

PANDEMIC ECONOMICS: A CASE STUDY OF THE
ECONOMIC EFFECTS OF COVID-19 MITIGATION
STRATEGIES IN THE UNITED STATES AND THE
EUROPEAN UNION

by

LUCY HUDSON

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Approved: Assistant Professor Keaton Miller, Ph.D.
Primary Thesis Advisor

The economic effects of the COVID-19 pandemic and the non-pharmaceutical interventions which were implemented to mitigate the spread have not yet been fully studied and evaluated due to the lack of published economic indicators. This paper provides statistics which reveal whether non-pharmaceutical interventions implemented during 2020 are correlated with economic indicators. This study utilizes statistical economic data of the United States and the European Union due to the fact that they both are large economic powers which have been impacted substantially more than other countries and unions regarding COVID-19 outbreaks and the economic costs. Ultimately, the three chosen non-pharmaceutical interventions (statewide lockdowns, school closures, and restaurant shutdowns) showed no strong correlation with the two chosen economic indicators (GDP and unemployment rate), suggesting a lack of evidence that non-pharmaceutical interventions have a significant impact on the economy.

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Introduction

This paper investigates the potential relationship between non-pharmaceutical interventions (NPIs) and the economy utilizing economic data and the NPI implementation timelines of the United States (US) and the European Union (EU). I first provide background information on COVID-19, the economic indicators of gross domestic product (GDP) and unemployment rates, three NPIs which include statewide lockdowns, school closures, and restaurant shutdowns, and the officials and organizations responsible for responses and strategies in the US and the EU. I then display timelines of the events concerning COVID-19 spread in the US and the EU from January 2020 through December 2020.

In the interest of keeping my paper concise, I focused my case study on the three most populous states of the US, which include California, Texas, and Florida, as well as the three most populous Member States of the EU, which include Germany, France, and Italy. I test the potential correlation between the three chosen NPIs and the state of each of these states and countries' economies using the computer program R. I utilize data concerning GDP, unemployment rates, and implementations of the three NPIs. In the conclusion of this paper, I summarize my findings of an absence of a strong relationship between NPIs and the economy.

Limitations

In the interest of keeping this paper focused, I am specifically analyzing the three most populous states of the U.S. and the three most populous Member States of the EU. This is because the higher populated states and Member States are more likely

to be confronted with larger waves of COVID-19 spread. Due to the fact that COVID-19 is still ongoing at the time of the composition of this paper, I will be focusing on the COVID-19 timeline of January 2020 through December 2020. There is also a limited amount of information on the topic of NPIs and COVID-19. I am not expecting to find an answer as how to best maintain the health of the economy during a pandemic, but rather aim for this paper to provide a better understanding of NPIs and how these strategies impact large economies during a pandemic.

Background

COVID-19

The “Severe Acute Respiratory Syndrome Coronavirus 2” (SARS-CoV2), more commonly known as COVID-19, has spread across the globe beginning in December 2019 when the first known cases hit Wuhan, China. It has completely transformed daily life for everyone as the number of cases have exponentially grown since the beginning of 2020. Schools have opted for virtual classes, businesses have struggled financially with shutdowns, and unemployment has skyrocketed, leaving many people unable to pay their rent and support their families. Hospitals have been overloaded with COVID-19 patients and frontline healthcare workers have struggled to keep up. School graduations, weddings, and even funerals have been either canceled or very limited in the numbers of attendees. People have been separated from at-risk family members who have low chances of surviving if they do unfortunately catch the disease. Everyone in some way or another has found the year of 2020 to be very emotionally and psychologically taxing.

As of December 2020, 1.59 million people across the world have died from COVID-19. Governments have implemented several strategies to desperately slow down the spread, such as putting entire cities on lockdown and establishing mask mandates and social distancing measures. These strategies are different non-pharmaceutical interventions, or NPIs. As the Center of Disease Control (CDC) has stated, the mitigation efforts and public health interventions have been found to be effective in reducing the number of cases. Early detected cases through testing, self-isolation, and the study of COVID-19 cases and contact tracing can be worthwhile in

order to stop community spread. Although these strategies have been studied and established as effective in slowing the spread of cases, countries have struggled to handle and recover the economy due to the unanticipated slow economic activity. It has been difficult to find ways to “reopen the economy” while also slowing the spread of COVID-19. In addition, there has been increasing pressure to “open up” the economy again due to the psychological fatigue caused by the lack of “normal” life.

Economic Indicators

Economic indicators are statistics pertaining to economic activity which are used in the analysis of the status of the economy and its performance. Economic indicators also can provide information needed in order to create predictions of future economic performance. Economic indicators are generally studied through indices, earnings reports, and economic summaries. Some examples of economic indicators that are used in economic analyses include unemployment rates, industrial production, GDP, and stock market prices. For the purpose of this study, I will be utilizing data pertaining to unemployment rates and GDP in my analyses of various American and European economies.

Unemployment Rates

The unemployment rate is a significant indicator of social and economic conditions. The unemployment rate is a percentage of the labor force which is currently without a job and actively searching for one. It responds to fluctuating economic conditions by either rising or falling. When economic conditions are harsh and available jobs are harder to find, the unemployment rate is generally predicted to rise. When unemployment rates rise, the consequences include a loss of income, pressure for

increased government spending on social benefits, and lower tax revenue. When economic conditions are good and available jobs are easier to find, the unemployment rate is generally predicted to fall. The unemployment rate is a lagging economic indicator, meaning that it typically takes a number of months before the unemployment rate bounces back from an economic downturn. The unemployment rate is a popular and commonly used economic indicator due to its international comparability and timely publicly available reports. The unemployment rates that will be used in this study will be seasonally adjusted to consider the predictable changes in unemployment, such as the typical higher rates of hiring during the holiday season. For EU Member States, the harmonized unemployment rates will be used. Harmonized unemployment rates include people who are jobless but are available for work and are searching for jobs. In the U.S., official unemployment rate statistics are provided by the U.S. Bureau of Labor Statistics (BLS), which is part of the U.S. Department of Labor. In order to collect data pertaining to unemployment rates, the Census Bureau, which is within the U.S. Department of Commerce, sends a Current Population Survey to a sample of 60,000 American households in order to study race, ethnicity, age, veteran status, gender, and geography to help further classify the unemployment statistics. In the EU, the European Commission, public institutions, and the media choose the patterns of unemployment rates as a common economic indicator. Banks in the EU also tend to use unemployment rates as an economic indicator in order to analyze business cycles. In the EU, unemployment rate data is typically gathered through labor force surveys (LFS). For EU Member States which do not have available LFS information, Eurostat estimates monthly unemployment rates instead.

GDP

GDP is classified as the total market value of all finished goods and services that have been produced in a country within a specific time frame. GDP is commonly used as an economic indicator for analyzing the health of a country's economy. GDP also is typically used to create an estimate of the size of the economy and the economic growth rate. When it comes to calculating GDP, all private and public consumption, government outlays, investments, additions to private inventories, paid-in construction costs, and the foreign balance of trade are all considered. When determining GDP statistics, data regarding expenditures, production, and incomes are generally used and then adjusted to take account of inflation and population. GDP is used by policymakers, investors, and businesses in order to determine strategies and decisions. Usually, GDP is reported yearly, but sometimes is also reported quarterly. In the U.S., the Bureau of Economic Analysis (BEA) reports GDP through surveys of retailers, manufacturers, and builders. The BEA also analyzes trade flows in order to find GDP statistics. In the EU, Eurostat calculates GDP using national statistics institutes which work with Eurostat. The Eurostat reports of GDP are used as a tool for determining the design, monitoring, and evaluation of EU policies. In order to calculate GDP, Eurostat uses national accounts which are sets of macroeconomic indicators that explain the status of the economy.

Non-Pharmaceutical Interventions

Nonpharmaceutical Interventions (NPIs) are actions taken by individuals and households as well as public measures for communities to slow the spread of contagious illnesses such as COVID-19. NPIs, otherwise known as community mitigation

strategies, are used to fight new illnesses that humans have little to no immunity against. NPIs are a way of controlling and combating illnesses when there are no vaccines or medicines available. Three types of NPIs that will be focused on in this paper are statewide lockdowns, school closures, and restaurant shutdowns.

Statewide Lockdowns

Governments across the world have implemented lockdowns. A lockdown is also referred to as “shelter-in-place,” which recommends or requires individuals to stay home with the exception of essential activities such as doctor appointments and grocery shopping. Due to the human-to-human transmission of COVID-19, movement restriction has been recognized as an influential factor in mitigating the increase in cases.

Lockdowns are “large scale physical distancing measures and movement restrictions” which the World Health Organization (WHO) claims are effective in limiting the spread of COVID-19. Lockdowns lower the number of individuals exposed to COVID-19 positive community members, which then leads to fewer infections. Although lockdowns are seen as a helpful in fighting the COVID-19 pandemic, it is recognized that lockdowns have a negative effect on individuals and communities due to the halting of everyday social and economic life. Some countries that have been heavily affected by COVID-19 had to resort to lockdowns in order to buy time to fight the rapid and exponential COVID-19 spread. During lockdowns, the WHO recommends that governments do what they can with this time to conduct testing and isolate cases, conduct contact tracing and quarantine all individuals who have been exposed or have tested positive for COVID-19, and motivate the people to continue their efforts in

following COVID-19 recommendations and guidelines. Lockdowns may be implemented at the individual or community level and may be legally imposed by authorities.

Lockdowns have a significant positive effect on limiting the spread and lowering the mortality rate of COVID-19. Lockdowns should be implemented, along with other public health measures, in the early phases of the COVID-19 spread in order to limit the spread before it becomes difficult to contain and control. The quarantining of individuals who were exposed to possible or confirmed COVID-19 cases prevents 44% to 81% of new cases and 31% to 63% of deaths when compared to the absence of a lockdown. (Nussbaumer-Streit, et. al, 2020) Lockdowns are effective in lowering the daily infection growth rate but fail to lower the absolute growth rate to 1.0 or less, which is the level where the COVID-19 pandemic would be controlled and contained. (Meo, et. al., 2020) A lockdown alone without any other supporting public health measures such as social distancing and mask mandates will not be sufficient in controlling the COVID-19 spread if individuals do not follow the guidelines and requirements of this measure.

Lockdowns have direct effects on GDP. The closing of workplaces directly decreases the economic output and affects the productivity of those employed. (Inoue, et. al., 2021) Lockdowns have also altered the behavior of consumers. Through times of the implementation of lockdowns due to rising cases, spending has decreased and even reached all-time lows. It appears lockdowns that are imposed for longer periods of time do not necessarily have a stronger negative impact on GDP than lockdowns imposed for shorter periods of time. (Desai, 2020) In terms of the relationship between lockdowns

and unemployment rates, businesses in the sectors of leisure, hospitality, and service, where in-person interactions are required, have been affected dramatically more than other sectors throughout the lockdowns during 2020. (Karabarounis, et. al., 2020)

Lockdowns have possibly increased unemployment rates because of the effects on these sectors. These specific sectors do not have the convenient option of working from home like other sectors such as financial services do. For example, lockdowns have led to the shutdowns of salons which has left many of those employed at salons with the increased likelihood of becoming unemployed. There is also a positive relationship between time spent at home and mobility during lockdowns and unemployment rates. (Karabarounis, et. al., 2020)

School Closures

In March of 2020, governments across the world decided to begin closing schools. According to a report made by the United Nations Educational Scientific and Cultural Organization (UNESCO), 192 countries decided to shut down all schools and universities by mid-April. These shutdowns have directly impacted over 90% of the global population of students. (Psacharopoulos, et. al., 2020) In order to continue education for students, schools have resorted to an online format. One example of a widely used platform for online education over the course of the pandemic has been Zoom Video Communications. Through this platform, students attend live meetings with their teachers and are able to interact with others.

Throughout the course of 2020 as conditions fluctuated, governments adjusted their measures and either continued the closure, reopened their schools partially, or fully reopened their schools based on their COVID-19 statistics and assessments of risk.

Schools have had to create plans for reopening without the certainty of when they could bring students back to their campuses and this has presented major challenges for schools across the world. During this time, it has been acknowledged that although limiting COVID-19 spread is important, it is critical that students can physically return to school. Although school closures have been proven to be effective in limiting COVID-19 spread, there are some widespread consequences of this measure. There is a deep connection between education, income, and life expectancy, and due to this connection, these school closures have the potential to cause long-term negative effects on the health of students. In addition, many parents with children at home are unable to fully dedicate their time to their jobs. This leads to a large decrease in productivity which in turn has consequences for the economy. (Donohue & Miller, 2020) School closures have also shed light on the inequalities that are present in different communities. Some communities have a larger number of resources for their students, while others do not. For example, children in low-income families tend to rely more than others on resources provided in school, and with online instruction they no longer have access to those resources. (Donohue & Miller, 2020)

When considering plans for a safe reopening, schools have implemented other NPIs in their structure for in-person learning. These NPIs include the wearing of masks and social distancing.

Although school closures seemingly do not have a direct impact on GDP, the earlier discussion explained how school closures could lead to lower productivity for those who were employed and had students learning from home. Employed adults with young children were more affected by school closures due to the need to supervise

young children at home while also keeping up with their jobs. In terms of the effects on unemployment rates, the school closures during the pandemic have disproportionately hit working women. Since women generally take on the role as the primary caretaker of their children, many have struggled with their jobs and even had to leave their jobs which then contributes to rising unemployment rates. (Fuchs-Schündeln, et. al., 2020)

Restaurant Shutdowns

The global restaurant industry was hit hard during 2020. Governments implemented restaurant shutdowns in order to encourage community members to stay home and lessen COVID-19 spread. This forced restaurants to resort to food delivery which massively impacted their revenue over the year. Many restaurants were not able to keep up with their costs which resulted in permanent closures.

The National Restaurant Association released their State of the Restaurant Industry report at the beginning of 2021 summarizing the devastating effects of the pandemic on restaurants. The restaurant industry in the U.S. saw a large drop in revenue in 2020 with reported total sales that were \$240 billion lower than the pre-2020 forecast. In the beginning of December of 2020, over 110,000 restaurants completely stopped their operations either temporarily or permanently. At the end of 2020, the industry reported a total of jobs that was almost 2.5 million lower than its total before the pandemic. The Association reported that up to 8 million employees in the restaurant industry were either laid off or furloughed.

As the conditions over the year changed, restaurants were able to partially reopen based on the current COVID-19 statistics in their communities. Over the course of 2020, many restaurants were able to provide outdoor dining. Since indoor settings

have been proven to be riskier for COVID-19 transmission, many restaurants were not able to offer indoor seating for customers. If areas had lower numbers of COVID-19 cases and a lower level of risk, many restaurants were able to reopen their indoor setting at a low capacity at the discretion of the government. But since many countries across the world experienced spikes of COVID-19 throughout the year, restaurants had to adjust and scale-back their capacity and services according to government requirements.

The shutdowns of restaurants during the pandemic in 2020 have a relationship with GDP. During 2020, the revenue produced in the restaurant industry had generally declined due to the inability to conduct normal operations such as dining. Due to the role of the restaurant industry in GDP, the decreased revenue and operations of restaurants which had shut down either temporarily or permanently affected GDP. When it comes to the relationship between restaurant shutdowns and unemployment rates, many workers in the industry became unemployed due to either the inability to work in a dine-in setting or the permanent closure of restaurants. In addition, unemployment in one sector such as the service sector can bleed into unemployment in other sectors. According to the BLS, for every 10 employees in restaurants and bars who lose their jobs due to the negative impact on revenue, 3.11 workers in other sectors of the economy become unemployed. (Garriga, et. al., 2020)

Organizations and Officials Responsible for COVID-19 Responses and Strategies

The Federal, State, and Local Levels of Government in the U.S.

The Federal government conducts surveys for the population's health status and needs, creates policies and lays standards, passes laws and regulations, funds biomedical and health services research, funds personal health services, assists in

providing medical resources to state and local governments, protects against international dangers related to health, and takes part in international efforts towards global health. It conducts these responsibilities through the power to regulate interstate commerce and the power to tax and spend for the general welfare. For the purpose of this study, the focus will be on the powers of several departments of the Executive Branch of the Federal Government. This is due to the number of powers these departments of this branch hold in implementing COVID-19 mitigation strategies and relief. These departments include the U.S. Department of State, the U.S. Department of Health and Human Services, and the U.S. Department of the Treasury.

The U.S. Department of State focused on the COVID-19 pandemic and took action to mitigate the spread of COVID-19 throughout the year of 2020. They released travel advisories, supported U.S. government efforts, brought Americans home from overseas, provided international aid, and maintained relations.

One major player in the battle against COVID-19 was President Trump's Coronavirus Task Force, which fell under the Department of State. President Trump and the White House organized their own Coronavirus Task Force during his term of presidency in late January 2020 as the COVID-19 pandemic began to unfold. In February of 2020, President Trump claimed his task force to be "very ready" to implement strategies to combat COVID-19 as cases began to appear in the U.S. When organizing the Coronavirus Task Force, President Trump gave Vice President Mike Pence power in overlooking the operations. The purpose of the Coronavirus Task Force was to monitor, contain, and fight the spread of COVID-19 while providing American citizens up-to-date and trustworthy data on the status of health and travel. Health and

Human Services (HHS) Secretary Alex Azar led the task force alongside 11 fellow administration officials. These officials included National Security Adviser Robert O'Brien, CDC Director Robert Redfield, National Institute of Allergy and Infectious Diseases Director Anthony Fauci, State Department official Stephen Biegun, Acting DHS Deputy Secretary Ken Cuccineli, Department of Transportation official Joel Szabat, Deputy National Security Adviser Matthew Pottinger, Advisor to the Chief of Staff Robert Blair, Domestic Policy Council Director Joseph Grogan, Deputy Chief of Staff for Policy Coordination Christopher Liddell, and Office of Management and Budget official Derek Kan. Ambassador Deborah Birx, a former State Department AIDS coordinator, was the coronavirus response coordinator, and Treasury Secretary Steven Mnuchin, Surgeon General Jerome Adams, and National Economic Council Director Larry Kudlow were added by the White House alongside other officials to the Coronavirus Task Force. President Trump initiated the creation of this task force in order to involve the entire government in the COVID-19 response. Ultimately, the purpose of the Coronavirus Task Force was to prepare and provide the required resources at the local and state levels, along with providing accurate COVID-19 updates and information and coordinating agencies in implementing COVID-19 mitigation strategies. In addition, the Coronavirus Task Force worked alongside Congress with funding for resources and health measure strategies. Vice President Mike Pence also had the responsibility of incentivizing governors, local officials, and Congress members to work together in order to provide representation to all agencies in the COVID-19 mitigation efforts.

The U.S. Department of Health and Human Services (HHS) aims to “enhance the health and well-being of all Americans, by providing for effective health and human services and by fostering sound, sustained advances in the sciences underlying medicine, public health, and services.”

One major governmental agency that falls under the HHS is the Centers for Disease Control and Prevention (CDC), which plays a major part in the time of the pandemic. The CDC is one organization of the HHS, a cabinet-level department. The CDC’s mission is to promote health and quality of life by preventing and controlling disease, injury, and disability. To accomplish its goals, the CDC works alongside officials around the nation and the world. With these officials, the CDC monitors health, detects and investigates health problems, conducts research to enhance prevention, develops and advocates sound public health policies, implements prevention strategies, promotes health behaviors, fosters safe and healthful environments, and provides leadership and training.

The CDC bases their mission on scientific knowledge acquired from recognizable and trustworthy public health officials and leaders. In January of 2020, the CDC organized an agency-wide response to COVID-19. The CDC focused most of its efforts on gathering knowledge concerning COVID-19 spread and its effects on communities and individuals. The CDC was committed to assist frontline healthcare workers, communities, and the public in the ultimate goal of protecting themselves and others. The CDC had been working to prepare first responders, healthcare providers, and health systems through gathering information, providing recommendations, investigating health effects, initiating nationwide public health measures, and providing

emergency risk management. The CDC also published over 180 advisory documents regarding infection control, hospital preparedness assessments, personal protective equipment (PPE), supply planning, and clinical evaluation and management. In addition to these efforts, the CDC also advised businesses, communities, and schools in their mitigation strategies. The CDC assisted school officials in their decisions regarding in-person classes and outbreak plans along with releasing advice on how to make, clean, and wear masks. The CDC also provided resources for businesses, schools, retirement communities, and other institutions for them to properly and effectively disseminate information concerning personal protection tips and provided guidance to businesses in order to assist the public and private sectors in shielding essential workers and improving the safety of workers with working from home and a more flexible sick day policy. In addition, the CDC released their own guides on the number of individuals that can be allowed in a public space during the pandemic.

In order to share their information and knowledge regarding COVID-19 with the public, the CDC used their COVID Data Tracker, published COVID-19 Science Updates, worked with the U.S. Census Bureau to conduct the Household Pulse Survey, led the SARS-CoV-2 Sequencing for Public Health Emergency Response, Epidemiology, and Surveillance (SPHERES), offered COVID-19 tests to state and local laboratories, and utilized their COVID-NET program to gather data on confirmed COVID-19 related hospitalizations. The CDC also released results of COVID-19 case investigations in their Morbidity and Mortality Weekly Report (MMWR) and published studies by researchers in their monthly Emerging Infectious Diseases journal.

Along with protecting individuals and communities, the CDC aimed to maintain health security for the public and travelers concerning global travel. The CDC provided guidance and education relating to COVID-19 to travelers and works alongside international, federal, state, local, and industry partners in these efforts. The CDC also provided resources for travelers such as an advisory web page, public health guidance, information on travel risk, an “after-you-travel” guidance, Travel Health Alert Notices, the publication of health information in airports, seaports, and land borders, and a southern border toolkit for partners. For the individuals who were traveling into the U.S. for working and living, the CDC released a communication toolkit in different languages, published information on COVID-19 in Newly Resettled Refugee Populations, worked with refugee resettlement agencies to provide COVID-19 education to refugees, and worked with communities and public health officials to educate essential workers on COVID-19 and provide them with resources due to their increased risk of COVID-19 from traveling.

In order to continue providing information to communities and individuals, the CDC provided video messages from CDC scientists, audio public service announcements (PSAs), printable flyers and posters with COVID-19 recommendations, and social media resources such as graphics and messages to continue incentivizing communities and individuals to spread information on COVID-19.

The mission of the U.S. Department of the Treasury is to “maintain a strong economy and create economic and job opportunities by promoting the conditions that enable economic growth and stability at home and abroad, strengthen national security by combating threats and protecting the integrity of the financial system, and manage

the U.S. Government's finances and resources effectively." During the time of COVID-19, the economy was hit hard which has affected people's job security and income.

The Treasury established the Coronavirus Aid, Relief, and Economic Security (CARES) Act and the Coronavirus Response and Relief Supplemental Appropriations Act of 2021 to "provide fast and direct economic assistance for American workers, families, and small businesses, and preserve jobs for American industries." The U.S. Department of the Treasury created the CARES Act in order to grant Economic Impact Payments of up to \$1,200 per adult for those who make less than \$99,000 yearly, or \$198,000 for joint filers, and \$500 per child under the age of 17, or up to \$3,400 for a family of four individuals. Up to \$600 per adult and \$600 for qualifying individual children could also be provided by the Coronavirus Response and Relief Supplemental Appropriations Act of 2021. People who had an adjusted gross income of up to \$75,000, or \$150,000 for joint filers or surviving spouses, were eligible to receive the full amount of the second payment, but for those whose adjusted gross income was higher, the second payment was lowered. This second payment was planned to be allocated automatically without any action by individuals.

The CARES Act also assisted small businesses. The Paycheck Protection Program was created by the Small Business Administration. With this program, small businesses could receive payments of up to 8 weeks of payroll costs with benefits. These payments were also eligible to be used to pay interest on mortgages, rent, and utilities. The Paycheck Protection Program focused on Americans who work at small businesses and planned up to a \$659 billion budget for job retention and other costs. Other eligible groups and individuals were nonprofit organizations, veteran

organizations, tribal businesses, and self-employed individuals or independent contractors, depending on if they met program size standards. The Treasury also claimed that the CARES Act maintained the job market in industries that had been affected by COVID-19 and had allowed for employee retention credit. This motivated employers who had been negatively impacted by COVID-19 to keep their employees through a 50% credit on up to \$10,000 of wages paid for incurred from March 13, 2020 through December 31, 2020.

In addition, the Treasury allowed for payroll tax deferral and payroll support. Employers and self-employed Americans were allowed to defer payment of the employer share of the Social Security tax that they originally were required to pay to the Federal government. This could be paid over the course of the next two years with half paid by December 31, 2021, and the other half by December 31, 2022.

The Treasury also provided resources which could help eligible businesses apply for payroll support. With the CARES Act and the Consolidated Appropriations Act of 2021, this payroll support had the power to allow continued payment of employee wages, salaries, benefits, and loans. The CARES Act also granted funds to state, local, and tribal governments during the pandemic. The CARES Act created the \$150 billion Coronavirus Relief Fund which generated those payments which could be used for necessary expenses caused by the public health emergency, expenses not included in the approved budget as of the date of enactment of the CARES Act, and expenses made from March 1, 2020 through December 31, 2021.

The Treasury also had the Emergency Rental Assistance Program, which provided \$25 billion to individuals and families who could not afford to pay rent and

utilities during the pandemic. The Treasury's Emergency Capital Investment Program (ECIP), established by the Consolidated Appropriations Act of 2021, was meant to motivate low- and moderate-income community financial institutes to increase their push for supporting small businesses and consumers within their communities. With ECIP, the Treasury planned to provide up to \$9 billion in capital to depository institutions that were certified Community Development Financial Institutions or minority depository institutions to give loans, grants, and forbearance for small businesses, minority-owned businesses, and consumers. Low-income communities had an especially high focus due to their disproportionate consequences of the negative economic impact of COVID-19.

Powers which are not given to the U.S. Federal government are given to the States and the people. These powers are shared between the State and the local governments. Citizens of the U.S. have a much closer relationship with the State and local governments than with the Federal government.

Each of the 50 states of the U.S. has its own constitution which tends to be much more intricate than the Federal level. Like the Federal government, State governments have an executive, legislative, and judicial branch. Every state's Executive Branch is led by a directly elected governor. Some other elected officials in the Executive Branch include the lieutenant governor, the attorney general, the secretary of state, and auditors and commissioners. Every state also has legislatures with elected representatives. The Legislative Branch of each state approves the budget and controls tax legislation and articles of impeachment. Each state has a bicameral legislature with the Senate and the House of Representatives. Each state's Judicial Branch is headed by the State supreme

court. The supreme court does not hold trials, but rather corrects mistakes from lower courts. Decisions made in the state supreme court can be appealed to the U.S. Supreme Court.

Throughout 2020, state governors have implemented strict measures to prevent and control the spread of COVID-19. States preserved powers to protect the health, safety, and welfare of the state's people, and these powers are called "police powers." Police powers are difficult to fully understand, especially during the pandemic, due to the undefined nature of them. States' police powers generally encompass infectious disease outbreaks. For example, imposing quarantines and working to isolate positive cases are included in these police powers. These examples of police powers are usually given to the state's health department or health agency.

The amount of power that states generally have in times of a pandemic is an open-ended topic. In addition, it is typical for courts to refrain from limiting the powers of governments in times of emergency. Although there have been pandemics in past years, this is the first period of time where state governors have applied wide-ranging powers to individuals and businesses for this long of a period of time. In the case of emergencies, state governments implemented emergency rules and legislation due to COVID-19. Many state governors declared states of emergency over the course of 2020, which then called for executive action. The state legislative branches implemented emergency legislation in order to allocate funds for mitigating COVID-19 and overseeing executive and judicial actions. Some examples of these emergency powers include Ohio's state quarantine order, Illinois' state evictions halting order,

Montana's declaration of state of emergency, Colorado's oversight of executive authority, New York's criminal procedure, and Arizona's special funding.

Local governments are split into counties and municipalities, or cities and towns. Municipal governments tend to be organized around the center of the population and fall in line with the districts that the U.S. Census Bureau uses to report statistics for things such as housing and population. Cities and towns tend to vary in size. Cities and towns usually manage parks and recreation services, police and fire departments, housing services, emergency medical services, municipal courts, transportation services, and public works. Although the Federal Government and State governments share many powers, local governments must solely use powers given by the State.

State governments allocate powers to local governments and local governments are limited to those powers. Due to Supreme Court precedents, it is typical of local governments to only exercise powers expressly granted by the state, powers necessarily and fairly implied from the grant of power, and powers crucial to the existence of local government. Since the beginning of the 20th century, states have adjusted their constitutions to grant increased powers to local governments.

Local governments establish charters which explicitly list local government powers and duties. The "home rule" is this relationship between state and local governments. This home rule establishes authorities in local governments which state governments usually must refrain from interfering. These home rules and charters are different among states and municipalities. The laws implemented by local governments usually must not overstep state laws. In states of emergency, such as the COVID-19 pandemic, local governments tend to utilize their individual emergency powers that do

not overstep federal or state laws. Some examples of matters concerning local governments are New York's funding for local governments throughout the pandemic, Philadelphia's school boards and education COVID-19 strategies, Sacramento's emergency funding expenditures through the CARES Act, local police powers and mask mandates, and virtual government meetings.

Rules and guidelines during an emergency can be implemented by local governments at the local level and these can then be enforced by local police departments. Examples of these rules and regulations during 2020 have been the various local governments' social distancing and mask mandates and the relationship between state and city governments and local police departments in ensuring the public's following of the implemented measures. In July 2020 in Atlanta, Georgia, Mayor Keisha Lance Bottoms issued Executive Order Number 2020-113 which established the mask mandate in public spaces. This order ignited controversy, and Georgia Governor Brian Kemp proceeded to sue Mayor Bottoms, claiming that she stepped outside of her legal authority and overstepped the statewide executive order which recommended, rather than required, individuals to wear masks in public spaces. A couple months later, Governor Kemp withdrew the lawsuit and then issued an executive statewide order which allowed for local governments to impose a required mask mandate under specific circumstances. This now meant that it was left up to private businesses to choose to implement a requirement for mask-wearing even if the city did not issue a mask mandate.

The EU: the ECDC and the EMA

Since the EU is a union of countries rather than states, it operates very differently than the U.S. The EU is composed of 27 Member States which include Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

The 27 EU Member States are unified by the EU through economics and politics. It originally was a solely economic union, the European Economic Community (EEC), but has transformed into an organization which covers many policy areas such as climate, environment, health, foreign relations, security, justice, and migration. Since the EU was formed, the border controls between EU countries have been dissolved, allowing citizens of EU countries to travel without restrictions among different Member States. Citizens of the EU can also live and work in any of the Member States.

The European Parliament, alongside the national parliaments which hold a great number of powers, work with European institutions. The idea of representative democracy governs the EU, and citizens are represented at Union level in the European Parliament while Member States are represented in the European Council and the Council of the EU.

The EU supports local EU governments in its national health policies with the aim of reaching common goals, gathering resources, and getting past challenges together. The EU creates EU-wide laws and standards for concerns regarding public health and provides funding and resources for health projects for all EU Member States. The EU health policy aims to protect and improve health, give equal access to

healthcare for all European citizens, and organize strategies for public health concerns that threaten more than one EU Member State.

There are two agencies which handle health issues for national governments. These are the European Centre for Disease and Prevention Control (ECDC) and the European Medicines Agency (EMA). The ECDC assesses risks and monitors public health threats in order to implement strategies for combating those threats. The EMA assesses the efficiency, safety, and quality of all EU medicines.

The ECDC has the mission of improving Europe's responses to infectious diseases such as COVID-19. The ECDC focuses on antimicrobial resistance, vaccine coverage, supporting the European Commission and Member States in improving the preparedness for cross-border health threats, strengthening partnerships, and improving their operations and monitoring.

The ECDC is an independent EU Agency which reports to the Management Board. The Management Board consists of members who are chosen by the Member States, the European Parliament, and the European Commission. The Management Board appoints a director and holds them accountable for their responsibilities of leadership and management of the ECDC. The Management Board also approves and overlooks the implementation of the ECDC's work and budget, gathers all yearly reports and accounts, acts as the head of the ECDC, and meets two times a year. The current Chair of the Management Board is Anni Virolainen-Julkunen, and the Deputy Chair is currently Zofija Mazej Kukovič.

The current director of ECDC is Dr. Andrea Ammon, MD, MPH, who was elected to this position for five years on June 16, 2017. Before becoming the director,

Dr. Ammon was ECDC's Acting Director since May 1, 2015. She has also recently filled roles at the Robert Koch-Institute in Germany. One role she served was as Head of Department for Infectious Disease Epidemiology. She has experience with coordinating national outbreak response team for infections, coordinating emergency planning for influenza, directing the national Field Epidemiology Training Program, organizing epidemiological research programs in infectious diseases, and administering scientific evidence.

Throughout 2020, the ECDC released multiple risk assessment reports concerning COVID-19. In one risk assessment published on March 12, 2020, the ECDC declared an immediate need for targeted action against COVID-19. Since COVID-19 was very new to communities and Member States, the ECDC assumed that there was no pre-existing immunity against the virus. The ECDC determined that COVID-19 was a moderate risk to the population, but high for the elderly and people with underlying health conditions.

The EMA is classified as a decentralized agency of the EU which handles evaluations, supervision, and monitoring of European medicines. The mission statement of the EMA is to “foster scientific excellence in the evaluation and supervision of medicines, for the benefit of public and animal health in the European Union (EU).” The EMA focuses on facilitating development and access to medicines, evaluating applications for marketing authorization, monitoring the safety of medicines across their life cycle, and providing reliable information on human and veterinary medicines in lay language. The EMA ultimately guides new medicines through the process of

development in labs to the prescription to patients while also backing pharmaceutical research and innovation.

In terms of their operations, the EMA cooperates with national authorities within the European medicines regulatory network. The purpose of this network is to gather and organize resources within the EU and allow the EMA to access a large number of scientific experts in the EU who specialize in the regulation of medicines. In regard to transparency in their work, the EMA publishes European public assessment reports to release information concerning the scientific basis for their recommendations on approved medicines.

An independent Management Board oversees the EMA and its operations which are done by EMA staff and managed by the EMA's Executive Director. Since early March of 2020, the EMA altered its organizational structure with the hopes of increasing efficiency. These changes included creating one human medicines division and four mission-critical task forces to back the human and veterinary medicines divisions with the goal of encouraging transformational change in prioritized areas. With these changes, the EMA hoped to increase their preparation for future obstacles and increase their readiness for rapid scientific advancements.

The EMA's Management Board has thirty-six members who are appointed. These members are expected to act in the public interest and do not serve any government, organization, or sector. The Management Board's purpose is to create the EMA's budget, approve programs, and encourage efficiency and cooperation within the EMA and its partner organizations. The EMA's Executive Director is responsible for legally representing the EMA. The Executive Director is tasked with overseeing

operations, staff, and planning programs. The staff are responsible for helping the Executive Director in their tasks. The EMA also has seven separate scientific committees which study and monitor medicines throughout their lifecycle in order to ensure safety once they reach the market. The EMA also has several working parties and related groups which are accessible to the scientific committees for consultations. These committees, parties, and groups all consist of European experts from EU Member States.

During the COVID-19 pandemic, the EMA assumed the role as contributor to the global fight against the virus through the efforts to increase efficiency in the development and approval of treatments and vaccines for COVID-19. The EMA also continued its support for access to medicines throughout the EU and worked on releasing consistent COVID-19 updates and information to the public. The EMA also had its own COVID-19 pandemic Task Force which handled COVID-19 related operations and organized fast action throughout all EU Member States.

The COVID-19 EMA pandemic Task Force (COVID-ETF) was led by Marco Cavaleri, who is the head of the office Anti-infectives and Vaccines. The COVID-ETF focused on fast action regarding development, authorization, and safety monitoring of COVID-19 treatments and vaccines. Some responsibilities of the COVID-ETF included studying data on possible COVID-19 medicines and finding medicines with potential, accessing data from and communicating with developers, working with the clinical trials facilitation group (CTFG) to organize clinical trials in the EU for potential COVID-19 treatments, reviewing COVID-19 medicine development plans, advising the Scientific Advice Working Party (SAWP) or the Committee for Medicinal Products for

Human Use (CHMP) on formal scientific advice and assessments, working with the Pharmacovigilance Risk Assessment Committee (PRAC) on topics such as safety concerns regarding COVID-19, and working with stakeholders and European and international organizations. The COVID-ETF was held accountable to the EMA's CHMP for all of its work.

In October 2020, the EMA COVID-19 Task Force was renamed the Steering Group. This group was responsible for responding to the ever-changing conditions of the pandemic. The EMA COVID-19 Steering Group also oversaw the EMA's activities through changes to the EMA's COVID-19 business continuity plan. Noël Wathion, the EMA's Deputy Executive Director, led the Steering Group. The Steering Group was overseen by a core group on policy and inter-institutional issues. This core group, which worked with the European Commission, was responsible for checking that the EMA aligned with other EU and global partners at both operational and political levels. Four cross-Agency work streams, including therapeutic response, supply chain, business continuity and impact, and human resources, all supported the Steering Group. These four work streams advised the Steering Group in issues regarding different measures relating to the four work streams.

The EMA published its own health threats plan, which aims to provide public responses to health threats such as COVID-19. This health threats plan releases information on the responsibilities of the EMA's scientific committees and staff and also publicized the EMA's communication with EU Member States, international partners, stakeholders, and the public. This health threats plan was put into place in early 2020 as the COVID-19 pandemic emerged.

The business continuity plan for the European medicines regulatory network organized and established the principles which made certain that the EMA, EU Member States, and the European Commission continue with their core regulatory activities and responsibilities in guarding public and animal health in the EU throughout the pandemic. This plan explicitly stated that the evaluation of COVID-19 treatments and vaccines were not allowed to be delayed and also established plans in the case of potential delays for evaluations irrelevant to COVID-19. Ultimately, this plan was created to prevent and plan for as many delays to evaluations and studies of medicines as possible.

The EMA continues to cooperate with the European Commission, the Health Security Committee, and the ECDC along with other global partners such as the WHO. The EMA, alongside other medicine regulatory agencies globally, were all working together under the International Coalition of Medicines Regulatory Authorities (ICMRA) in hopes of speeding up the development of and increasing the accessibility to COVID-19 vaccines and treatments. The OPEN Initiative, which hoped to allow for the sharing of scientific knowledge, overcome shared obstacles, and increase the transparency of regulatory decisions, was created in order to grant the WHO and medicines regulators separate from the EU access in the EMA's assessments. The EMA was heading the OPEN Initiative through their prioritization of assessments of COVID-19 vaccines and treatments. In order to do so, the EMA also participated in CHMP evaluations and the COVID-ETF. This initiative was set to run from December 2020 until the end of the pandemic.

In terms of their efforts to lessen the spread of COVID-19, the EMA worked to consistently review and change its measures as the conditions changed. Although most of the EMA staff were working from home since mid-March of 2020, the EMA continued its virtual meetings for its scientific committees and parties and stakeholders. The EMA also was ensuring that its measures align with those implemented by the European Commission and the Dutch Government since the EMA is hosted by the Netherlands.

COVID-19 Timelines: U.S. and EU Highlights January 2020 – December 2020

The U.S.

January 2020

- 1/20/20: The CDC begins screening for COVID-19 at JFK International, San Francisco International, and Los Angeles International airports.
- 1/21/20: The first US COVID-19 case is reported in Washington state.
- 1/31/20: The Trump Administration imposes restrictions on travelers who have been to China in the past 2 weeks, not including immediate family members of American citizens or permanent residents.

February 2020

- 2/2/20: Global air travel is restricted.
- 2/3/20: US declares a Public Health Emergency.
- 2/25/20: The CDC predicts COVID-19 will reach pandemic status.
- 2/29/20: The first reported COVID-19 related death is found near Seattle in Washington.

March 2020

- 3/6/20: 21 out of 46 passengers on a cruise ship are docked in San Francisco while awaiting testing.
- 3/13/20: President Trump declares a National Emergency and imposes travel ban on non-US citizens who visited any of 26 European countries within 2 weeks of coming to the US.
- 3/15/20: The CDC recommends avoiding gatherings of 50 people or more for the upcoming 8 weeks.
- 3/17/20: The Trump Administration calls on Congress to create an economic stimulus package for Americans and provide financial relief checks. The University of Minnesota begins trials testing Hydroxychloroquine as a possible treatment for COVID-19.
- 3/19/20: California is the first state to implement a statewide stay-at-home order.
- 3/26/20: The Senate passes the CARES Act. The U.S. now has the largest number of COVID-19 cases in the world at 81,321 with over 1,000 deaths.
- 3/27/20: President Trump signs the CARES Act into law.
- 3/30/20: The FDA issues an emergency use authorization (EUA) for hydroxychloroquine sulfate and chloroquine phosphate products.

April 2020

- 4/2/20: 10 million Americans are reported to have lost their jobs and 6.6 million Americans are reported to have applied for unemployment benefits since the end of March.

- 4/8/20: President Trump encourages use of hydroxychloroquine for treating COVID-19, but the American Heart Association issues a warning stating the risks for those with heart-related problems.
- 4/21/20: Santa Clara County, California officials report two COVID-19-related deaths on February 6 and February 17, making these the earliest known deaths due to COVID-19.
- 4/30/20: American Airlines and Delta Airlines announces plans to impose a mask requirement for all passengers and flight attendants. Lufthansa Group, JetBlue, and Frontier Airlines follow in their steps and announce mask requirement plans soon after.

May 2020

- 5/9/20: The FDA authorizes use of saliva-based COVID-19 tests.
- 5/12/20: Anthony Fauci, MD, Director of the National Institute of Allergy and Infectious Diseases, believes that the US death toll count of 80,000 is possibly lower than the actual number of deaths.
- 5/21/20: President Trump announces deal with AstraZeneca for quick development of the AZD1222 COVID-19 vaccine. The HHS believes the first doses of the vaccine have the potential to become available in October 2020 and report phase 3 clinical studies will take place over the summer.
- 5/27/20: The death toll reaches over 100,000, the highest of any country.

June 2020

- 6/10/20: Cases surpass 2 million.

- 6/20/20: The National Institute of Health (NIH) stops hydroxychloroquine trials as they find that it is an ineffective treatment for COVID-19 with no consequences or benefits. Southern states encounter large increase in cases.
- 6/22/20: *Science Translation Medicine* releases a study finding that it is possible that up to 80% of Americans could have had an undetected COVID-19 case.
- 6/26/20: The White House Coronavirus Task Force holds a briefing addressing concerns over the growing number of cases in some southern states.
- 6/30/20: Fauci believes cases have the potential to reach over 100,000 per day.

July 2020

- 7/2/20: Select states halt reopening plans and revert to previous measures.
- 7/7/20: Cases reach over 3 million and the U.S. initiates a withdrawal from the WHO.
- 7/10/20: The U.S. sets 7 single-day records over the course of 11 days. Georgia, Utah, Montana, North Carolina, Iowa, and Ohio set new single-day records for COVID-19 cases.
- 7/13/20: Over 5 million Americans are reported to have lost health insurance due to job loss.
- 7/14/20: Moderna reports the results of phase 1 and 2 of clinical trials of their COVID-19 vaccine. The vaccine is reported to have resulted in immune responses in all three groups of fifteen subjects.
- 7/16/20: The U.S. sets new record for number of daily cases. The record is now 75,600 cases in one day.

- 7/21/20: AstraZeneca and CanSino Biologics vaccines appear to have resulted in immune responses.
- 7/22/20: The HHS and the Department of Defense (DOD) collaborate with Pfizer and BioNTech to plan for 100 million doses of COVID-19 vaccine BNT162 in December.
- 7/27/20: Senate creates the HEALS Act to provide more stimulus checks, support small businesses, and assist businesses in creating plans to reinstate in-person employment. The Moderna vaccine enters phase 3 trials and is granted \$472 million by President Trump to increase number of subjects to 30,000.

August 2020

- 8/1/20: The U.S. reports that the number of cases in July reached over double the total of cases of any other month during 2020. The case count in July reached 1.9 million.
- 8/3/20: Deborah Birx, Coronavirus response coordinator, reports the beginning of a new phase of the pandemic due to different patterns in the spread of cases across the country. The Trump Administration collaborates with GlaxoSmithKline and Sanofi Pasteur in a \$2.1 billion deal in order to increase the funding and efficiency of vaccine developments.
- 8/11/20: The Trump Administration and Moderna partner in a \$1.5 billion deal to gain access to 100 million doses of its mRNA-1273 vaccine. The Big Ten and Pac-12 football conferences announce plans to cancel the season in the fall due to COVID-19 concerns.

- 8/13/20: Presidential nominee Joe Biden encourages state governors to implement mask mandates until November.
- 8/16/20: The CDC begins working with California, Florida, Minnesota, North Dakota, and Philadelphia to create plans for vaccine distribution.
- 8/17/20: The top three leading causes of death in the U.S. is now heart disease, cancer, and COVID-19.
- 8/18/20: Colleges that reopened decide to resort back to online classes due to COVID-19 outbreaks.
- 8/28/20: The first case of COVID-19 reinfection is found.

September 2020

- 9/1/20: The U.S. announces plans to refuse collaboration with the WHO in the creation of COVAX, a program launched to organize the distribution of vaccines.
- 9/3/20: Over 51,000 cases are reported at colleges across the country.
- 9/13/20: Midwest states see a sharp rise in cases.
- 9/14/20: Airports stop screenings at some airports for travelers coming from other countries.
- 9/15/20: The CDC reports recent confirmed cases are 2.4 times more likely to have dined in restaurants.
- 9/16/20: The HHS and DOD report plans for free COVID-19 vaccines to become available for all Americans beginning in January 2021.
- 9/22/20: Deaths in the country reach over 200,000.
- 9/23/20: A new strain of COVID-19 is reported at Houston Methodist Hospital.

- 9/25/20: Midwest states see a large increase in cases.
- 9/29/20: The HHS releases plans to distribute 100 million rapid COVID-19 tests in order to help in the reopening of schools.

October 2020

- 10/2/20: President Trump and the First Lady are reported to have tested positive for COVID-19.
- 10/5/20: President Trump is released from hospital and continues to receive treatment.
- 10/8/20: 39 states report large spikes in the number of cases. 9 states report 7-day records for positive cases. Wisconsin and Hawaii report a new record for the weekly death toll. The White House encounters a COVID-19 outbreak which results in 34 infections.
- 10/9/20: The Trump Administration reaches a \$486 million deal with AstraZeneca in order to start the development of an antibody COVID-19 treatment.
- 10/15/20: The U.S. reports another large increase in cases. 60,000 cases are reported.

November 2020

- 11/4/20: A new record of 100,000 new cases across the country in one day is reported which causes a shortage of N95 face masks at hospitals and other health care facilities.
- 11/5/20: COVID-19 cases in colleges across the country reach 250,000 due to students coming back to campus for fall semester.

- 11/8/20: The U.S. reaches over 10 million cases.
- 11/9/20: President-Elect Biden releases plans for a COVID-19 Transition Team and releases names of individuals who will join his Transition COVID-19 Advisory Board.
- 11/11/20: After a study on the cell phone mobility data from large cities across the U.S., a majority of new cases are determined to have come from indoor gatherings.
- 11/16/20: HHS Secretary Alex Azar reports that the FDA is working quickly to allow for emergency use of Pfizer and Moderna vaccines.
- 11/17/20: The FDA approves first rapid COVID-19 at-home test.
- 11/18/20: Deaths in the U.S. reach 250,000.
- 11/20/20: The CDC advises Americans to resist traveling during the holidays due to large spikes across the country in cases and hospitalizations.

December 2020

- 12/10/20: The FDA advisory panel announces support for Pfizer and BioNTech vaccine.
- 12/11/20: The FDA issues an EUA for Pfizer and BioNTech vaccine to begin distribution of vaccines to healthcare workers.
- 12/14/20: Deaths reach over 300,000 across the country.
- 12/17/20: The FDA advisory panel endorses the Moderna vaccine.
- 12/18/20: The FDA issues an EUA to begin distribution of the Moderna vaccine.
- 12/23/20: The Trump Administration buys another 100 million doses of the Pfizer and BioNTech vaccine.

- 12/29/20: The first case of new COVID-19 variant recently found in the United Kingdom is reported in Colorado.
- 12/31/20: The CDC reports 2.8 million Americans have been vaccinated. 14 million vaccine doses out of the 20 million allocated vaccine doses have been distributed across the country which is slower than initially planned.

The EU

January 2020

- 1/24/20: The first case in Europe is found in France.
- 1/28/20: Germany reports several cases.
- 1/31/20: The Civil Protection Mechanism assists EU citizens in non-European countries in traveling back to Europe.

February 2020

- 2/1/20: Italian officials report cases in the Lombardy, Piedmont, and Veneto regions.
- 2/14/20: France reports the first COVID-19-related death in Europe.
- 2/23/20: Italy reports a large spike in cases, making it the first outbreak in Europe.
- 2/28/20: Member States of the EU coordinate to buy protective equipment, ventilators, and COVID-19 testing kits.

March 2020

- 3/3/20: The EU provides up to 700 million Euro to Greece due to its higher numbers of refugees and migrants. The EU's Civil Protection Mechanism assists

Greece in medical equipment supply, medical teams, shelters, tents, and blankets.

- 3/8/20: Italy begins implementing public health measures such as social distancing. Spain, France, and other Member States follow in Italy's footsteps.
- 3/15/20: The EU works on allowing for the exports of PPE to countries which are outside the EU borders.
- 3/17/20: The EU shuts down the borders of at least 26 countries and bans visitors from any other country for a minimum of 30 days. 7 epidemiologists and virologists from several Member States join together to form a panel with a mission to create and implement EU response strategies and recommendations and organize risk management based on scientific facts.
- 3/18/20: The EU implements its "green lane" border entryways to allow essential goods and medical and PPE to come into Member States within the single market.
- 3/19/20: Member States are allowed to make state aid rules more flexible to make certain that adequate liquidity is provided to businesses.
- 3/20/20: The EU coordinates medical supply standards in order to increase production capacity. The EU also begins creating a stockpile of essential supplies such as ventilators, reusable masks, laboratory supplies, and therapeutics ("rescEU") to prevent shortages.
- 3/23/20: The EU adjusts its budgetary rules in order to make them more flexible for Member States which inevitably have to endure increased spending.
- 3/25/20: All Member States are now affected and are reporting cases.

- 3/26/20: The EU stops empty flights. The EU provides financial support of 800 million Euro for public health emergencies through the EU Solidarity Fund.
- 3/27/20: The EU makes 37 billion Euro available for the Coronavirus Response Investment Initiative. This initiative's goal is to provide adequate support to healthcare systems, enterprises, and labor markets.

April 2020

- 4/6/20: The EU makes 8 billion Euro available for minimum 100,000 European firms.
- 4/8/20: The ECDC releases recommendations for mask mandates. Many Member States begin planning for readjustments to their responses such as the reopening of schools and small businesses.
- 4/15/20: The European Commission and the European Council release guidelines for EU countries when reopening and lifting restrictions.
- 4/16/20: The European Investment Bank (EIB) establishes a guarantee fund and provides 65 billion Euro for supporting economic health of EU countries.
- 4/17/20: The European Commission provides guidance and an EU toolbox for assistance in creating contact tracing apps which assist in COVID-19 mitigation. The European Parliament ensures that all apps created must follow data protection and privacy legislation rules. The EU also provides over 3 billion Euro in its mission to assist in the improvements of testing abilities and research.
- 4/20/20: The European Commission partners with other organizations in order to create and establish their European COVID-19 Data Platform which has the purpose of improving the collection and release of research data.

- 4/23/20: The Fund for European Aid to the Most Deprived provides assistance in the delivery of food and basic material assistance through electronic or paper vouchers in efforts to lower the risk of COVID-19 spread. The fund also helps provide PPE to frontline workers. In addition, three main cohesion funds, the European Regional Development Fund, the European Social Fund, and the Cohesion Fund, allows for a more flexible movement of resources to different areas. Cases in the EU/EAA and the United Kingdom (UK) reach over 1 million.
- 4/24/20: The EU releases guidelines to help workers return safely to the workplace. The guidelines include information for risk assessment and the plans for care of sick workers, along with more information for certain sectors.

May 2020

- 5/5/20: France reports cases from as early as December and claims COVID-19 hit Europe almost a month prior to when Chinese officials reported the virus to the WHO.
- 5/13/20: The European Commission releases guidelines regarding tourism and travel in order to assist in the organization of travel restrictions across all Member States.
- 5/17/20: Europe's largest economy, Germany, goes into a recession.
- 5/21/20: The EU Aviation Safety Agency (EASA) and ECDC coordinate to release guidelines for the handling of individuals traveling on planes during the pandemic.

- 5/27/20: The European Commission implements Next Generation EU, which is a 750 billion Euro recovery instrument, along with a new long-term EU budget in efforts to support the economy.

June 2020

- 6/4/20: The European Central Bank (ECB) allows for a total of 1.35 trillion Euro to be included in the pandemic emergency purchase program.
- 6/8/20: The European Innovation Council (EIC) provides 314 million Euro to innovation companies which contribute to the fight against COVID-19.
- 6/11/20: The European Parliament and the European Commission establish SARS-CoV-2, the virus behind COVID-19, as part of risk group three of the EU Biological Agents Directive in order to establish more support of the health and safety of European workers. The EIB provides BioNTech SE 100 million Euro in the form of debt financing to support vaccine development.
- 6/14/20: The EU's "Re-open EU" website launches. It publishes information for travelers regarding European travel plans and vacations during the pandemic.
- 6/15/20: Member States begin slowly lifting travel restrictions. The European Parliament pushes for the Schengen zone, a passport-free area, to return to its full operations.
- 6/17/20: The European Commission releases an EU vaccines strategy.
- 6/19/20: The European Parliament focuses on increasing protection for cross-border and seasonal workers. The EU also implements financial support and market crisis measures and makes the EU farm policy more flexible to accommodate for the needs of farmers, fishermen, and small agri-food

businesses. The European Parliament also makes rules more flexible for banks in order to push them to lend money to companies and households.

- 6/27/20: The EU along with its global partners take part in the “Global goal: unite for our future” summit and agrees upon providing 6.15 billion Euro under the Coronavirus Global Response initiative. The total in funding under this initiative is now 16 billion Euro.
- 6/30/20: The EU announces plans to reopen borders to travelers from 15 countries due to the importance of politics, diplomacy, and revenue from tourism. The U.S., Brazil, and Russia are not included in the approved countries.

July 2020

- 7/6/20: The EIB coordinates with a German vaccine developer, CureVac, and establishes a 75 million Euro loan agreement to further the efforts for the development and production of vaccines.
- 7/10/20: The European Parliament allows for more flexibility in clinical trials in order to increase the speed of vaccine development.
- 7/21/20: The EU announces a stimulus package in their efforts to help save their economies.
- 7/23/20: The European Parliament discusses long-term budget cuts with heads of state and government but does not want to commit to the deal unless there is a plan for new sources of EU revenue.

August 2020

- 8/6/20: The ECDC releases a report on children and school settings in relation to COVID-19.

- 8/11/20: Under Horizon 2020, a research and innovation program, the EU provides a variety research projects with 128 million Euro.

September 2020

- 9/4/20: The European Commission adopts proposal for a European Council recommendation that ensure that measures used by Member States that restrict travel are coordinated and communicated at the EU level.
- 9/16/20: The European Parliament decides to move ahead with the recovery plan to give the EU the ability to borrow 750 billion Euro on the markets.
- 9/17/20: The European Commission releases a proposal to coordinate and organize restrictions and measures imposed by member states and requires clear communication at the EU level. The European Parliament endorses the proposal and encourages coordinated health assessments and methodologies. The European Parliament decides to increase the EU's 2020 budget by 6.2 billion Euro in order to provide more assistance for less wealthy regions and invest in the development of a vaccine. The European Parliament also pushes the EU to get supplies, improve local drug manufacturing, and improve the organization of EU national health strategies.
- 9/18/20: The ECDC releases testing strategies.

October 2020

- 10/15/20: The European Commission releases information on its vaccination strategies across Member States and establishes prioritized groups in the vaccination process.

- 10/19/20: Belgium closes restaurants and implements a curfew in their efforts to prevent higher increases in cases. Belgium had reported over 48,000 cases over the past week. The European Commission organizes an EU-wide system (“gateway”) to improve the contact tracing and warning apps across all borders of Member States. Some apps include Germany’s Corona-Warn-App, Ireland’s Covid tracker, and Italy’s Immuni. The European Commission plans for other apps to get connected during October and November.
- 10/24/20: Poland President Andrzej Duda is reported to have tested positive for COVID-19.
- 10/27/20: The EU began using the Sure instrument earlier in the year which allows for increased funding to EU countries of a maximum of 100 billion Euro for loans. These loans are to help businesses keep their employees, lessen working hours, and provide income support. The first payments were sent out at this time.

November 2020

- 11/11/20: The European Commission begins establishing a European Health Union which has the mission to better prepare and respond to the COVID-19 pandemic and future pandemics.
- 11/12/20: The EU commits to giving 500 million Euro to get vaccines for low and middle-income countries. The EU now becomes one of the biggest donors to the Covax facility.

- 11/25/20: The EU finalizes contracts with AstraZeneca, Sanofi-GSK, Janssen Pharmaceutica NV, BioNTech-Pfizer, CureVac, and Moderna in order to secure vaccines for EU countries.

December 2020

- 12/2/20: The European Commission has growing concerns over the potential for cases to increase over the winter. Member States insist on individuals to adhere to physical distancing and mask mandates and strongly encourage communities to continue to provide adequate testing and contact tracing. The European Commission also advises individuals to familiarize themselves with travel precautions and encourages Member States to continue working on their vaccination strategies.
- 12/14/20: The European Council and the European Parliament work together on the EU4Health program which has the purpose to fight against cross-border health dangers and establish stronger European health systems. The funding for the EU4Health program was established to be 5.1 billion Euro from 2021 to 2027.
- 12/18/20: The European Council and the European Parliament set rules for the Recovery and Resilience Facility, which can create 672.5 billion Euro in the form of loans and grants. The European Commission provides 20 million rapid antigen tests to EU countries.
- 12/21/20: The EMA endorses BioNTech/Pfizer, and the European Commission authorizes the vaccine.

- 12/27/20: Vaccines begin to be distributed among Member States based on each country's vaccination plans.

Analysis of 3 US States and 3 EU Member States

This case study will focus on the three most populous states of the US, which include California, Texas, and Florida, as well as the three most populous Member States of the EU, which include Germany, France, and Italy. This study has a focus on monthly COVID-19 case data and unemployment rate data rather than daily or weekly data. For GDP, quarterly estimates will be used. In addition, this study analyzes statewide lockdowns rather than county-level or region-level lockdowns for the purpose of keeping the study concise and clear. In order to analyze these implementations of NPIs (lockdowns, school closures, and restaurant shutdowns) and their effects on the economic indicators of GDP and unemployment rates, figures displaying 2020 Monthly Confirmed Cases, 2020 Quarterly GDP, and 2020 Monthly Confirmed Cases and Unemployment Rates are provided under “List of Figures” for each studied US state and EU Member State. Charts displaying broad timelines of statewide lockdowns, school closures, and restaurant shutdowns are provided under “List of Charts.”

The 3 US States

California

California is home to almost 40 million people and boasts the largest economy of any state in the US with about a \$3.2 trillion GDP as of 2019. Throughout 2020, California faced many great difficulties in containing COVID-19 spread among its large population and maintaining levels of GDP that were comparable to before the pandemic.

California reported some of the earliest known COVID-19 cases in the US in January 2020 in Santa Clara County in Northern California. Due to major concerns regarding a looming pandemic, Governor Gavin Newsom was quick to respond with plans for mitigation strategies to implement in the case of COVID-19 spread throughout the state. As shown in Figure 1a, California saw an increase in monthly new cases from January to July 2020. As the summer approached, California began reporting rapid waves of new cases. In July, over 270,000 new cases were reported, making this month the worst yet for the state. Throughout August, September, and October, the count of new cases seemed to slow down at a more comfortable rate. But, as Governor Newsom was dreading, the number of new cases picked up again as the holidays approached. During November, it was clear that the COVID-19 spread was quickly getting out of control again. In the month of December, California reported a staggering 1,070,577 new cases, making a new record for the state's reports of new COVID-19 cases.

As seen in Figure 1b, California's 2020 quarterly GDP fluctuated with the unstable economic conditions. At the end of 2020 Quarter 1, California reported a GDP of about \$2.8 trillion. Once COVID-19 was determined to be a threat to public health in March, GDP began to suffer and sharply declined to \$2.5 trillion at the end of Quarter 2. As the year progressed, California was able to increase its GDP to \$2.7 trillion at the end of Quarters 3 and 4.

Due to the harsh economic conditions that the state faced throughout its struggles through the pandemic, it was clear that California would suffer from high unemployment rates. As shown in Figure 1c, California began 2020 with an unemployment rate of 3.90%. Once March came around and the concerns over COVID-

19 grew rapidly, the unemployment rate skyrocketed from 5.30% in March to 15.50% in April. This extreme change was largely due to the measures Governor Newsom had to implement to fight COVID-19 spread in the state. The record for the unemployment rate was set in May at 16.40%. As the year progressed with changing mitigation strategies, the unemployment rate began to decrease, largely due to pressure that Governor Newsom faced in shifting focus from public health concerns to concerns regarding the economic wellbeing of the state and its residents. Many people were outraged at the consequences of the strict mitigation strategies that Governor Newsom put into effect at the beginning of the pandemic in March 2020 and the backlash resulted in the pulling back of restrictions such as restaurant shutdowns.

As shown in Figure 1c, although cases were at an all-time high December, the unemployment rate was much lower (9.0%) than compared to May (16.40%). This appears to be due to the strict and immediate restrictions that were imposed during the beginnings of the pandemic. This can be due to the uncertainty of what would happen for the rest of the year when it was difficult to predict how long restrictions would last. In December 2020, it is possible the unemployment rate settled down to 9.0% due to the lack of similar restrictions to those in the beginning.

Texas

Texas is the second largest state in the US by population with almost 30 million people. The GDP of the state was \$1.9 trillion in 2019, making it the second largest economy in the US following California.

Throughout 2020, Texas faced a great number of new COVID-19 cases each month according to Figure 2a. At the beginning of the pandemic, Texas reported 10

cases in February. Governor Greg Abbott of Texas announced a statewide disaster on March 13, 2020 in hopes of quickly responding to growing numbers of new cases. From March to July, Texas suffered a sharp rise in new cases, which is likely due to the pulling back of restrictions beginning in May. In July 2020, Texas reported 276,397 new cases in just one month, setting a new record for the number of new cases so far in the state's timeline of the pandemic. Due to the concerning growth in new cases and the inability for hospitals to keep up, Governor Abbott decided to halt reopening and closed the bars. In addition, Governor Abbott issued an executive order and decreased restaurant capacity back to 50%. After July, the number of new cases began to decline quickly. By September, the monthly number of new cases decreased to 143,710. Although Texas saw improvements in monthly new case growth, the number of new cases per month began rising again. In December 2020, the new record for new monthly cases in Texas was set at 509,748.

As a large and influential economy of the US, Texas is used to high levels of GDP. According to Figure 2b, at the end of Quarter 1 of 2020, Texas reported a GDP of \$1.7 trillion. At the end of Quarter 2, GDP fell to \$1.6 trillion. This was likely due to the quick implementation of mitigation strategies across the state. At the end of Quarter 3, GDP rose back to \$1.7 trillion, which was likely caused by the reopening of the state and the continued operations of businesses such as restaurants and bars. At the end of 2020 at Quarter 4, GDP settled at \$1.7 trillion.

When looking at unemployment rates, Texas saw a great amount of fluctuation during 2020, which was predictable given the conditions caused by the pandemic. (Figure 2c) At the beginning of the year, the unemployment rate was at 4.50%. By May,

the unemployment rate of the state skyrocketed to 13.0%, the highest unemployment rate reported in 2020 for the state. Following May, the unemployment rate fell back down to 6.30% in August. For the following months of 2020, Texas saw some smaller fluctuations in the unemployment rate and settled at 7.20% at the end of December.

As shown in Figure 2c, the unemployment rate was at its highest at the beginning of restrictions. The unemployment rate in December was much lower (7.2%) than the peak during May (13.0%). Although cases were low in May, the uncertainty of the events of 2020 and the quick implementation of strict measures which suddenly impacted businesses is likely the reason why unemployment rose so high. It is likely the unemployment rate fell at the end of the year due to the pressure to maintain economic health and keep the state as open as possible.

Florida

With a population of 21.48 million, Florida is the third largest state by population in the US. Florida's GDP amounted to about \$1.1 trillion in 2019. Florida was unique in its approach to the pandemic and opted for lighter restrictions and mitigation strategies than compared to both California and Texas. The state became widely known for its much more relaxed approach to the pandemic during 2020.

At the beginning of March 2020, Governor Ron DeSantis confirmed that the first 2 COVID-19 cases were detected in the state. As shown in Figure 3a, Florida faced a sharp rise in cases from March to July. Florida began reporting its first cases in March, and by the end of the month the monthly new case count reached 6,739. Although it was clear that COVID-19 would become an issue for Florida, Governor DeSantis emphasized the economic losses that would be incurred if strict mitigation

strategies were implemented. Governor DeSantis decided to declare a state of emergency with the purpose of gaining access to federal funding and support. Although Governor DeSantis made it clear that he wanted to avoid strict restrictions on the state, he began imposing certain restrictions on schools and businesses. He believed that a statewide lockdown was unnecessary and would be too harmful to residents and businesses. By the beginning of April, Governor DeSantis recognized the concerns over COVID-19 and issued a statewide lockdown. At the beginning of May, he announced the lifting of the lockdown and the entrance into “full phase one” of reopening. In July, 320,596 new cases were reported. Following this record for the state, Florida saw a rapid decrease in monthly cases. From July to September, the monthly reported number of cases decreased quickly to 79,790. Although this was an accomplishment for Florida, the number of monthly new cases went on the rise again and reached another high of 299,514 new monthly cases at the end of December 2020.

Figure 3b reports the quarterly GDP for Florida throughout 2020. At the end of Quarter 1, Florida reported a GDP of about \$963 billion. At the end of Quarter 2, Florida’s GDP fell quickly to \$880 billion. This was likely due to the restrictions imposed at the time. At the end of Quarters 3 and 4, GDP rose again to about \$950 billion, which was likely due to the lack of restrictions during the second half of the year.

As shown in Figure 3c, Florida began 2020 with an unemployment rate of 2.80%. Florida faced its highest unemployment rate in May at 13.70%, which was likely due to the introduction of restrictions. During July, when the state reported the highest number of monthly new cases, the unemployment rate was 11.30%. Although

July set the record for the monthly number of new cases, it is likely that this unemployment rate (11.30%) was lower than the previous months due to a lack of strict restrictions. As the year progressed, the unemployment rate had a generally downward trend, reaching as low as 6.10% at the end of December 2020.

The 3 EU Member States

Germany

Germany is the biggest Member State of the EU by population. Over 83 million people call Germany home. Due to having the biggest population in the EU, it is clear that Germany would face some challenges during the pandemic. In 2019, Germany's annual GDP was reported to be 3.4 trillion euro. Germany is recognized as one of the largest economic powers in the world. Germany was applauded for its seemingly successful approach to the pandemic throughout 2020.

As shown in Figure 4a, Germany managed to keep the monthly number of new cases fairly consistently low throughout the year as compared to other countries around the world. Germany reported its first cases at the beginning of the year in January. By the end of January, the public health system of Germany, led by German Chancellor Angela Merkel who was a scientist herself, already began quickly making moves to respond to the pandemic. At the end of February, 74 new cases were reported. Germany began requiring travelers from high-risk countries to provide exposure and contact information. The pandemic quickly gained speed during March and April, reaching a monthly number of new cases of 98,845 for the month of April. The restrictions increased due to the concerns over growing monthly new cases. Although this was a sudden increase in the monthly number of new cases, the monthly number of new cases

declined in May and remained fairly low throughout the summer months which allowed for an easing of restrictions. From May to August, the monthly number of cases ranged from 20,000 to 33,000. Once September came around, Germany faced the beginning of a sharp and dramatic increase in the monthly number of new cases. At the end of September, 43,319 new cases were reported. In November, Chancellor Angela Merkel started Germany's "lockdown light" for the month. This imposed new restrictions such as the shutting down of bars, restaurants, cinemas, theaters, and gyms. In addition, social distancing measures were reimplemented. At the end of December, 675,188 new cases were reported for the month, making it a record for Germany. It is believed that the dramatic increase in COVID-19 cases in the later part of 2020 was due to the lack of restrictions over the summer. In all of 2020, Germany did not once reach the point of overwhelming its hospitals which was an astounding accomplishment. Experts believed that this was due to Germany's intensive care infrastructure which was far more high-quality than those of other EU Member States. Germany's focus on testing and contact tracing contributed to its success. Although Germany reported some of the highest levels of COVID-19 cases in the EU, its public health infrastructure and focus on testing dramatically reduced the mortality rate than compared to other EU Member States. In addition, Germany prioritized getting children back in school and kept schools open throughout most of 2020 despite waves of cases, which was a very different strategy utilized than that of the U.S.

Figure 4b displays Germany's quarterly GDP throughout 2020. At the end of Quarter 1 of 2020, Germany reported a GDP of about 859.3 billion euro. At the end of Quarter 2, the country's GDP fell to 779.8 billion euro. After this sharp decrease in

GDP, Germany saw a rise at the end of Quarter 3 with a GDP of 838.8 billion euro. This rise was likely due to Germany's success in navigating through the pandemic due to a focus on strong scientific analyses and data. At the end of Quarter 4, Germany's GDP settled at 846.8 billion euro, which was close to what the GDP was reported as at the end of Quarter 1.

As shown in Figure 4c, Germany's unemployment rate did not change drastically throughout 2020. At the beginning of the year, the unemployment rate was 3.40%. As the year progressed, it consistently slightly increased. The highest reported unemployment rate was at the end of the year in December at 4.60%. The lack of severe fluctuations in unemployment rates throughout 2020 was likely due to Germany's approach to economic downturns. Rather than allowing for employers to lay off large numbers of workers throughout the year and then require those laid off to apply for unemployment benefits on their own, Germany subsidized employers' payrolls.

France

As of 2019, the population of France was 67.06 million. France is another large Member State of the EU in terms of both population and economic power. The reported annual GDP for France in 2019 was about 2.3 trillion euro. With both a large population and a high GDP, France was another EU Member State to face major difficulties during the pandemic.

As shown in Figure 5a, France reported its first COVID-19 cases in January 2020. At the end of February, France reported 98 new monthly cases. Just a short period of time later, France reported 52,028 new cases for the month of March. During the month of March, France implemented its first lockdown to mitigate the spread. French

President Emmanuel Macron took action and began imposing restrictions in order to limit travel throughout the country. In April, 77,453 new cases were reported for the month. Following April, the monthly number of new cases began declining. France began reopening schools and businesses during May due to the declining number of new cases. In June, restrictions were all lifted by the end of the month. Although it seemed to flatten and become steadier, the number of monthly new cases picked up again following July. For the month of July, 23,118 new cases were reported. The monthly number of new cases continued to rise rapidly over the next several months. Due to the growing concern over the rising number of new cases, President Macron imposed a second lockdown for the month of November. In November 854,863 new cases were reported for the month. This set a record for the number of monthly new cases for France throughout 2020. In December, restrictions began lifting once again and the monthly number of new cases decreased dramatically to 397,937 which was likely due to the strict measures implemented in the previous month.

As shown in Figure 5b, France ended Quarter 1 of 2020 with a GDP of €580 billion. At the end of Quarter 2, France reported a GDP of €515 billion. This sharp decrease was likely due to the increase in the number of COVID-19 cases and the beginnings of restrictions during the pandemic. France reported a GDP of €593 billion at the end of Quarter 3 and a GDP of €588 billion at the end of Quarter 4. This is an interesting case because France reported a higher GDP at the end of Quarter 4 than compared to the end of Quarter 1. This could show a possible connection between GDP and the sharp decrease in COVID-19 cases along with France refraining from imposing lockdowns and shutdowns throughout most of the year.

As shown in Figure 5c, France saw slight fluctuations in its unemployment rate throughout 2020. In January 2020, the unemployment rate was reported as 8.10%. This is an interesting case because the unemployment rate actually lowered, rather than increased, until the end of June 2020. This is likely due to France's commitment to spending on COVID-19 unemployment throughout the year. Although the lower unemployment rate appears to be an indicator of an improving economy, these numbers conceal the large loss of economic activities. The budget for unemployment throughout 2020 large and was a major cost for France since the beginning of the pandemic. This spending was likely what kept unemployment rates from rising drastically. As the summer approached, the unemployment rate began rising. At the end of summer in September, the unemployment rate reached a high of 9.30%. During the following months, the unemployment rate steadily lowered again.

Italy

In 2019, Italy was home to over 60 million people, making it the third largest EU Member State by population, and reported a GDP of almost €1.8 trillion. Italy attracted attention from all over the world during 2020, largely due to its struggles during the pandemic.

As shown in Figure 6a, Italy reported its first cases in January 2020. Initially, Italy did not recognize COVID-19 as a great threat. At the end of February, the monthly count of new cases reached over 1,000. Although new cases were being reported, many Italian politicians believed that COVID-19 would not have an impact on the country's economy. In March, Italy saw the number pick up quickly and the effects of the spread intensified. During March, the monthly count of new cases reached a staggering

104,664, which was likely due to the lack of early action by the Italian government. Following March after a lockdown was imposed, Italy saw a decrease in cases. Italian President Sergio Mattarella began lifting some restrictions in early May to allow for the economy to pick up again. In August, the monthly count of cases began to rise again. President Mattarella decided to reimpose some containment measures such as capacity limits at cultural sites and a mask mandate. Italian residents who failed to comply with mandates and rules faced fines. Since rapid COVID-19 tests were approved for use in schools, Italy did not have to close down its schools for the entirety of the year. At the end of November, the monthly count of new cases reached an all-time high of 922,124. The next month, Italy reported a significant decrease in the monthly count of new cases. During December, the monthly count of new cases was 505,612. One major lesson Italy learned from 2020 was to place measures in a timely manner to effectively prevent spread rather than follow the effects.

As shown in Figure 6b, Italy faced a sharp downturn in GDP in Q2. At the end of Q1, Italy reported a GDP of €423 billion, and by the end of Q2, the GDP dropped to €373 billion. At the end of Q3, Italy's GDP rose up to €429 billion, and decreased slightly at the end of Q4 to €424 billion. These fluctuations were likely due to the patterns of spread and implementation of mitigation strategies throughout Italy during 2020.

As shown in Figure 6c, Italy's unemployment rate shifted throughout 2020. At the beginning of the year, Italy's unemployment rate was 9.60%. It began decreasing until April, in which it reached a low of 7.40%. One reason for this unexpected drop in unemployment rate is that Italians gave up on job searches amid COVID-19. Unlike the

U.S., Italy, like other EU Member States, created a large budget for financially supporting its unemployed residents. Following April, the unemployment rate began rising again. In July, Italy's unemployment rate reached 9.70%, an all-time high for the year. For the remainder of the year, the unemployment rate remained fairly consistent with the exception of a drop to 8.80% in November. Italy ended 2020 with an unemployment rate of 9.0%.

Method

Two files, Percent Change in GDP.csv and Percent Change in Unemployment Rate.csv, were created and contained information regarding State/State Member, Quarter/Month, Statewide Lockdown, School Closures, Restaurant Shutdowns, the Percent Change in GDP, and the Percent Change in Unemployment Rate. In the program R, these files were used to gather statistics regarding the correlation between statewide lockdowns, school closures, and restaurant shutdowns and the percent change in GDP and the percent change in unemployment rate. In order to avoid omitted variable bias, three models were created for each economic indicator.

Results

Percent Change in GDP

As seen in Figure 9, three separate models were created. In the first model, restaurant shutdowns were found to be statistically significant (-0.191), pointing towards a correlation between restaurant shutdowns and a decrease in the percent change in GDP. In the second model, US states and EU member states were added. Florida, France, Germany, Italy, and Texas are shown, relative to California data. In this model, restaurant shutdowns were the only statistically significant statistic (-0.214). These measures of restaurant shutdowns and percent changes in GDP showed a correlation. In the third model, quarter three and quarter four were added, relative to quarter two. The statistics from both quarter three (0.179) and quarter four (0.092) were both statistically significant, showing that the percent change in GDP from quarter three was 0.179 higher than quarter two, and the percent change in GDP from quarter four was 0.092 higher than quarter two. The adjusted R-squared statistics across the three models varied. In the first model, the data explained 64% of the variation in the percent change in GDP. In the second model, when US states and EU Member States were added, the R-squared statistic decreased (56%). In the third model, when quarters were added, the data explained over 85% of the variation in the percent change in GDP.

Percent Change in Unemployment Rate

As seen in Figure 10, the first model produced no statistically significant results. All three of the NPIs tested did not appear to impact or correlate well with the percent changes in unemployment rate. In the second model, when US states and EU Member

States were added, restaurant shutdowns were shown to be statistically significant (0.467) which points towards a correlation between restaurant shutdowns and an increase in the percent change in unemployment rate. In the third model, when months were added, much more data appeared to be statistically significant. The data for August (-0.843), December (-0.874), February (-0.946), July (-0.665), June (-0.782), March (-0.407), May (-0.618), November (-0.840), October (-0.832), and September (-0.690) were all statistically significant numbers relative to data for the month of April. The adjusted R-squared increased slightly across the three models. The third model, which produced the highest R-squared, showed that the data explained over 32% of the variation in the percent change in unemployment rate.

Discussion

Overall, the NPIs chosen explain the variation in GDP change much more than unemployment rate change. This could mean that NPIs potentially are more important to GDP than to unemployment rate. The weaker explanation in the variation in unemployment rate could also be due to the significantly different patterns in unemployment rates in US states and EU Member States throughout 2020.

Unemployment rates in EU Member States remained at low levels throughout a time of economic difficulty while unemployment rates in US states such as California skyrocketed. This could be due to the differences in unemployment policies in the US and the EU. In future studies, it could be beneficial to investigate the policies regarding unemployment during a pandemic in order to have a better understanding as to why unemployment rates in EU Member States were significantly lower than unemployment rates in the US. Other economic indicators such as consumer spending have potential to be a more accurate measure for the economic effects of NPIs.

Based on the data gathered, it appears that restaurant shutdowns were somewhat correlated with changes in GDP and unemployment rate unlike statewide lockdowns and school closures. Although restaurant shutdowns did show statistical significance in the first two models for GDP and the second model for unemployment rate, there was a lack of statistical significance in the third models of both economic indicators. Based on this study, this suggests a lack of evidence that statewide lockdowns, school closures, and restaurant shutdowns have a relationship with changes in GDP and unemployment rate. It is possible that the inclusion of additional NPIs and other economic indicators could provide evidence of a stronger relationship between NPIs and economic

indicators. A future study may benefit from including more control variables such as mask mandates, the voting habits of the population due to the politicization of the pandemic, and the count of COVID-19 infections and deaths. It is possible that omitted variable bias hindered this study.

Existing literature suggests that the mobility of a population affects the economy rather than the implementation of NPIs. It is suggested that even when NPIs are lifted, the economy might not recover as strongly as expected. Economic activity relies partly on the behavior of the population, and it is likely that individuals may not have felt safe enough to go back to their normal pre-pandemic lives. Evidence suggests that countries which lift NPIs should also dedicate time and effort into building the confidence in the population to resume their everyday activities in order to help the economy bounce back. (Chen, et al. 2020)

The topic of NPI implementation and the state of the economy during a pandemic is important but studies are currently limited due to the unavailability of data needed to deeply investigate the topic. The year of 2020 was a highly unusual time in the world and there is a lack of previous similar events to draw comparisons on. Although this was a major obstacle in this study, observations of patterns in the economy and NPI implementation during the time of COVID-19 can be useful for future pandemics.

List of Abbreviations

Non-pharmaceutical intervention: NPI

United States: US

European Union: EU

Severe Acute Respiratory Syndrome Coronavirus 2: SARS-CoV2

Center for Disease Control: CDC

World Health Organization: WHO

Gross Domestic Product: GDP

Bureau of Labor Statistics: BLS

Labor Force Surveys: LFS

Health and Human Services: HHS

Personal protective equipment: PPE

Public Health Emergency Response, Epidemiology, and Surveillance: SPHERES

Morbidity and Mortality Weekly Report: MMWR

Public service announcement: PSA

Coronavirus Aid, Relief, and Economic Security Act: CARES

Emergency Capital Investment Program: ECIP

European Economic Community: EEC

European Center for Disease and Prevention Control: ECDC

European Medicines Agency: EMA

COVID-19 EMA pandemic Task Force: COVID-ETF

Clinical trials facilitation group: CTFG

Scientific Advice Working Party: SAWP

Committee for Medicinal Products for Human Use: CHMP

Pharmacovigilance Risk Assessment Committee: PRAC

International Coalition of Medicines Regulatory Authorities: ICMRA

Food and Drug Administration: FDA

Emergency use authorization: EUA

National Institute of Health: NIH

Department of Defense: DOD

European Investment Bank: EIB

European Union Aviation Safety Agency: EASA

European Central Bank: ECB

List of Figures

Cases, Unemployment Rate, and GDP

California

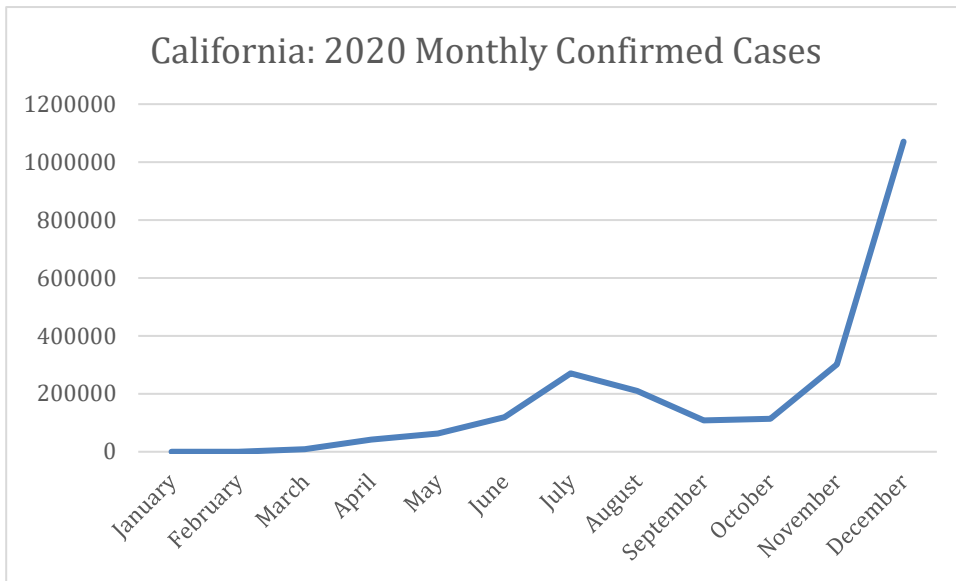


Figure 1a: data gathered from *The New York Times*

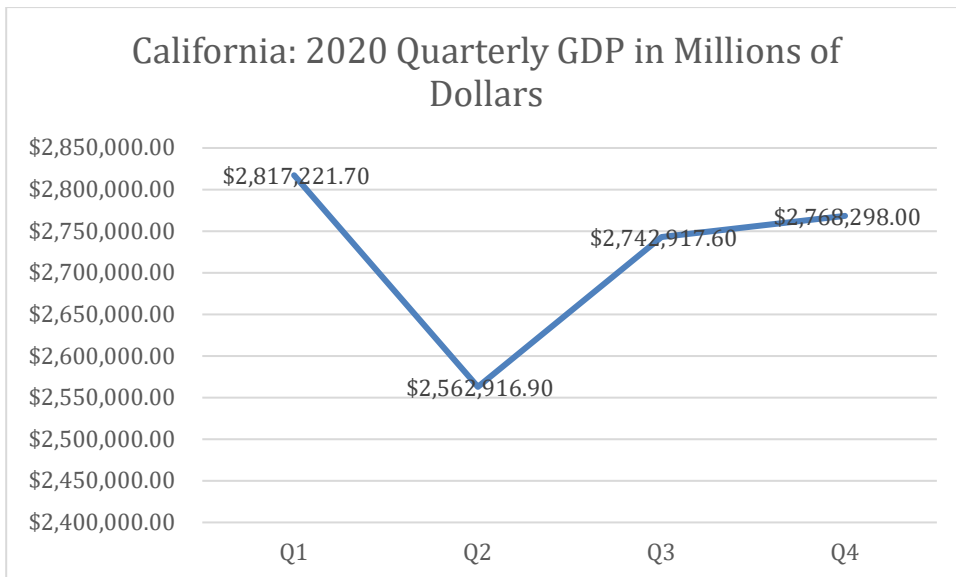


Figure 1b: data gathered from FRED



Figure 1c: data gathered from *The New York Times* and FRED

Texas

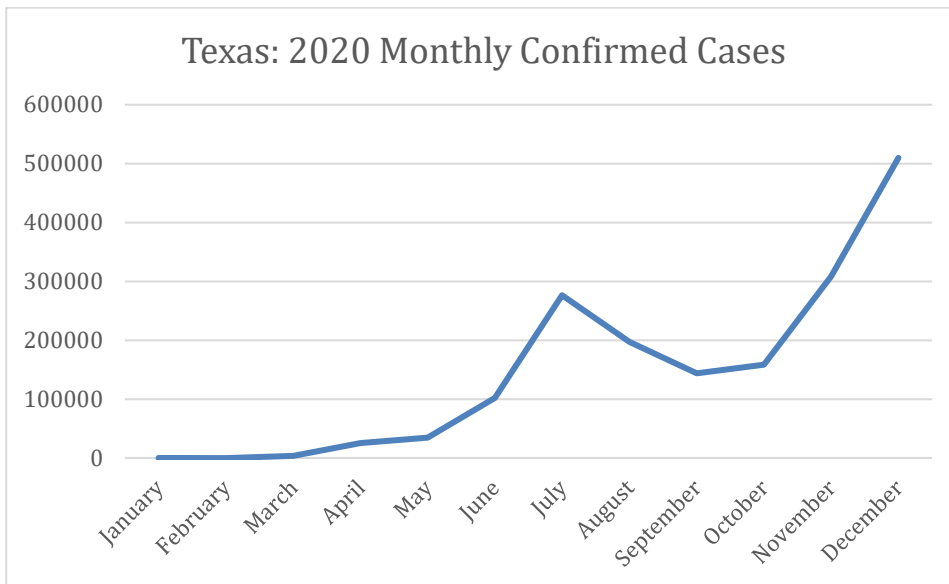


Figure 2a: data gathered from *The New York Times*

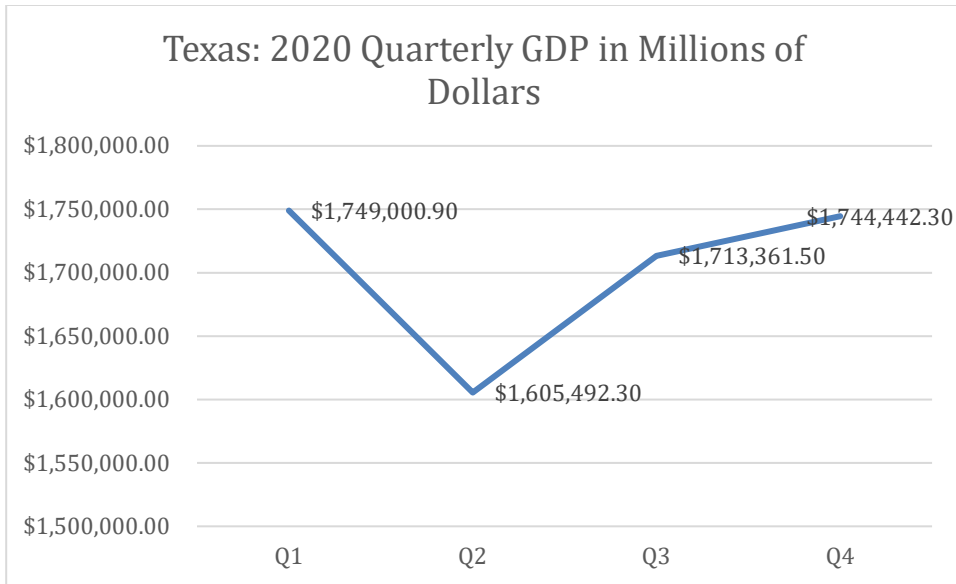


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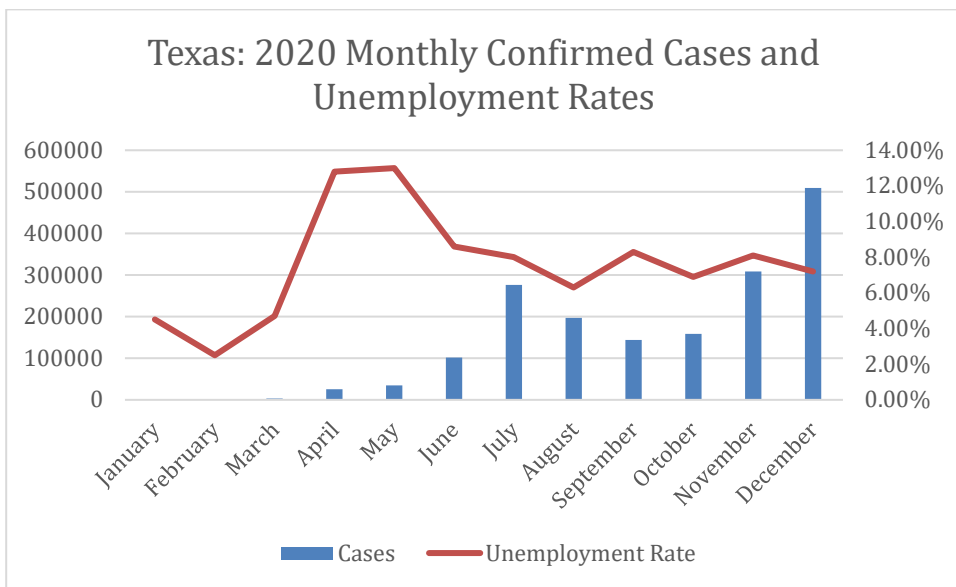


Figure 2c: data gathered from *The New York Times* and FRED

Florida

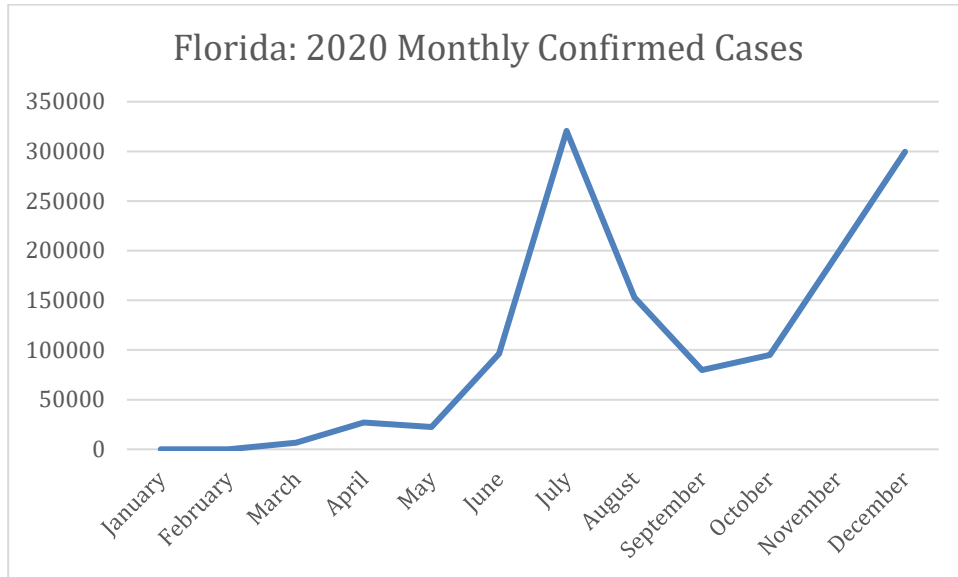


Figure 3a: data gathered from *The New York Times*

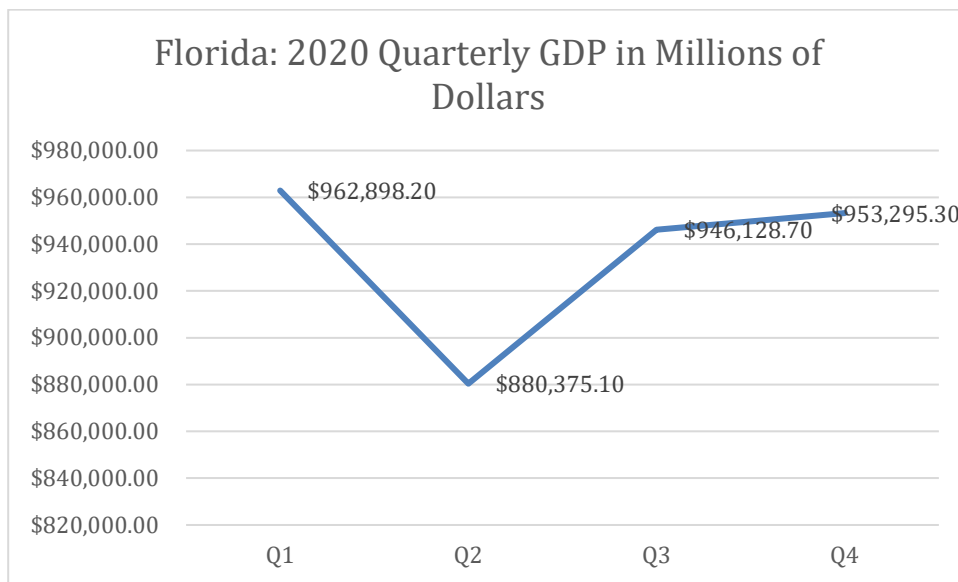


Figure 3b: data gathered from FRED

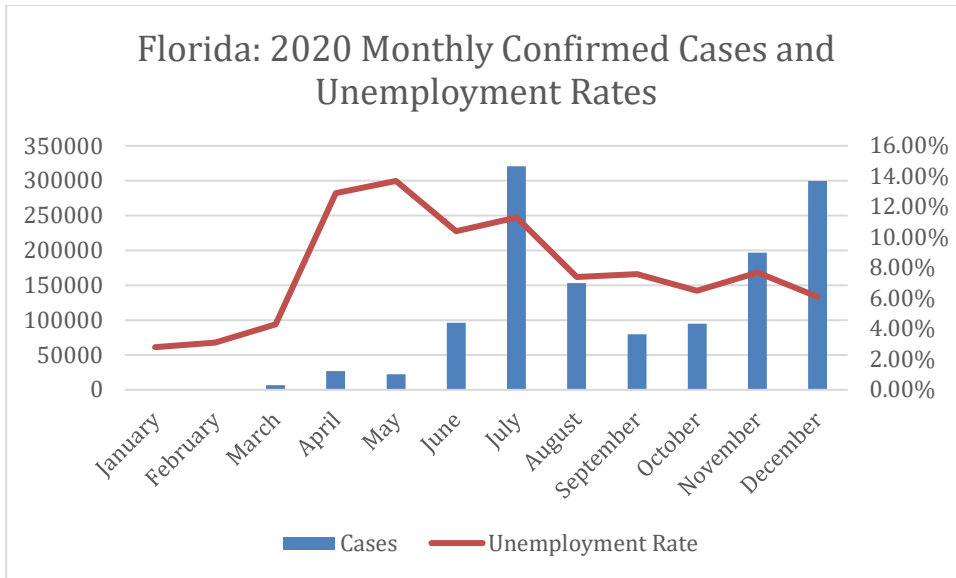


Figure 3c: data gathered from *The New York Times* and FRED

Germany

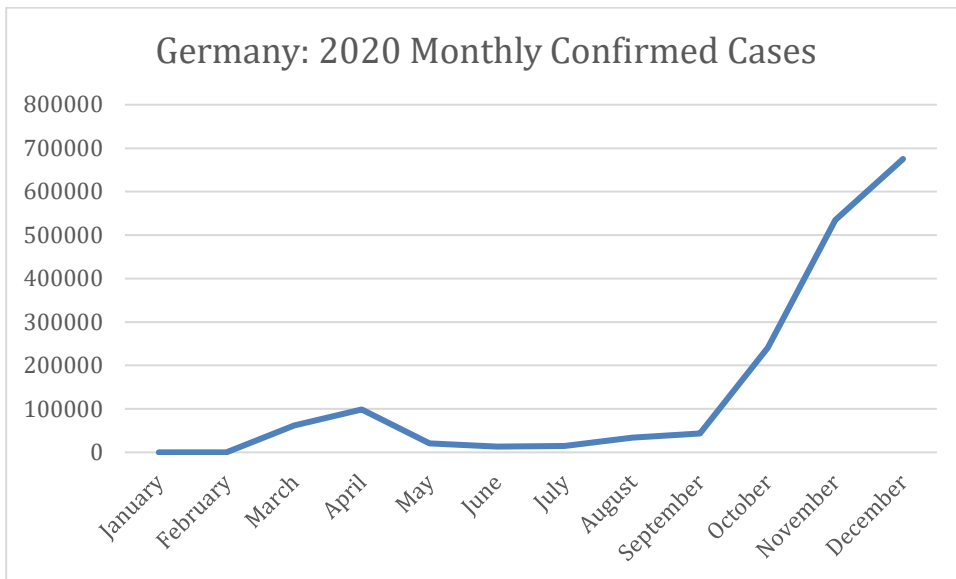


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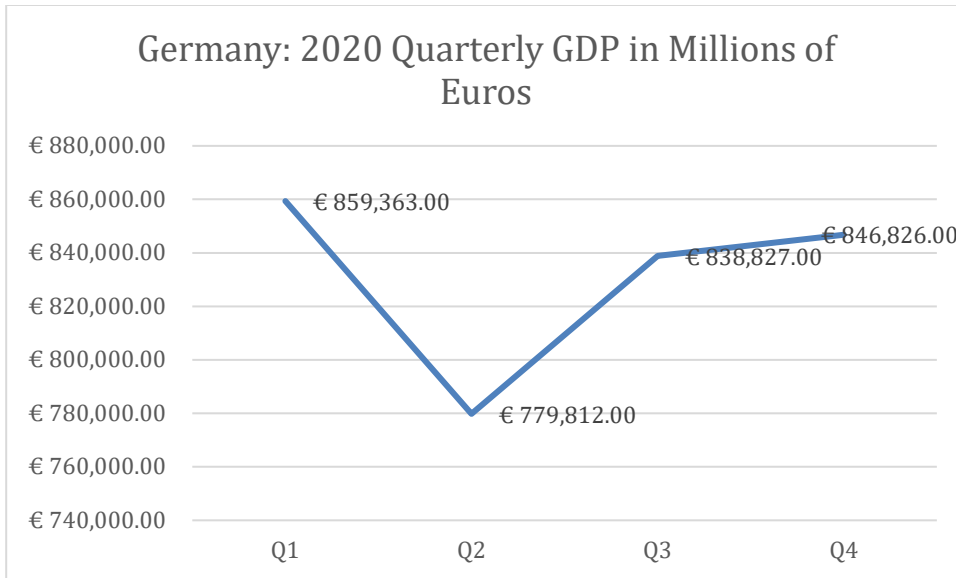


Figure 4b: data gathered from FRED

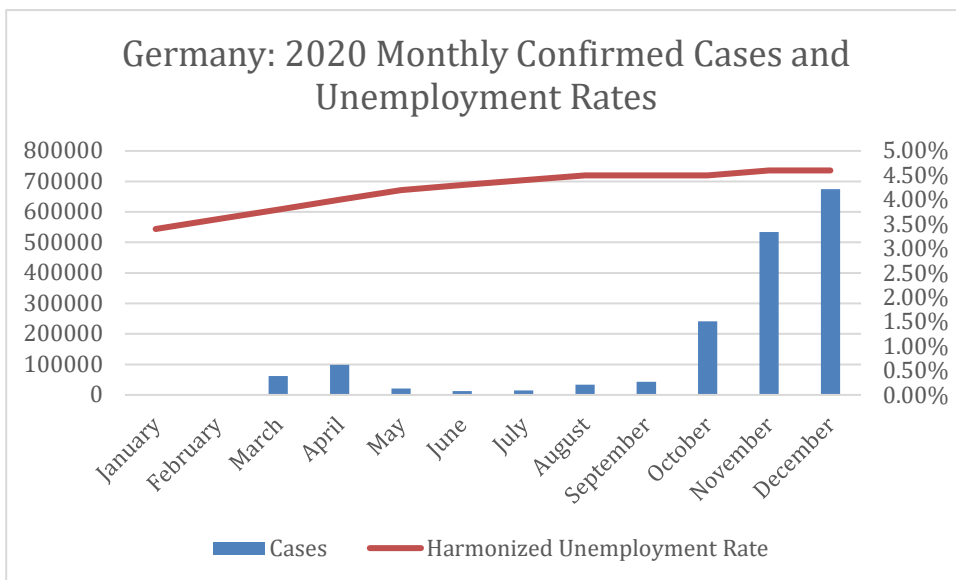


Figure 4c: data gathered from *The New York Times* and FRED

France

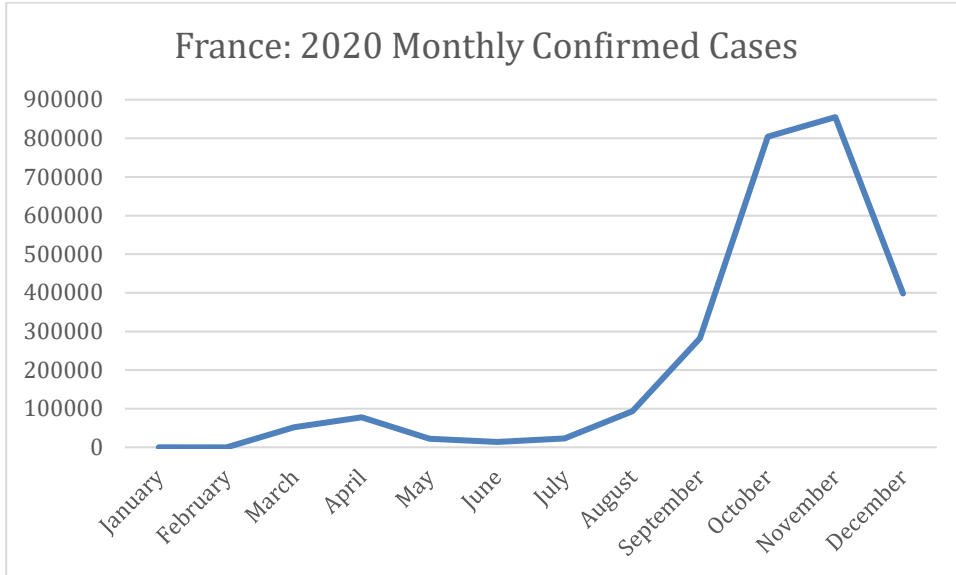


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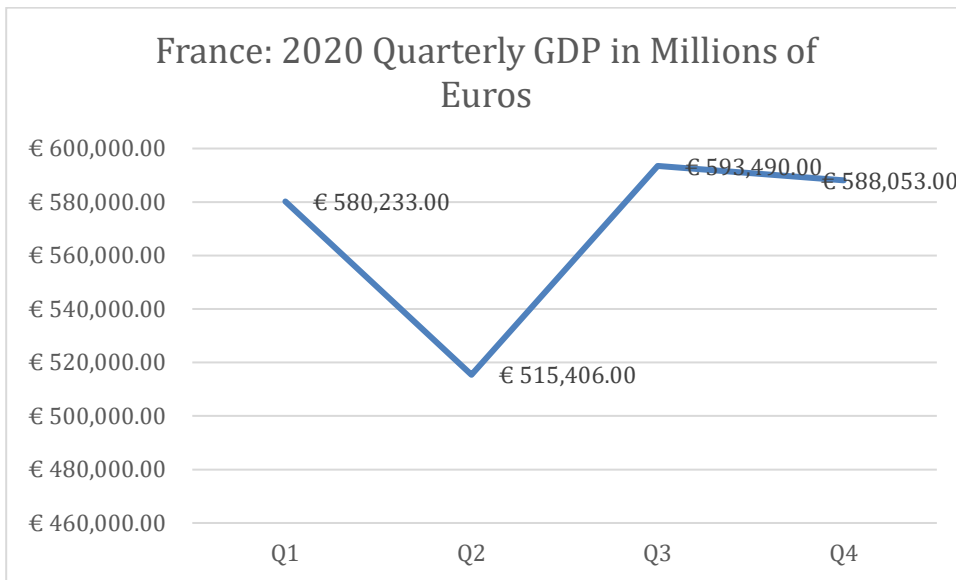


Figure 5b: data gathered from FRED

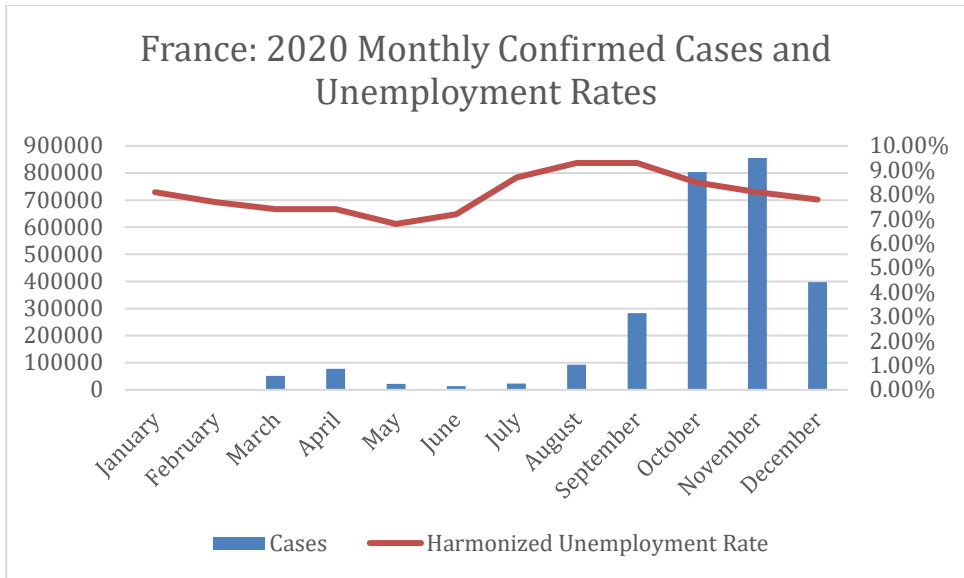


Figure 5c: data gathered from *The New York Times* and FRED

Italy

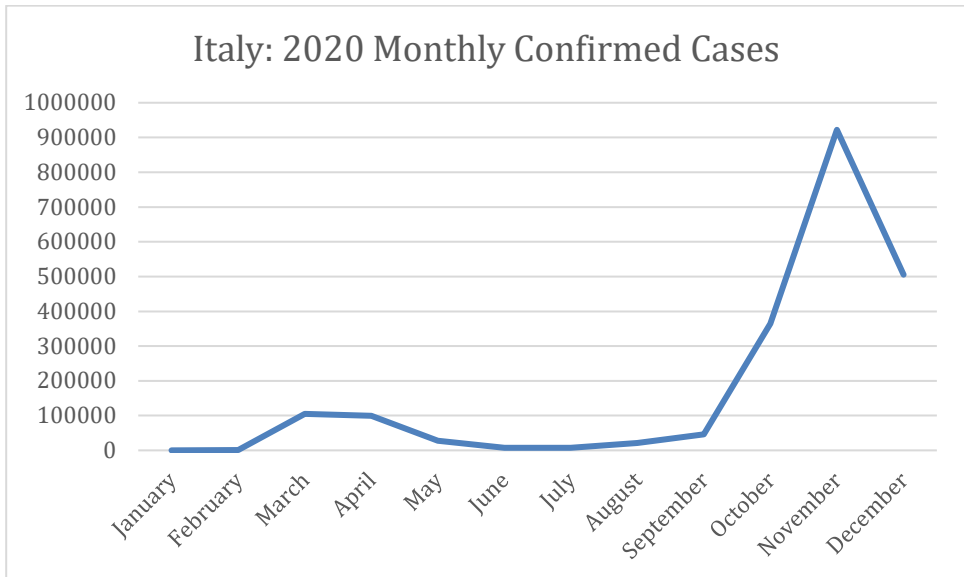


Figure 6a: data gathered from *The New York Times*

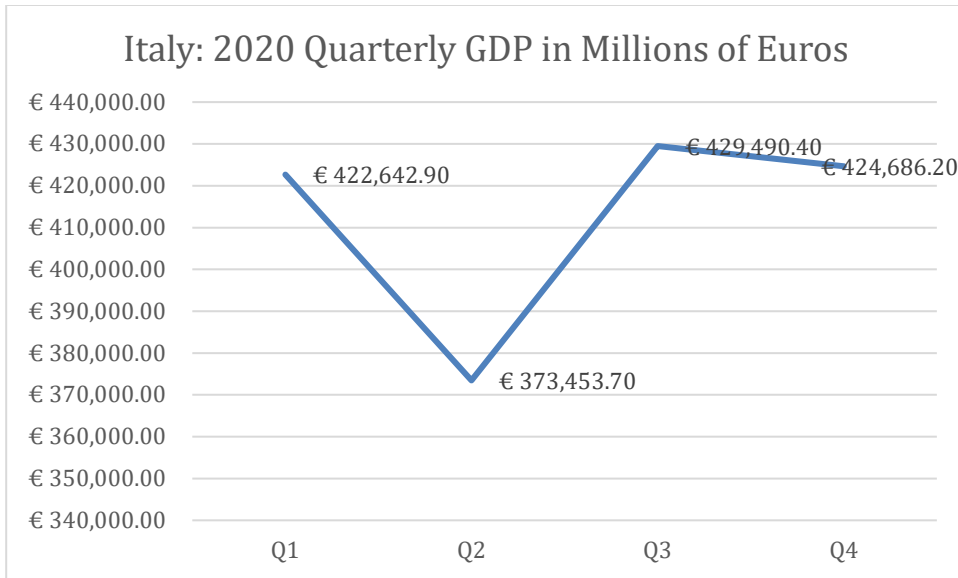


Figure 6b: data gathered from FRED

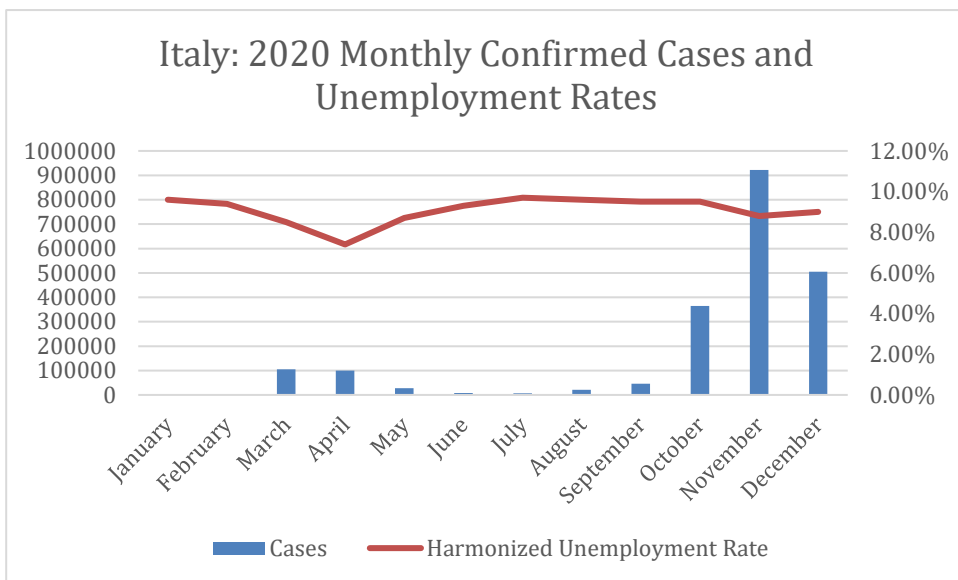


Figure 6c: data gathered from *The New York Times* and FRED

Percent Changes in Economic Indicators

2020 Percent Change in GDP

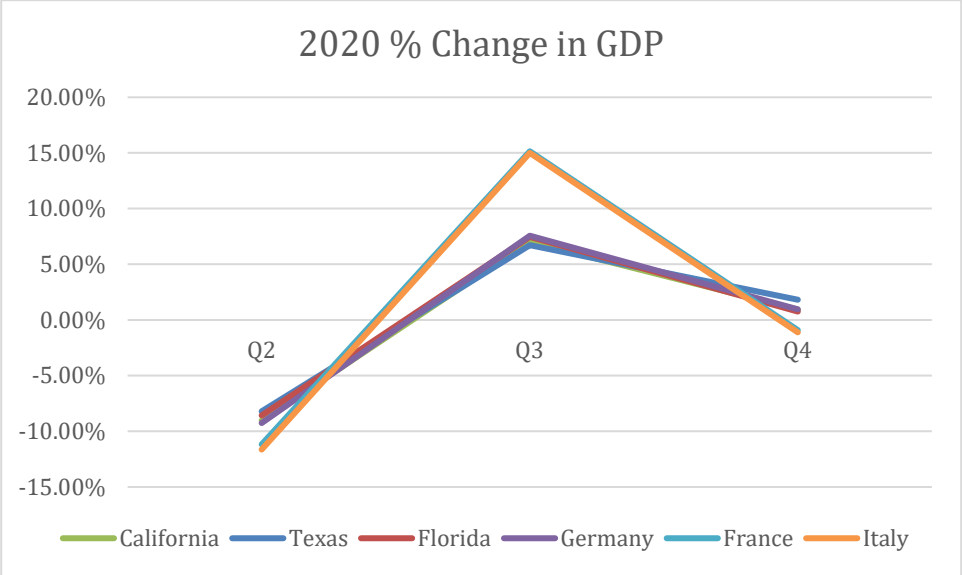


Figure 7: data gathered from FRED

2020 Percent Change in Unemployment Rate

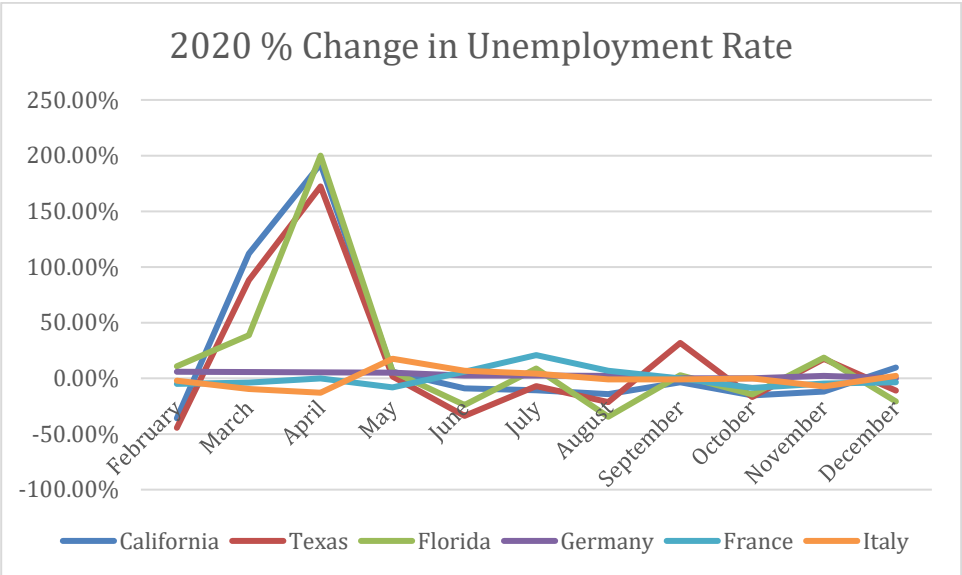


Figure 8: data gathered from FRED

Percent Change in GDP Regression

```

##
## =====
##                               Dependent variable:
##                               -----
##                               change
##                               (1)      (2)      (3)
## -----
## statewide_lockdown            0.076      0.080      0.013
##                               (0.060)    (0.078)    (0.049)
##
## school_closures              -0.042     -0.024     -0.030
##                               (0.030)    (0.044)    (0.027)
##
## restaurant_shutdowns         -0.191***  -0.214**   -0.016
##                               (0.056)    (0.072)    (0.061)
##
## factor(state_member_state)Florida
##                               -0.050     -0.009
##                               (0.048)    (0.029)
##
## factor(state_member_state)France
##                               -0.002     -0.007
##                               (0.055)    (0.032)
##
## factor(state_member_state)Germany
##                               0.012      -0.015
##                               (0.055)    (0.033)
##
## factor(state_member_state)Italy
##                               0.003      0.001
##                               (0.048)    (0.028)
##
## factor(state_member_state)Texas
##                               -0.040     0.004
##                               (0.048)    (0.030)
##
## factor(quarter)3
##                               0.179***
##                               (0.042)
##
## factor(quarter)4
##                               0.092***
##                               (0.024)
##
## Constant                      0.098***   0.110**   -0.062
##                               (0.023)    (0.048)    (0.048)
## -----
## Observations                   18          18          18
## R2                             0.706      0.767      0.939
## Adjusted R2                   0.643      0.561      0.852
## Residual Std. Error           0.051 (df = 14)  0.057 (df = 9)  0.033 (df = 7)
## F Statistic                   11.218*** (df = 3; 14)  3.711** (df = 8; 9)  10.770*** (df = 10; 7)
## =====
## Note:                          *p<0.1; **p<0.05; ***p<0.01

```

Figure 9: regression results for percent change in GDP

Percent Change in Unemployment Rate Regression

```

##
##                               Dependent variable:
##                               -----
##                               change
##                               (1)      (2)      (3)
## -----
## statewide_lockdown            0.191      0.211      0.271
##                               (0.212)    (0.217)    (0.228)

```

```

##
## school_closures          0.072          -0.163          -0.267
##                          (0.109)          (0.154)          (0.168)
##
## restaurant_shutdowns     0.323          0.467**         0.095
##                          (0.195)          (0.209)          (0.276)
##
## factor(state_member_state)Florida
##                          -0.018          -0.088
##                          (0.183)          (0.176)
##
## factor(state_member_state)France
##                          -0.318          -0.394*
##                          (0.203)          (0.201)
##
## factor(state_member_state)Germany
##                          -0.313          -0.350*
##                          (0.211)          (0.207)
##
## factor(state_member_state)Italy
##                          -0.333*         -0.356*
##                          (0.194)          (0.189)
##
## factor(state_member_state)Texas
##                          0.043           0.020
##                          (0.172)          (0.163)
##
## factor(month)August
##                          -0.843***
##                          (0.299)
##
## factor(month)December
##                          -0.874***
##                          (0.240)
##
## factor(month)February
##                          -0.946***
##                          (0.306)
##
## factor(month)July
##                          -0.665**
##                          (0.300)
##
## factor(month)June
##                          -0.782**
##                          (0.300)
##
## factor(month)March
##                          -0.407*
##                          (0.232)
##
## factor(month)May
##                          -0.618**
##                          (0.282)
##
## factor(month)November
##                          -0.840***
##                          (0.259)
##
## factor(month)October
##                          -0.832***
##                          (0.299)
##
## factor(month)September
##                          -0.690**
##                          (0.299)
##
## Constant                  -0.069          0.162           1.024***
##                          (0.071)          (0.171)          (0.307)
## -----
## Observations              66              66              66
## R2                        0.252           0.329           0.510
## Adjusted R2              0.216           0.235           0.322
## Residual Std. Error      0.403 (df = 62)  0.398 (df = 57)  0.375 (df =
47)
## F Statistic              6.978*** (df = 3; 62)  3.492*** (df = 8; 57)  2.712*** (df =
18; 47)
## =====
## Note:                      *p<0.1; **p<0.05; **
*p<0.01

```

Figure 10: regression results for percent change in unemployment rate

List of Charts

Checklist of NPIs

California

Chart 1

<i>Month</i>	Statewide Lockdown	School Closures	Restaurant Shutdowns
<i>January</i>	No	No	No
<i>February</i>	No	No	No
<i>March</i>	Yes	Yes	Yes
<i>April</i>	Yes	Yes	Yes
<i>May</i>	No	Yes	No
<i>June</i>	No	Yes	No
<i>July</i>	No	Yes	No
<i>August</i>	No	Yes	No
<i>September</i>	No	Yes	No
<i>October</i>	No	Yes	No
<i>November</i>	No	Yes	No
<i>December</i>	Yes	Yes	Yes

Texas

Chart 2

<i>Month</i>	Statewide Lockdown	School Closures	Restaurant Shutdowns
<i>January</i>	No	No	No
<i>February</i>	No	No	No
<i>March</i>	No	Yes	Yes
<i>April</i>	Yes	Yes	Yes
<i>May</i>	No	Yes	No
<i>June</i>	No	Yes	No
<i>July</i>	No	Yes	No
<i>August</i>	No	Yes	No
<i>September</i>	No	Yes	No
<i>October</i>	No	Yes	No
<i>November</i>	No	Yes	No
<i>December</i>	No	Yes	No

Florida

Chart 3

<i>Month</i>	Statewide Lockdown	School Closures	Restaurant Shutdowns
<i>January</i>	No	No	No
<i>February</i>	No	No	No
<i>March</i>	No	Yes	Yes
<i>April</i>	Yes	Yes	Yes
<i>May</i>	No	Yes	No
<i>June</i>	No	Yes	No
<i>July</i>	No	Yes	No
<i>August</i>	No	No	No
<i>September</i>	No	No	No
<i>October</i>	No	No	No
<i>November</i>	No	No	No
<i>December</i>	No	No	No

Germany

Chart 4

<i>Month</i>	Statewide Lockdown	School Closures	Shutdowns
<i>January</i>	No	No	No
<i>February</i>	No	No	No
<i>March</i>	No	Yes	Yes
<i>April</i>	No	No	Yes
<i>May</i>	No	No	No
<i>June</i>	No	No	No
<i>July</i>	No	No	No
<i>August</i>	No	No	No
<i>September</i>	No	No	No
<i>October</i>	No	No	No
<i>November</i>	Yes	No	Yes
<i>December</i>	Yes	Yes	Yes

France

Chart 5

<i>Month</i>	Statewide Lockdown	School Closures	Restaurant Shutdowns
<i>January</i>	No	No	No
<i>February</i>	No	No	No
<i>March</i>	Yes	Yes	Yes
<i>April</i>	Yes	Yes	Yes
<i>May</i>	No	No	No
<i>June</i>	No	No	No
<i>July</i>	No	No	No
<i>August</i>	No	No	No
<i>September</i>	No	No	No
<i>October</i>	No	No	No
<i>November</i>	Yes	No	Yes
<i>December</i>	No	No	No

Italy

Chart 6

<i>Month</i>	Statewide Lockdown	School Closures	Restaurant Shutdowns
<i>January</i>	No	No	No
<i>February</i>	No	No	No
<i>March</i>	Yes	Yes	Yes
<i>April</i>	Yes	Yes	Yes
<i>May</i>	No	Yes	Yes
<i>June</i>	No	No	No
<i>July</i>	No	No	No
<i>August</i>	No	No	No
<i>September</i>	No	No	No
<i>October</i>	No	No	No
<i>November</i>	No	No	No
<i>December</i>	Yes	Yes	Yes

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