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Macroeconomic Aspects of the Coronavirus Epidemic: Eurozone, EU, US and Chinese Perspectives

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Summary:

The Corona Virus (COVID-19) epidemic represents a major challenge for the world economy. While a detailed longer-term diffusion path of the new virus cannot be anticipated for individual countries, one may anticipate international supply shocks and declining GDP growth in many OECD countries and China in 2020; and one should expect falling asset prices in Asia, the United States and the European Union plus the United Kingdom – except for the price of risk-free government bonds. In the course of 2020/21 the US, the EU and the UK, as well as other countries, will face both an increasing number of infected patients as well as a higher case fatality ratio. Health care expenditures in the US will increase more than in the Eurozone and the EU in the medium term, a development that undermines the international competitiveness of the United States. Regression results show that per capita income is a positive function of the effective trade openness and of the new Global Health Security Index indicator from the NTI/Johns Hopkins University. A rising health care-GDP ratio in the US is equivalent to a rising US export tariff. Output growth in the Eurozone, the US and China can be expected to fall by about 1.6% in 2020, while the inflation rate in the Eurozone could fall to 1%. The COVID-19 challenge for the US Trump Administration is a serious one, since the lack of experts in the Administration will become more apparent in such a systemic stress situation – and this might well affect the November 2020 US presidential election which, in turn, would itself have considerable impacts on the UK and the EU27 as well as EU-UK trade negotiations. Many countries will face a massive shock from a sharp epidemic-related decline of tourism.

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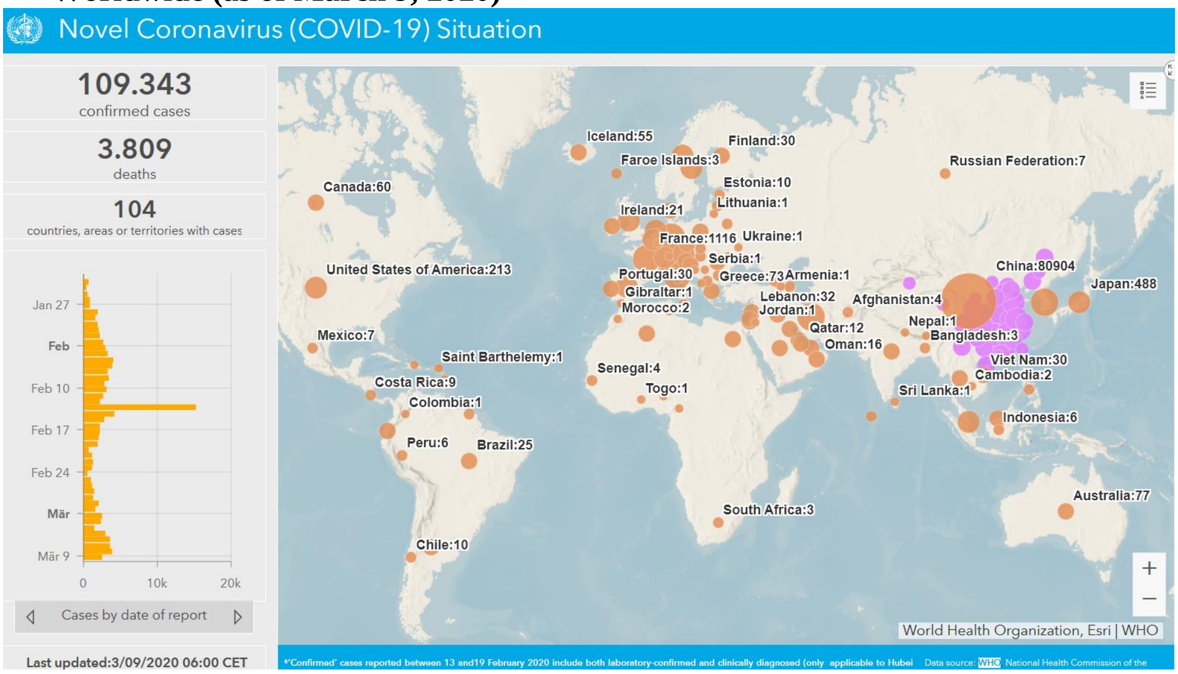
1. Introduction

The Corona virus (for short COVID-19, or Corona Virus Disease 2019) epidemic which started at the end of 2019 in the Wuhan area of China has, within three months, affected about 90,000 people worldwide of which approximately 3,000 have died. The number of countries reporting infections has increased rapidly and the high case fatality rate has caused many individuals, firms and governments to react in various ways in order to try to limit the spread of the virus. In the EU and the US, this has included imposing quarantine on people who have recently returned from abroad – for example, from China – or who have participated in certain social events (such as the carnival celebrations in western Germany in late February, where in one location alone, the city of Heinsberg which is close to Düsseldorf, many people seem to have contracted the virus) in which individuals who have tested positive for COVID-19 had also participated and who have been on the radar of health authorities. Many firms in Germany and France have encouraged employees to practice home office and thus have tried to minimize infection risks within the company. Such adjustment measures in firms, while pragmatic, will go along with reduced labor productivity and innovation, but at least a lot of important work can still be done remotely. COVID-19 is spreading worldwide and in early March 2020 one had the impression of a pandemic: with over 100 countries affected, about 110,000 people infected and nearly 4,000 fatalities (for an overview see the map of the WHO as of March 9, 2020[1] and tables in Appendix 1).

Map 1: World Health Organization map of the 2019 Corona Virus Spreading Worldwide (as of March 9, 2020)



Source: Map extracted from *https://experience.arcgis.com/experience/685d0ace521648f8a5beeeee1b9125cd* *(last accessed 09.03.2020).*

[1] It should be noted that, for example, Turkey has yet to notify the World Health Organization of any COVID-19 infections; however, the absence of the virus in the country is highly improbable.

An epidemic typically starts with a small diffusion of the number of people infected, after a few months or quarters there will be a peak as counter measures by government as well as individuals - as physicians in the health system - have been implemented. After the peak has been reached, the number of infected will gradually fall. From this perspective, the macroeconomic effects in a first stage of an epidemic should be rather modest, followed by a peak of negative output shocks – finally followed by a potentially enhanced economic upswing as postponed investment and consumption in the private sector could increase. Both mortality and morbidity statistics published should affect aggregate demand on the one hand, but also aggregate supply on the other hand as there will be less people working in factories and offices in an epidemic period. Of particular relevance for the control of the spatial spreading of COVID-19 are measures which effectively impose a quarantine on those who are infected; and for many other people, the authorities could impose restrictions on mobility at the regional, the national and the global level. Many people, including tourists and business people, will be eager to reduce their level of international travel, particularly to regions/countries with high infection problems. From this perspective, China – where COVID-19 started in late 2019 – has a specific problem, but one should also notice that China has had growing numbers of visitors, including business people, and tourists in the two decades after 1990 (see Appendix 2).

The statistics on China's regional incidence of COVID-19 infections show that two provinces are primarily affected which suggests that the drastic quarantine measures imposed by the national and regional authorities seem to have been effective. As regards the EU, Italy is a hotspot with more than 7,000 confirmed cases at the end of the first week of March. The Center for Disease Control were reporting eleven fatalities in the US on March 7, 2020, while the World Health Organization (WHO) were documenting no COVID-19 related deaths in the United States on the same day (the WHO figures were subsequently updated in the following days).

As regards the economic impact of COVID-19 in various countries, one may point out that it is not only direct and indirect channels into the real economy which will be relevant, but digital news channels – e.g. the diffusion of COVID-19 related information in the internet – could affect the behavior of investors and consumers as well as policymakers. Psychological effects on the demand side could play a strong role in the current epidemic and negative effects on the aggregate demand side could overlap with supply-side disturbances from international problems in the delivery of intermediate inputs. The Interim Economic Assessment of the OECD (2020) from March 2, 2020 has argued that global output growth could decline to a low rate of 2.4 percent, down from the 2.9 percent of 2019 – but in 2021, the output growth would rise to 3.3 percent in the world economy (see following table).

Table 1: Interim Economic Outlook (OECD, 2020), Year-on-Year Percentage Change in Real GDP Growth Forecasts for Selected Countries/Economies

		2020		2021	
Countries	2019	2020 Interim EO	Difference from November EO	2021 Interim EO	Difference from November EO
World	2.9	2.4	-05	3.3	0.3
G20	3.1	2.7	-0.5	3.5	0.2
Australia	1.7	1.8	-0.5	2.6	0.3
Canada	1.6	1.3	-0.3	1.9	0.2
Euro Area	1.2	0.8	-0.3	1.2	0.0
Germany	0.6	0.3	-0.1	0.9	0.0
France	1.3	0.9	-0.3	1.4	0.2
Italy	0.2	0.0	-0.4	0.5	0.0
Japan	0.7	0.2	-0.4	0.7	0.0
Korea	2.0	2.0	-0.3	2.3	0.0
Mexico	-0.1	0.7	-0.5	1.4	-0.2
Turkey	0.9	2.7	-0.3	3.3	0.1
United Kingdom	1.4	0.8	-0.2	0.8	-0.4
United States	2.3	1.9	-0.1	2.1	1.1
Argentina	-2.7	-2.0	-0.3	0.7	0.0
Brazil	1.1	1.7	0.0	1.8	0.0
China	6.1	4.9	-0.8	6.4	0.9
India	4.9	5.1	-1.1	5.6	-0.8
Indonesia	5.0	4.8	-0.2	5.1	0.0
Russia	1.0	1.2	-0.4	1.3	-0.1
Saudi Arabia	0.0	1.4	0.0	1.9	0.5
South Africa	0.3	0.6	-0.6	1.0	-0.3

Source: Own representation based on table in OECD (2020), p. 2. Note: G20 aggregate does not include the EU, and projections are based on data available to February 28, 2020.

While China and other countries in Asia are facing the epidemic as a crucial challenge for the health system and the political as well as the economic system Western Europe and the United States try to anticipate the spreading of the virus and to develop an adequate response in health policy, economic policy and in the field of international cooperation.

As regards China, the province of Hubei (with the epidemic center of Wuhan) was very strongly affected by COVID-19 and the Chinese authorities have largely closed down production in the region, but schools and universities across the whole region have also undertaken quarantine measures. Authorities in China have closed down production in several regions which implies that firms in Europe, the US and Asia face a shortage of intermediate inputs from China; negative demand effects in China and in other countries could also be observed. Sales of cars fell in February 2020 by about 80% compared to the previous month before which clearly indicates a case of a strong negative sectoral demand shock.

One key intermediate export of China are computer chips which are imported by companies in the US, Europe, Asia, Latin America, Australia and Africa. The first sector facing a reduction in production after Chinese export slowdown will be computer and mobile phone producers as well as producers of modern screens. In a second round of supply-chain transmissions, digital service providers would obviously have to slow down planned expansion of such services and this in turn would reduce productivity growth in OECD countries and Newly Industrialized Countries. If Chinese firms can restore production capacity rather quickly, the negative supply-side effects for other countries should be rather modest, but if there is a second wave of COVID-19 in China, the global supply side shock of COVID-19 could be rather big. Taking into account the digital productivity slow-down in the world economy this shock would come on top of sectoral declines in tourism and logistics.

As regards the response from International Organizations to the COVID-19 outbreak in China, they typically recalled international personnel located in Beijing home in early and mid-February. European, American as well as Japanese firms in many cases followed the example of international organizations; those coming back to EU28 countries or the US were expected to implement a 14 days self-isolation in home quarantine.

While many observers of the COVID-19 epidemic – and politicians in the US, the EU and China/Japan/Republic of Korea - raise questions related to national health system challenges, there is not much awareness that the novel corona virus with its potential as a worldwide epidemic (a pandemic) concerns a global public evil; and fighting the virus in these and other countries stands for a global public good. It is obvious that fighting a global public evil requires cooperation among the leading economies and in the relevant international organizations (e.g. the World Health Organization, the International Monetary Fund, the World Bank, UNHCR – in the case of refugees). In this perspective, the fact that the world's global technological leader, the United States, is governed by the Trump Administration which refutes multilateralism might become a serious problem. Fighting a pandemic is a global public good and if there are considerable political free rider problems, or simply political inconsistencies and inefficiencies in major OECD countries, the fight against the global epidemic will be not really successful. This in turn implies that many more lives could be lost than in the case of efficient and effective global cooperation.

The fact that the world economy is facing the challenge of COVID-19 as a global problem in early 2020 could mean that the world economy is facing an instability problem, namely to the extent that the output decline in 2020/21 will seriously affect more than one half of the world economy: The disease emerged in China, standing for about 17.5 percent of world real income and thus a bit more than the US and the EU28 with each representing 16.5 percent in 2018 (PPP figures according to the World Bank). If national and international epidemic shocks translate into a serious economic slowdown in China in 2020, it will automatically have major negative international spillovers to the EU and the US and from these two actors there will be a strong negative repercussion effect on China. In short, a COVID-19 pandemic in the new world economy of triadic interdependency EU-US-China, requires enhanced international cooperation and multilateralism; but the Trump Administration is emphasizing bilateralism which means that the efficiency of OECD countries+China fiscal/monetary policy cannot be efficient. This in turn makes fighting the pandemic more difficult since an economic downturn in the global North would undermine economic stability and prosperity in the global South which implies that the problem of insufficient resources in the health sector of developing countries would be reinforced.

If the G20 countries would, in the end, face a simultaneous COVID-19 problem – outside China the peak of the pandemic may still be expected to occur only in summer 2020 (and possibly a second wave in autumn 2020 or thereafter) – there could be a global recession, as the G20 stands for 81 percent of global GDP. If the diffusion of COVID-19 can be stopped rather quickly, there is no major reason to worry with respect to the output and job development in the world economy, but if the pandemic should go on until 2021 or even beyond, there could emerge a very serious global stability problem. Given the pandemic and the likely size of the economic shock in sectors such as tourism and logistics – plus economic multiplier effects - policymakers should potentially be rather concerned in North America, Europa, Asia and other regions of the world economy.

Moreover, as regards the EU27/Eurozone and the US it will be interesting to take a closer look at the one sector which is directly exposed to the pandemic, namely the health care sector. The size and characteristic of that sector in the EU and the US clearly justifies the argument that this is a systemically relevant sector. To the extent that the health care sector and the economy – with health insurance linked to firms in the US – are characterized by inefficiencies, the COVID-19 challenge will reveal those inefficiencies to a considerable extent.

If there is a person with a suspected infection, a test is typically necessary and if the result of that test is positive, the respective person must stay in quarantine at home or go to hospital. If patients exhibit a serious reaction to COVID-19, they will typically be taken care of as in-patients in hospitals where strict quarantine conditions and protective measures for the people working there are necessary. The US Congress has appropriated an extra $8 billion in early March to increase the health care budget in the context of COVID-19 cases. Italy has introduced an additional package to the value of €7 billion in an extra budget on March 5, 2020, in order to fight the challenge posed by the virus. The very high mortality rate in Italy in early 2020 suggests that the number of infected people in Italy has been underestimated. This raises questions about the quality of the Italian health system and health policy in Italy, respectively. On March 9, 2020, the Italian government imposed a lockdown on the whole country, while Austria has signaled that it wants to restrict free travel between Italy and Austria (which are both Schengen area countries).

Employees of firms in many countries have cancelled planned meetings in Italy and tourism in Italy is also bound to suffer considerably in 2020. As regards German and French car producers, as well as producers of machinery and equipment in Germany and France, firms in both countries partly rely on intermediate inputs from Italy so that distortions of relevant production in Italy will also slow down industrial output in Germany. This situation will, of course, encourage firms to seek alternative intermediate product suppliers. As regards a comparison of the US and the EU, European firms are more dependent on international intermediate inputs than firms in the US (WELFENS/IRAWAN, 2014). A general problem for the US, the EU, China and all other countries with novel corona virus problems is that vaccination against the COVID-19 will not be available before 2021.

The travel and tourism sector will be negatively affected by the COVID-19 pandemic; this sector stood for 10.4% of global GDP and 319 million jobs in 2018 (WTTC, 2019). If the global tourist sector declines by 30% in 2020, global output growth would decline by 1.2 points compared to forecasts - and expectations - of 2019 and 96 million jobs would be lost as a direct effect. By March 6, 2020, the airline Lufthansa had decided to cancel 7,000 flights scheduled for 2020 which is about 50% of all flights: with a strong focus on flights to China, Republic of Korea, Italy and Iran which all are countries with high number of infections.

The share of tourism in national output in selected countries is shown in the following table. Countries with a high share of tourism in national output should expect high output growth dampening effects. However, one should not overlook the aspect that French people, for example, who would normally go on vacation abroad will instead book a vacation within

France – thus replacing part of the normally large incoming international tourist groups from many countries. Hence popular tourist destination countries have some opportunities to adjust for the declining international tourism. The internet creates many opportunities to substitute international visits of business people. Trade fair events can also partly be organized as a virtual event if necessary. However, it is useful to consider scenarios of a contraction of international tourism value-added by 20%, 40% and 50% (see following table). For Germany, France, Italy (and the UK), a 50% decline brings a GDP decline of about 1%; for Italy, this would imply a recession in 2020. The decline of expenditures in tourism broadly defined – including entertainment (restaurants etc.) – would raise the negative output effect furthermore. As regards tourism receipts relative to GDP in EU countries, Switzerland and Turkey, high figures were in Bulgaria (6.8%), Estonia (5.8%), Greece (8.7%), Spain (5.7%), Croatia (18.4%), Cyprus (13.9%), Luxembourg (7.0%), Malta (12.7%), Portugal (8.3%), Slovenia (5.9%), Switzerland (3.9%) and Turkey (50% according to Eurostat, see Appendix 3); as regards the statistics on Turkey, one may assume that the figure is doubtful. It is clear that countries such as Greece, Cyprus, Malta and Portugal might face new problems as a consequence of a dramatic decline in tourism expenditures in the context of a coronavirus pandemic, the same applies to Turkey. There are two countries which could have strong improvements in the current account balance from the net effect of COVID-19 on receipts and expenditures in tourism. In 2018, German expenditures stood at €80.9 billion, while receipts were €36.4 billion (balance -€44.5 billion), so that a relatively strong decline of international tourist expenditures – with additional substitution effects in favor of higher domestic tourism expenditures – should reinforce the current account balance of the Eurozone. A similar effect could be expected in the UK which had a net balance of -€17.3 billion in 2018 (for more details, see table in Appendix 3). For the US, a 50% contraction of international tourism would bring about an output decline of 0.6% as a direct effect. As the subsequent table shows, there are many small countries which would face serious output contractions in the case of a 50% decline of international tourism: There is a group of countries who could have an output decline of over 10%, and for the Lebanon, which at the beginning of 2020 was already in an unstable fiscal and economic situation, the projected output decline would be -7.67%; for Jordan the output decline expected is 7.37%, followed by Cyprus, Thailand and Malta with -6.91%, -6.46% and -6.43%, respectively. The output decline for Croatia would be 9.90%, for Portugal 5.01%, for Greece 4.95% and for Spain 2.86%; thus there is a risk that the Euro Crisis could return (for more countries, see following table and Appendix 4).

Table 2: Selected Countries Strongly Affected by a Decline in International Tourism Receipts (based on appendix and the underlying calculations; direct real GDP effect)

Country	International tourism exp / GDP US$	International tourism, receipts (current US$) /GDP US$	International tourism, receipts (% of total exports)	Decline of international tourism, receipts (current US$) / GDP US$		
				by 20%	by 40%	by 50%
Croatia	2.85%	19.80%	38.59%	15.84%	11.88%	**9.90%**
Cambodia	4.40%	19.69%	26.24%	15.75%	11.81%	**9.84%**
Lebanon	11.29%	15.35%	45.42%	12.28%	9.21%	**7.67%**
Jordan	3.54%	14.73%	41.33%	11.78%	8.84%	**7.37%**
Cyprus	6.21%	13.82%	18.92%	11.05%	8.29%	**6.91%**
Thailand	2.91%	12.92%	19.63%	10.34%	7.75%	**6.46%**
Portugal	2.71%	10.02%	22.71%	8.01%	6.01%	**5.01%**
Greece	1.79%	9.90%	26.38%	7.92%	5.94%	**4.95%**
Morocco	2.56%	8.08%	22.08%	6.46%	4.85%	**4.04%**
Luxembourg	4.64%	7.81%	3.99%	6.25%	4.69%	**3.91%**
Bulgaria	3.45%	7.79%	11.67%	6.23%	4.67%	**3.89%**
Estonia	5.37%	7.59%	10.22%	6.07%	4.55%	**3.79%**
Slovenia	3.25%	6.25%	7.32%	5.00%	3.75%	**3.13%**
Hungary	2.08%	6.08%	7.15%	4.86%	3.65%	**3.04%**
Malaysia	3.69%	6.07%	8.83%	4.86%	3.64%	**3.04%**
Tunisia	2.39%	5.82%	11.95%	4.65%	3.49%	**2.91%**
Spain	1.88%	5.73%	16.30%	4.58%	3.44%	**2.86%**
Singapore	6.96%	5.61%	3.18%	4.49%	3.36%	**2.80%**
Austria	3.13%	5.58%	10.01%	4.47%	3.35%	**2.79%**
Egypt	1.15%	5.06%	24.61%	4.05%	3.04%	**2.53%**
Turkey	0.65%	4.81%	16.62%	3.85%	2.89%	**2.41%**
Ethiopia	0.73%	4.21%	46.54%	3.36%	2.52%	**2.10%**
Vietnam	2.41%	4.11%	3.90%	3.29%	2.47%	**2.06%**
Ireland	1.93%	3.83%	3.14%	3.07%	2.30%	**1.92%**

Source: Own representation of data from the World Development Indicators and own calculations.

Historically, there were previous cases of international epidemics (pandemic is a worldwide epidemic), such as the Spanish influenza in 1918/1919, the Asian influenza in 1957 and the Hong Kong influenza in 1968 (KILBOURNE, 2006). In the severe Spanish influenza, between 30 and 60 million people succumbed to the disease worldwide. BELL/LEWIS (2004, p. 159) argue that no firm conclusions have been achieved on the long run effects of international epidemics.

The authorities have focused on reducing the number of, or avoiding the holding of, public events with many people as well as the interaction of many people in any given place - in the Wuhan area, factories and workplaces were closed over several weeks. In many countries, quarantine was imposed on people who have returned from China and on people who have shown COVID-19 symptoms. The infection typically brings respiratory problems and the elderly in many of the countries affected indeed seem to face a rather high mortality rate. As COVID-19 affects the lungs of the infected, regions/countries with bad air quality and high shares of smokers should go along with a relatively high mortality rate; weak environmental policy thus could translate into particularly serious COVID-19 problems. This Corona virus is, however, not the first epidemic of the early 21st century. In 2003, SARS (or Severe Acute Respiratory Syndrome) – the outbreak of which was also traced back to China - was the first international epidemic of the century, followed by MERS (Middle East Respiratory Syndrome) which mainly affected some countries in the Middle East.

With the outbreak of COVID-19, the world economy is clearly facing transitorily lower economic growth in 2020 than had been projected in autumn 2019 (based, for example, on the IMF World Economic Outlook). The IMF has declared on March 4 (IMF, 2020) that it will make an additional $50 billion in funding available to member countries fighting the Corona virus with particular funding reserved for rather poor countries.

In the EU and the Eurozone, respectively, Italy – actually Northern Italy - had been most affected by COVID-19 by the end of February 2020. It is not fully clear why Italy in particular is facing so many cases of infections and a relatively high mortality rate. Looking at health system quality indicators thus seems to be useful and the subsequently discussed indicator of the NTI/Johns Hopkins University study – the Global Health Security Index - is considered to be an adequate aggregate indicator with several useful sub-indicators: The aggregate index has a clear focus on epidemic risks and the quality of the respective national health system; the indicator shows a large variation across countries in the EU, the OECD and G20 countries, respectively. There are some links between this indicator and macroeconomic development, including the following:

- A high score in the Global Health Security Index could be interpreted as a quality signal by foreign investors for whom often high quality health provision for managers in the host country, as well as a good health system for the workers employed in the subsidiary abroad, are important aspects to consider in the context of international investment and locational choice for greenfield investment projects or international M&As.
- Not only does the quality of the respective health system matter but also the efficiency of the health system and hence cost aspects – indirectly visible in tax rates and social security contribution rates – of production. Countries with rather inefficient health systems have a specific problem in cost competitiveness; certainly in labor intensive industries. The United States has, somewhat surprisingly, some specific problems in this field that have gone almost unnoticed by most international macroeconomists for many years. In the context of the COVID-19 epidemic, which had already reached the US in late February 2020, the inefficiencies of the US health system could become visible again.

For the health systems of the respective countries and regions, respectively, the Corona virus epidemic is a particular challenge; as in any epidemic scenario, there are particular risks that physicians and nursing personnel could be infected, and hospitals as well as nursing and care institutions for the elderly are potential hot spots in terms of infection risk. Special clothing, masks and disinfection measures should typically protect the life of physicians and nursing personnel. At the same time, there are standard plans and approaches of protection and treatment aimed at controlling infections (quarantines of affected individuals of a few weeks being one of the standard measures) and the spreading of the virus. However, with masks and other protective devices in stock in only limited numbers, an international spreading of the virus can quickly lead to shortages; for example, at the beginning of March 2020, the French government seized all available stocks of medical masks nationally and forbade the exporting of masks in the fear of having an under-supply of masks if such medical goods would be exported in considerable number. In Germany, authorities imposed similar restrictions in the first week of March.

Epidemics can have grave negative consequences on local, national or international demand. In the case of the SARS epidemic, for example, tourism in Hong Kong reduced by 90 percent in two months in the first quarter of 2003. A study on the case of a serious epidemic in the US by the US Congressional Budget Office (CBO, 2005) thus also assumes considerable negative demand effects from an epidemic which, of course, would affect many people and which would also have a certain fatality rate. In a similar EU-related simulation study on the macro effects of an epidemic, JONUNG/ROEGER (2006) adopt a similar analytical approach, but also assume a permanent negative shock to population growth (-0.75 percent).

As regards the preparedness of countries to deal with the present Corona virus epidemic, it is interesting to consider the results of the analysis of the NTI/JOHNS HOPKINS UNIVERSITY (2019) – for more GHS Index rankings, see Appendix 5 - which shows various elements of preparedness of countries to deal with an epidemic. The leading country in the relevant Global Health Security Index, according to this study is the US, with a No. 1 ranking in the aggregated overall indicator, other OECD countries and some Newly Industrialized Countries are also in the group of leading countries. The UK and the Netherlands are ranked No. 2 and No. 3, respectively, in the aggregate Health Security Indicator, France is ranked No. 11, and Germany No. 14 in the aggregate indicator. Developing countries typically have low rankings in the overall indicator and the sub-indicators. Thailand stands out among the Newly Industrialized Countries with a favorable position in the aggregate indicator (No. 6) and in some sub-indicators. In the aggregated indicator, China is ranked No. 51, India is on No. 57; while the Russian Federation occupies 63rd position, Romania and Bulgaria are No. 60 and 61, respectively – even further behind is, surprisingly, Luxembourg (No. 67). Clearly, few economic experts are thus far aware of these critical rankings in the Global Health Security Index first published in late 2019; rankings which highlighted certain weak points in the European Union.

As of early March 2020, it is obvious that international tourism and passenger air transportation are negatively affected by the Corona virus epidemic. Given the fact that more than 50% of global trade is trade in intermediate products, there are also shocks to international supply chains. Moreover, trade fairs and sports events have been cancelled so that also hotels, restaurant and other related services have been negatively affected. As several countries/regions have closed schools and universities, the education system is also negatively affected. It is clear that the closing of production facilities in several regions of Asia will lead to distortions in terms of Asia-EU and Asia-US supply chains so that there is a supply shock to firms in the tradables sector in the EU and the US, respectively.

With firms in the services sector starting to lay off workers, and with a more pessimistic economic perception on the part of households and investors, aggregate demand is slowing down in spring 2020 on the one hand, on the other hand the demand in the non-tradables sector (services) in particular can be expected to fall. The main effect of the epidemic thus is:

- A negative supply shock in the tradables sector in the short and medium term
- A negative demand shock in the tradables sector and in the non-tradables sector (the negative demand shock in the non-tradables sector might dominate initially, partially due to a sharp contraction of demand in tourism and entertainment) in the short term; once a vaccination becomes available in OECD countries and G20 countries, respectively, demand growth should become positive again.
- A negative aggregate international demand shock in the medium term which could stem from both reduced consumption and investment postponement effects – with many countries generating parallel negative spillover effects in neighboring countries and with main trading partners, respectively; China is a top trading partner of both the US and many EU countries, thus the outbreak of COVID-19 in China has affected very many OECD countries.

The analytical perspective on the macroeconomics of the COVID-19 is straightforward and shown subsequently in sections 2 and 3: at first with a focus on the health system and the economic implications to be considered (Section 2), followed by a more narrow Mundell model analysis (Section 3) to which some other theoretical effects are linked. The final section will consider some key policy conclusions.

Basically, as regards policy responses, one may want to consider three aspects:

- The supply-side response of government in the health system; for example, governments buying extra quantities of medical equipment and medicines which should drive up prices in the respective sectors.
- Monetary policy, which mainly concerns the US, the Eurozone, the UK and China. In a small open economy, an expansionary monetary policy under fixed exchange rate would be not effective; only fiscal policy would work – and it could work if government can finance some deficit spending with a clear focus on the non-tradable sector (e.g. construction activities for infrastructure).
- Fiscal policy, which mainly concerns the US, EU countries, the UK and China plus other Asian countries exposed to the virus shock; Thailand, for example, normally has a rather high number of Chinese tourists and business people visiting every year, but with the problem of COVID-19 in China, these visits will decline dramatically and Thailand could decide to adopt an expansionary fiscal policy. A similar logic could hold for other ASEAN countries as well. To the extent that certain countries in Asia are effectively fixing the exchange rate vis-à-vis the US dollar, a macro analysis in a fixed exchange rate system would be adequate.

In a significant policy step, the US Federal Reserve System reduced the interest rate in early March 2020 by 0.5 percentage points. It is not clear that expansionary monetary policy is adequate to cope with a negative supply-side shock. The US interest rate reduction will stimulate aggregate demand in the US and, in this context, could also stimulate net exports of goods and services through a real depreciation of the currency. At the same time, the associated real appreciation of the Euro will dampen aggregate demand in the Eurozone; and a similar argument will hold with respect to China whose currency appreciation would dampen China's GDP. The dampening of output in both China and the Eurozone will dampen US aggregate output through a dampening effect on US net exports.

In the Eurozone, the European Central Bank (ECB) does not have much room to maneuver and possibly welcomes the FED's interest rate reduction since this will also reduce the interest rate in the Eurozone. Given the fact that in the US, the UK and the Eurozone interest rates are already very low, there is some risk that a reversal interest rate effect will occur (BRUNNERMEIER/KOBY, 2018) which could dampen aggregate output as a reduction of the interest rate brings a reduction of banks' profits from the deposit business which could compensate the valuation gains the banks experience with high interest legacy bonds in the banks' balance sheets. The ability of banks to extend loans could critically depend on net-worth – once this constraint becomes binding – and hence lower central bank interest rates would bring about a decline of loans to firms and the real economy, respectively; traditional monetary policy is no longer expansionary. As regards the ECB, it still has some room to maneuver despite a zero central bank interest rate (and negative deposit rates for banks) as the ECB could step up Quantitative Easing – with the potential problem of having to go above the current upper limit of 1/3rd of outstanding government bonds – and it could also give more long term conditional loans to banks at favorable interest rates, namely under the condition that banks would extend more loans to firms. It is, however, not fully clear what the medium-term purpose of such a measure should be if this would raise the excess supply of the tradables sector in the Eurozone and the EU, respectively – there is some risk that this would depress the global level of tradables prices, a development which, in turn, could destabilize the world economy in the medium term.

Expansionary fiscal policy could also be considered in the US, the EU (the EU countries) and China. Given the interdependency of the US, the EU and China, fiscal policy coordination would be adequate, but it is unclear what institution could/should be the platform to achieve this type of coordination. The US-Sino trade conflict has at least been moderated somewhat through the US-China trade agreement in early February 2020 so that some bilateral coordination of fiscal policies of the US and China is not excluded. Some coordination between the US and the EU countries could take place via the OECD, but given the competence gap in the Trump Administration in the Treasury, this might be difficult to achieve: The Trump Administration could fill only about 3,000 of the roughly 4,000 political appointee roles which became vacant at the end of the previous Obama Administration, which means that the Trump Administration suffers from a lack of about 1,000 experts in key fields (WELFENS, 2019) – and the Treasury is a key institution exposed here. The G20 as a coordination platform is rather excessive and overly complex, so that one might consider the OECD's outreach program, which includes China and India, to be a reserved but nevertheless effective platform for international policy coordination.

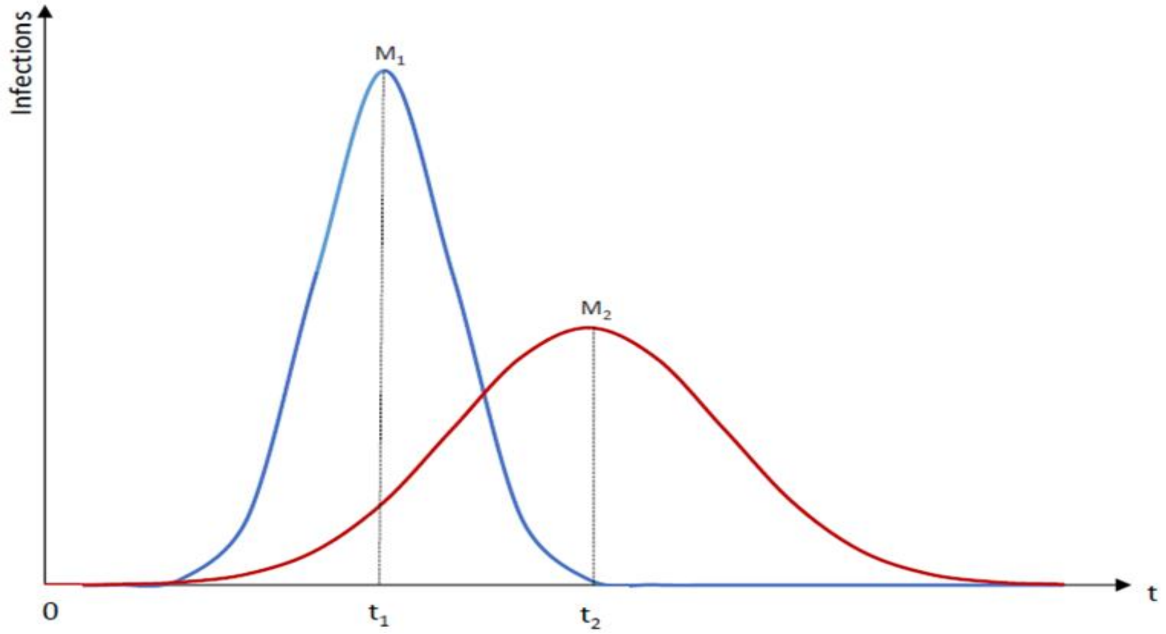
As regards the US, the Eurozone/UK and China, there is one specific distinction concerning the Western world (e.g. US+Eurozone+UK+Switzerland) versus China, namely that safe haven effects can be expected in a period of an international epidemic – indeed in favor of the US and main Eurozone countries such as Germany, France, the Netherlands and Austria; plus the UK and Switzerland. These countries should benefit from lower nominal and real interest rates, but should also face a nominal and real appreciation of the currency. The following section considers the SARS experience briefly and emphasizes that certain characteristics of the health systems of the US and EU countries have crucial macroeconomic effects that have thus far not been thoroughly considered in Economics. Section 3 considers theoretical macroeconomic aspects.

2. SARS Experience and Health System Aspects of the COVID-19 Epidemic

In 2003, China/Hong Kong experienced the SARS epidemic in the second quarter, which reduced output in the third quarter considerably in Hong Kong as well as in parts of mainland China. This incident has motivated several researchers to look into the macroeconomic effects of an epidemic where production losses due to the illness of workers/managers and death among the workforce were one key element of analysis. The SARS epidemic was over relatively fast and did not become a major shock to the world economy; not least since China at the time represented only 4% of world GDP. DÖHRN (2020) has estimated that China's decline of real income was 2.4% in the first quarter of 2020. This negative income effect will negatively affect the US, the Eurozone, the UK and other countries. The international diffusion of COVID-19 may be expected to be large: Those infected with the respiratory disease SARS could be rather easily identified, while people infected with the novel corona virus often show no visible symptoms of the disease.

One key challenge with an epidemic concerns the burden for the health system and hospitals, respectively. If the personnel in the health system and the capacities of hospitals approach critical limits rather quickly in an epidemic setting, the mortality figures will rise quickly. From this perspective, it is quite important in every epidemic scenario that health policy measures help to postpone the peak of infections and thereby to bring down the level of stress on hospitals to a manageable level. Ideally, health policy shifts the peak from M_1 to M_2 on the time axis and in this context adequate testing and broad quarantines are often crucial (see following figure).

Figure 1: The Effect of Health Policy Intervention on the Peak of an Epidemic



Source: Own representation.

It is also noteworthy that of those infected with COVID-19, circa 80 percent of patients recover with relatively mild symptoms, while 14 percent have serious illness-related complications and about 6 percent face critical illness (ECDC, 2020). The latter effect can be expected particularly in the age group above 65. From this perspective, the median age of countries is of interest: The higher the median age in the respective society is, and the higher the share of elderly people in a country considered, the higher the risk of a high morbidity. From the perspective of morbidity, Canada, Germany, Italy, Spain and Japan with a rather high share of elderly people could face more problems than, for example, France, the UK or the US (see following table).

Table 3: Median Age and Percentage of Total Population Aged 65 and over in Selected Countries

Country	Median Age (Years)	Country	Percentage of Total Population Aged 65 and Above (% Total Pop.)
Japan	45.53	Japan	27.58
Germany	45.09	Italy	22.75
Italy	43.99	Germany	21.46
Switzerland	41.85	Sweden	20.10
Netherlands	41.47	France	20.03
Spain	40.99	Spain	19.38
Sweden	40.91	Netherlands	19.20
France	40.43	Switzerland	18.62
United Kingdom	40.07	United Kingdom	18.40
Republic of Korea	38.85	United States	15.81
Singapore	37.88	Republic of Korea	14.42
United States	37.3	Singapore	11.46
China	35.12	China	10.92
Iran (Islamic Republic of)	27.99	Iran (Islamic Republic of)	6.18

Source: Own representation of data: data for the median age from UN https://data.un.org data for 2012; data for percentage of the total population over 65 from World Bank, World Development Indicators, data for 2018; ranked highest to lowest.

While it is clear that an epidemic could to some extent contribute to a rise of the overall health expenditure-GDP ratio as the number of inpatients in hospitals is rising – and output will transitorily fall – one cannot rule out that this ratio is almost constant (or could even fall); the latter case occurs if the incidence of morbidity is rather high for groups with underlying conditions and in the older age brackets so that elderly patients infected with COVID-19 could die rather suddenly and will not experience the normal two last years of life. In these last two years, in the United States, 30 per cent of life time health expenditures occur (DPE, 2016). If infected elderly patients die one year earlier than expected, the health expenditure during the last two years of life of the elderly affected would be cut by about half. Only broad statistical analysis in the future will shed more light on these aspects.

As regards the length of the time period of the infection, it is clear that China was the starting point and might return to full production by mid-2020, but the geographic spreading of the epidemic – with a certain number of patients travelling from various countries for business or tourist or family trips to China – will see time lags in the eruption and development of the epidemic. It seems that Portugal, for example, was affected rather late in Europe and also some countries in Latin America could be affected with a considerable delay so that the infection peak in parts of Europa and Latin America could be at least a quarter after the peak in China. As regards the diffusion of the epidemic in the EU – outside Italy – it is possible that travelling between Italy and several neighboring countries (and between China and EU countries, including Italy) has brought a critical number of imported infections which will not make it possible to easily control the epidemic. However, as the SARS epidemic has shown, a single infected tourist coming to Italy could have created the critical number of infected people in Italy. More research is needed to identify the sources of the epidemic in Italy. In the general public discussion, many people are likely to consider it plausible that immigrants are to be blamed – hence the epidemic could become a driver for populist debates in Europe or the US (and elsewhere).

It is not clear whether or not in autumn 2020/winter 2021 a second wave of the pandemic could start. Hence, it is still not clear whether there will be only a short-term one-off negative economic effect in most OECD countries and China as well as other countries; in this context both the financial sector and the real economy could be affected. In some cases, infections might also concern members of parliament or governments in various countries which in turn could made political decision-making more complex. The legal system of the countries concerned might in turn face a wave of liability and litigation cases in the context of epidemic with many novel legal questions faced in many countries.

As regards forecasts of international epidemic incidence, a group of researchers at the Johns Hopkins University has suggested an interesting approach which is mainly based on international and national air traffic passenger links (GARDNER/ZLOJUTRO/REY, 2020). According to this forecast, from late January 2020 the United States would be expected to be a country – with many air traffic links to China – that could face a serious challenge in the context of the epidemic. It is not fully clear whether or not the Trump Administration has considered this research and its implications. In talks with the leading insurance companies on March 10 (and in the days before), the Trump Administration has negotiated that the costs of testing for the novel corona virus would largely be covered by these companies. However, with 13 percent of the population without health insurance coverage, there is some specific US health care problem since people who are uninsured might turn to physicians rather late or not at all, if they have symptoms that resemble COVID-19. Illegal immigrants also might become a problem in the fight against the epidemic in the US. An apparent gap in terms of US health management is the lack of testing in February 2020 as pointed out in the international comparison of the US, the Republic of Korea and China (MEYER/MADRIGAL, 2020).

Illness of the workforce as well as death reduce the effective labor input in the macroeconomic production function (and in the production function of individual firms affected by such cases in the respective workforce). JONUNG/ROEGER (2006), in particular, focused on the effects of a pandemic on tourism and trade as two sectors significantly affected by an epidemic shock abroad – with the potential of an international transmission of the disease; the main insights from this study were that while a pandemic would take a large toll in terms of human suffering, it would not be likely to be a major threat to the EU economy. Typically, output would face a short-term decline but thereafter it would recover rather quickly. A crucial element of an epidemic shock in the first quarter of 2006 –

the scenario considered - would be the negative effect on the tourism and entertainment sectors that accounted for 4.4% in the EU25 and also in the US. If one would assume an 80% output decline in demand, the output decline would be 3.5 percent of GDP in the next quarter and, for the whole year, the aggregate demand effect would translate into a real GDP dampening of 0.5%. However, in the following year, GDP would increase by one percentage point more than in the baseline scenario. Clearly, within the EU, southern countries/countries in the Mediterranean area could be assumed to be particularly affected by the epidemic shock since the share of tourism and entertainment in these countries would be relatively large. In the JONUNG/ROEGER (2006) approach, about 2/3rds of the European output shock is supply-induced while 1/3rd is demand induced. The key finding of the authors thus is that a strong output reduction – relative to the business-as-usual case – will occur in an epidemic, but part of the dip in output will be recovered the following year.

At the same time, one might add that Germany would be particularly negatively affected because of its relatively high export-GDP ratio (relative to the country size). An output dampening effect on Italy, Spain, France and Germany would be an economically relevant output dampening effect for the whole of the Eurozone and the EU, respectively. Given the size of the Eurozone, a dampening on Eurozone output would translate into a dampening effect on US exports and output, respectively; and the same applies to a dampening effect on Chinese exports and real GDP. One may also note that the authors did not consider the role of rising costs in the health system. Such costs could indeed be considerable and since health costs in the US, Germany/France (Western Europe; read: the Eurozone) and China differ considerably, one should indeed consider the effects of an international epidemic shock on the relative health care costs and the implications for the respective trade balances and current account positions, respectively.

As regards the US and the Eurozone, it is useful to consider some key aspects of the respective health care systems; for simplicity, the Eurozone will be considered here only as the sum of Germany and France – occasionally as Germany, France and Italy. The main differences between the US and Germany are as follows:

- The health care expenditure-GDP ratio is 18% in the USA (for 2018), but only 12% in Germany and France, while life expectancy in the Eurozone is clearly higher and infant mortality lower than in the US (for more see Appendix 6). Disregarding certain fields of medical excellence in the US, one cannot overlook that the US health system is partly inefficient. It is quite strange that the number of gynecologists per women in the US is only one half that of the corresponding number for Germany. Moreover, an average clinical surgery in the US will cost three times as much as in the US (GÖPFFARTH, 2012, p. 30).
- If health care in the US is on average 35% more expensive than health care in Germany/France, there is a serious macroeconomic implication: Assuming that the share of US profits in US gross domestic product is 1/3rd - as is often assumed for Western OECD countries – US exporters have a health cost related disadvantage vis-à-vis the Eurozone (Germany/France/Italy/Spain/Netherlands for simplicity) of (2/3rds) of 6 percent = 4 percent; inefficiencies in the US health system effectively amount to a 4% export tax. Indeed, in the US, health insurance for workers and employees is typically related – outside of Medicare for those aged 65 years and over, and the poor strata which get Medicare from government – to having a job so that the inefficiencies of the US health care system is equivalent to an export tax of the US of 4 percent. The Trump Administration's debate about an excessive US trade

balance deficit thus should start with taking stock of the inefficiencies of the US health care system and – related to this – the apparently enormous lobbying power of part of the US health sector and the lack of price transparency and competition in the hospital sector. By contrast, the health system of Singapore relies on a strict benchmarking of hospitals in Singapore, regardless whether those are private or publicly organized (for an overview of the Singaporean health system in comparison to the US, see US COMMERCIAL SERVICE, 2015).

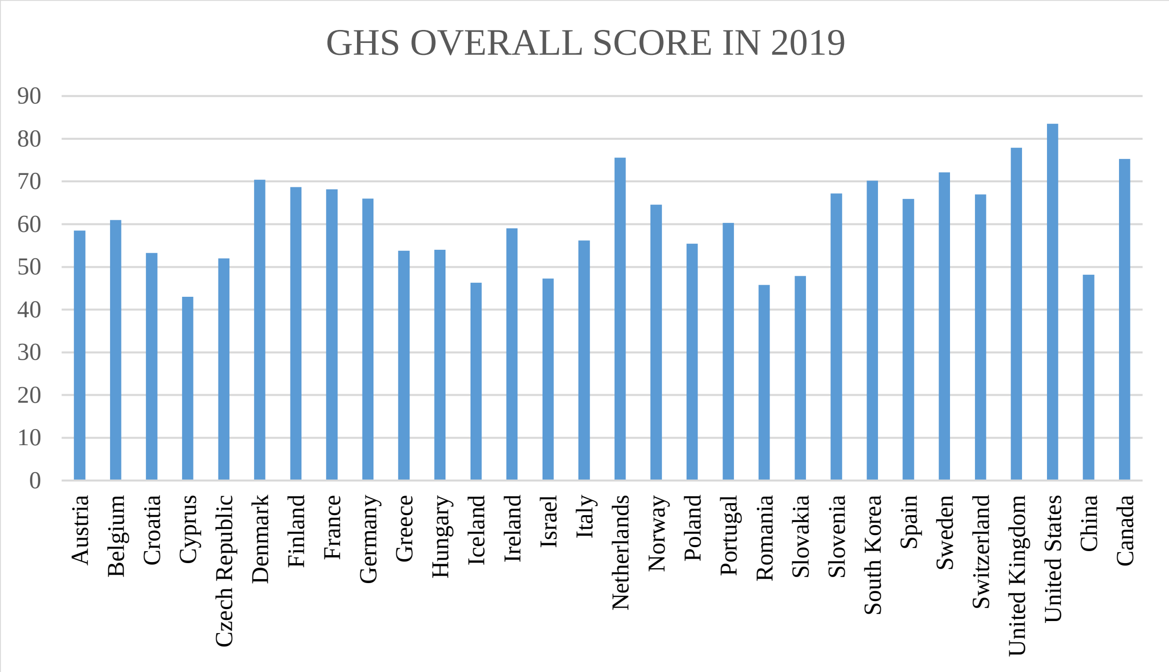
- An epidemic affecting all major OECD countries would raise the health care expenditure cost relative to GDP in the US and in the Eurozone, namely through higher expenditures on the one hand and a lower GDP which will reduce due to a rising illness rate of the workforce. If there were to be a full-blown US (or EU) COVID-19 epidemic, hospital costs would increase strongly. As regards the United States, this could mean that the US comparative disadvantage in labor-intensive sectors – effectively also representing high health care costs – would further be reinforced and hence the US trade balance deficit-GDP ratio and the current account deficit-GDP ratio would rise.

Health system reforms can, of course, not be designed and implemented in the short run, but there is no doubt that such reforms should be carefully considered in the EU and even more so in the US. The stress impulse from the COVID-19 epidemic reveals these problems.

It is rather surprising that the enormous US lead in health expenditures relative to GDP – or to life expectancy years – has gone relatively unnoticed over decades in macroeconomic analysis: The US spends 1/3rd more than Western Europe, but has a lower life expectancy and a higher infant mortality rate which is a real puzzle for the US health system and is part of the US weakness in international competitiveness in the production and export of goods, respectively. Within the OECD, every member country could benefit by learning something from every other member country; thus comparative system analysis should remain an important and useful field of International Economics - which it has not been since the end of the Cold War.

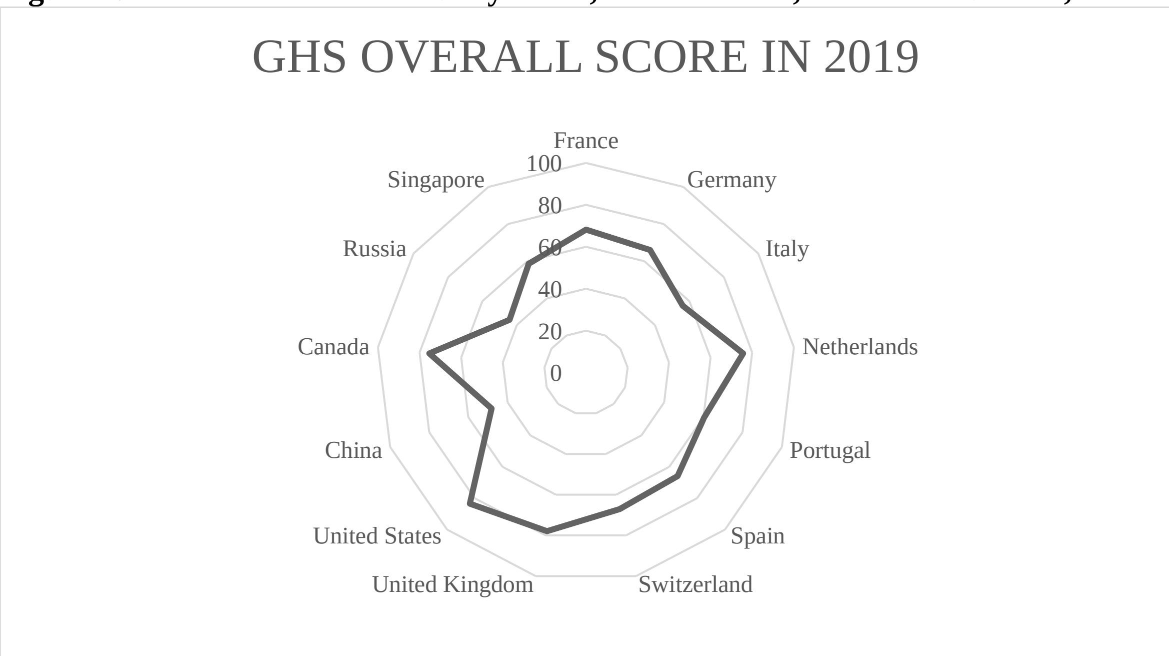
As regards the findings of the Johns Hopkins University with regard to its global health security indicator (NTI/JOHNS HOPKINS UNIVERSITY, 2019) about preparedness for dealing epidemics, it is noteworthy that with respect to pillar 4, namely sufficient & robust health system to treat the sick & protect health workers, many EU countries have a rather modest ranking and are ranked in the middle group of the 195 countries considered in the Global Health Security Index: Ireland (ranked 41), Luxembourg, Slovakia, Greece, Czech Republic, Italy, Romania, Hungary, Lithuania – and, in the weakest group, Estonia (behind South Africa) which is astonishing and not really acceptable as a status for an EU country. This at least points to the problem that the EU so far has not sufficiently considered a minimum level of health system quality as a requirement for EU membership; indeed including such a quality requirement in the Copenhagen Criteria II (an updated version of the Copenhagen Criteria) should be considered in the medium term by the European Parliament, the Commission and the Council as well as the EU member countries. There is considerable variation amongst OECD countries, plus China and Singapore (see following figures). Explaining the GHS index position of individual countries is an interesting question.

Figure 2: The Global Health Security Index Overall Score, Selected Countries, 2019



Source: Own representation based on data from NTI/Johns Hopkins University (2019)

Figure 3: Global Health Security Index, Overall Score, Selected Countries, 2019



Source: Own representation based on data from NTI/Johns Hopkins University (2019)

As regards the Global Health Security Index, it is remarkable that Russia, China, Italy and Spain have rather weak positions in the aggregated overall index as the above graph shows. However, even some high per capita income countries – Singapore and Switzerland – are not showing a strong position. Taking a look at the number of infections in early March 2020, China, Iran and Italy were leading countries, in terms of mortality the US had a much higher ranking than in the comparative number of infections; this points to a large number of non-identified infections in the United States. Weak points in the US health system could explain this.

It is clear that an international epidemic poses serious risks to the world economy. The ability for firms in all countries to rely rationally on an international division of labor and knowledge is clearly undermined and put at risk if a large number of countries do not achieve high quality indicator marks in the Global Health Security Index.

3. Cross Country Regression Results with the GHS Indicator and Trade and FDI Intensity

As regards the quality of the health care system, it is important to understand the link between the quality indicator Global Health Security Index and real per capita income. The relevance of the Global Health Security Index for economic analysis is crucial in two ways:

- The index presents the respective country's position in a key field of health care
- The index could be used as a health system-related proxy for the effective labor input available in production, possibly including foreign experts and managers flying into the country in order to provide certain services for the production of goods and services which are not fully covered in the statistics, but which play a key role for subsidiaries producing abroad: The higher the ranking in the GHS, the higher the willingness of such experts and managers to temporarily work in the country concerned and to the extent that the GHS index is a proxy for the quality of the health system, one may also assume that the effective use of the workforce could be reflected here (more healthy workers contributing to value-added). Other variables which could explain per capita GDP could be considered in a cross-country regression and the results are straightforward as shown subsequently.

A simple cross country regression for explaining per capita real GDP (purchasing power parity figures) through the GHS index, the true trade openness and the foreign direct intensity – for 174 countries – shows a good regression fit for this simple approach based on 2018 figures; true openness is a measure for trade intensity corrected for the size of the economy (small countries, proxied here by GDP relative to the average GDP in the sample of countries) and the variable thus reflects both the international division of labor and effective import competition. The true FDI intensity (FDI inflows and FDI outflows) is a similar variable for foreign direct investment; in addition, the true FDI inflow intensity was included. However, neither of the FDI variables were significant.

The regression, which included the true FDI inflow variable, explains 44.6 % of the variation of real per capita GDP across countries and both the GHSI and the true trade openness variable are significant at the 1% level. The coefficient of the true trade openness is about three times as big as that of the GHS indicator. If one takes logs of the real per capita GDP figure, the coefficients are better to interpret, namely as a semi-elasticity and the adjusted R2 rises slightly to 46.7; note that in this variant, the true inward FDI variable was dropped and only the true FDI intensity is used. Once longer time series for the GHSI would be available, panel date analysis with this indicator will become possible so that one could shed more light on the link between health system quality and economic welfare.

Table 4: Regression for Real Per Capita GDP (PPP) Figures: Cross Country Analysis for 2018 (174 countries; list of countries and data source: see Appendix 7)

	(1) ln_gdppc	(2) ln_gdppc	(3) gdppc	(4) gdppc
ghs	0.0395***	0.0402***	623.3***	652.3***
	(0.00395)	(0.00398)	(82.62)	(82.10)
ifdi_trueo~n	-1.279		-55470.3	
	(1.191)		(34015.1)	
trade_true~n	0.735***	0.721***	16624.0***	15966.6***
	(0.113)	(0.110)	(3711.1)	(3820.4)
fdi_trueopen		-1.394		-34391.2
		(1.055)		(31443.0)
_cons	7.759***	7.714***	-4808.6	-6025.0
	(0.199)	(0.205)	(3844.5)	(4004.5)
N	174	174	174	174
R-sq	0.475	0.476	0.465	0.455
adj. R-sq	0.465	0.467	0.456	0.446
rmse	0.848	0.847	16205.2	16357.4

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Source: Own representation. For the full list of countries and the data sources, please see Appendix 7.

An important policy conclusion to be drawn here is that the IMF, the OECD, the EU, the World Bank and other institutions, which try to support economic growth in the world economy through specific programs for member countries or partner countries, should pay more attention to the quality of the health system of the recipient countries.

US Health System Problems

As regards the US, one should also not overlook that the case of a serious illness in the family is the most important risk factor for a middle class family to fall from this position into poverty. CASE/DEATON (2020) have analyzed the problem of death from despair/suicides - and the issue of the opioid crisis - in the US and have shown that in Western Europe only Scotland has a suicide rate that is similar to the high rate in the US. The share of uninsured Americans has reduced under the Obama Administration, but under the Trump Administration it has increased from a share of 11 percent to 13 percent in 2019.

One may point out that personal bankruptcy due to health care expenditures is a rarely known phenomenon in EU countries with a general health insurance coverage, while that type of bankruptcy is a frequently occurring problem in the US and many households face the problem of living in fear of not being able to pay the next health bill. A survey in the US found that medical bills are the most important cause of consumer bankruptcy – with 18-25 percent directly caused by medical debt cases (AUSTIN, 2014). In another survey, a key finding was that 56 million Americans under the age of 65 had trouble paying medical bills in 2013 (LAMONTAGE, 2014). 10 million American adults are expected to face problems with paying medical bills although they have year-round insurance (LAMONTAGE, 2014). For discussion of further aspects of health related to productivity aspects in the US, see DPE (2016).The COVID-19 epidemic is likely to create many additional health problems in the US; some patients might die, but most will, of course, survive – however, in many cases, high medical bills could be faced. In the US, the epidemic therefore could likely become an impulse for a decline of real per capita consumption, more so than in the Eurozone or the EU, respectively, where universal health coverage is common. One also has to anticipate that many people in the US will not undergo early testing for the Corona virus since they are afraid of high medical bills and this, in turn, will bring a higher mortality rate in the US than in the Eurozone. In the US, this could lead to a delayed epidemic which would lead to much higher health and output costs in the US than a European-type of broad health insurance system would imply. However, one may point out that a simple extension of Medicare options to individuals below 65 years of age will not solve the US health system inefficiencies alone; the question of how to organize more competition and incentives for healthier living (e.g. without the problem of obesity) as well as lobbying aspects would have to be considered. Econometric work that looks only at US health expenditures and not at the ratio of health expenditure to national income (or GDP) is often misleading for policy reforms.

The quality of the health care system could also be relevant for the attractiveness of a country as an investment location. Top managers and international investors certainly will be interested in a high quality of health system in the host country locations envisaged. From this perspective, one could plug the NTI/Johns Hopkins Global Health Security Index findings (once more data points are available) into a modified modern gravity equation for foreign direct investment – for a basic FDI gravity modelling analysis, see WELFENS/BAIER (2018).

4. Theoretical Macro Aspects of the Corona Virus Epidemic

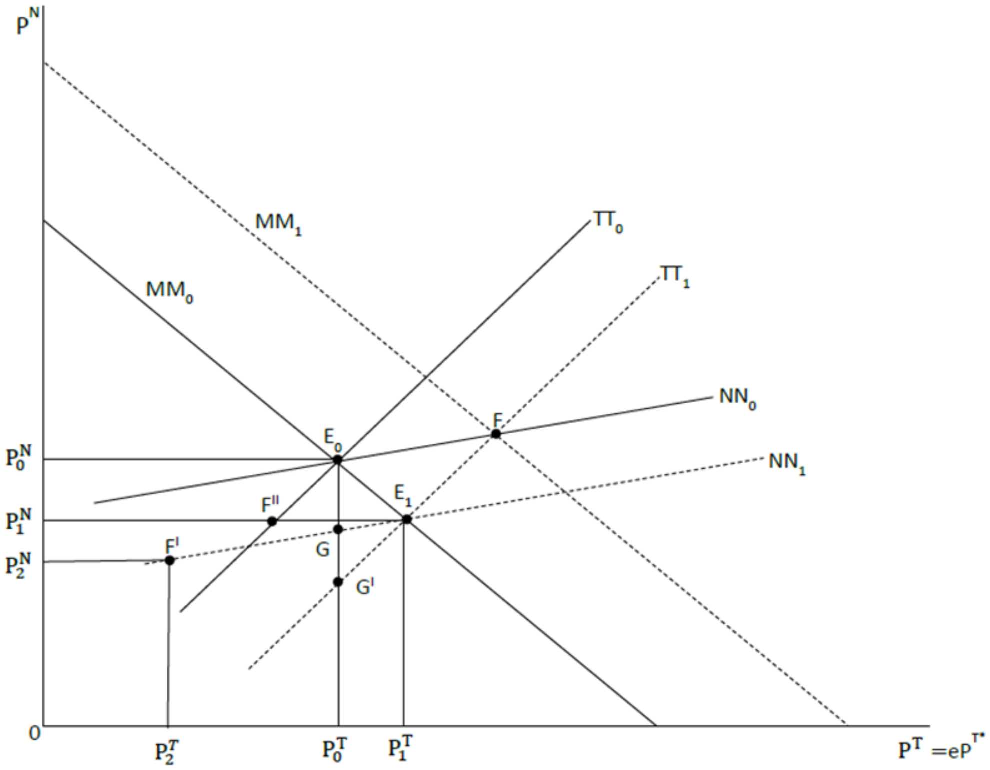
The role of health system costs has already been mentioned above and one may point out that this problem has rarely been considered in the literature. In aging societies, health care cost will tend to increase further over time. As regards aging, the speed of aging in Germany, Spain and Italy exceeds that of France after 2025 considerably. From a political economy perspective, one cannot exclude that important social and political conflicts will run across age brackets. In the case of BREXIT, for example, the majority for BREXIT in the referendum in 2016 (and in the UK General Election of December 2019 in which there was a majority for pro-BREXIT parties) was in all age groups above 45 years; incidentally, this suggests stronger EU disintegration dynamics after 2025 in part of the European Union.

As regards the effects of an epidemic on the overall economy – with a tradables sector (T) and a non-tradables sector (N) – a simple analytical starting point is the Mundell Structural Equilibrium Model which looks at the equilibrium conditions in the T market and the N market as well as the money market (money market equilibrium is portrayed in the MM curve: $M = Pm(Y_0, i_0)$ where M is the nominal money supply, P the aggregate price level consisting of a tradables price sub-index P^T and a non-tradables price sub-index P^N; Y is output, i the nominal interest rate, m is the real demand for money). The MM curve in P^N-P^T space is negatively sloped as $P= (P^N)^{ß"}(P^T)^{1-ß"}$ where 0<ß"<1 is a weighting factor. The TT curve – portraying T-market equilibrium – is positively sloped as is the NN curve, portraying N market equilibrium. With international arbitrage in the goods market and free trade, $P^T=eP^{T*}$ (e is the exchange rate, P^{T*} the world market price of tradables; * denotes foreign variables). Hence in a fixed exchange rate regime, changes in P^{T*} will raise P^T and this in turn will translate into an excess demand in the money market – firms in the small open economy will export more to eliminate this excess demand so that the MM curve will be shifted to the right through the intervention in the money market, read: the rise of money supply). To the right of the TT curve there is an excess supply in the T-market which, in the case of a small open economy, means a corresponding trade balance surplus. While the original Mundell model (MUNDELL, 1968) assumes a fixed exchange rate, one may, of course, consider the basic model under flexible exchange rates as well. Free trade plus arbitrage will bring about $P^T=eP^{T*}$ where in the short run the nominal exchange rate would be determined from the Branson model or interest parity if the setting is one of flexible exchange rates.

To the extent that the COVID-19 pandemic reduces global demand for oil and gas, the tradables world price index (P^{T*}) is reduced: an exogenous international price shock from the perspective of a small open economy. In a setting with flexible exchange rates, the short-term reaction of the exchange rate is influenced by US monetary policy – relative to monetary policy in the Eurozone, the UK, Switzerland and China. As US monetary policy has reduced the interest rate by 50 basis points in late February 2020, the US$ should face a temporary depreciation; the small open economy considered here (say, the UK) would therefore face an appreciation of the currency in the setting with flexible exchange rates where the combination of the change of P^{T*} and e should amount to a fall of P^T. Only in the case that other countries (i.e. not the US) reduce the interest rate rather strongly should one witness a depreciation of the currency so that e rises and the combination of the rise of the exchange rate and the fall of P^{T*} translates into a fall of P^T or an increase of P^T.

The slope of the TT curve is a steeper than that of the NN curve since own price elasticity is assumed to exceed the cross price elasticity. The supply in the T market positively depends on the T price and negatively on the N price as well as some supply shift variable V^T, while the T demand is a negative function of the T price and a positive function of the N price (and a similar economic logic applies, of course, to the N market). The subsequent graph (Fig. 3) is a modified version of Mundell's book Monetary Theory (MUNDELL, 1968, Chapter 9) where Mundell assumes a fixed exchange rate (e) and full employment (output Y is the weighted sum of N-output and T-output, but one may relax this assumption).

Figure 4: Mundell Structural Model with Tradables and Non-Tradables



Source: Own representation

The supply shock to the tradables sector shifts the T-curve downwards (from TT_0 to TT_1), the negative demand shock to the non-tradables sector shifts the N-curve downwards (from NN_0 to NN_1). If the new intersection point (E_1) is on the initial money market equilibrium curve MM_0, the finding is:

- The price of the non-tradables has reduced in absolute and relative terms
- The price of the tradables has increased

If, however, output is declining, the money market equilibrium curve shifts to the right and the point E_1 would stand for an excess supply in the money market. One may assume that primarily the price of non-tradables will fall if there is sufficient wage and price flexibility in that sector. The COVID-19 shock in the world economy could bring about an exogenous decline of the world tradables price index P^{T*} and hence in the P^T sub-price index so that – with the nominal exchange rate given – the domestic tradables price index will fall. Such a deflationary price impulse for both the non-tradable and the tradable sectors implies that the demand for money will fall as the aggregate price level declines and hence the MM curve shifts further to the right and the excess supply in the money market will increase further; this, in turn, could cause enhanced deflationary pressure which in the medium term would imply declining output.

If there is a deflationary pressure on prices of tradables in world markets, the economy might switch to point F’ on the NN_1-equilibrium line and hence P^T_2 and P^N_2, respectively. In the tradables sector, there would be excess demand so that over time there will be a rising foreign indebtedness. At the same time, in a system of fixed exchange rates the central bank would have to intervene in the foreign exchange market and would sell foreign reserves so that the money supply would reduce – the MM curve would shift from MM_0 to the left (not shown in the diagram). If there is a system of flexible exchange rates, one would have to consider the effects in the short-term BRANSON model, namely that in e-i-space the equilibrium line for foreign bonds would shift upwards so that a nominal depreciation and a rise of the interest rate will occur. The nominal depreciation means that in the Mundell Structural Model, the price P^T will increase due to the rise of e; point G' could correspond to this situation which stands for an excess demand in the non-tradables market.

One could modify the Mundell model by stating that the demand in the non-tradables sector is not just $N^d= N^d(P^T, P^N)$ but $N^d=N^d(P^T, P^N, G_0)$ where G is the fiscal policy variable. An expansionary fiscal policy thus would shift the NN curve upwards. One could also consider a real wealth effect in both the demand for T-goods and for N-goods where real wealth simply would be $A':= M/P + KP'/P$ where P' is the stock market price index and K the capital stock. In such a modified setting, one could then analyze both monetary policy and fiscal policy.

If there is a fall of the aggregate price level, the MM curve will shift to the right so that in the previous equilibria E_0 and E_1 there would be an excess supply in the money market. An excess supply should normally bring down sectoral sub-price indices and a fall of the aggregate price level; firms would normally also lay off workers. With heterogenous workers, say skilled workers employed in the T-sector and unskilled workers employment in the N-sector, an excess supply of the N-sector would be a problem in the sense that unemployed unskilled workers would need retraining in order to find a new job in the T-sector.

As regards the macroeconomic order of magnitude of output decline in the context of the Coronavirus problem, one may assume a 40% decline of demand in the tourism and entertainment sectors which for the EU, the US and Asia, implies an output decline of about 1.6% in 2020. This means that the projections of about 3% global growth from 2019 are no longer relevant and only about 1.4% global growth should be expected. Output growth could be further dampened if demand decline would be stronger than 40%. However, the dampening could be moderated if an international fall of the relative oil price would occur. Indeed world oil prices have decreased by about $15 per barrel between January 2, 2020, and March 2, 2020 (see Appendix 8). On March 6, 2020, the Brent oil price stood at $45 per barrel but on March 9 it had already fallen to $31. It should be noted that an output decline of 1.6 % in the US and in China would bring a spillover reduction of Eurozone/EU output by about 0.3%. Thus it holds: on top of the direct -1.6% of output growth in the EU, one should get an additional effect which brings an overall output decline of -1.9% compared to a baseline scenario. It will not be easy to adopt a compensating expansionary fiscal policy in EU countries and the EU, respectively. Moreover, it is clear that the shocks to international production networks cannot be healed by national fiscal policy, rather broad cooperation between the EU and Asian countries and the US could be useful here. Given the global excess supply in tradables world markets in 2020, the inflation rate in the Eurozone could fall to 1% in 2020. A decline in the inflation rate in combination with a year long depression in the tourism sector and serious problems in the air transportation and shipping sectors (e.g. cruise ships) could bring liquidity problems for a sizable number of firms – for a small number also solvency problems – so that higher spreads on corporate bonds and reduced loan growth of banks could dampen economic development.

5. Financial Markets Aspects

COVID-19 is an international epidemic which has raised doubts amongst international investors with respect to US stock market developments and stock market prices in the Eurozone and the UK. The long run rise of relative stock markets came to an end in February 2020. Hence, the economic upswing in the US and the EU, plus the UK, has also come to an end in spring 2020. As oil prices have started to fall, this contributes to stabilizing economic developments in the EU and the UK; however, in the US output is dampened in the oil and gas sector and this in turn – along with an anticipated reduction of aggregate demand – will contribute to lower output growth. US monetary policy has reduced the interest rate in early 2020, but its ability to stabilize output growth is quite limited.

One should not rule out that the COVID-19 problem will lead to enhanced political instability in some countries. In a broader perspective, political instability has become an element of certain OECD countries and the Bank for International Settlements' 2018 Annual Report of indeed has pointed out the problem of political instability and the problem that political instability can easily transform into economic instability (BIS, 2018). Political instability could raise risk premiums in the corporate sector and thus dampen investment growth. As regards the impact of a political shock in Europe, the BREXIT shock has been important in recent years for both the UK and the Eurozone. KADIRIC/KORUS (2019) show that the corporate bond yields have increased in the UK by 23 basis points for maturities of 3-5 years, 21 basis points for 5-7 years, 18 basis points for 7-10 years and for maturities above 10 years by 16 basis points; in the Eurozone, the impact on corporate risk premiums was 9 basis points for maturities 1-3 years, 3-5 years and above 10 years. This means that political shocks could bring about higher corporate risk premiums and hence a dampening effect on investment, output and jobs.

As regards oil prices, there could be a considerable decline in the course of 2020 (Appendix 8), not least since Saudi Arabia und Russia found it difficult to agree on oil production cuts in early March 2020. A strong fall of oil prices will contribute to very low inflation rates in the EU, China and the US, but in the US very low oil prices could also bring about output reduction in the fracking sector and some problems for US banks with large exposure through loans to the oil and gas sector. With declining oil and gas prices there will also be corresponding current account effects in major importing OECD/EU countries while the US could face a worsening of the current account position. Countries which are both net oil importers and have a net expenditure position in tourism should be natural winners from the international Coronavirus crisis.

6. Political Economy Aspects in the Western World

With respect to the United States, the Coronavirus problem is a particular challenge for the Trump Administration which suffers in many fields from a lack of expertise and thus might have serious problems in finding an efficient and effective answer to the questions posed by an epidemic in 2020. It should not be surprising if the Coronavirus would have a decisive impact on the outcome of the US presidential elections on November 3, 2020. It is clear for the large majority of the population that government and the political system, respectively, have to take care of the international epidemic – and that the US Congress and the national government/the President of the United States are largely responsible for the policies adopted.

If Donald Trump should not be re-elected on November 3, the European Union would have a reinforced political position since a President on a Democrat ticket would most likely continue traditional US support for regional integration in Europe and other regions of the world economy – which was interrupted under President Trump. This implies that the COVID-19 challenge for the US could have strong political implications in the field of transatlantic economic relations; and the envisaged EU-UK free trade agreement would certainly look different if the EU is in a relatively strong position vis-á-vis the UK compared to the alternative setting where the position of the Johnson government is quite strong due to political backing of an anti-EU oriented newly re-elected Trump. For the EU, there is no reason not to push for a final EU-UK negotiation round in mid-November 2020. Beyond such medium-term perspectives, there are more long run questions raised by the COVID-19 epidemic.

7. Growth Model Perspective

An epidemic can obviously affect not only cyclical output developments in the medium term but also long run economic development; that is economic growth. Here, a brief look at an adequately modified rather simple neoclassical model setting can be useful. One crucial issue concerns the question of health insurance coverage (h) and its effect on potential output and economic welfare, respectively. In this section, only a few aspects can be analyzed, namely to what extent an epidemic – or waves of epidemics – could affect the long run level of the growth path and the growth rate of per capita income (y) in the steady state (read: in the very long run). For simplicity, a crucial aspect has to be ignored here, namely that typically a higher health insurance coverage will raise life expectancy; an important issue for which Western EU countries and the US provide relevant evidence. One may also point out here that a traditional modern growth modeling approach amounts to ignoring this crucial aspect, namely by assuming that households are maximizing utility (depending on per capita consumption C/L) in an approach with an infinite time horizon. This infinite time horizon is a way to simplify some of the task of modelling; however, it amounts to ignoring that the length of a lifetime is an endogenous variable. From this perspective, my emphasis on a systemic comparison of social market economies in Western Europe and the US is rather adequate, namely to calculate effective lifetime per capita consumption or effective lifetime per capita income – and here the figures for Germany and France are indeed equal to the US value (WELFENS, 2019); but the Western European countries have the additional advantage that infant mortality is lower than in the US (one could argue that risk averse individuals/parents would thus have a preference for living in Germany/France).

In a more long run perspective, a simple modified neoclassical growth model can be useful where the basic approach used here relies on WELFENS (2011): Denoting real GDP by Y, the share of foreign ownership in the capital stock of country 1 (home country) by α*, the savings rate of domestic households as s (0<s<1) and the savings rate of foreign investors as s' (0<s'<1), we have for aggregate savings (with * denoting foreign variables, t" is the income tax rate, the profits of foreign subsidiaries are assumed to be untaxed in country 1):

(1) $$S = s(1-t")Y(1-\alpha^* ß) + s'\alpha^* ßY$$

The share of the workforce covered by health insurance is denoted by h (0<h<1), K is the capital stock, A is knowledge and ß and ß' are positive parameters (with 0<ß<1; assumption $h^{ß'(1-ß)}>1$ so that a higher insurance coverage rate brings a higher production potential):

(2) $$Y = K^{ß}\left(ALh^{ß'}\right)^{1-ß} = K^{ß}\left(AL\right)^{1-ß} h^{ß'(1-ß)}$$

Population growth is assumed to be n (an exogenous parameter) and the growth rate of knowledge (a) is also an exogenous parameter:

Defining k':= K/(AL) and y':=Y/(AL) – where AL is labor in efficiency units – we can write (with d' denoting the capital depreciation rate):

(3) $$dk'/dt = \left(s(1-t")(1-\alpha^* ß) + s'\alpha^* ß\right)h^{ß'(1-ß)}k'^{ß} - \left(a+n+d'\right)k'$$

Hence the steady state solution (steady state is denoted by #) is given by:

(4) $$k'\# = \left[\frac{\left(s(1-t")(1-\alpha^* ß) + s'\alpha^* ß\right)h^{ß'(1-ß)}}{\left(a+n+d'\right)}\right]^{\frac{1}{(1-ß)}}$$

(5) $$y' = h^{ß'(1-ß)}\left[\frac{\left(s(1-t")(1-\alpha^* ß) + s'\alpha^* ß\right)h^{ß'(1-ß)}}{\left(a+n+d'\right)}\right]^{\frac{ß}{(1-ß)}}$$

Consider the following semi-exogenous growth rate of the population (with n' being an exogenous parameter, C" and h" are positive parameters so that the parameter h" dampens the epidemic shock parameter C"):

(6) $$n = n'\left(1 - C"\left(1-h"h\right)\right)$$

Per capita income in the steady state y:=Y/L thus is given by (with e’ denoting the Euler number and t the time index):

(7) $$y\# = h^{ß'(1-ß)} \left[\frac{\left(s\left(1-t''\right)\left(1-\alpha * ß\right) + s'\alpha * ß\right) h^{ß'(1-ß)}}{\left(a + n'\left(1 - C''\left(1-h''h\right)\right) + d'\right)} \right]^{\frac{ß}{(1-ß)}} e'^{n'\left(1 - C''\left(1-h''h\right)\right)t}$$

(7’) $$y\# = h^{ß'} \left[\frac{\left(s\left(1-t''\right)\left(1-\alpha * ß\right) + s'\alpha * ß\right)}{\left(a + n'\left(1 - C''\left(1-h''h\right)\right) + d'\right)} \right]^{\frac{ß}{(1-ß)}} e'^{n'\left(1 - C''\left(1-h''h\right)\right)t}$$

The insurance coverage ratio h raises the steady state per capita income y#. The growth rate of long run output (g_Y) therefore is given by:

(8) $$g_Y = a + n'\left(1 - C''\left(1-h''h\right)\right)$$

The key aspects of growth here is h affects both the level of the growth path and growth rate in the steady state. The effect of h on the level of the growth path is ambiguous, but a rise of h will raise the growth rate of per capita income in the steady state. One might want to consider links between the growth rate of knowledge a and h, for example through a rather simple function (with a’ and a” both standing for a positive parameter):

(9) $$a = a' + a''h$$

The reason for such a positive link between health insurance coverage and the growth rate of knowledge could be the fact that a high ratio h implies that more children will be able to go to school and to finish higher education studies; in a society with a rather small h, illness of parents would otherwise force young adults to interrupt human capital formation to take care of ill parents. Technically speaking, a’ is here the purely exogenous growth rate of knowledge and a”h thus reflects the positive effects of more human capital formation – this includes that a share of individuals with tertiary education will become researchers - on the creation of new knowledge and the growth rate of knowledge, respectively (see on the knowledge production function and the impact of researchers for the case of EU countries JUNGMITTAG/WELFENS, 2020).

8. Implications for Policymakers

If there is a recession in 2020/2021, an expansionary fiscal policy would have to be adopted which should include novel complementary measures to introduce digital platforms that could offer better future opportunities to source imported inputs from a more diversified supplier pool. Even some aspects of competition law might have to be reconsidered here, namely that the pooling of intermediate imports from non-EU countries should be facilitated for small and medium-sized firms in the European Union. Notification of such pooling would be adequate.

The role of the health systems in open economies should be studied more carefully. For too long this problem has been largely neglected in International Economics. The role of health for productivity, the size of the effective workforce and for entrepreneurship should be studied and comparative international studies could be useful here.

More cooperation in international health policy – a field hardly existing in some countries – is needed and a more formalized pattern of cooperation could be adequate. The role of the World Health Organization is crucial and this indeed is part and parcel of the valuable multilateral system that the EU should defend at the G20 and beyond. It could be quite useful to create an interdisciplinary research network on Efficient and Innovative Health Systems which could be co-financed by G20 countries, but which would have to leave scientific organizers clear freedom in creating international research networks.

Analytical links between health policy and macroeconomics should be studied in a systematic way; as well as links between macroeconomic dynamics and health. In aging societies, expenditures on health care will rise in OECD countries – and also in China in the long run. There is a body of literature that looks into social security, employment, growth and budget deficit dynamics, but there are neglected fields in terms of health system analysis and modern macroeconomics. Moreover, little research has been conducted on the political economy of health care reform. Aging societies in democracies might face particular conflicts in government funding, namely with regard to the extent to which government transfers in favor of broadening health care or broadening pension systems should be designed. Whether or not there is a structural conflict of interests between the younger generations and the older generations is an open question. A PEW survey for the US, clearly did show (PEW, 2020) that key policy priorities – say the top 6 topics – differed much between old and young, except for the field of health care cost.

It is clear that economic globalization and certainly trade in intermediate products goes along with specific risk, partly related to logistics, partly related to an epidemic risk between the producing countries and the countries that are part of the logistics chain. With the Global Health Security Index the NTI/Johns Hopkins University research group has developed a very useful index which is not only important for understanding the quality of the health systems in most countries in the world but which could also be useful for a better understanding of the risk to international production chains and the risks faced by foreign investors in various host countries.

Every epidemic has four main economic challenges: a) how to minimize international and national diffusion; b) how to efficiently help those patients who are ill; c) how to quickly develop a vaccine that could help to make a very large part of society immune, for example against the relevant virus; d) how to fight the negative macroeconomic effects of the epidemic. As regards a) and b), countries which are in the medium range or the lower part of the index tables have every reason to work on improving their position in an international comparative perspective. Obviously, when it comes to benchmarking, the creation of different benchmarking groups could be useful, for example countries could be grouped according to the size of per capita income and the intensity of trade and foreign direct investment (relative to total investment).

The EU has a particular problem, namely that the ECB has little room to maneuver left. Hence, options for a coordinated fiscal policy and joint measures to rebuild international production networks quickly should be carefully studied. There is little doubt that lobbying against an effective anti-epidemic policy could be strong - influential soccer clubs in many EU countries, for example, can be expected to wage a fierce battle against playing lucrative soccer matches in empty stadiums; here the European Commission should develop clear principles that emphasize the authoritative role of experts and physicians with relevant specializations. As regards the role of the health systems in EU countries, it would be adequate to emphasize more strongly in the public political debate the many advantages of European type health insurance systems. This, of course, does not mean to overlook important opportunities to make health systems in EU countries more efficient and innovative. As regards cooperation with the US, more transatlantic city partnerships (twinning EU cities with cities in the US) could be useful; benchmarking the health care systems might be included as a field of comparison in such partnerships. With respect to a potential future free trade agreement between the EU and the US, it is not in the EU's interest to allow US health care providers easy access to markets in the EU since this would certainly bring a strong tendency to raise hospital costs in Europe – this is not in the interest of people in the EU. In this perspective, the COVID-19 problem in the US will hopefully become a starting point for the US Administration as well as many state governments to reconsider carefully reform options in the health care sector.

As regards the EU(27), it should be useful to modernize health systems in many member countries with weak scores in the Global Health Security Index. This is not only in the interest of the respective countries but of all EU member countries and the world economy, respectively. Epidemic protection investment thus could become a new field of common co-financing in the EU. From an Economics perspective it is crucial to emphasize that protection against epidemics has partly elements of an international public good. This naturally makes adequate international cooperation – for example, in the EU, but indeed in the G20 and the world economy - necessary. It makes cooperation rather difficult if national economic policy is organized in a rather inconsistent way as is the case in Germany (KAUFMANN, 2009). From this perspective, the COVID-19 pandemic requires national policy reforms (in Germany including reforms at the level of the states which have a considerable responsibility in epidemic policy).

A new and broader benchmarking of health systems should be considered more by foreign investors worldwide. The United States seems to face a particular problem of health system inefficiencies which could be remedied on the basis of more national and international benchmarking, particularly in the hospital sub-system. More comparative research is needed in both Europe, Asia and the US; and economists could certainly contribute in many ways, often teaming up with colleagues from the medical sciences, to stimulate both health system reform and more medium- and long-term stability. As the US and the EU – plus the UK –

face growing competition from Asia and China, respectively, it could be useful for the EU and the US to cooperate in a better way which should include finding the optimal policy mix for economic stabilization as well as new ways for better health care.

The EU is facing a serious triple challenge in 2020: The Coronavirus epidemic as a health care challenge, the ongoing internal conflicts regarding a potential new refugee wave – mainly linked to the Syrian civil war and the instability in Afghanistan – and a global output decline which is partly related to the pandemic. With the pending bankruptcy in Lebanon, there is an additional risk of a new refugee wave for the EU since about two million refugees live in the Lebanon. If economic and politic chaos should shape Lebanon in 2020, there could be massive refugee waves from the Lebanon to Turkey and from Turkey to the EU (plus some direct refugee moves from Lebanon to EU countries). Obviously, the European Commission is facing considerable challenges in 2020. The Commission should become more active in coordinating epidemic policies in the EU – it is strange that in some European countries soccer games are taking place behind closed doors without spectators because the risk of COVID-19 spreading is considered too high, but in early March, 2020, several EU countries have allowed soccer games to go on as usual. The question of European soccer tournaments is also one important issue. Common standards in the epidemic policies of EU countries should be adopted and the EU should help developing countries as well as neighboring countries which face particular pandemic problems. Compared to the US, Western EU countries – countries in the Eurozone – seem to have relatively high quality health systems and, at the bottom line, the EU in the future should push for exporting the Social Market Economy and become more eager in adopting EU reforms.

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Appendix 1: World Health Organization COVID-19 Statistics

Table 5: World Health Organization Statistics on COVID-19 in Chinese Regions as of 9 March 2020

	Confirmed cases	Deaths
Hubei	67,743	3,007
Guangdong	1,352	8
Henan	1,272	22
Zhejiang	1,215	1
Hunan	1,018	4
Anhui	990	6
Jiangxi	935	1
Shandong	758	6
Jiangsu	631	0
Chongqing	576	6
Sichuan	539	3
Heilongjiang	481	13
Beijing	428	8
Shanghai	342	3
Hebei	318	6
Fujian	296	1
Guangxi	252	2
Shaanxi	245	1
Yunnan	174	2
Hainan	168	6
Guizhou	146	2
Tianjian	136	3
Shanxi	133	1
Liaoning	125	1
Gansu	124	2
Hong Kong SAR	114	3
Jilin	93	1
Xinjiang	76	3
Inner Mongolia	75	1
Ningxia	75	0
Taipei	45	1
Qinghai	18	0
Macao SAR	10	0
Xizang	1	0
Total	**80,904**	**3,124**

Source: Own representation of data available from the WHO, Corona Virus Situation Dashboard, figures as of 9 March 2020 https://www.who.int/emergencies/diseases/novel-coronavirus-2019.

Table 6: World Health Organization Statistics on COVID-19, Number of Infected Persons for Selected Countries as of 9 March 2020

Countries	Number of Persons Infected
China	80,904
Republic of Korea	7,382
Italy	7,375
Iran (Islamic Republic of)	6,566
France	1,116
Germany	902
Spain	589
Japan	488
Switzerland	332
United Kingdom	277
Netherlands	256
United States	213
Sweden	203
Belgium	200
Austria	102
Australia	77
Greece	73
Canada	60
India	39
Denmark	36
Brazil	25
Ireland	21
Saudi Arabia	15
Argentina	12
Mexico	7
Russian Federation	7
Indonesia	6
South Africa	3
Nigeria	1

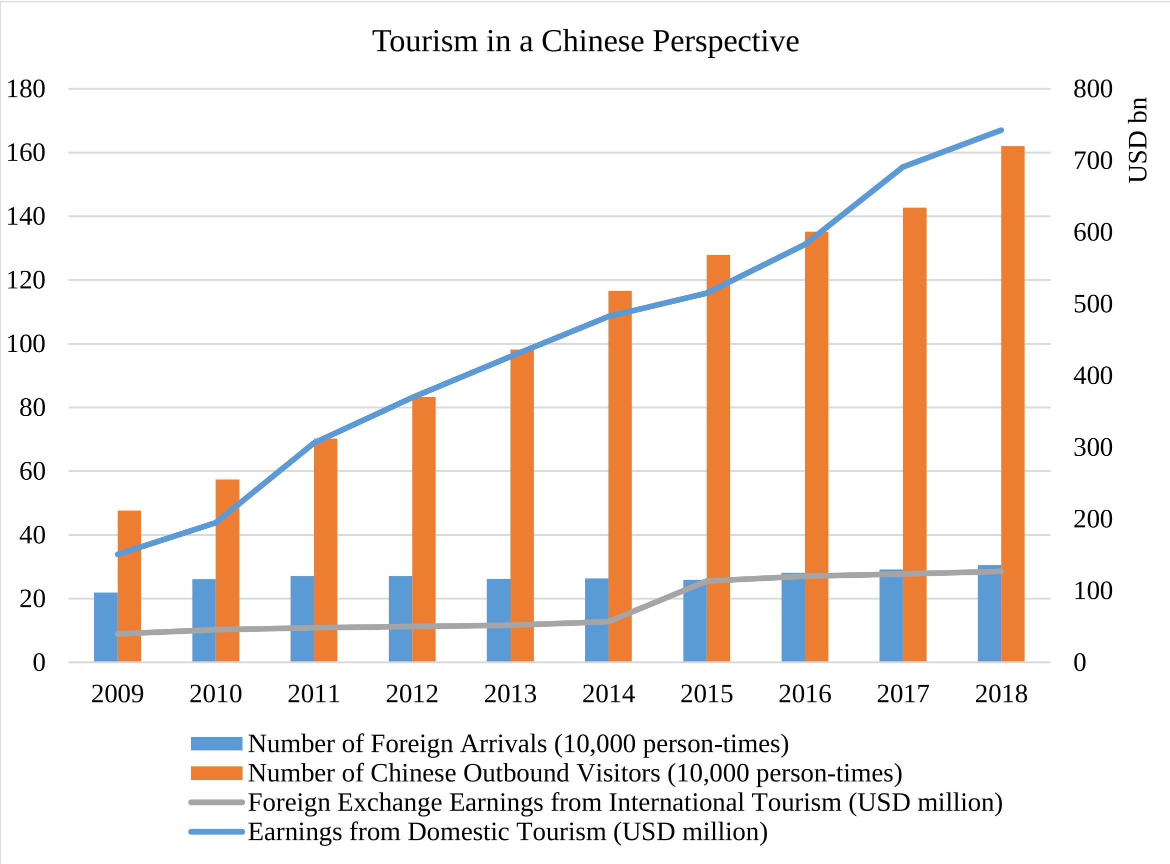
Source: Own representation of data available from the WHO, Corona Virus Situation Dashboard, figures as of 9 March 2020 https://www.who.int/emergencies/diseases/novel-coronavirus-2019. It should be noted that Turkey has yet to notify the WHO or officially confirm any cases of COVID-19 infection or deaths in the country.

Appendix 2: Tourism in a Chinese Perspective

Tourism in a Chinese Perspective

China has had an increasing number of foreign arrivals and the number of Chinese outbound travelers has also increased – indeed, it has almost quadrupled between 2009 and 2018. As regards the earnings from domestic tourism relative to GDP, the share has increased from 2.9% in 2009 to 5.7% and 5.5% in 2017 and 2018, respectively. From this perspective, travelling restrictions at the national or international level for Chinese tourists could have considerable negative effects, both within China and in the primary destination countries for Chinese tourists. While earnings from domestic tourism is not the same as value-added, it is clear that the strong decline of domestic tourism would already effect China's aggregate output considerably. A decline of, for example, 50% in 2020 could reduce Chinese GDP by about two percentage points and this in turn could have negative spillover effects to the Eurozone/EU and the US.

Figure 5: Tourism in a Chinese Perspective



Source: Own representation of data from the National Bureau of Statistics of China

Appendix 3: Travel Receipts and Expenditures in Balance of Payments, Selected Countries, 2013 and 2018

Table 7: Travel Receipts and Expenditures in Balance of Payments, Selected Countries, 2013 and 2018

	Receipts (million EUR)		Relative to GDP 2018 (%)	Expenditures (million EUR)		Relative to GDP 2018 (%)	Balance (million EUR)
	2013	**2018**		**2013**	**2018**		**2018**
EU-27 (1)	126010.7	158148.2	1.17287059	86737.8	109245.4	0.81019396	48902.7
Belgium	10074	7548	1.64151261	16692	15687	3.41155383	-8139
Bulgaria	2890.8	3822.5	6.81531695	840	1584.4	2.82490207	2238.1
Czechia	5303.1	6312.6	3.04118653	3493.8	5055.5	2.43556039	1257.1
Denmark	5385.1	7710.4	2.55869681	7584.1	8887.5	2.94931753	-1177.1
Germany	31081	36390	1.08809731	68793	80933	2.41997745	-44543
Estonia	1255.8	1515.7	5.82157713	802.8	1245.5	4.78377932	270.2
Ireland	3370	5237	1.61616748	4669	6270	1.93495705	-1033
Greece	12152	16086	8.70861702	1835	2191	1.18616063	13895
Spain	51589	69023	5.74142421	12359	22692	1.8875505	46331
France	53103	55450	2.35647595	31787	40528	1.72233106	14922
Croatia	6135.9	9488.6	18.3798191	679.3	1434.2	2.778106	8054.4
Italy	33063	41712	2.36272201	20309	25484	1.44350805	16228
Cyprus	2211	2940	13.9087322	944	1315	6.22108261	1625
Latvia	651	897	3.0770814	538	660	2.26407327	237
Lithuania	1035.2	1274.2	2.81501577	805	1185.5	2.61905604	88.7
Luxembourg	3797	4230	7.04376627	2422	2731	4.547642	1499
Hungary	4042.8	5850.4	4.37307803	1437.1	2238.6	1.67331678	3611.7
Malta	1057.2	1573.8	12.7136718	288.8	440.5	3.55850325	1133.3
Netherlands	10343	15236	1.96837627	15589	17956	2.31977975	-2720
Austria	15237	19559	5.07088322	7738	10143	2.62968293	9416
Poland	8549.1	11911.5	2.39976598	6646.4	8249.6	1.66201649	3661.9
Portugal	:	16840	8.25910439	:	4662	2.28645752	12178
Romania	1391.6	2876.2	1.40548914	1507.7	4522.2	2.2098265	-1646
Slovenia	2093.5	2704.1	5.90998103	1068.3	1389.5	3.03683985	1314.6
Slovakia	1997.7	2709.8	3.02025167	1782	2225.4	2.48035577	484.5
Finland	3044	3102	1.32354824	3989	5151	2.19780689	-2049
Sweden	8181.8	12651.3	2.68486585	11551.6	15293.4	3.24557377	-2642.1
United Kingdom	34675.6	41167.5	1.69851377	45854.5	58442.9	2.41127274	-17275.4
Iceland	813	2657.8	12.0876672	638.9	1553.8	7.06667819	1104
Norway	:	4956.2	:	:	14699.4	:	-9743.2
Switzerland	12644	14370.4	3.90612832	12163.3	15539.5	4.22391033	-1169.1
Montenegro	666	1001	0.16766925	37	58	0.0097151	943
North Macedonia	200.8	324.8	6.9653235	98.3	219.8	4.71360254	105
Albania	:	1855.7	17.3460708	:	1426.1	13.3304045	429.6
Serbia	792	1317	10.3032294	841	1396	10.9212667	-79
Turkey	21089.4	21482.1	50.1268215	3623.3	3888.2	9.07281446	17593.9
Bosnia and Herzegovina	516.5	875.8	0.13421813	100.6	221.3	0.03391467	654.4
Kosovo*	647.5	1228.2	7.32846837	135.3	302.3	1.80377462	925.9

Source: Eurostat, Industry and Services, Tourism - Table 3: Travel receipts and expenditure in balance of payments, 2013–2018

Appendix 4: International Tourism Receipts as Percentage of Gross Domestic Product and Output Decline

Table 8: International Tourism Receipts as Percentage of GDP and Output Decline

Country Name	*International tourism exp / GDP US$*	*International tourism, receipts (current US$) /GDP US$*	*International tourism, receipts (% of total exports)*	*Decline of the International tourism, receipts (current US$) / GDP US$*		
				by 20%	*by 40%*	*by 50%*
Turks and Caicos Islands	0.41%	76.98%		61.59%	46.19%	**38.49%**
Macao SAR, China	2.56%	73.27%	88.73%	58.61%	43.96%	**36.63%**
Antigua and Barbuda	7.02%	60.29%	84.31%	48.23%	36.17%	**30.14%**
Maldives	8.13%	57.33%	82.69%	45.86%	34.40%	**28.66%**
St. Lucia	4.53%	51.46%	81.27%	41.17%	30.88%	**25.73%**
Grenada	3.46%	46.21%	84.34%	36.97%	27.73%	**23.10%**
Seychelles	6.41%	38.42%	35.42%	30.74%	23.05%	**19.21%**
St. Kitts and Nevis	5.84%	36.31%	60.64%	29.05%	21.78%	**18.15%**
Vanuatu	2.30%	35.55%	62.84%	28.44%	21.33%	**17.77%**
St. Vincent and the Grenadines	5.92%	29.71%	76.27%	23.76%	17.82%	**14.85%**
Bahamas, The	4.31%	27.23%	77.25%	21.78%	16.34%	**13.61%**
Cabo Verde	4.91%	26.51%	53.58%	21.21%	15.90%	**13.25%**
Belize	2.67%	26.03%	45.21%	20.82%	15.62%	**13.01%**
Fiji	2.89%	24.74%	51.32%	19.79%	14.85%	**12.37%**
Samoa	0.51%	23.32%	62.57%	18.65%	13.99%	**11.66%**
Montenegro	1.33%	22.24%	52.17%	17.79%	13.34%	**11.12%**
Dominica	5.45%	20.15%	68.54%	16.12%	12.09%	**10.07%**
Georgia	5.45%	19.99%	39.54%	15.99%	11.99%	**9.99%**

Croatia	2.85%	19.80%	38.59%	15.84%	11.88%	**9.90%**
Jamaica	3.20%	19.72%	53.38%	15.78%	11.83%	**9.86%**
Cambodia	4.40%	19.69%	26.24%	15.75%	11.81%	**9.84%**
Curacao	17.10%	19.34%	31.57%	15.47%	11.61%	**9.67%**
Sao Tome and Principe	4.17%	17.03%	73.19%	13.62%	10.22%	**8.51%**
Lebanon	11.29%	15.35%	45.42%	12.28%	9.21%	**7.67%**
Albania	11.59%	15.27%	48.20%	12.22%	9.16%	**7.63%**
Mauritius	5.08%	15.20%	38.88%	12.16%	9.12%	**7.60%**
Jordan	3.54%	14.73%	41.33%	11.78%	8.84%	**7.37%**
Cyprus	6.21%	13.82%	18.92%	11.05%	8.29%	**6.91%**
Thailand	2.91%	12.92%	19.63%	10.34%	7.75%	**6.46%**
Malta	3.56%	12.68%	8.76%	10.14%	7.61%	**6.34%**
Iceland	7.07%	12.09%	25.55%	9.67%	7.25%	**6.04%**
Hong Kong SAR, China	7.31%	11.54%	6.13%	9.24%	6.93%	**5.77%**
Tonga	9.15%	10.68%	45.89%	8.54%	6.41%	**5.34%**
Gambia, The	0.64%	10.29%	48.27%	8.23%	6.17%	**5.14%**
Bahrain	10.66%	10.16%	12.74%	8.13%	6.09%	**5.08%**
Portugal	2.71%	10.02%	22.71%	8.01%	6.01%	**5.01%**
Armenia	11.73%	9.95%	26.32%	7.96%	5.97%	**4.97%**
Greece	1.79%	9.90%	26.38%	7.92%	5.94%	**4.95%**
Marshall Islands	14.19%	9.08%	15.59%	7.27%	5.45%	**4.54%**
Dominican Republic	1.12%	8.84%	37.45%	7.07%	5.30%	**4.42%**
Panama	2.01%	8.63%	20.78%	6.90%	5.18%	**4.32%**
Morocco	2.56%	8.08%	22.08%	6.46%	4.85%	**4.04%**
Qatar	6.14%	7.96%	14.86%	6.37%	4.78%	**3.98%**
Luxembourg	4.64%	7.81%	3.99%	6.25%	4.69%	**3.91%**
Bulgaria	3.45%	7.79%	11.67%	6.23%	4.67%	**3.89%**
Estonia	5.37%	7.59%	10.22%	6.07%	4.55%	**3.79%**
Costa Rica	1.93%	6.64%	19.40%	5.32%	3.99%	**3.32%**

Solomon Islands	3.81%	6.59%	13.57%	5.27%	3.96%	3.30%
Comoros	3.82%	6.51%	50.44%	5.21%	3.91%	3.26%
Haiti	6.20%	6.42%	34.86%	5.14%	3.85%	3.21%
Madagascar	2.23%	6.34%	20.22%	5.08%	3.81%	3.17%
Sri Lanka	2.80%	6.31%	27.67%	5.05%	3.78%	3.15%
Slovenia	3.25%	6.25%	7.32%	5.00%	3.75%	3.13%
Hungary	2.08%	6.08%	7.15%	4.86%	3.65%	3.04%
Malaysia	3.69%	6.07%	8.83%	4.86%	3.64%	3.04%
Azerbaijan	5.23%	6.03%	11.10%	4.82%	3.62%	3.01%
Kyrgyz Republic	5.60%	6.02%	18.73%	4.81%	3.61%	3.01%
Tunisia	2.39%	5.82%	11.95%	4.65%	3.49%	2.91%
Spain	1.88%	5.73%	16.30%	4.58%	3.44%	2.86%
Singapore	6.96%	5.61%	3.18%	4.49%	3.36%	2.80%
Austria	3.13%	5.58%	10.01%	4.47%	3.35%	2.79%
Rwanda	3.96%	5.55%	25.89%	4.44%	3.33%	2.78%
Bosnia and Herzegovina	1.82%	5.36%	12.73%	4.29%	3.22%	2.68%
New Zealand	2.25%	5.35%	19.08%	4.28%	3.21%	2.67%
El Salvador	1.88%	5.26%	18.19%	4.21%	3.15%	2.63%
United Arab Emirates	4.35%	5.16%		4.13%	3.10%	2.58%
Egypt, Arab Rep.	1.15%	5.06%	24.61%	4.05%	3.04%	2.53%
Bhutan	3.23%	4.95%	15.54%	3.96%	2.97%	2.47%
Turkey	0.65%	4.81%	16.62%	3.85%	2.89%	2.41%
Moldova	3.83%	4.37%	14.49%	3.50%	2.62%	2.18%
Tanzania	1.41%	4.25%	29.37%	3.40%	2.55%	2.12%
Lao PDR	5.29%	4.22%	12.18%	3.37%	2.53%	2.11%
Ethiopia	0.73%	4.21%	46.54%	3.36%	2.52%	2.10%
Nicaragua	2.66%	4.15%	9.87%	3.32%	2.49%	2.07%
Vietnam	2.41%	4.11%	3.90%	3.29%	2.47%	2.06%
Uruguay	2.20%	4.09%	14.87%	3.27%	2.46%	2.05%

Mongolia	6.29%	4.03%	6.82%	3.22%	2.42%	2.01%
Ireland	1.93%	3.83%	3.14%	3.07%	2.30%	**1.92%**
Uganda	1.22%	3.80%	18.62%	3.04%	2.28%	**1.90%**
Serbia	3.63%	3.80%	7.67%	3.04%	2.28%	**1.90%**
Oman	4.05%	3.75%	6.44%	3.00%	2.25%	**1.88%**
Czech Republic	2.48%	3.38%	4.31%	2.70%	2.03%	**1.69%**
Namibia	0.48%	3.36%	9.83%	2.69%	2.02%	**1.68%**
Australia	2.95%	3.30%	14.46%	2.64%	1.98%	**1.65%**
Slovak Republic	2.67%	3.13%	3.27%	2.51%	1.88%	**1.57%**
Honduras	2.17%	3.11%	10.23%	2.49%	1.86%	**1.55%**
Botswana	1.45%	3.09%	7.84%	2.47%	1.85%	**1.55%**
Latvia	2.26%	3.07%	5.01%	2.46%	1.84%	**1.54%**
North Macedonia	2.23%	3.05%	5.09%	2.44%	1.83%	**1.53%**
Timor-Leste	5.08%	3.02%	64.00%	2.42%	1.81%	**1.51%**
Philippines	3.77%	2.94%	10.76%	2.35%	1.76%	**1.47%**
Switzerland	2.94%	2.88%	4.39%	2.30%	1.73%	**1.44%**
Netherlands	2.84%	2.83%	3.35%	2.26%	1.70%	**1.41%**
Zambia	1.79%	2.78%	7.43%	2.22%	1.67%	**1.39%**
Poland	1.81%	2.69%	4.84%	2.15%	1.61%	**1.34%**
Sweden	3.25%	2.68%	5.91%	2.15%	1.61%	**1.34%**
South Africa	1.72%	2.66%	8.89%	2.13%	1.59%	**1.33%**
Lithuania	2.24%	2.66%	3.23%	2.12%	1.59%	**1.33%**
France	2.09%	2.63%	8.08%	2.11%	1.58%	**1.32%**
Uzbekistan	5.39%	2.60%	9.30%	2.08%	1.56%	**1.30%**
Nepal	3.16%	2.56%	27.78%	2.05%	1.54%	**1.28%**
Denmark	2.95%	2.56%	4.60%	2.05%	1.53%	**1.28%**
Sudan	0.03%	2.55%	20.88%	2.04%	1.53%	**1.28%**
Italy	1.81%	2.48%	7.87%	1.98%	1.49%	**1.24%**
Bolivia	2.68%	2.41%	9.38%	1.93%	1.44%	**1.20%**

Myanmar	0.17%	2.35%	10.59%	1.88%	1.41%	**1.17%**
Trinidad and Tobago	0.63%	2.27%	4.87%	1.82%	1.36%	**1.14%**
Tajikistan	0.32%	2.27%	15.31%	1.82%	1.36%	**1.14%**
Mozambique	0.92%	2.25%	5.54%	1.80%	1.35%	**1.12%**
Peru	1.54%	2.20%	8.72%	1.76%	1.32%	**1.10%**
Israel	2.64%	2.18%	7.42%	1.74%	1.31%	**1.09%**
Saudi Arabia	2.28%	2.16%	5.41%	1.73%	1.29%	**1.08%**
Belarus	1.94%	2.05%	2.89%	1.64%	1.23%	**1.02%**
Finland	2.63%	2.05%	5.28%	1.64%	1.23%	**1.02%**
Suriname	2.90%	2.03%	3.21%	1.63%	1.22%	**1.02%**
Colombia	1.70%	2.00%	12.25%	1.60%	1.20%	**1.00%**
Guatemala	1.43%	1.98%	11.13%	1.58%	1.19%	**0.99%**
Mexico	1.15%	1.95%	4.96%	1.56%	1.17%	**0.97%**
Djibouti	0.75%	1.93%		1.54%	1.16%	**0.96%**
Belgium	3.84%	1.91%	2.32%	1.53%	1.15%	**0.96%**
Ukraine	6.33%	1.73%	3.84%	1.39%	1.04%	**0.87%**
Ecuador	0.96%	1.73%	7.61%	1.39%	1.04%	**0.87%**
United Kingdom	2.41%	1.70%	5.66%	1.36%	1.02%	**0.85%**
West Bank and Gaza	5.17%	1.68%	8.44%	1.34%	1.01%	**0.84%**
Cameroon	2.37%	1.64%	8.67%	1.31%	0.98%	**0.82%**
Norway	4.28%	1.63%	4.27%	1.31%	0.98%	**0.82%**
Germany	2.64%	1.53%	3.22%	1.22%	0.92%	**0.76%**
Ghana	2.03%	1.52%	4.42%	1.22%	0.91%	**0.76%**
Indonesia	1.12%	1.50%	7.47%	1.20%	0.90%	**0.75%**
Kazakhstan	1.59%	1.48%	3.95%	1.18%	0.89%	**0.74%**
Brunei Darussalam	4.31%	1.40%	2.70%	1.12%	0.84%	**0.70%**
Guinea-Bissau	5.12%	1.37%	5.26%	1.10%	0.82%	**0.69%**
Romania	2.12%	1.36%	3.24%	1.09%	0.82%	**0.68%**
Chile	1.03%	1.33%	4.63%	1.07%	0.80%	**0.67%**

Canada	1.96%	1.28%	4.03%	1.03%	0.77%	**0.64%**
Nauru	5.65%	1.27%	5.14%	1.02%	0.76%	**0.64%**
United States	0.91%	1.25%	10.24%	1.00%	0.75%	**0.62%**
Korea, Rep.	2.15%	1.23%	2.74%	0.98%	0.74%	**0.61%**
Argentina	2.52%	1.15%	7.86%	0.92%	0.69%	**0.58%**
Russian Federation	2.34%	1.13%	3.68%	0.90%	0.68%	**0.56%**
India	0.95%	1.07%	5.43%	0.86%	0.64%	**0.54%**
Paraguay	1.36%	0.97%	2.72%	0.78%	0.58%	**0.49%**
Sierra Leone	1.49%	0.95%	5.16%	0.76%	0.57%	**0.48%**
Japan	0.57%	0.91%	4.87%	0.73%	0.55%	**0.46%**
Iraq	3.50%	0.89%	2.16%	0.71%	0.53%	**0.44%**
Lesotho	12.38%	0.88%	1.92%	0.70%	0.53%	**0.44%**
Guyana	2.06%	0.72%	1.75%	0.58%	0.43%	**0.36%**
Kuwait	10.18%	0.65%	1.08%	0.52%	0.39%	**0.33%**
Malawi	1.92%	0.61%	3.84%	0.49%	0.37%	**0.30%**
Angola	0.72%	0.53%	1.35%	0.42%	0.32%	**0.26%**
Nigeria	3.33%	0.50%	2.91%	0.40%	0.30%	**0.25%**
Eswatini	0.91%	0.35%	0.86%	0.28%	0.21%	**0.17%**
Brazil	1.19%	0.34%	2.30%	0.27%	0.20%	**0.17%**
China	2.04%	0.30%	1.52%	0.24%	0.18%	**0.15%**
Pakistan	0.92%	0.26%	2.71%	0.21%	0.16%	**0.13%**
Afghanistan	1.17%	0.26%	3.10%	0.21%	0.15%	**0.13%**
Bangladesh	0.44%	0.13%	0.81%	0.10%	0.08%	**0.07%**
Burundi	0.76%	0.13%	1.37%	0.10%	0.08%	**0.06%**
Congo, Dem. Rep.	0.24%	0.13%	0.38%	0.10%	0.08%	**0.06%**
Mauritania	0.73%	0.11%	0.29%	0.09%	0.07%	**0.06%**
Guinea	3.81%	0.07%	0.19%	0.06%	0.04%	**0.04%**

Source: Own representation of data from the World Development Indicators

Appendix 5: Global Health Security Index, Results Top 40 by Overall Score and Individual Indicators

Table 9: Global Health Security Index, Results Top 40 by Overall Score and Individual Indicators

OVERALL SCORE			1. PREVENTION OF THE EMERGENCE OR RELEASE OF PATHOGENS			2. EARLY DETECTION & REPORTING FOR EPIDEMICS OF POTENTIAL INTERNATIONAL CONCERN			3. RAPID RESPONSE TO AND MITIGATION OF THE SPREAD OF AN EPIDEMIC		
Rank		Score	Rank		Score	Rank		Score	Rank		Score
1	United States	83.5	1	United States	83.1	1	United States	98.2	1	United Kingdom	91.9
2	United Kingdom	77.9	2	Sweden	81.1	2	Australia	97.3	2	United States	79.7
3	Netherlands	75.6	3	Thailand	75.7	2	Latvia	97.3	3	Switzerland	79.3
4	Australia	75.5	4	Netherlands	73.7	4	Canada	96.4	4	Netherlands	79.1
5	Canada	75.3	5	Denmark	72.9	5	South Korea	92.1	5	Thailand	78.6
6	Thailand	73.2	6	France	71.2	6	United Kingdom	87.3	6	South Korea	71.5
7	Sweden	72.1	7	Canada	70.0	7	Denmark	86.0	7	Finland	69.2
8	Denmark	70.4	8	Australia	68.9	7	Netherlands	86.0	8	Portugal	67.7
9	South Korea	70.2	9	Finland	68.5	7	Sweden	86.0	9	Brazil	67.1
10	Finland	68.7	10	United Kingdom	68.3	10	Germany	84.6	10	Australia	65.9
11	France	68.2	11	Norway	68.2	11	Spain	83.0	11	Singapore	64.6
12	Slovenia	67.2	12	Slovenia	67.0	12	Brazil	82.4	12	Slovenia	63.3
13	Switzerland	67.0	13	Germany	66.5	13	Lithuania	81.5	13	France	62.9
14	Germany	66.0	14	Ireland	63.9	13	South Africa	81.5	14	Sweden	62.8
15	Spain	65.9	15	Belgium	63.5	15	Thailand	81.0	15	Spain	61.9
16	Norway	64.6	16	Brazil	59.2	16	Italy	78.5	16	Malaysia	61.3
17	Latvia	62.9	17	Kazakhstan	58.8	17	Greece	78.4	17	Canada	60.7
18	Malaysia	62.2	18	Austria	57.4	18	Ireland	78.0	18	Chile	60.2
19	Belgium	61.0	19	South Korea	57.3	19	Estonia	77.6	19	Denmark	58.4
20	Portugal	60.3	20	Turkey	56.9	20	Mongolia	77.3	20	Norway	58.2
21	Japan	59.8	21	Armenia	56.7	21	France	75.3	21	New Zealand	58.1
22	Brazil	59.7	22	Hungary	56.4	22	Georgia	75.0	22	Madagascar	57.8
23	Ireland	59.0	23	Chile	56.2	23	Argentina	74.9	23	South Africa	57.7
24	Singapore	58.7	23	Singapore	56.2	24	Saudi Arabia	74.4	24	Micronesia	56.9
25	Argentina	58.6	25	Latvia	56.0	25	Albania	74.3	25	Uganda	56.5
26	Austria	58.5	26	Croatia	55.2	26	El Salvador	73.9	26	Armenia	55.5
27	Chile	58.3	27	New Zealand	55.0	27	Slovenia	73.7	27	Serbia	55.1
28	Mexico	57.6	28	Greece	54.2	28	Austria	73.2	28	Germany	54.8
29	Estonia	57.0	29	Ecuador	53.9	28	Malaysia	73.2	29	Latvia	54.7
30	Indonesia	56.6	30	Slovakia	53.5	30	Chile	72.7	30	Indonesia	54.3
31	Italy	56.2	31	Georgia	53.2	31	Croatia	72.3	31	Japan	53.6
32	Poland	55.4	32	Spain	52.9	32	Ecuador	71.2	32	India	52.4
33	Lithuania	55.0	33	Portugal	52.8	32	Mexico	71.2	33	Hungary	52.2
34	South Africa	54.8	34	Switzerland	52.7	34	Laos	70.4	34	Albania	52.0
35	Hungary	54.0	35	Malaysia	51.4	35	Japan	70.1	34	Laos	52.0
35	New Zealand	54.0	36	Czech Republic	51.1	36	Kenya	68.6	36	Bosnia and Herzegovina	51.8
37	Greece	53.8	37	Poland	50.9	37	Indonesia	68.1	37	Peru	51.7
38	Croatia	53.3	38	Indonesia	50.2	38	Zimbabwe	65.6	38	Morocco	51.5
39	Albania	52.9	39	Vietnam	49.5	39	Kyrgyz Republic	64.7	39	Mexico	50.8
40	Turkey	52.4	40	Japan	49.3	40	Singapore	64.5	40	Argentina	50.6

4. SUFFICIENT & ROBUST HEALTH SYSTEM TO TREAT THE SICK & PROTECT HEALTH WORKERS

Rank		Score
1	United States	73.8
2	Thailand	70.5
3	Netherlands	70.2
4	Canada	67.7
5	Denmark	63.8
6	Australia	63.5
7	Switzerland	62.5
8	France	60.9
9	Finland	60.8
10	Belgium	60.5
11	United Kingdom	59.8
12	Spain	59.6
13	South Korea	58.7
14	Norway	58.5
15	Malaysia	57.1
16	Serbia	56.6
17	Portugal	55.0
18	Argentina	54.9
18	Slovenia	54.9
20	Sweden	49.3
21	Poland	48.9
22	Germany	48.2
23	Latvia	47.3
24	Mexico	46.9
25	Austria	46.6
25	Japan	46.6
27	Croatia	46.5
28	Iceland	46.4
29	Nicaragua	45.9
30	China	45.7
30	Turkey	45.7
32	New Zealand	45.2
33	Brazil	45.0
33	Peru	45.0
35	Saudi Arabia	44.8
36	India	42.7
37	Israel	42.2
38	Singapore	41.4
39	Bulgaria	41.0
40	Belarus	40.6

5. COMMITMENTS TO IMPROVING NATIONAL CAPACITY, FINANCING AND ADHERENCE TO NORMS

Rank		Score
1	United States	85.3
2	United Kingdom	81.2
3	Australia	77.0
4	Finland	75.4
5	Canada	74.7
6	Mexico	73.9
7	Indonesia	72.5
8	Lithuania	72.1
8	Slovenia	72.1
10	Liberia	71.5
11	Sweden	71.3
12	Thailand	70.9
13	Japan	70.0
14	Argentina	68.8
15	Estonia	67.6
16	Kenya	67.1
17	Ethiopia	65.8
18	Switzerland	65.6
19	Uganda	65.4
20	Kyrgyz Republic	64.8
21	Vietnam	64.6
22	Norway	64.4
23	South Korea	64.3
23	Turkey	64.3
25	United Arab Emirates	63.4
26	Peru	63.0
26	Portugal	63.0
28	Denmark	62.6
29	Germany	61.9
29	Italy	61.9
31	Bulgaria	61.5
32	Netherlands	61.1
32	Spain	61.1
34	Uzbekistan	60.5
35	Colombia	60.1
36	Cambodia	60.0
37	Cameroon	59.9
38	Belgium	59.7
39	New Zealand	59.4
40	Myanmar	59.1

6. OVERALL RISK ENVIRONMENT AND COUNTRY VULNERABILITY TO BIOLOGICAL THREATS

Rank		Score
1	Liechtenstein	87.9
2	Norway	87.1
3	Switzerland	86.2
4	Luxembourg	84.7
5	Austria	84.6
6	Sweden	84.5
7	Andorra	83.5
8	Monaco	83.1
9	France	83.0
10	Canada	82.7
11	Germany	82.3
12	Netherlands	81.7
13	Iceland	81.2
14	Finland	81.1
15	Singapore	80.9
16	San Marino	80.5
17	Denmark	80.3
18	Australia	79.4
19	Belgium	78.2
19	United States	78.2
21	Ireland	77.4
22	Portugal	77.3
23	New Zealand	77.2
24	Spain	77.1
25	Uruguay	74.8
26	United Kingdom	74.7
27	South Korea	74.1
28	Czech Republic	74.0
29	Slovenia	73.7
30	Estonia	73.3
31	United Arab Emirates	72.4
32	Malta	72.3
33	Malaysia	72.0
34	Costa Rica	71.7
34	Japan	71.7
36	Slovakia	71.5
37	Seychelles	71.1
38	Chile	70.1
39	Barbados	69.9
40	Cyprus	69.6

GHS INDEX RESULTS

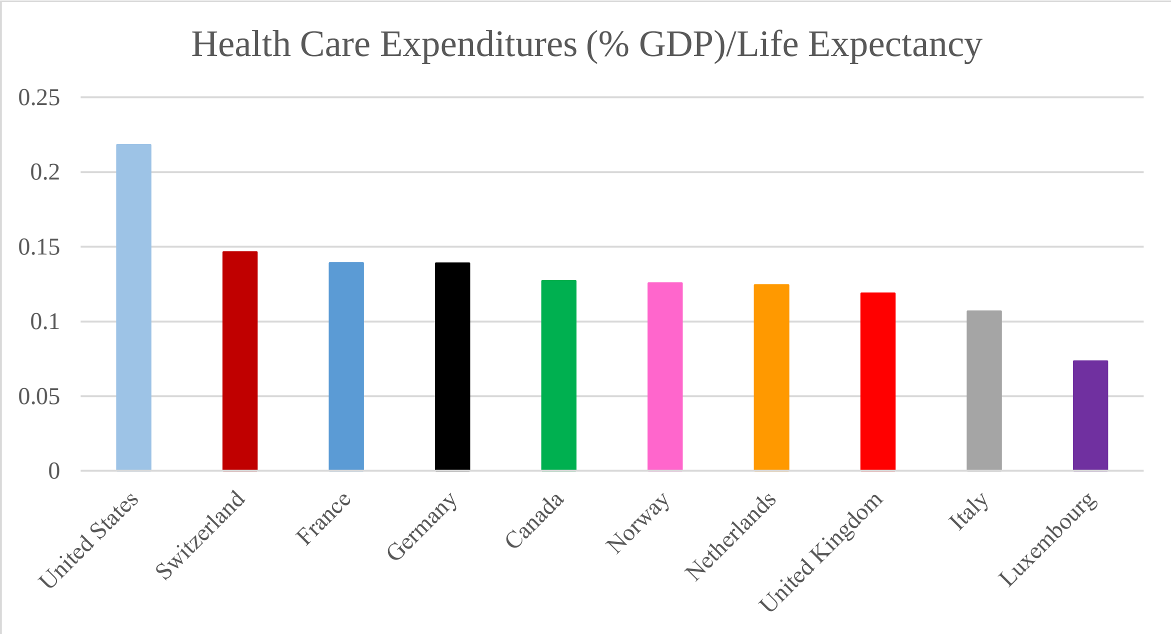
All data are normalized to a scale of 0 to 100, where 100 = best health security conditions.

- Most prepared
- More prepared
- Least prepared

Source: Global Health Security Index, NTI/Johns Hopkins University (2019)

Appendix 6: Health System Comparison, US and Western Europe

Figure 6: Health Care Expenditures as Percentage of GDP/Life Expectancy for Selected Countries, 2016



Source: WELFENS (2019)

The figure above, based on WELFENS (2019), shows the variation between health care expenditures (expressed as a percentage of gross domestic product) and estimated life expectancies. One can clearly see a significant difference between the US and western European countries (selected EU member states and Switzerland). The cause for this is the higher spending on health care and lower life expectancy in the use, raising questions about the efficiency of the US health care system.

International coordination of the US in the field health policy has been weakened by internal decisions of the Trump Administration. One feature of the US Trump Administration is that the senior director, Rear Admiral Timothy Ziemer, of Global Health and Biodefense on the National Security Council left the Trump Administration in May 2018. In a letter to the National Security Adviser Robert O'Brien, dated February 18, 2020, a group of 27 senators proposed that a new global health security expert should be appointed to the NSC. On February 26, 2020, President Trump appointed Vice President Pence to head the anti-pandemic efforts of the Administration relating to COVID-19.

Appendix 7: Regression Country List and Source Data

Stata	*Variables*	*Measures*	*Units*	*Source*
gdppc	GDP per capita	PPP (current international $)	$ millions	World Bank
ghs_o	GHS Index	overall score		NTI/Johns Hopkins (2019)
ifdi	FDI inflows	US dollars at current prices	$ millions	World Bank
ofdi	FDI outflows	US dollars at current prices	$ millions	World Bank
exports	Exports of goods and services	US dollars at current prices	$ millions	World Bank
imports	Imports of goods and service	US dollars at current prices	$ millions	World Bank
gdp	GDP	US dollars at current prices	$ millions	World Bank

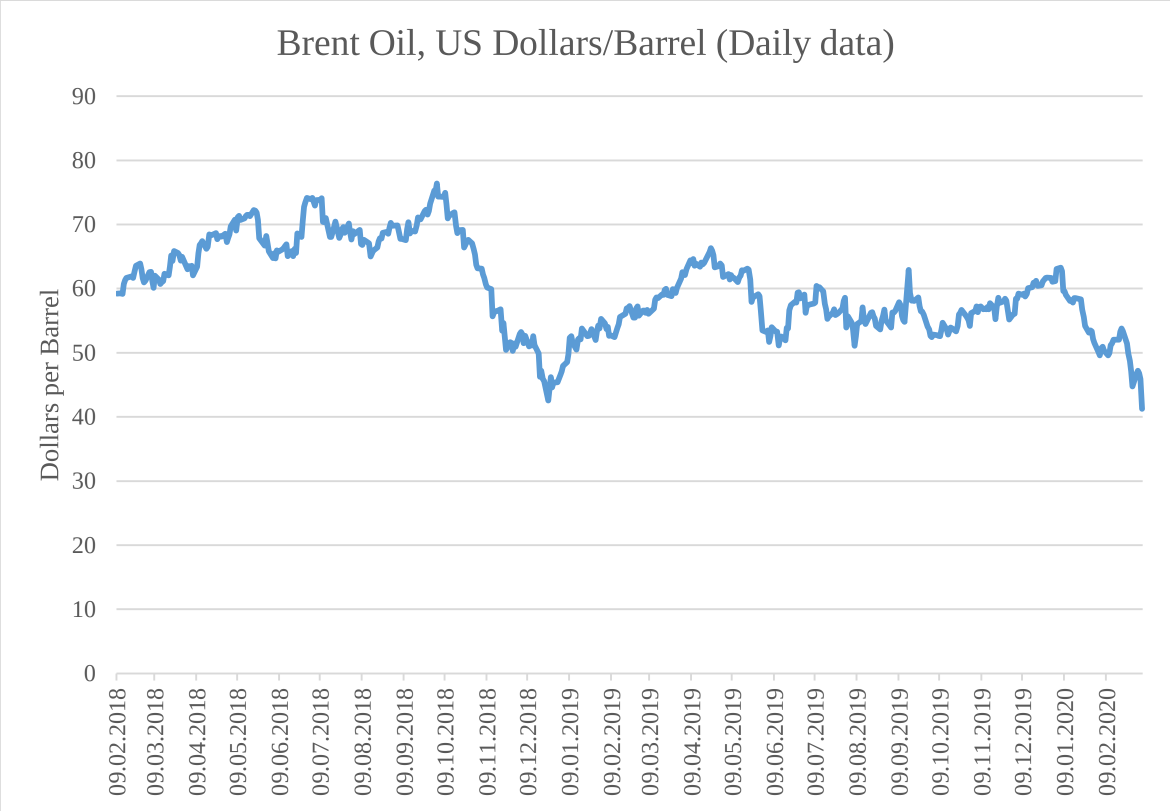
Country List

Afghanistan	Dominican Republic	Libya	Seychelles
Albania	Ecuador	Lithuania	Sierra Leone
Algeria	Egypt	Luxembourg	Singapore
Angola	El Salvador	Madagascar	Slovakia
Antigua and Barbuda	Equatorial Guinea	Malawi	Slovenia
Argentina	Estonia	Malaysia	Solomon Islands
Armenia	Eswatini	Maldives	South Africa
Australia	Ethiopia	Mali	South Korea
Austria	Fiji	Malta	Spain
Azerbaijan	Finland	Mauritania	Sri Lanka
Bahamas	France	Mauritius	St. Kitts and Nevis
Bahrain	Gabon	Mexico	St. Lucia
Bangladesh	Gambia	Moldova	St. Vincent and The Grenadines
Barbados	Georgia	Mongolia	Sudan
Belarus	Germany	Montenegro	Suriname
Belgium	Ghana	Morocco	Sweden
Belize	Greece	Mozambique	Switzerland
Benin	Grenada	Myanmar	Tajikistan
Bhutan	Guatemala	Namibia	Tanzania
Bolivia	Guinea	Nepal	Thailand
Bosnia and Herzegovina	Guinea-Bissau	Netherlands	Timor-Leste
Botswana	Guyana	New Zealand	Togo
Brazil	Haiti	Nicaragua	Tonga
Brunei Darussalam	Honduras	Niger	Trinidad and Tobago
Bulgaria	Hungary	Nigeria	Tunisia
Burkina Faso	Iceland	North Macedonia	Turkey
Burundi	India	Norway	Tuvalu

Cabo Verde	Indonesia	Oman	Uganda
Cambodia	Iraq	Pakistan	Ukraine
Cameroon	Ireland	Panama	United Arab Emirates
Canada	Israel	Papua New Guinea	United Kingdom
Central African Republic	Italy	Paraguay	United States
Chad	Jamaica	Peru	Uruguay
Chile	Japan	Philippines	Uzbekistan
China	Jordan	Poland	Vanuatu
Colombia	Kazakhstan	Portugal	Vietnam
Comoros	Kenya	Qatar	Yemen
Congo, Rep.	Kiribati	Romania	Zambia
Congo, Dem. Rep.	Kuwait	Russia	Zimbabwe
Costa Rica	Kyrgyz Republic	Rwanda	
Cote d'Ivoire	Laos	Samoa	
Croatia	Latvia	Sao Tome and Principe	
Czech Republic	Lebanon	Saudi Arabia	
Denmark	Lesotho	Senegal	
Dominica	Liberia	Serbia	

Appendix 8: Oil Price Developments

Figure 7: Brent Oil Prices, US Dollars per Barrel (Daily Data), 09.02.2018 – 06.03.2020



Source: Own representation of data available from finanzen.net

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