the similarities between the two crises.

4.3 How macroeconomic variables reacted to COVID-19 and GFC

Li et al. (2022) analyse the implications of the pandemic crisis on macroeconomic variables, comparing the results obtained with what happened during the 2008 financial crisis.

The COVID-19 pandemic has had a huge global impact. In particular, in the USA it has caused a slowdown in the growth of the country, resulting in a recession of the economy.

The negative effects of the pandemic have been seen in all economic sectors: from oil production to industrial production, resulting in an increase in the unemployment rate and a decreasing in the consumption.

Regarding the industrial production, table 16 gives a clear and comprehensive picture of US industrial production. As can be seen, in 2020 the industrial production index fell from 109.2 (calculated in January 2020) to 98.9 (recorded in July 2020). The average value of the decrease in production is more serious than that recorded during the 2008 financial crisis.

This is due to the combined action of two factors: the lockdown (limitation of people's movements) and the contraction of the flow of international trade.

Table 16

Time Period	Financial Crises
2008-08-01	100.8
2008-09-01	96.366
2008-10-01	97.3
2008-11-01	96.1
2008-12-01	93.3
2009-01-01	91.1
Time Period	**COVID-19**
2020-01-01	109.2
2020-02-01	109.3
2020-03-01	104.6
2020-04-01	91.3
2020-05-01	92.07
2020-06-01	97.6
Average Total Decline in Industrial Productivity	
Financial Crises	**COVID-19**
95.8	98.9

Source: Calculations by Li et al. (2022)

Figure 34 provides a comparison between industrial production during the financial crisis and industrial production during the pandemic.

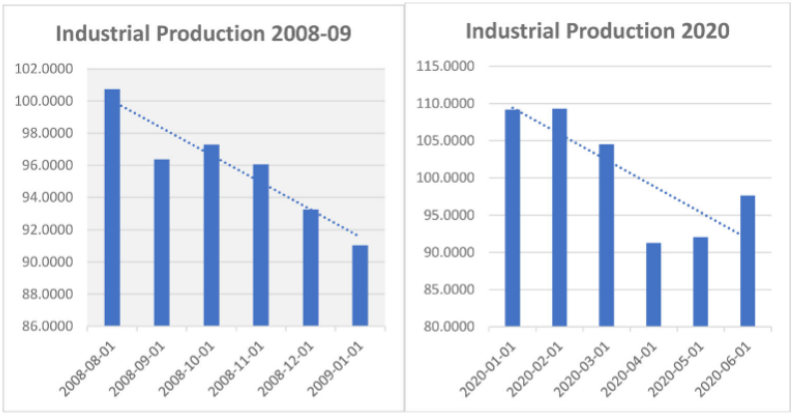

Fig. 34 Comparison of Industrial Production during GFC and COVID-19
Source: Calculations by Li et al. (2022)

Looking at Figure 34, in 2008 the value of industrial production goes from 100.8 (recorded in August 2008) to 91.1 (recorded in January 2009), with an average decrease of 95.8. This is lower than during the pandemic.

All this can be explained by recalling that, unlike the GFC where the endogenous nature of the crisis had led to a loss of liquidity and a reduction in bank reserves, in the case of the pandemic, the exogenous nature of the crisis had a decisive impact on industrial production, causing a worse decline than during the three-year period 2007-2010.

Table 17 provides a comprehensive and detailed overview of US consumer spending.

Table 17

Time Period	Financial Crises
2008-08-01	10603.0
2008-09-01	10537.9
2008-10-01	10514.9
2008-11-01	10487.6
2008-12-01	10447.6
2009-01-01	10500.6
Time Period	**COVID-19**
2020-01-01	13416.4
2020-02-01	13402.4
2020-03-01	12536.1
2020-04-01	10999.3
2020-05-01	11936.7
2020-06-01	12644.7
Average Total Decline in Real Personal Consumption Expenditure	
Financial Crises	**COVID-19**
10515.3	12489.3

Source: Calculations by Li et al. (2022)

During the Global Financial Crisis consumer spending fell from 10603 million dollars to 10500.6 million dollars, with an average total decline in consumer spending of 10515.3 million dollars. The reason for this decline was the tight cash flow that characterized the GFC.

Likewise, during the pandemic, the disruption of daily activities imposed by the lockdown had a severe impact on consumption. In particular, there was an average total decline in consumer spending of $12,489.3 million.

Comparing the data for the GFC with those for the 2020 crisis, it is possible to demonstrate that the crisis caused by the spread of COVID-19 had a worse impact on consumer spending than the 2008 GFC.

Figure 35 provides a graphical representation of the above.

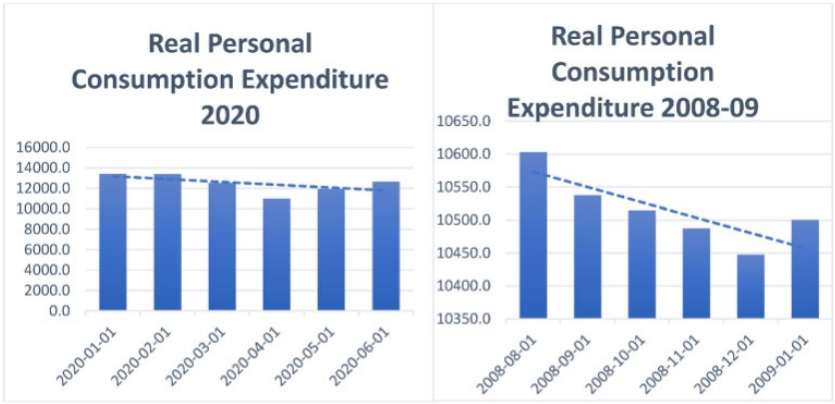

Fig. 35 Real Personal Consumption Expenditures During COVID-19 and GFC
Source: Calculations by Li et al. (2022)

Table 18, and the resulting graphs in figure 36, show the likelihood of a reduction in the recession in 2020 and 2008/2009. During the 2008 GFC, the probability of recession was 100%. This was partly due to rising inflation, partly to the failure of major American companies and banks.

A similar scenario occurred in 2020 with the spread of COVID-19, and the subsequent pandemic.

However, in the case of the 2020 crisis, in order to revive the economy, but at the same time ensure public safety, a series of measures were taken that provided for a gradual return to normality with subsequent recovery of the markets in the short term.

Table 18

Time Period	Financial Crises
2008-08-01	99.95
2008-09-01	100.00
2008-10-01	95.80
2008-11-01	99.98
2008-12-01	100.00
2009-01-01	100.00
Time Period	**COVID-19**
2020-01-01	25.58
2020-02-01	58.30
2020-03-01	100.00
2020-04-01	100.00
2020-05-01	37.85
2020-06-01	37.85
Average Total of Smoothed US Recession Probabilities	
Financial Crises	**COVID-19**
99.29	59.93

Source: Calculations by Li et al. (2022)

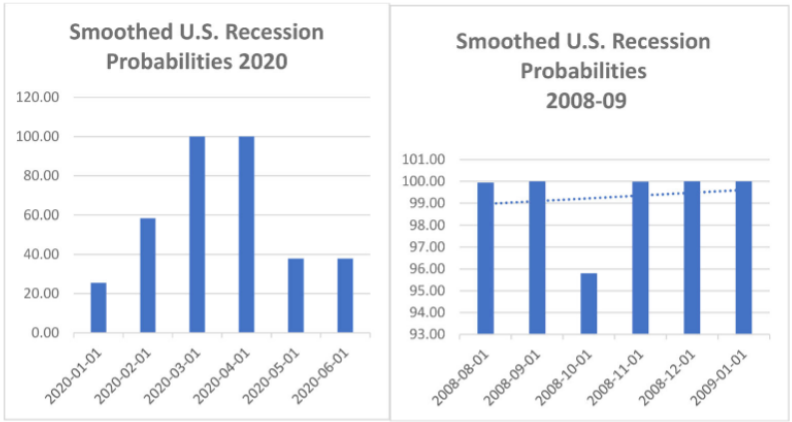

Fig. 36 Smoothed US Recession Probabilities During GFC and COVID-19
Source: Calculations by Li et al. (2022)

Finally, table 19 allows us to see clearly and in detail the levels of unemployment in the USA during the Global Financial Crisis and the pandemic.

Table 19

Time Period	Financial Crises
2008-08-01	6.1
2008-09-01	6.1
2008-10-01	6.5
2008-11-01	6.8
2008-12-01	7.3
2009-01-01	7.8
Time Period	**COVID-19**
2020-01-01	3.6
2020-02-01	3.5
2020-03-01	4.4
2020-04-01	14.7
2020-05-01	13.3
2020-06-01	11.1
Average Total Decline in Unemployment Rate	
Financial Crises	**COVID-19**
6.8	8.4

Source: Calculations by Li et al. (2022)

Figure 37 is a graphic representation of the comparison between the rate of unemployment during the pandemic and the one during the GFC.

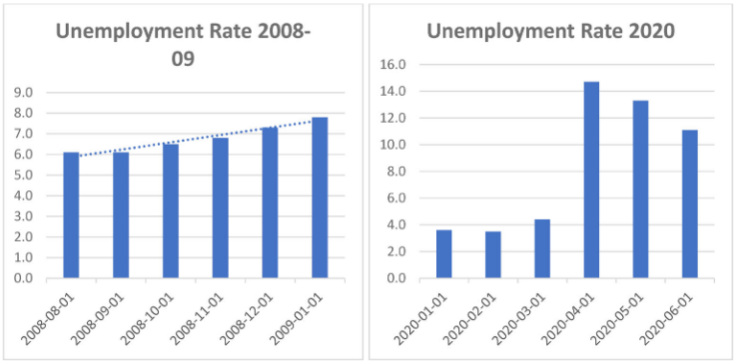

Fig. 37 Unemployment Rate During Financial Crises and Pandemic
Source: Calculations by Li et al. (2022)

From the analysis of table 19 and the graphs in figure 37, it is possible to observe that the unemployment rate is lower in 2008 than in 2020. The reason for this situation is to be found in the sharp decline in economic activity due to the introduction of lockdown that has forced the closure of many companies and business activities, resulting in increased redundancies, and thus the unemployment rate.

4.4 Comparison of reactions and measures taken by the main Central Banks to face the financial crisis of 2008 and the crisis of 2020

The size and nature of COVID-19 has been a major international challenge.

To address this crisis, monetary and fiscal policy measures had to be implemented, which were faster and more effective than those adopted during the 2008 financial crisis.

Traditionally, the first measure taken by Central Banks when an economic downturn occurs is to lower interest rates. This measure aims to reduce the level of indebtedness of households and businesses by increasing investment and consumption.

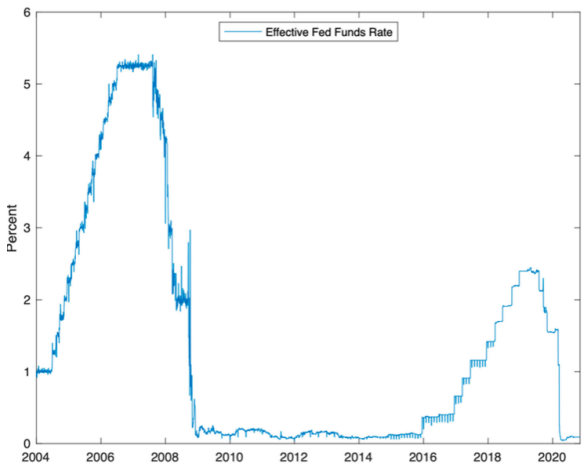

Fig. 38 Interest rate policy in the US around the 2008 and Covid-19 crises
Source: Board of Governos of the Federal Reserve System (US), retrieved from FRED

Unfortunately, the reduction in interest rates is not always effective. Indeed, if economic instability continues unabated, further measures are needed. In this case a Central Bank will have to assume the role of "lender of last resort" (LOLR), in order to ensure liquidity to banks and financial institutions.

The 2008 Global Financial Crisis highlighted the fact that financial markets were characterised by a strong liquidity shortage. To address this, the Fed introduced swap lines with a select group of Central Banks.

These swap lines were subsequently reused during the crisis that hit the eurozone in 2012-2013.

With the advent of the pandemic, the Federal Reserve has expanded its swap lines, raising the ceiling of dollars that can be traded to 450 billion. The goal was to alleviate the global liquidity shortage by consoling the Fed's "last resort" role.

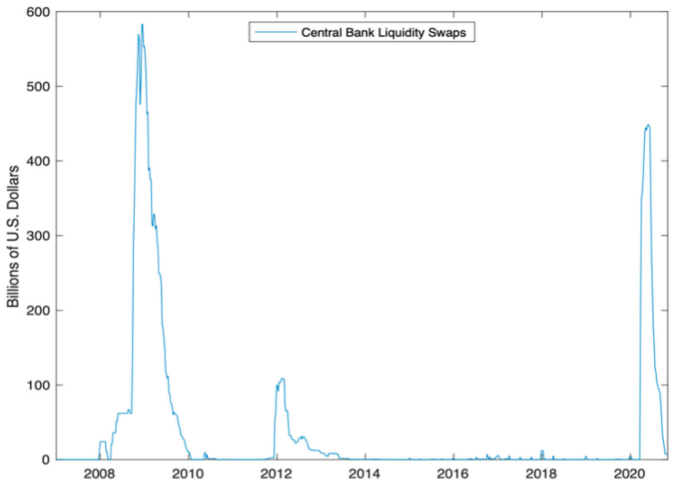

Fig. 39 Currency swap lines between the Fed and other Central Banks
Source: Board of Governos of the Federal Reserve System (US), retrieved from FRED

In order to avoid the bankruptcy of the investment bank "Bear Stearns", a $168 billion government incentive package was announced in March 2008.

This type of intervention led to the creation of a new instrument called "Maiden Lane LLC", which provided for the acquisition of the mortgage business of "Bear Stearns" by JPMorgan.

The introduction of this new instrument inaugurated and consolidated the Fed's role as a "dealer of last resort": the Fed could then use its balance sheet to acquire assets that no other market participant could absorb.

In October 2008 a new instrument was introduced, the "Commercial Funding Facility LLC", whose function was to purchase commercial card directly from eligible issuers. This tool has gained considerable popularity, so much so that it was restored on 17th March 2020 to face the

crisis of COVID-19. In that situation the Fed considered necessary to introduce, in support of the "Commercial Funding Facility LLC", two new instruments: the "PMCCF" and the "SMCCF". These are two new credit lines whose purpose is to provide liquidity to the primary and secondary markets.

Indeed, on 9th April 2020 the Fed announced the creation of the "Main Street Lending Program", with the aim of acquiring loans made to small/medium-sized businesses and non-profit organizations. In particular, eligible banks originate and maintain 5% of the loans, while the remaining part is absorbed by an SPV financed by the facilities.

In terms of long-term positive impact on the Central Bank balance sheet, the most significant monetary response to the 2008 crisis has been "quantitative easing". This measure foresees the reduction of financial charges when the reference rate cannot be lowered beyond the zero-lower limit by targeting other interest rates (for example those with longer maturities in the yield curve).

Thus interpreted, "quantitative easing" can be seen as an extension of interest rate policy, which involves the acquisition by the Central Bank of short-term public debt.

"Quantitative easing" has been very successful, and has also been adopted by other Central Banks such as the Bank of England and the ECB.

On 31st March 2020, the Fed established the "Foreign and International Monetary Authority Repo Facility" (FIME), a tool that allows Central Banks and international monetary authorities to exchange their US Treasury securities in dollars. The purpose of this instrument was to provide liquidity to all banks without access to swap lines.

If we analyse the political responses that the European Central Bank provides to curb the consequences of the pandemic, they can be summed up in an increase in loans to banks and an increase in asset purchases. In fact, on 12nd March 2020, the ECB earmarked €120 billion to

increase the acquisition of assets. A few days later, on 18th March 2020, the European Central Bank announced the introduction of the PEPP, with the aim of integrating monetary policy (reducing the yield of some financial instruments such as long-term bonds), supporting markets.

Despite the differences between the two crises, the measures adopted by Central Banks are practically the same:

1. Reduction of interest rates;
2. Provision of liquidity to financial institutions;
3. Unconditional support for the financial markets.

Finally, the fact that Central Banks are behaving like "traders of last resort" was the subject of much controversy during the 2008 crisis. However, it proved to be of great help even in 2020 during the pandemic.

What has really changed in the decade between the two crises has been the evolution that has affected the financial intermediation sector, which is seen today as fundamental for lending money.

The analysis and the comparison between the GFC and the 2020 crisis have led to important conclusions that can be summarised as follows.

The 2008 financial crisis was one of the most severe financial crises since the Great Depression of the 1930s. Also known as the "Great Recession", the GFC led to the failure of economic activity, the economic downturn and financial decline. The event that caused this crisis was the collapse of the US housing market in 2006. The consequences of this collapse (for example: the failure of banks, collapse of house prices, etc.) did not limit themselves to the United States alone, but quickly spread around the world.

The comparison between the financial crisis of 2008 and the crisis of 2020 revealed the similarities and the differences between the two. In particular, despite the similarities in terms of uncertainty, collapse and reaction, the differences were the master. As pointed out by the same economist Marc-Oliver Strauss-Kahn (2020), the differences between the two crises are superior to the common aspects: the two crises, although similar, show very different characteristics (for example in terms of speed and shape).

The analysis of the reactions of the main macroeconomic variables has yielded interesting results. As for the factor "industrial production", due to the exogenous nature of the pandemic, on average the decrease was greater during 2020. A similar scenario occurred for the "real personal consumption expenditures", where, on average, losses were more severe during the pandemic. Finally, as regards the unemployment rate, again the number of unemployed was higher in 2020 (the main cause is the lockdown) than in 2008.

Examining the economic and monetary policies adopted by the main Central Banks, it can be concluded that: despite the obvious differences between the two crises, The response and the measures taken to address the negative consequences of the GFC and the 2020 crisis were the

same. In both cases, an attempt has been made to reduce interest rates, to provide liquidity and support to financial institutions and markets.

CONCLUSION

This thesis aimed to examine in depth the reaction of financial markets to the COVID-19 pandemic.

Through a comprehensive review of the literature, I initially explained the nature and the spread of COVID-19, followed by an analysis of its financial and macroeconomic consequences. Then, I explored the policies adopted by governments and Central Banks to stabilize markets and compared the COVID-19 pandemic with the 2008 Global Financial Crisis (GFC), highlighting key similarities and differences in market reactions and policy responses.

The analysis revealed that the COVID-19 pandemic had a significant impact on financial markets, particularly in terms of volatility and investor behaviour. The pandemic led to a substantial shift in investments towards safer assets, particularly in European markets, where uncertainty and fear were more pronounced compared to the United States and Japan. Despite these challenges, some markets, such as the U.S., demonstrated a relatively rapid recovery, highlighting the varied economic resilience across regions.

Government and Central Banks interventions were crucial in mitigating the economic fallout. While the specific measures varied across countries, common strategies included interest rate cuts, asset purchase programs, and liquidity support. These policies were generally effective in stabilizing financial markets, though they also exposed new vulnerabilities, such as increased leverage in the non-financial sector.

Comparing COVID-19 with the 2008 Global Financial Crisis, it is evident that both crises were marked by significant uncertainty and rapid policy responses, but they differed in their origins and impacts. The pandemic, being an exogenous shock, led to a sharper decline in key

economic indicators, such as industrial production and consumer spending, than the GFC. However, the policy response to the pandemic was more extensive and swifter, reflecting lessons learned from the 2008 crisis.

In conclusion, this thesis has demonstrated the profound impact that the COVID-19 pandemic had on global financial markets, revealing both the vulnerabilities and the resilience within different regions. The unprecedented nature of the pandemic required swift and robust policy responses, which, while effective in stabilizing markets, also introduced new challenges, such as increased leverage and potential future financial instability.

The comparison with the 2008 Global Financial Crisis has underscored how each crisis, despite differing in origin and dynamics, has tested the global financial architecture in unique ways. While the policy responses to COVID-19 were shaped by the lessons of 2008, the pandemic highlighted the need for even more adaptable and forward-looking strategies, particularly in the face of exogenous shocks that are beyond the control of traditional economic tools.

However, it is important to recognize the limitations of this analysis. The rapidly evolving nature of the pandemic and the ongoing economic repercussions mean that some of the long-term effects on financial stability and economic inequality are still unfolding. Future research should focus on these areas, particularly on how the interplay between health crises and economic policies might influence global markets in the decades to come.

Ultimately, the findings of this thesis point to the critical importance of preparedness and flexibility in economic policymaking. As the world continues to grapple with the aftershocks of the COVID-19 pandemic, the insights gained from this crisis should inform more resilient

financial systems, capable of withstanding not only the known challenges but also the unknown crises that the future may hold.

REFERENCES

- A. Sansa, Nuhu. *"The Impact of the COVID-19 on the Financial Markets: Evidence from China and USA."* Electronic Research Journal of Social Sciences and Humanities; 30th March 2020. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3562530
- Aizenman, Joshua; and Ito, Hiro. "*Post COVID-19 exit strategies and emerging markets economic challenges."* Wiley; 2nd March 2022. https://onlinelibrary.wiley.com/doi/full/10.1111/roie.12608
- Albulescu, Claudio Tiberiu. *"COVID-19 and the United States financial markets' volatility."* Elsevier; 25th July 2020. https://www.sciencedirect.com/science/article/pii/S1544612320303202
- Ali, Mohsin; Alam, Nafis; and Rizvi, Syed Aun. *"Coronavirus (COVID-19) - An epidemic or pandemic for financial markets."* Elsevier; 2020. https://www.sciencedirect.com/science/article/pii/S2214635020301350
- Andrian, Tobias; Fabio M., Natalucci; and Mahvash S., Qureshi. *"Macro-Financial Stability in the COVID-19 Crisis: Some Reflection."* International Monetary Fund; December 2022. https://www.annualreviews.org/content/journals/10.1146/annurev-financial-110821-022107
- Asumadu Sarkodie, Samuel; and Phebe, Asantewaa Owusu. *"Global assessment of environment, health and economic impact of the novel coronavirus (COVID-19)."* Springer; 5th June 2020. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7272320/
- Bahrini, Raéf; and Assaf, Filfilan. *"Impact of the novel coronavirus on stock market returns: evidence from GCC countries."* AIMS Press; 27th September 2020.

https://www.aimspress.com/article/id/5f7072d2ba35de7f28a37293

- Bayer, Christian; Benjamin, Born; Ralph, Luetticke; and Gernot J. Müller. *"The coronavirus Stimulus Package: How large is the transfer multiplier?"* Oxford Academic; June 2020. https://academic.oup.com/ej/article-abstract/133/652/1318/6992881
- Bergant, Katharina; and Kristin, Forbes. *"Policy packages and policy space: Lessons from Covid-19."* Elsevier; 2nd June 2023. https://www.sciencedirect.com/science/article/pii/S0014292123001289
- Boshkoska, Meri; and Nikolche, Jankulovski. *"Coronavirus impact on global economy."* Academica brâncuşi publisher; 22nd February 2021. *https://eprints.uklo.edu.mk/id/eprint/6221/*
- Cachanosky, Nicolas; Bryan P., Cutsinger; Thomas L., Hogan; Guglielmo J., Lutero; and Alessandro W., Salter. *"The Federal Reserve's response to the COVID-19 contraction: An initial appraisal."* Wiley; 8th March 2021. https://onlinelibrary.wiley.com/doi/abs/10.1002/soej.12498
- Camous, Antoine; and Grégory Claeys. *"The evolution of European economic institutions during the Covid-19 crisis."* Wiley; 2020. https://onlinelibrary.wiley.com/doi/10.1002/epa2.1100
- Canuto, Otaviano. *"The impact of coronavirus on the global economy."* Policy Center for the New South; June 2020. https://d1wqtxts1xzle7.cloudfront.net/63821342/PB_20-58_Canuto_Coronavirus_Global_Economy20200703-114618-nz00qx-libre.pdf?1593808068=&response-content-disposition=inline%3B+filename%3DTHE_IMPACT_OF_CORONAVIRUS_ON_THE_GLOBAL.pdf&Expires=1720692195&Signature=Xb-

njoslHDAZrkejGwcJRynabEFjexhPST9NNQ9CveT0YWYiOr6ukN45zr-sD~uV5yP~2ftfiLpskzqt~QMMbfBLpha6OM4SJzqFNo4iVVu4ximUqblA1-V~-Q5mGj3S6mL6Qyi8briGQZ4qikROGKPUEB-dxlg~6gtxuSSuCYK9S~RK8b-wvDB-R003unva1ouNR7bgrM7jnfjPCydmgozuC-HfnS-b3uT6cvXG0SQ7Ww9U9rZbrTMGcpJzcNzXoylH5ZvnEgvzKQt-izhyH~F69F-G~mOgXFkAAfWqNQvg9iq225wW-spm2Ux9TUnRW10InyTRNLeYBvtUN0-BLQ__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA

- Chang, Winston W. *"Financial Crisis of 2007-2010."* University of Buffalo; 30th June 2011. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1738486
- Demertzis, Maria; André, Sapir; Simone, Tagliapietra; and Guntram B., Wolf. *"An effective economic response to the coronavirus in Europe."* Bruegel; 12th March 2020. https://www.bruegel.org/policy-brief/effective-economic-response-coronavirus-europe
- E. Bloom, David; Michael, Kuhn; and Klaus, Prettner. *"Modern Infectious Diseases: Macroeconomic Impacts and Policy Responses."* IZA- Institute of Labor Economics; August 2020. https://docs.iza.org/dp13625.pdf
- Eichenbaum, Martin S.; Sergio, Rebelo; and Mathias, Trabandt. *"The Macroeconomics of Epidemics."* National bureau of economic research; 2020. https://www.nber.org/system/files/working_papers/w26882/w26882.pdf
- Ettmeier, Stephanie; Chi Hyun, Kim; and Alexander, Kriwoluzky. *"Financial market participants expect the coronavirus pandemic to have long-lasting economic impact in Europe."* Econstor; 2020. https://www.econstor.eu/handle/10419/220016

- Fana, Marta; Sergio, Torrejón Pérez; and Enrique, Fernández-Macías. *"Employment impact of Covid-19 crisis: from short term effects to long terms prospects."* Springer; 15th July 2020. https://link.springer.com/article/10.1007/s40812-020-00168-5
- Fu, Shenze; Liu, Chengkun; and Wei, Xinyang. *"Contagion in Global Stock Markets during the COVID-19 Crisis."* Wiley; 2021. https://onlinelibrary.wiley.com/doi/full/10.1002/gch2.202000130
- Grasselli, Matheus R. *"Monetary Policy Responses to Covid-19: A Comparison with the 2008 Crisis and implications for the Future of Central Banking."* Taylor & Francis; 2022. https://www.tandfonline.com/doi/full/10.1080/09538259.2021.1908778?casa_token=PrRWk4duJAAAAAAA%3Ao9X4wyIKGfGmPyLvBS-Pu1WlVRVjpVmOPM8O9Ikicll3UbL0TlA0SMfabRrQ5cjku-fZjLYXaRmP https://www.sciencedirect.com/science/article/pii/S0275531921000234
- Huynh, Nhan; Anh, Dao; and Dat, Nguyen. *"Openness, economic uncertainty, government responses, and international financial market performance during the coronavirus pandemic."* Elsevier; September 2021. https://www.sciencedirect.com/science/article/pii/S2214635021000800
- Ito, Takayasu. *"Impact of the coronavirus pandemic crisis on the financial system in the eurozone."* Wiley; 13rd August 2020. https://onlinelibrary.wiley.com/doi/abs/10.1002/jcaf.22466#:~:text=The%20financial%20market%20was%20cautious,after%20the%20pandemic%20crisis%20started
- Jena, Pradyot Ranjan ; Ritanjali, Majhi; Rajesh, Kalli; Managi, Shunsuke; and Babita, Majhi. *"Impact of COVID-19 on GDP of major economies: Application of the artificial neural network forecast."* Elsevier; 18th December 2020.

https://www.sciencedirect.com/science/article/pii/S0313592620304604

- Joachin Gormsen, Niels; and Ralph, S.J. Koijen. *"Coronavirus: Impact on Stock Prices and Growth Expectations."* Oxford University Press; 11th September 2020. https://academic.oup.com/raps/article/10/4/574/5904278
- Kanapickiene, Rasa; Deimante, Teresiene; Daiva, Budriene; Greta, Keliuotyté-Staniulènienè; and Jerkaterina, Kartasova. *"The impact Covid-19 on European financial market and economic sentiment."* Journal of International Scientific Publications; 2020. https://epublications.vu.lt/object/elaba:73275063
- Laborda, Ricardo; and Jose, Olmo. *"Volatility spillover between economic sectors in financial crisis prediction: Evidence spanning the great financial crisis and Covid-19 pandemic."* Elsevier; 4th March 2021. https://www.sciencedirect.com/science/article/abs/pii/S0275531921000234?via%3Dihub
- Li, Yung-zhang; Yu, Yong-hao; Ray, Samrat; and Dong, Wen-ting. *"The Impact of COVID-19 on UK and World Financial Markets."* Jundishapur Journal of Microbiology; 25th January 2022. https://www.researchgate.net/publication/359879523_The_Impact_of_COVID-19_on_UK_and_World_Financial_Markets
- Li, Zongyun; Panteha, Farmanesh; Kirikkaleli, Dervis; and Rania, Itani. *"A comparative analysis of COVID-19 and global financial crisis: evidence from US economy."* Routledge; 23rd July 2021. https://hrcak.srce.hr/file/435953
- Maliszewska, Maryla; Aaditya, Mattoo; and Dominique, van der Mensbrugghe. *"The potential Impact of COVID-19 on GDP and Trade."* World Bank Group; April 2020.

https://documents1.worldbank.org/curated/pt/295991586526445673/pdf/The-Potential-Impact-of-COVID-19-on-GDP-and-Trade-A-Preliminary-Assessment.pdf

- Nurkhodzha, Akbulaev; Mammadov, Ilkin; and Aliyev, Vasif. *"Economic impact of Covid-19."* Sylwan; May 2020 https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3649813
- S. Eichenbaum, Martin; Sergio, Rebelo; and Mathias, Trabandt. *" Epidemics in the New Keynesian model."* Elsevier; July 2022. https://www.sciencedirect.com/science/article/pii/S0165188922000392#:~:text=In%20their%20model%2C%20an%20epidemic,leads%20to%20an%20aggregate%20contraction
- Strauss-Kahn, Marc-Oliver. *"Can we compare the COVID-19 and 2008 crises?."* SUERF; 5th May 2020. https://www.suerf.org/wp-content/uploads/2023/12/f_dfdfab9941ac833a0c364aa2e608185e_13389_suerf.pdf
- Walmsley, Terrie; Adam, Rose; and Dan, Wei. *"The Impacts of the Coronavirus on the Economy of the United States."* Springer; 2020. https://link.springer.com/article/10.1007/s41885-020-00080-1
- Wójcik, Dariusz; and Stefanos, Ioannou. *"Covid-19 and finance: market developments so far and potential impacts on the financial sector and centres."* Wiley; 12th June 2020. https://onlinelibrary.wiley.com/doi/full/10.1111/tesg.12434
- Zagurska-Antoniuk, Victoria; Iryna Suprunova; and Tetiana, Zavalii. *"The potential impact of the COVID-19 pandemic on GDP per capita in European countries."* , ResearchGate; November 2020.

https://www.researchgate.net/publication/351605019_The_potential_impact_of_the_COVID-19_pandemic_on_GDP_per_capita_in_European_countries

- Zareen Gofran, Ruhana; Andros, Gregoriou; and Lawrence, Haar. *"Impact of Coronavirus on liquidity in financial markets."* Elsevier; 18th April 2022. https://www.sciencedirect.com/science/article/pii/S104244312200049X

WORD OF THANKS

Al termine di questo elaborato, mi sembra doveroso dedicare uno spazio per ringraziare tutte le persone che, con il loro supporto, mi hanno sostenuto durante il mio percorso universitario e di scrittura della tesi.

Innanzitutto, vorrei ringraziare il mio relatore, il Prof. Patrizio Tirelli, per la sua guida e il suo supporto durante lo sviluppo di questa tesi. La sua disponibilità e i suoi consigli sono stati fondamentali per il completamento di questo lavoro.

Un ringraziamento speciale va alla mia famiglia, che mi ha sempre incoraggiata e sostenuta in ogni fase della mia vita. Grazie ai miei genitori e a mio fratello Matteo per il loro amore incondizionato, per avermi sempre spronato a dare il massimo e per aver creduto in me anche nei momenti più difficili.

Non posso non includere in questi ringraziamenti la mia cagnolina Daisy, che con la sua compagnia mi ha motivata durante le lunghe giornate di studio. La tua presenza affettuosa ha reso questo viaggio un po' meno solitario e molto più dolce.

Infine, un grazie di cuore alle mie amiche, con cui ho riscoperto il valore dell'amicizia. Mi siete state accanto non solo durante il percorso universitario, ma anche nei momenti più importanti di questa esperienza. Grazie per la vostra vicinanza, per il sostegno e per i tanti momenti di condivisione che hanno reso questo cammino ancora più significativo.