

## A rough google translation of the so-called German "Panic Paper" from early 2020

### How can we get COVID-19 under control

#### 1. The Situation and the strategy

The pandemic COVID-19 virus is the greatest challenge for politics, society and the economy in Germany and Europe since the end of the Second World War. A look at the data from Asia and the reports from neighboring European countries show that underestimating the magnitude of this challenge will lead to immense, irreversible damage.

Most virologists, epidemiologists, doctors, economists and political scientists answer the question "what happens if nothing is done" with a worst-case scenario of over a million deaths in 2020 - for Germany alone. A team of experts from RKI (Robert Koch Institute, German Equivalent of the CDC ) RWI (Economic research institute and think tank in Essen, Germany), IW (German Economic Institute a private think tank), SWP (German Institute for International and Security Affairs, a government-linked think tank), University of Bonn University of Nottingham Ningbo China (many professorial links to Gates Foundation), University of Lausanne and University of Kassel confirms these figures with an overall model developed for Germany.

Avoiding this worst case therefore has top strategic priority and, according to the calculations and recommendations of this team of experts, is not only absolutely necessary, but also always possible.

What should be done?

1. **Communication:** The worst case, with all the consequences for the population in Germany, must be clearly, resolutely and transparently made clear.
2. **Unity:** Avoiding the worst case is to be defined as a central political and social goal. Politics and citizens must act as a unit.
3. **Comprehensibility:** The citizens must be able to understand that the following measures can only be implemented with their help for their well-being.

- a) Social contacts are to be reduced to a minimum for a certain period of time (social distancing) and an end to these measures must be made dependent on the comprehensible public impact of these measures.
- b) The effect of the measures can best be made comprehensible to all citizens in real time by expanding the testing. Citizens with self-suspicion and the entire circle of contacts of citizens who tested positive should be tested consistently. Extensive testing enables the citizens affected by exit restrictions to act actively in crisis management. We have to switch from the method “we test to confirm the situation” to the method “we test to get ahead of the situation” (South Korea proves this impressively). Central recording of all tests carried out and future tests is essential. A determination of the national test capacity (capacity of tests, medical personnel for implementation, evaluation) and their greatest possible increase are overdue. This allows a shared observation of the spread and containment with all citizens. Step-by-step intervention in economic and social processes that is appropriate to the situation is only made possible in this way and the acceptance and sensibility of measures that restrict freedom is increased.
- c) Even if the epidemic is successfully contained, the capacity for the necessary medical care must be increased. The situation will be made worse by the fact that not only intensive medical care for the seriously ill with ventilators, but also for those with moderate illnesses, an outpatient and inpatient oxygen supply will be necessary (China proves this).
- d) The federal government must start a comprehensive mobilization campaign. The current crisis caused by COVID-19 is a severe blow to trust in the institutions. This has to be counteracted because the government has to become a mobilizing factor. Motto: «Something very threatening is coming our way, but we have recognized the danger and act decided and considered. We need all forces in society to come together and work. Then we will still avert the danger ». In order to mobilize societal perseverance, hiding the word case is not an option. Whoever wants to avert danger has to know it.

## **2. Modelling calculations and the search for a strategy**

The main reason why the great danger posed by COVID-19 was not seen until recently is the difficulty of intuitively understanding exponential growth. A modeling should help to understand the dynamics of COVID-19. To do this, we need to know, among other things, the speed of spread and the mortality rate of the virus. Since the beginning of the outbreak in Wuhan (PR China), the mortality rate of the virus has been repeatedly downplayed with reference to a possible "dark figure". Asymptomatic and mild cases have rarely been tested and would therefore reduce the actual mortality rate even further if these unknown cases were factored in. This and other arguments have long led to an underestimation of the danger posed by the virus. It was only the dramatic situation in Italy that led to a rethink in some cases, although unfortunately all indicators suggest that the high point of new infections there is still a long way off. If unsuccessful containment measures are taken, the situation there is likely to worsen by more than a power of ten in terms of number of cases and deaths, even in the hardest hit regions.

The estimate of the mortality rate can best be done with the data from South Korea. There, the various outbreaks were successfully brought under control with minimal exit restrictions, primarily through efficient testing and isolation. This would not have been possible if there were a significant number of unreported cases. There was never a call for self-isolation in the case of mild symptoms, which would not have achieved much in the flu season and in the case of a virus that is contagious for a very long time. The systematic search for contact also tested a large number of people who had no symptoms at all. Therefore, a very small number of unreported cases can be expected in South Korea. The case mortality rates per age group can therefore be regarded as a good reference, which can still be easily increased, since deaths are still reported regularly, although few new cases are added. These figures are also coherent with the figures from China outside Hubei, which has been tested much more intensively. For the distribution of the cases across the various age groups and the age pyramid in South Korea, the mean case mortality rate is currently 1.1%. Adjusted to the age structure for Europe, a mean case mortality rate of 1.8% is obtained with the best hospital care.

The data from South Korea should therefore be viewed as minimum values for the final case mortality rate once an outbreak has subsided and all infected are cured or dead. During the exponential expansion one can assume a preliminary (English: naive) case mortality rate of around 1%. In a very moderate scenario, the RKI is currently assuming a mortality rate of 0.56 %. In the further modeling, a case mortality of 1.2% is used.

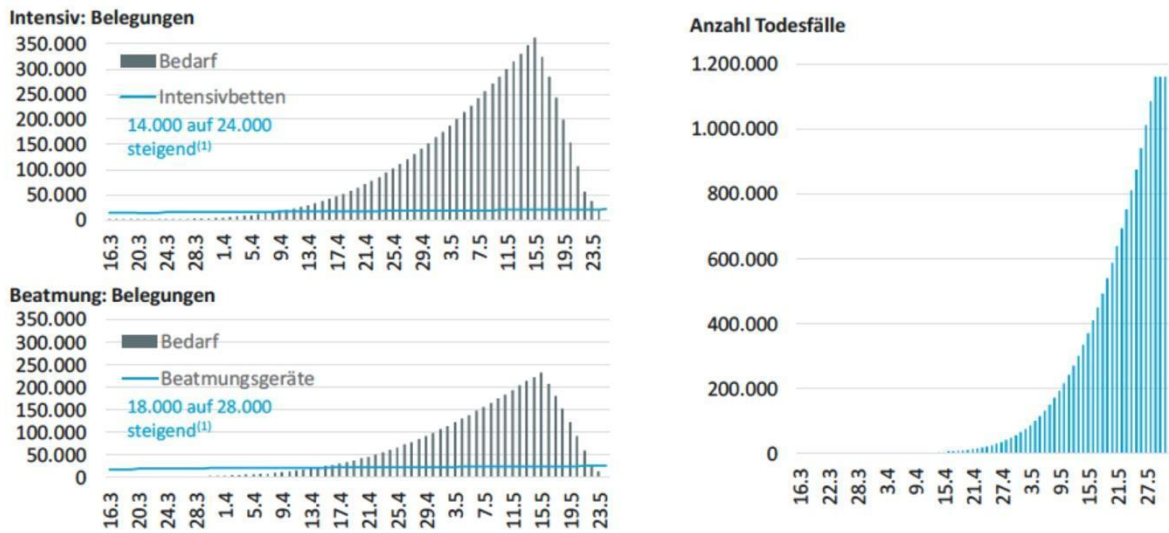
We assume that 5% of the infected people have to be hospitalized and of these, 30% require intensive medical care and a further 20% require at least ventilation using appropriate equipment. The RKI assumes a hospitalization rate of 4.5%, of which

25% will require intensive care. In addition, we assume that the length of stay in the intensive care unit is ten days if the patients are transferred as quickly as possible to the extreme to be able to use scarce resources for the next patient. We set nine days for ventilation on a ventilator and eight days for patients who need hospitalization without such support. The mortality rates are depending on the type of action differentiated. In relation to the total number of infected persons, it is 1.2% with good hospital care in the model and 2.0% with rationing due to insufficient hospital care - in each case related to the population of all infected persons.

In terms of hospital care capacities, we assume that there are currently 14,000 intensive care beds available for people infected with COVID-19. Another 14,000 are available for patients with other diseases. However, these may not be sufficient to provide adequate care for emergencies (e.g. heart attacks, strokes, etc.). We also assume that there are 18,000 ventilators for people infected with COVID-19 and almost 300,000 beds in hospitals and rehabilitation clinics. We also assume that it will be possible to gradually increase these numbers over the next few weeks - to 24,000 "free" intensive care beds, 28,000 ventilators and an additional 60,000 beds in hotels and exhibition halls.

With regard to the speed of spread, the number of reported infected cases in Germany currently seems to double roughly every three days. Initial measures to reduce physical contact, such as the prohibition of large events and the minimization of travel activities, should lead to lengthening the time until the number of infected people has doubled. In the worst-case scenario, we assume that the doubling time will increase from three to six days by April 14 - and to nine days by the end of April. Under these worst case assumptions, the number of infected people will nevertheless increase rapidly and relatively soon make up 70% of the population. A massive overload of the health system is therefore to be expected (Figure 1). Over 80% of intensive care patients would have to be turned away by the hospitals due to a lack of capacity. It is taken into account that additional intensive care beds and ventilators will be made available in the near future. The rationing phase could last two months. In this scenario, more than a million deaths could be expected.

Abbildung 1: Szenario „Worst Case“

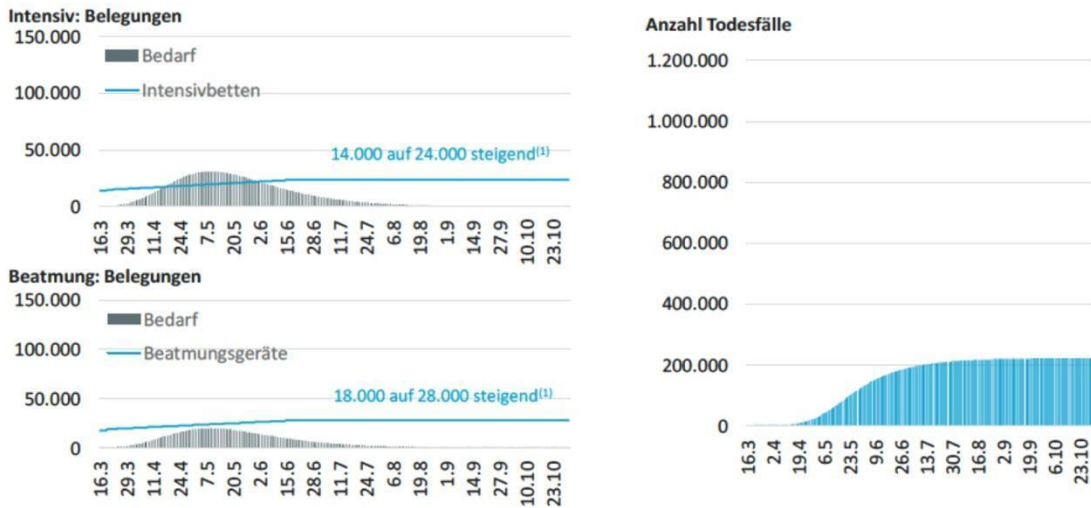


	Anzahl	Anteil	Anteil	Höchste	Rationierung	Abzu-
		Bevölk.	Infizierte	Auslastung	Ab	Dauer (d)
Insgesamt Infizierte	57.411.181	69,3%		132%	9,5	9
Todesfälle	1.159.441	1,40%	2,02%	950%	14,4	39
Abklingen: unter 1.000 Neu-Infizierte ab		11,5		1768%	9,4	45
Gesamtdauer ab 16 3. in Tagen		56				

In order to avoid this worst case and to achieve a more positive stretching out of cases, the measures to reduce physical contact must be much more far-reaching. If it is possible to extend the period of time up to doubling to six days by the beginning of April and continue at this rate to nine days by mid-April, it will be possible to strain the capacities of the healthcare system significantly less. Nonetheless, we expect the intensive capacities to be overutilized at a rapid rate. In total, however, "only" around 15% of the patients with an obligation to the patient had to be refused (Figure 2). Ventilators, however, were always sufficiently available. This statement applies under the premise that there are many devices and in intensive care beds will be made available in the next few days and weeks.

However, the state of emergency will last much longer than in the worst case mentioned above, in the case of seven months in mode II. Only around 20% of the population would then be infected with the virus. The number of deaths was estimated to be around 220,000. The negative macroeconomic effects of the case-stretching, however, were of enormous magnitude (see below).

Abbildung 2: Szenario „Dehnung“



	Anzahl	Bevölk.	Anteil Infizierte	Anteil Todesfälle
Insgesamt Infizierte	17.437.760		21,1%	
Todesfälle	221.914		0,27%	1,27%
Abklingen: unter 1.000 Neu-Infizierte ab		9.10		
Gesamtdauer ab 16.3. in Tagen		207		

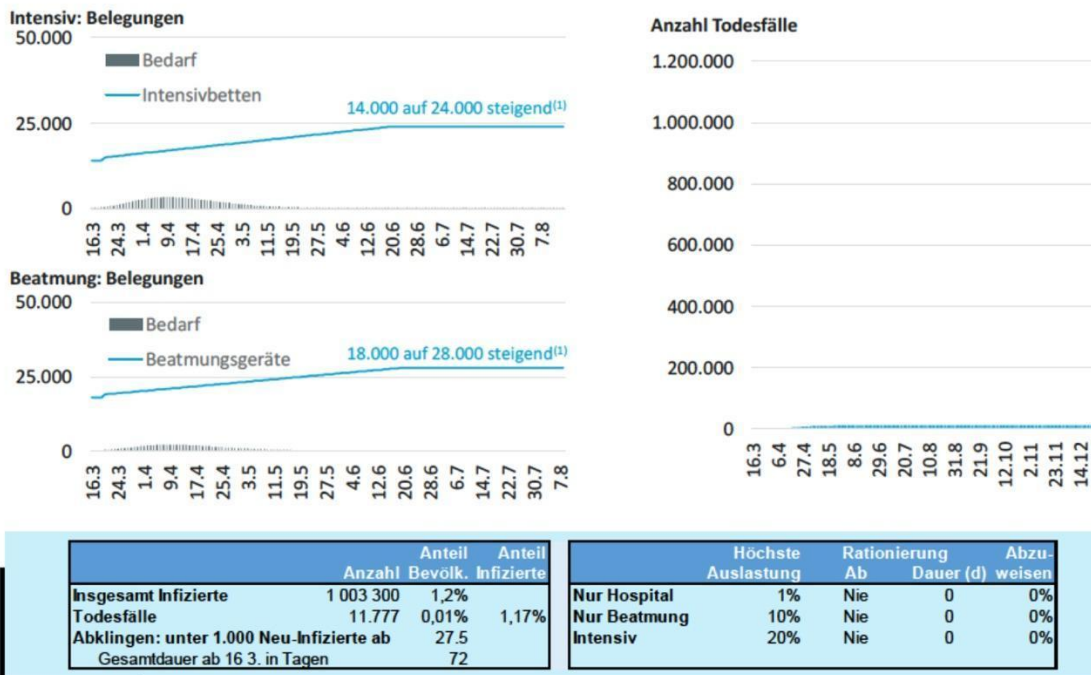
  

	Höchste Auslastung	Rationierung Ab	Dauer (d)	Abzuweisen
Nur Hospital	11%	Nie	0	0%
Nur Beatmung	83%	Nie	0	0%
Intensiv	158%	17.4	46	16%

Finally, we consider the scenario "Hammer and Dance" (Figure 3), described below and mostly discussed internationally among experts. If it is to succeed, extensive testing and isolation can effectively prevent the spread of the virus, the effects were much milder. In the present model, around one million people were infected, but only around 12,000 died. The mortality rate was 1.2%. In total, this condition could last about two months. However, if only a very small part of the population were at least immune to the currently prevailing virus, a high level of vigilance had to be maintained afterwards.

Figure 3: "Hammer and Dance" scenario

Abbildung 3: Szenario „Hammer and Dance“



### 3. Economic and social consequences

The German economy is a high-performance machine that provides a high degree of material wealth and public goods such as comprehensive health care and public safety that are accessible to all citizens year after year. Their efficiency is based on a high degree of division of labor inside and outside the country. The prerequisite for this is that the majority of all existing companies and employees are operational and the integrity of the overall system is not questioned.

This is exactly what makes the economy as vulnerable as a high-performance engine, because only the simultaneous functioning of all of its components ensures the functionality of the entire system. In normal operation, moderate economic fluctuations can be effectively smoothed out over time, primarily through social security systems. As long as the machine is running more or less at full speed, minor system malfunctions are not a serious problem. Each working day more or less then translates into a slightly larger or smaller amount in the final invoices and smaller GDP. This “normal world” has now been suspended, we are on uncharted territory.

If the measures proposed here to contain and control the Covid-19 epidemic do not work, the entire system could be called into question in the sense of a "meltdown". There is a risk that this will change the community into a completely different basic state, leading to anarchy. Accordingly, it would be naive to assume that a double-digit percentage decline in GDP, say beyond 20%, would mean a linear extrapolation of the losses from the absence of a few working days and would otherwise not call the system as a whole into question. For this reason, the strategy of containment - which dominates all other considerations - must be combined with precautions in order to keep the economic consequences as low as possible.

An essential prerequisite for this is that the strategy to contain and control Covid-19 is actually implemented consistently. If one were to proceed too hesitantly, there would also be a threat of overloading the capacities of health care as with an initially successful but then loosened strategy too early. The only viable option should therefore be the establishment of a two-stage strategy: It requires 1) the strict suppression of new infections implemented as quickly as possible until the reproduction rate is close to 1, and 2) includes a comprehensive and consistent system of individual testing and isolation of the identified cases.

That would allow the rest of the economy to quickly return to almost normal operations and open the prospect that this crisis will not be bigger than the economic and financial crisis in 2009. It would of course be best if this second stage could be initiated immediately so as to avoid economic losses. But that is not possible, the test capacities have to be built up first. As long as that has not happened, the only thing left is the "mallet" ("The Hammer") of strong social distancing, regardless of the exact state of infection of all those affected.

The time that is bought with this first stage must be rigorously linked to the development of the test strategy for the second stage. From an economic point of view, it is important to provide households and companies with acute support services during this time and to create the basis for the conditions for a restart of economic activities to be in place when entering the second stage. The provision of extensive financial resources for the financial sector can only be part of setting the course for economic policy. Because various factors make the current crisis (even with comparable rates of contraction) more serious than the economic crisis of 2009. The crisis of that time originated in the financial sector and particularly affected industry. The COVID-19 crisis is having a broader impact on economic life, is also affecting service providers and will therefore have a stronger impact on the labor market. At the same time, the stabilization measures in 2009 could be concentrated on the financial sector as a systemically important key element. Such a "quarantine" of a



sector is impossible with COVID-19. Even with comparable rates of contraction, the COVID-19 crisis will be broader, deeper and longer than the financial crisis.

### **Economic development scenarios**

This conclusion can already be illustrated by means of rough calculations that ignore various adjustment processes and complications. The estimates presented here are based on national accounts-based bottom-up estimates of the significance of the crisis for the various economic sectors. Macroeconomic modeling is deliberately not sought here, as its functionality is doubtful for the current situation in view of the considerable and, above all, dynamic changes in numerous variables. The values determined for the development of GDP and value added in industry are based on numerous settings and assumptions. Each one is vulnerable in itself, but they serve to determine an initial overall picture in different scenarios. The settings are rather conservative, so they represent the upper middle of the possible developments and are not worst-case scenarios.

The decisive factor is that the scenarios do not differ or only differ indirectly according to the spread of the virus infection in Germany, but rather according to the politically enforced and medically necessary reactions to it. The duration of the interruption of the normal division of labor and market processes (here national) is the decisive influencing factor.

#### **Scenario 1: "Quick control"**

The first scenario assumes that the spread of the epidemic can be slowed down after an initial period of exit restrictions and that the number of cases will drop significantly within six weeks. This corresponds to a period until the end of the Easter holidays and is therefore largely the same as the current status quo, possibly supplemented by the implementation of assembly bans. A further restriction by exit restrictions is not assumed here. In view of the economic consequences, but also the social inequality consequences of longer-term homeschooling, it is urgently necessary to bring kindergartens and schools back to normal operations after the Easter break. In the further course, the infection is controlled through intensive testing, follow-up and isolation, possibly banning major events or selective interventions. Social and economic life is largely returning to normal. This scenario corresponds to the positive experiences from East Asia.

After the phase of exit restrictions of 1.5 months, a further month of massive disruptions due to closed borders and the associated interrupted supply chains is assumed for major industrial sectors. This assumes that the pandemic has a comparable time profile, at least in Europe; The developments in the USA gives rise to particular uncertainties, but there is less wholesale dependency.

The phases of the slump are followed by two months with reduced disruption, during which economic activity gradually returns to normal. It will be another three months before catch-up effects are taken into account, which in each of these months compensate for a third of the economic management lost in a crisis month.

This scenario results in a drop in GDP of 4 percent compared to the reference scenario and is to be seen as an economic best case. For industry this means a minus of 9 percent. For comparison: During the global economic crisis of 2009, GDP fell by 6 percent, and industrial value added by 19 percent. The state budget would have to pay more and less revenue in the order of 80 billion euros. The developments assumed here therefore lead to a somewhat weaker decline in GDP than in 2009, while the service sector would be more severely affected. The downside risks contained therein make it plausible, however, to assume a downward trend that is broadly comparable to the global economic crisis.

### **Scenario 2: "Return of the crisis"**

The second scenario assumes that with exit restrictions of two months it will be possible to massively contain the spread of the infection. Afterwards, a largely normal economic life is possible. However, in the second half of the year the epidemic will return in no less dramatic dimensions. Such a development can also be expected for the following year.

Economic activity would be considerably reduced in the months of the exit restrictions and gradually return to normal in the following two months. Due to the expected renewed outbreak of the disease, there are no catch-up effects. Two months with exit restrictions and two months of recovery are also assumed in autumn.

For the economy as a whole, this scenario means a decline of 11 percent, for industry a minus of 19 percent. In industry, this is similar to the crisis of 2009; in the service sector, the decline is much more pronounced. However, this scenario is much more critical than the crisis of 2009 because a double wave of infections would also be expected in the coming year. The crisis would therefore last twice as long, which would not be comparable to 2009 and the subsequent boom in 2010.

### **Scenario 3: "long suffering"**

The third scenario assumes that it will not be possible to contain the epidemic quickly. Exit restrictions of four months are necessary, up to the summer vacation in mid-July. Thereafter, no significant restrictions on economic life are made. Accordingly, it is

assumed that economic activity will be significantly subdued for four months and that it will return to normal in another two months. In three more months there will be catch-up effects, but only to a lesser extent due to the experience of the crisis and the high level of uncertainty.

For the economy as a whole, a decline of 9 percent is to be expected, for industry of 15 percent. This is likely to be an optimistic assumption. Possible self-reinforcing effects that occur with the long duration of the crisis are not taken into account here. If a systematic downward spiral develops, not just a slump to a lower level that will then be stable for four months, deeper cuts are to be feared; this also applies to a further extension.

#### **Scenario 4: "Abyss"**

The fourth scenario assumes an uncontrolled and uncontrollable development. It is not possible to contain the virus epidemic. Exit restrictions are set for the rest of the year. This means a permanent reduction in economic activity to a lower level. A further decrease in economic output is assumed after four months with exit restrictions.

In this situation, GDP would collapse by 32 percent and industry by 47 percent. If the second-round effects continue to intensify and negative expectations become more firmly established, an accelerated downward trend could not be ruled out. This scenario is tantamount to an economic collapse, the social and political consequences of which are hard to imagine.

#### **Assessment**

Despite all the uncertainties, the estimates show that under all circumstances scenario 1 ("quick control") must be worked towards. Scenario 4 ("abyss") would be an unimaginable economic catastrophe that would lead to socially unimaginable consequences. Presumably the treatment of the sick would be called into question rather than a permanent shutdown of the land would be accepted. Scenario 3 ("long suffering") threatens to become one if the exit restrictions are extended further and further and to transform into scenario 4 ("abyss"). On this path it is never clear whether it leads into the abyss - this will unleash negative dynamics that accelerate downward developments. Scenario 2 ("return of the crisis") represents a strong contraction without a return towards the old level in the next year.

Scenario 1 ("quick control") gives the chance to come out of the crisis with an economic balance sheet that is similar to the global economic crisis of 2009. This is bad enough, but it would be a glimmer of hope. It is crucial that, on the one hand, the exponential spread of the virus can be stopped and the infection rate ( $R_0$ ) reduced to below 1 before Easter. On the other hand, it must be possible to prevent a return to

uncontrolled waves of infection through interventions that do not destroy economic and social life in Germany. To do this, the infection rate must be kept at a maximum of approx. Comprehensive testing, the identification of contact persons via electronic movement profiles, the isolation of sick people and suspected cases, and possibly the prevention of major events or access restrictions for facilities for the elderly can all contribute to this. Permanent or even longer exit restrictions must, however, be avoided.

### **Necessary economic policy measures**

Phase I of the COVID-19 fight was initiated at the latest with the partial exit restrictions from March 16, 2020 with school closings, mobility restrictions, business closings, office and production closings etc. and tightened by assembly bans etc. In order to lower the incidence rate after the end of the exit restrictions (phase II) and then to keep it at a stable level so that another uncontrolled outbreak can be prevented, extensive health policy measures are necessary (see Section 4).

These measures and the structures required for them must be implemented and built up at short notice in order to be able to credibly enter phase II after the Easter holidays. A return to previous economic and social life can only be guaranteed with a foreseeable end of the exit restrictions.

In order to limit the economic damage beyond that, the following economic policy measures are necessary, some of which have already been decided:

--It has already been decided to extend short-time work to limit unemployment, as in the 2009/10 financial crisis. This also reduces companies' solvency risks.

--Liquidity support to ensure the short-term viability of the companies concerned via development banks (loan support) and tax deferrals, as already decided.

--Direct company transfers, limited in time for companies that are stuck in the supply shock and demand shock at the same time and that, beyond the liquidity problems, have been hit economically by the COVID-19 crisis.

--Participation in companies through a sovereign wealth fund: the economic stabilization fund that is now being planned should also provide for capital participation in large companies. State participation must be given a clear perspective of an exit after the crisis. At the level of the federal states, responsibility for small businesses lies solely because of their proximity and the administrative advantages.

--Tax relief to limit massive losses caused by the economic crisis. There are opportunities here for a positive impetus from the crisis, which can also be seen as the starting signal for a renewed upswing.

--Stabilization of municipal finances, which will come under massive pressure due to additional spending in the wake of the public stalemate and the expected collapse in trade tax. The federal states must meet their responsibilities here.

--Economic measures after the end of the crisis, when demand-side stimuli are necessary.

A particular economic and political challenge is likely to be that the exit from the crisis mode with a largely standstill of public life demands the various industries differently.

--If the restrictions on public life can be gradually lifted after Easter, the areas of consumption are likely to be reactivated quickly. People want and can consume. In most cases, government aid would be limited to bridging liquidity plus one-off transfers.

--In many, especially company-related service areas, business activities could then also start again, e.g. Auditor, inspection, car service. For postponable services such as For construction work, the expectation of sustainable stabilization is crucial.

--The internationally active companies are limited in the crisis phase both by a lack of supplies, especially from abroad, and by the unavailability of workers. The latter will relax when the schools and daycare centers open again; for the former, a contribution can only be made through the availability of transport capacities etc. at national level.

--The asymmetry with regard to the time profiles of the economic crisis in other economies remains a persistent burden for an internationally interlinked economy like the German one. This is where companies are in demand for their flexibility to adapt. However, this would also mean that international companies would be able to rely on economic policy support for a longer period of time (for example through equity investments).

Against this background, the economic policy response to the current crisis cannot remain purely national. Likewise, it is not enough to leave responsibility for the European dimension of the economic policy response to the European Central Bank (ECB) alone. What is needed is a coordinated fiscal strategy at European level. These efforts must include financial support for other EU countries that would otherwise be financially overburdened by the containment of the crisis (especially Italy). In addition

to the ECB's PEPP, other instruments must therefore be used, such as existing or new credit lines from the European Stability Mechanism ESM or COVID-19 joint bonds. The discussion about the specific instruments should not obscure the need for a coordinated fiscal strategy.

#### **4. Conclusions for action and open communication**

##### **4a. Emphasize the worst case!**

We need to get away from communication that is centered on the case mortality rate. With a case mortality rate that sounds insignificant in terms of percentage, which mainly affects the elderly, many people then, unconsciously and unacknowledged, think to themselves: “Well, this is how we get rid of the elderly who are dragging our economy down, we are already too many on earth, and with a bit of luck I will inherit a little earlier». These mechanisms have certainly contributed to downplaying the epidemic in the past.

In order to achieve the desired shock effect, the specific effects of a on human society must be made clear:

- 1) Many seriously ill people are taken to hospital by their relatives, but rejected and die in agony at home, gasping for breath. Suffocating or not getting enough air is a primal fear for everyone. The same applies to the situation in which there is nothing you can do to help relatives who are in mortal danger. The pictures from Italy are disturbing.
- 2) "Children are unlikely to suffer from the epidemic": Wrong. Children are easily infected, even with exit restrictions, e.g. with the neighborhood children. If they then infect their parents and one of them dies in agony at home and they feel that they are to blame for, for example, forget to wash their hands after playing, it is the most terrifying thing a child can ever experience.
- 3) Consequential damage: Even if we only have reports on individual cases so far, they paint an alarming picture. Even those who have apparently cured after a mild course can apparently experience relapses at any time, which then suddenly end fatally, due to a heart attack or lung failure, because the virus has found its way into the lungs or heart unnoticed. These may be isolated cases, but will constantly hover like the sword of Damocles over those who were once infected. A much more common consequence is fatigue and reduced lung capacity that lasts for months and probably years, as has been reported many

times by SARS survivors and is also the case now with COVID-19, although the duration cannot of course be estimated yet.

In addition, historical arguments should also be made, according to the mathematical formula: 2019 = 1919 + 1929

One only needs to illustrate the figures presented above with regard to the assumed mortality rate (more than 1% with optimal health care, i.e. well over 3% due to overload when infected), compared to 2% with the Spanish flu, and with regard to the too expected economic crisis if containment fails, then this formula will make sense to everyone.

#### **4 b. Output “worst case avoidance” as a strategic goal for Germany and the EU**

It should be clear to everyone that individual countries in the EU can hardly be successful alone in the fight against the virus. The economic and human exchange is far too close. Political shock waves know no borders. A meltdown in a single EU Member State would have widespread effects. That is why the EU needs an active role here more than ever. Germany can take on a pioneering role here not only politically, but also organizationally and industrially, both in containing the epidemic (production / procurement of test kits and PCR machines, development of mobile test stations) and in measures to mobilize society to cushion it the social and political consequences.

#### **4c. Communicate action plan for the population**

##### **4c 1 High Test Capacity**

By far the most important measure against a virus like SARS-CoV-2 is to test and isolate the infected person. Both people with self-suspicion and the entire circle of contact persons of people who tested positive should be tested. If the test capacity is insufficient, testing can be limited to patients with severe pneumonia and post mortem in all suspected cases in order to be able to determine at least the number of deaths precisely. Any lack of testing, however, is certain to result in rapid exponential spread of the virus.

The test capacity to be aimed for (here assuming simultaneous strict exit restrictions over several weeks) can be determined using rules of thumb (provisional findings must be refined). In the exponential phase, one can assume a preliminary (naive) case mortality rate (deaths divided by confirmed cases) of 1% in European countries if the majority of all cases are found by testing. If the case mortality is below this value, it must be assumed that the number of deaths is not counting correctly. If the case mortality is above that,  $dead * 100$ , we'd have to find that many cases. To find them,

under very good conditions, you need 20 \* more tests than the number of cases you want to find. Sample calculation Germany at the end of March: we estimate that the actual number of deaths is 500-1000 (heavily underreported). This means that 50,000 to 100,000 cases would have to be found. If you want to find a large part of it, you need e.g. 100,000 to 200,000 tests per day over the course of 10 days, or half of them over 20 days (which increases the period with exit restrictions and increases the risk of failure).

As soon as the estimated necessary testing capacity is reached, the number of newly found cases per day will initially skyrocket. If the estimate was correct, it comes down again after the time span (e.g. after 10 days). If not, the necessary test capacity was underestimated and urgently needs to be increased in order to achieve the desired result.

Testing requires innovative solutions in order to make both the evaluation in the laboratory and the collection of throat swabs less time-consuming. Protecting those in contact with potentially infected people is extremely important. This was done in South Korea with drive-in and telephone cell test stations where the throat swabs are carried out by the person to be tested, without direct contact with the test staff. In order to send a positive signal to the population and to solve the problem of access to the test stations, especially for people without their own car, mobile test stations in the form of delivery vans could also be developed. Overpressure inside the car (through air filters or provisionally through compressed air bottles) prevents viruses from entering. The throat swabs are bagged, sealed, disinfected with alcohol and stored in a laboratory chapel, all actions being carried out through rubber gloves. In this way, approaching the population can also be signaled and presence in all neighborhoods can be marked.

The massive testing must be supported by an efficient contact search for people who have tested positive, with some of this being done manually according to the procedure that the RKI already suggests ("Who were you in contact with for five days before the symptoms began?"). In order to make testing faster and more efficient, the use of big data and location tracking is inevitable in the long term.

Anyone who tests positive must be isolated, be it at home or in a quarantine facility; this has to be clarified in more detail. Even single quarantine at home (without roommates) can easily lead to further infections in the same apartment block if handled improperly.

As soon as these measures have been implemented, they can immediately contain the small outbreaks that are likely to flare up again and again relatively inexpensively over several years.



#### 4 c 2 Lessen social contacts

Measures for “social distancing” are needed to support massive testing and especially with relatively large numbers of cases (more than a few dozen per day) or if the test capacity cannot be ramped up quickly enough: working from home, banning mass events in sports and Culture, the closure of schools and universities, the closure of even small social events such as sports clubs, the closure of restaurants and bars, the closure of all non-vital shops and the closure of all non-vital businesses.

Everyone can assess the effects of each measure himself: the point is to reduce the possibility of infection. If there are football games with 50,000 participants in a big city from time to time, but millions of people meet on public transport every day, closing football games is hardly more than symbolic, especially when there is a virus that hardly is hardly contagious beyond 2 meters.

In the current phase of the epidemic, we can (hopefully) assume that the test capacity can be ramped up very quickly. On this basis, it is better to have a very sharp but short period of exit restrictions only until the testing and isolation measures take effect. A longer period of exit restrictions cannot be maintained economically or socially.

A probably plausible but optimistic schedule for Germany in the next few weeks could look like this: consisting of a combination of testing and isolation with accompanying strict but short exit restrictions. The reproduction factor at generation = 4 indicates how fast the virus is spreading:  $R = 2.2$ : unchecked exponential spreading (\* 2.2. Every four days);  $R = 1$ : linear expansion.  $R < 1$ : epidemic decline.

First cautious estimate of the course of the containment strategy against Covid-19

Zeitrahmen	Reproduktionsfaktor	Massnahmen
Vor 16. März	$R=2.2$	nur sehr lockere Präventivmassnahmen
Ab 16. März	$R=1.6$	Schulschliessungen, Social Distancing
Ab 23. März	$R=1.2$	Umfassende und striktere Ausgangsbeschränkungen
Ab 6. April	$R=0.8$	Testkapazität massiv hochgefahren auf 50.000 pro Tag

Ab 13. April	R=0.5	Testkapazität auf 100.000 pro Tag
Ab 20. April	R=0.8	Schrittweise Lockerung der Ausgangsbeschränkungen; Wiederaufnahme des Schulbetriebes, sobald dies ohne erneutes Aufflammen der Epidemie möglich ist
Ab 27. April	R=0.5	Testkapazität auf 200.000 pro Tag, effiziente und gut ein- gespielte Kontaktsuche von Hand und durch Big Data (Lo- cation Tracking usw.)

\* The information on R in this table are estimated values based on observational data from all countries for which reliable data are available, as well as from specialist publications. When modeling the course of the epidemic, these values are input parameters. Simulations cannot determine the value R and its change during the epidemic more precisely; they always remain initial assumptions.

With regard to the number of new cases found every day, we expect that it will only decrease from April 13th or maybe even from April 20th (apparently inflection point), since we have a large backlog of cases that have not yet been found, which is only slowly when the test capacity is increased needs to be worked up. We expect the actual inflection point of the infections on April 6th.

#### **4 c 3 beds and increase oxygen capacity**

Even if the epidemic is successfully contained, the existing capacity for the necessary hospital care can easily be overwhelmed. Efforts should not concentrate on the abstract concept of "beds in the intensive care unit", but rather on the specific infrastructure required, in particular on the oxygen supply and the number of ventilators as well as the corresponding staffing. The peak of the corresponding need is only reached about three weeks after the peak of new infections has been reached.

#### **4 c 4 Jointly distanced: Social sponsorship of the Covid-19 containment through a Germany-wide and transparent awareness and mobilization campaign**

The current crisis caused by COVID-19 has the potential to permanently shake trust in the democratic institutions in Germany. This can and must be counteracted. This works best when the state - federal, state and local authorities - acts proactively and in a coordinated manner and thus becomes active and visible not as a "paralyzing" but rather as a mobilizing factor. The most important communication message from state actors: the virus is a risk for everyone. It will change our lives in the short, medium and long term. We have recognized the risk, work together on all levels, orientate ourselves on the scientific and practical evidence and act decisively but not in a panic.

Only with the coming together and the action of all forces in society can we slow down the number of new infections and ultimately contain the virus. To do this, the state needs the help of all citizens; only then can we contain the virus as quickly as possible and guarantee democratic coexistence (both politically, socially and economically).

This requires comprehensive and coordinated information and clarification as well as concrete instructions from all state authorities. We have to assume that a considerable part of the population, who is informed by media reports and social media, suspects that at the moment the number of cases and the number of deaths are far underestimated. The message that the test capacity is now being massively increased is presumably received with relief. The announcement that this could lead to a sharp rise in the number of cases and deaths in the short term is also likely to be expected. It is important to make it clear right from the start and to communicate aggressively that successful measures will only have an impact on the number of new infections found and the number of deaths after a considerable delay.

In addition to comprehensive information and clarification from state authorities, the state is particularly dependent on solidarity from civil society. This “together” has to be considered and communicated with. This requires a common narrative (#wirbleibenzuhause, or «distant together» - «physical distance - social solidarity») and, in the best case, many faces (celebrities, politicians, scientists) who can talk about and identify with the campaign.

The mobilization campaign for (even) stronger civil society solidarity is aimed at two different communities: the physical neighborhood community and the online community. The neighborhood community is mobilized to help with the care of people in home quarantine and to shield risk groups. Here it is important to include the large number of civil society institutions, for example the church associations, as well as political foundations (local offices) and associations (e.g. sports clubs, rifle clubs, neighborhood helpers, etc.). Direct contact with this community can be established through mobile test stations, so that the community is practically on the doorstep in constant contact with the local health authorities charged with containing the epidemic. At the same time, support offers can be created for them (apps for communication, coordination). We should already thank these helpers politically and ask them to step up their activities and at the same time praise them for their own initiative. However, networking and coordination is important so that the aid can be efficiently coordinated.

The online community also has a very important role to play. Without mobilization and solidarity, it increases the spread of false information and can lead to

radicalization. However, part of the community can safely be involved in cushioning the social impact of exit restrictions, protection of risk groups and quarantine. There are already important offers in this regard; these should and must be expanded (medical care, psychological offers or simply shared leisure activities online). Here, too, civil society institutions can help (see above) as well as celebrities (e.g. We Kick Corona initiative by Joshua Kimmich and Leon Goretzka, #wirbleibenzuhause). A call for a joint «fact check» of information and further hackathons would also be conceivable in order to overcome the challenges using digital approaches. Here, too, it is important to foster a feeling of “mutual distance”.

Older people can also find their way around with smartphones and social media relatively easily, but often need technical help and, above all, personal advice on how to successfully navigate the various platforms. In order to counter a generation conflict (millennials infect older people), children, adolescents and young adults could and should be actively involved in the awareness-raising and information campaign.

Only with social cohesion and mutual distance from one another can this crisis not only be overcome with not too great a loss, but also be future-oriented for a new relationship between society and the state.