CPB Netherlands Bureau for
Economic Policy Analysis

The effect of the pandemic and Non-Pharmaceutical Interventions on household consumption

During the pandemic, consumption has depended on the health risks and the non-pharmaceutical interventions (NPIs) that have restricted economic activity. Because NPIs lower health risks, despite lowering consumption in the short-run, over the longer-run NPIs may increase consumption compared to not intervening.

Most of the short-run decline in consumption during the first wave was a voluntary response to the health risks.

CPB Background Document

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1 Introduction

This background document contains more detailed evidence underpinning the points made in the box in the November forecast (CPB, 2020). As with the box, this background document asks what we can learn from the consumption response during the first wave for subsequent waves and whether non-pharmaceutical interventions (NPIs) face a trade-off between consumption and health? Since some NPIs involve closing certain sectors or placing supply restrictions on others, it seems intuitive that NPIs that restrict economic activity lower consumption. Indeed, compared to what would have happened without a pandemic, NPIs clearly lower consumption. However, that's not the correct counterfactual – the correct counterfactual is what would have happened to consumption in an otherwise identical world with a pandemic but without the NPIs. Recently published cost-benefit analyses for the Netherlands (Kolen, 2020, en Frijters, 2020) assume that most or all of the consumption decline would not have happened without NPIs. This background document reviews the available evidence for this assumption.

To make a plausible counterfactual we need to dissect the mechanisms behind the consumption changes. Roughly speaking there are three interacting processes at work. Firstly, household consumption depends directly on the pandemic. The higher the health risks associated with a given type of consumption, the less households will undertake those types of consumption. If going shopping comes with a 1% probability of severe health consequences or even death, many households will not go. This will have knock-on effects on the income and consumption of those employed in these sectors. The second mechanism is that governments have imposed NPIs, such as closing sectors or limiting the number of customers in specific sectors. Clearly, if all restaurants are closed, households can't spend money eating out. Finally, the third mechanism is that government imposed NPIs lower the number of infections (how much NPIs lower the number of infections is the subject of some debate, see for example, Flaxman et al. 2020 or Atkeson et al. 2020). The NPIs have a direct effect on consumption by reducing the possibilities to consume but may also increase future consumption by reducing the health risks associated with consuming. The overall effect on consumption over the entire course of the pandemic is the net effect of all three mechanisms.

Two types of evidence that have been published to look into the effects of NPIs on consumption: data driven empirical evidence and theory driven structural models. Each type have their strengths and weaknesses and neither give a definitive answer on their own. However, looking at both allows us to get a better answer to whether NPIs increase or lower consumption.

Empirical evidence from the current pandemic focusses on estimating the short-run effects of NPIs by comparing consumption in the weeks before and the weeks after they were implemented. Some use these estimates to decompose the observed consumption declines in the first wave into a component caused by voluntary behavioural changes and a component caused by NPIs. These studies give us detailed information about which households voluntarily reduced consumption and by how much. However, since these studies do not model the effect of NPIs on infection rates, they do not allow for the construction of a counterfactual for what would happen to consumption over longer periods without NPIs.

Since the current pandemic is still ongoing, evidence about the effects of NPIs over the longer-run depends on empirical evidence from past epidemics and theoretical models that link economic processes to the progression of the pandemic. These theoretical models do allow the construction of counterfactuals for what would happen without NPIs. However, these models are highly stylised and make simplifying assumptions at odds with real world observations. Given their highly stylised nature, this document will only briefly introduce some of the models and discuss how relaxing some of their restrictive assumptions may alter their conclusions.

This document is structured as follows. Before delving into the analysis, some clarifying remarks explaining what this document takes into account are in order. Section 2 gives a stylised description of why a counterfactual is so important. Thereafter section 3 presents the empirical literature that decomposes the observed declines in consumption or economic activity in the first wave into voluntary reductions or the direct effects of NPIs. Section 4 discusses evidence about the longer term effects of NPIs from past pandemics and theoretical models and discusses the relevance of their results. Section 5 discusses how the direct effects of NPIs and the voluntary consumption reductions may differ in subsequent waves before the final section offers some concluding comments.

Clarifying remarks

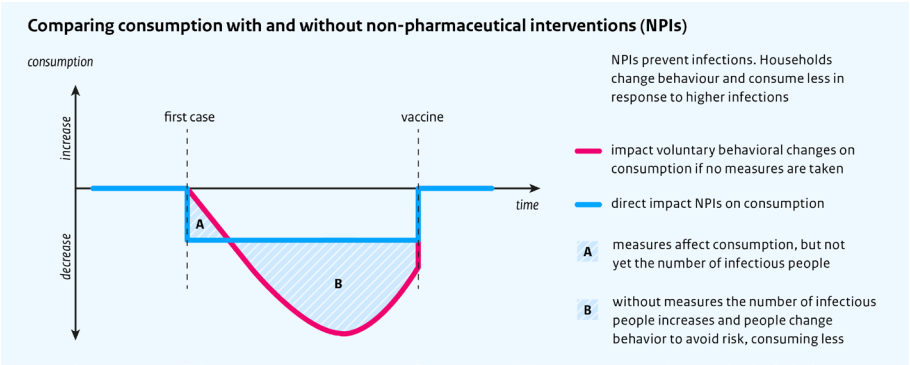
Firstly, this document focuses on the possible trade-off between NPIs and measured economic activity. It is not an analysis of optimal policy because it does not take into account the value people put on health or on liberty. These are clearly both important and need to be taken into account when policy makers choose the appropriate level of NPIs. Secondly, this background document is primarily a macro picture based on aggregate data. Clearly the pandemic has impacted some groups harder than others. For example, people working in hospitality have been hit much harder than those who can work at home and young people on flexible contracts have been hit harder than 40 year olds on permanent contracts. Except where these differences are key to the macro effects, this memo will ignore them. Thirdly, this background document focuses mainly on packages of NPIs rather than individual interventions.

2 The importance of the correct counterfactual

Estimating the consumption and output consequences of NPIs is not straightforward because we do not observe what would have happened without NPIs. Figure 1 gives a stylised representation of two extreme cases. Firstly, the blue line shows the consumption effect in a country where the government imposes 100% effective NPIs that lower $R_t<1$[1] when the first case is identified and keeps them in place until a vaccine is available. The NPIs keep infections at a negligible level such that households can ignore health risks. In this extreme case, only the NPIs affect consumption and consumption remains lower until they are removed. The second case given by the red line represents what would happen if no NPIs are undertaken and infections are allowed to increase naturally. As the number of infections increase, consumption activity is associated with higher and higher health risks, so households reduce consumption to lower these risks.

[1] R_t indicates the average number of people each infected person infects at time t.

Figure 1 Short and long-run effects of non-pharmaceutical interventions



Whether this hypothetical package of NPIs has a net positive or negative effect on consumption over the period until a vaccine arrives depends on the difference between the path of the red line and the blue line in figure 1. The blue line is the economy treated with NPIs and the red line represents a control economy that is identical except for the NPIs. Comparing the red and the blue line illustrates the short and longer-run effects of NPIs on consumption. Initially when the NPIs are imposed they have no immediate effect on the number of infectious people but they do lower consumption. This short-term effect is shown by area A. As time goes by, the NPIs reduce the number infectious people below what would happen if the NPIs were not imposed. Eventually the health risks associated with consumption may lower consumption by more than the NPIs would have done. This longer-term effect is shown by area B. If area A is bigger than area B, then these NPIs have a net negative effect on consumption and vice versa. Nonetheless, without compensation, the costs of the NPIs are born by different people (restricted sectors like hospitality) than those who benefit from increased consumption later (non-restricted sectors). However, if area B is bigger than area A it's possible to transfer some of the gains to those who lose in a way that leaves everyone better off than without NPIs.

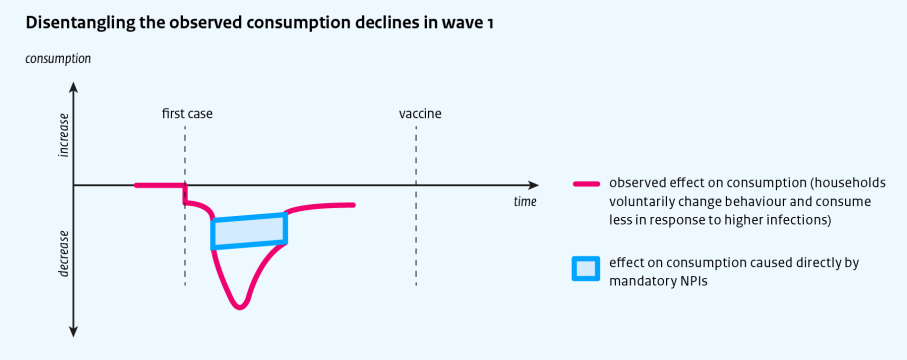
3 Empirical evidence from the first wave

There are a number of empirical studies that have attempted to disentangle the direct effects of NPIs on consumption or economic activity from the effects of voluntary reductions in consumption. Before describing in more detail what these studies find, it is instructive to have a clear idea of what these studies actually show.

Figure 2 gives a stylised representation of what happened to consumption in the first wave. We observe the net effect of both NPIs and voluntary changes together, which in figure 2 is given by the red line. Some of the total effect is the direct effect of NPIs, which is given by the blue box. In almost all countries, sometime after the first cases was discovered in each country, governments implemented NPIs. In the period before NPIs were implemented, voluntary social distancing had already started reducing consumption (Chetty et al. 2020; Chen et al. 2020), hence the stylised red line is already below the baseline before the NPIs are implemented. Once the NPIs were implemented, consumption and economic activity fell further. Measuring the jump depicted by the blue box gives an empirical estimate of the short-run consumption effects. For a number of weeks after the NPIs were implemented case numbers, hospital admissions and deaths kept increasing, which kept lowering consumption. Eventually, the combination of NPIs and voluntary social distancing reduced $R_t<1$ and the number of infections and associated health risks fell. As the number of infections fell, consumption increased

before the NPIs were gradually removed (in the stylised figure all of the NPIs are removed at once). The removal of NPIs also gives an opportunity to measure their short-run effects by measuring the jump in consumption when they are removed.

Figure 2 Short-run effects of NPIs are measured by the consumption fall when they are implemented



Some published studies go further than measuring the discrete jumps caused by changing NPIs. They report which share of this observed fall in consumption or economic activity in the first wave was due to NPIs vs voluntary social distancing. It's worth emphasising that if NPIs were 100% effective and were implemented on or before the first cases such that no health risks were perceived, these studies would say that 100% of consumption declines could be attributed to the NPIs even if without the NPIs health risks would have lowered consumption by much more. As such, these empirical studies do not tell us if NPIs increase of lower consumption because they ignore the longer-term effects. They do, however, give us an upper bound on the consumption effects of NPIs and tell us how much consumption responds to the pandemic itself. This later allows us to say something about how much consumption would fall without NPIs.

Of the empirical studies that have been performed, perhaps the most impressive is Chetty et al. (2020). Chetty et al. (2020) use low-level data on transactions from the US where different states and counties implemented and relaxed NPIs at different times. Across the US there was also a wide range of infection rates at any given time. Because of the variation in timing of NPIs and infection rates, this data allows Chetty et al. (2020) to compare regions with similar infection rates that did and did not implement NPIs – they conclude that the NPIs only had a small effect on consumption. What's perhaps more impressive about the detailed data they use is that they can explain why the short-run effects were small because they have data on the types of people who changed spending in the pandemic. They find that most of the consumption fall was caused by high income households responding to health risks. By reducing spending on high risk activities, high income households lowered the incomes of lower income households working in those activities, who subsequently lowered spending on a wide range of activities. They conclude that it is unlikely aggregate consumption will recover until higher income households are convinced the health risks have become small.

Drawing lessons from the US for the Netherlands is not always appropriate because the Dutch economy has a more generous safety net and a different policy response. Nonetheless, similar results to Chetty et al. (2020) using transactions data have been reported for the Netherlands by Golec et al. (2020). They compare the effects of NPIs with voluntary changes in transactions at municipality level in the Netherlands. They find that for every unit increase in NPI strictness on a scale of 0-100, the value of consumer transactions fell by 0.05%. In contrast, one additional hospitalised Covid-19 case in a municipality lowered transactions by 2.79%. Given that there are 355 municipalities in the Netherlands and that at the peak of the first wave over 400 people were

admitted to hospital every day, these results suggest that most of the decline in consumption in the first wave can be attributed to voluntary changes in consumption rather than NPIs.[2]

In addition to these studies on transactions, a growing number of studies have found similar results in a wide range of countries using different measures of consumption or economic activity. For the EU, Chen et al. (2020) use electricity usage and mobility data[3] from Google and conclude that voluntary changes in behaviour explain the majority of the differences in economic activity across regions and that NPIs haven't had a significant effect. Gupta et al. (2020) use mobility data for US states and show that economic activity fell significantly even in states that did not impose significant NPIs. They conclude that most of the reduction in mobility was voluntary.

Other studies report explicit shares for the proportion of the observed consumption declines due to NPIs vs voluntary activity reduction. Goolsbee and Syverson (2020) report that only about 12% of the observed reduction in mobility in the US can be attributed to NPIs and the remaining 88% is voluntary. Chen, Qian and Wen (2020) report similar findings for China. When pooling data across all advanced economies IMF (2020) report that about 60% of the reduction in economic activity is due to voluntary behavioural changes. By using a dynamic model, IMF (2020) show that economic activity recovers more quickly after NPIs than after voluntary social distancing. One explanation for this is that NPIs lower the rate of infections more quickly than voluntary social distancing does, leading to a faster recovery in consumption once health risks have fallen. Similarly low estimates for the contribution of NPIs to observed consumption declines have been reported for South Korea by Aum, Lee and Shin (2020a and 2020b) and for Japan by Watanabe and Yabu (2020) even though both these countries had much lower infection rates than Western countries.

One possible exception is Sweden. In contrast to most countries, Sweden relied more heavily on voluntary measures and their economy performed better than average among OECD countries in the first wave. However, the OECD average isn't necessarily the most appropriate benchmark to compare Sweden to. To address this issue, Born, Dietrich and Müller (2020) compare Sweden to a synthetic control created from a weighted average of countries made to closely match Swedish economic performance before the crisis. They find a compulsory lockdown in Sweden would have increased the GDP contraction by about 20% in the first half of 2020, whilst reducing infections by 75% and deaths by 50%. The size of this extra short-term output loss from a stricter lockdown is very similar to the micro data estimates from other countries.

At this point in time there would appear to be a consensus in the literature from a wide range of countries that voluntary changes in behaviour explain the majority of the fall in consumption and economic activity in the first wave. Whilst these studies typically find that NPIs have had a short-term effect on consumption, the NPIs only account for a small proportion of the observed declines. In contrast, consumption responds a lot to health risks.

[2] Since the restrictions were implemented nationally in the Netherlands and most of the increased economic uncertainty the pandemic brought with it reflects macroeconomic uncertainty, the NPI variable in Golec et al (2020) likely also captures the effect of uncertainty on economic activity.

[3] Fernandez-Villaverde and Jones (2020) show that changes in mobility are highly correlated with changes in GDP. The key advantage of using mobility data to proxy economic activity is that it is available on a daily basis. Since it is available on a much higher frequency than GDP it allows researchers to more accurately determine which changes took place before or after NPIs were announced.

4 NPIs over the longer-run

Whilst the short-run empirical evidence described above provide invaluable insights, they don't allow us to estimate a counterfactual over the entire duration of the pandemic. For that we can look at past epidemics and pandemics or we need a structural model linking economic decisions to the spread of the virus. Evidence from previous pandemics such as the Spanish flu pandemic of 1918-20 or more recent epidemics also suggests that NPIs don't have a large effect on consumption over the entire duration of a pandemic. In the Spanish flu, Correia, Luck and Verner (2020) found that US states that implemented stricter NPIs earlier had smaller output losses. In 21st century pandemics, such as SARs, MERs, swine flu and Ebola, Ma, Rogers and Zhou (2020) report that output losses were smaller in countries that managed to keep the death rate lower. Unfortunately, neither Spanish flu or the more recent epidemics are similar enough to the corona pandemic to be a reliable guide to the effect of NPIs over the entire duration of the pandemic. Spanish flu killed many young and working age people and the economy was significantly different 100 years ago. The more recent epidemics were much smaller than the current pandemic.

The other approach is to include economic behaviour into epidemic modelling, which is a new field in economics but with a growing number of studies. Nonetheless, as should be expected for such a young field, the models are highly stylised and abstract from many real world features of the pandemic that are likely to be quantitively important. For example, few models include a mechanism whereby infection risk lowers consumption through voluntary choices – most earlier models generated a link between the economy and the pandemic by assuming infected individuals and those who die don't produce any output. For example Acemoglu et al. (2020) show that imposing NPIs can lower deaths and increase output compared to doing nothing by reducing the number of people absent from work. Empirical evidence such as Chetty et al. (2020) show that this mechanism is relatively unimportant. Epidemiological models with economic behaviour also typically assume that NPIs and voluntary social distancing are identical and equally effective at lowering infections for a given amount of foregone consumption. In other words, policy makers don't have better information about the transmission of viruses and individuals don't have better real-time information about the level of risk (ie. how crowded a bar or restaurant is). Furthermore, these models typically ignore the discrete jump in health risks that occurs when healthcare systems are overwhelmed and they ignore the possibility of reinfection from mutated strains of the virus.

Even with these restrictive assumptions in place these models find relatively small trade-offs between health and consumption. For example, Bognanni et al. (2020) explicitly model a mechanism whereby households voluntarily reduce consumption and other economic activity in the face of infection risk. Specifically, the health risk associated with consumption or going to work is proportional to the number of infected people who are economically active and is calibrated to US data from the first wave. They find a small trade-off if eradication isn't possible – small enough that if effective vaccines will be available within 2-3 years the value of lives saved easily outweigh the reduction in economic activity. A similar model for the US by Brzezinski et al. (2020) finds that simply by adding medical costs to the consumption declines, NPIs lower the economic costs of the pandemic.

5 Lessons for subsequent waves

The main determinant of consumption declines in subsequent waves are likely to be the health risks the pandemic brings with it. Nonetheless, thinking about an appropriate counterfactual allows us to consider how the consumption effects of subsequent waves will differ from the first.

Subsequent waves can differ from the first through both how NPIs affect consumption and how consumers respond directly to the virus. Firstly, in subsequent waves we know more about the virus and which NPIs are most effective for a given restriction on people's lives. For example, we may learn that an intervention like facemask mandates are highly effective at reducing transmission but with minimal direct impact on economic activity (Karaivanov et al. 2020). We may also get better at implementing the existing NPIs so that each NPI is more effective at reducing transmission and the associated health risks for a given reduction in economic activity. For example, the testing and isolation system may be more effective in subsequent waves than in the first, or firms may become better at selling over the internet.

The voluntary social distancing response may also differ in subsequent waves. Firstly, since the first wave treatments have improved, such as the use of Dexamethasone (Matthay and Thompson, 2020) or placing patients in a prone position (Zang et al. 2020). As such the health risks associated with a given level of infections has declined. Presumably this will lead to less voluntary reduction in economic activity. Furthermore, people who have been exposed to the virus in the first wave likely have some degree of immunity or think they won't get seriously ill if infected again because they didn't the first time. This confidence about idiosyncratic health risks will likely lead to less voluntary social distancing (Asimakopoulou et al. 2020). Another factor that could reduce the consumption response in subsequent waves is that in the first wave there was a lot more uncertainty about the virus than there is today. For example, we have much more information that the health risks for those under 40 years old appear to be small. As such, in subsequent waves under 40s may reduce their economic activity less than in the first wave when this wasn't so clear. The consumption response could also be smaller if large numbers of people have become bored with the virus and choose to ignore it.

On the other hand, the consumption response could be bigger. During the first wave the prospects for a vaccine were much more uncertain than today. In contrast to March 2020, we know now that effective vaccines will be available and they will be available to most people much sooner than was initially expected. As such, any households contemplating postponing consumption until after a vaccine arrives have significantly less time to wait. Postponing a wedding for 6 months is much more palatable than postponing for 2 years. Additionally, if people under 40 reduce their economic activity less, which increases transmission, people over 50 may reduce their economic activity more. Since over one-third of the population of the Netherlands is over 50 and that 50-70 year olds have higher incomes than 20-30 year olds, increased economic activity from young people may reduce overall consumption. For example, 20-30 year olds may go out and spend €20 in a bar, so 50 year olds don't go out to a restaurant for a €200 meal or even decide to postpone buying a new car for €30,000.

6 Conclusion

In the short-run, NPIs that restrict economic activity face a trade-off between health and consumption, although the evidence so far from a wide range of countries say that NPIs have only a relatively small short-run effect on consumption. Whether the longer-run benefits of NPIs reducing infections is enough to outweigh the short-run costs of NPIs is still unclear but cannot be ruled out. Over the period until enough people have been vaccinated for the virus to be eradicated, if policy makers face a trade-off between health and consumption it is much smaller than the observed decline in consumption would imply because a large share of the consumption declines are caused by the health risks.

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