Economic Commentaries

Efficient vaccination against COVID-19 entails major macroeconomic benefits

Magnus Lindskog and Ingvar Strid[1]
The authors work in the Riksbank's Monetary Policy Department.

If an efficient vaccination means that the coronavirus pandemic can be shortened by a month, the gain for the Swedish economy is estimated at around SEK 25 billion in terms of GDP. However, depending on how the spread of infection looks prior to vaccination is complete, it could be between SEK 15 and 40 billion. The savings in the public sector are estimated at SEK 20 billion.

The coronavirus pandemic has entailed major economic costs for Sweden and other countries in 2020, in the form of lower GDP and higher unemployment, for instance. At present, the spread of infection is rapid, but the development of a vaccine against COVID-19 has increased optimism that the end of the crisis is in sight.

Vaccination of the population means that the share of those that are immune increases and the spread of infection can be stopped. When society returns to normal, the wheels of the economy can begin grinding faster once again.

We make rough estimates of the economic value of an effective vaccination.

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Governments and other responsible parties in Sweden and other countries have announced that the vaccination against COVID-19 will be safe and as rapid as possible. In this Commentary, we discuss how large the positive effects on gross domestic product (GDP), employment and public finances could be if the pandemic is shortened by one month with the aid of a vaccine. This depends, for instance, on how quickly the vaccine can be produced and distributed and how efficiently the vaccination process is carried out.[2] [3]

During the autumn, the number of confirmed cases and deaths from COVID-19 has increased again in Sweden and Europe, and the forecasts for economic developments have been revised down, see Sveriges Riksbank (2020a). At the same time, a number of positive results from vaccine tests were reported in November.[4] A number of vaccines against the disease have now been approved in certain countries and are on the brink of being approved in other countries, which has led to widespread optimism that the pandemic can be stopped. This has in turn boosted confidence in a global economic recovery, which is reflected, for instance, in the positive reactions on stock exchanges around the world following the vaccine news in November.

The pandemic has entailed major costs in terms of loss of production, higher public debt and a decline in employment, for the Swedish economy in 2020. We use these costs as a base for our calculations, which use a number of simplified assumptions. The figures reported here should therefore be regarded as rough estimates. But our overall assessment is that there are considerable economic values at stake, and that rapid vaccination would entail major gains for the economy as a whole.

We begin by describing our assumption as to how vaccination will affect the spread of infection, as this is the starting point for assessing the economic value. After that, we discuss which are the largest economic costs of the pandemic and

[2] We do not discuss the economic value of the vaccine in relation to not carrying out vaccination, see for instance, Acharya et al (2020). Instead, we assume that the vaccinations will be carried out and we calculate what the economic effects will be relative to small differences in the efficiency of the vaccination programme.

[3] According to the World Health Organisation's decision-making framework for implementing mass vaccination, the most important considerations concern questions of coordination, planning, prevention of infection, vaccination strategies, community engagement and equitable access to vaccines, see World Health Organisation (2020). In Sweden, it is the Public Health Agency of Sweden that is to produce a national vaccination plan on behalf of the Government, see Public Health Agency of Sweden (2020a).

[4] In November 2020, 13 vaccine candidates underwent phase 3 trials. Pfizer and BionTech have announced that their vaccine is 95 per cent effective in a final analysis of phase 3 trials published on 18 November. Moderna has announced that its vaccine is 94 per cent effective in an analysis published on 30 November. To follow the latest developments in vaccines against COVID-19, one can use, for instance, the New York Times "Coronavirus Vaccine Tracker", https://www.nytimes.com/interactive/2020/science/coronavirus-vaccine-tracker.html.

how they can be measured. Then, we describe a simple conceptual framework for calculating the gains from rapid vaccination. Finally, we report calculations of these gains expressed in terms of effects on GDP, public finances and the labour market

Mass vaccination can stop the spread of infection

Our starting point is that the only realistic way of stopping the pandemic in the near future is to mass vaccinate the population. Despite restrictions, the infection is currently being spread rapidly in Sweden and several other countries, which indicates that the share of the population that is immune to the coronavirus is still limited. This conclusion is also supported by studies measuring how large a percentage of the population has antibodies against the virus.[5] [6] The central assumption in this Commentary is that vaccination will mean that the share of the population that is immune will become sufficiently high to stop the spread of infection. This will in turn have positive effects on economic developments.

Economic costs of the pandemic

The economic costs of the pandemic can in general be divided up into direct and indirect costs. Direct costs concern, for instance, the cost of medical care, sickness insurance and infection tracking. One can also include costs in the form of human suffering and deaths here, which are more difficult to quantify. The most measurable economic loss to society consists of indirect costs that arise when production, employment and incomes become lower as a result of social distancing, that is, when people keep a distance from one another to reduce the risk of infection. This means that more people are staying home and that those who work in branches such as hotels, restaurants, culture, passenger transport and physical retail trade are hit particularly hard economically.[7] However, other branches than these can also be affected negatively by the generally lower demand or by bottlenecks in production chains. As long as the infection continues to spread and there is no end to the pandemic in sight, there is also uncertainty over how the economy will develop going forward, which is dampening consumption and investment. Costs of postponing medical care and in the form of poorer mental and physical health are also examples of indirect effects of the pandemic.

It is very difficult to say how the pandemic will affect the economy in the longer run.[8] Vaccination and an end to the spread of infection mean, however, that the long-term negative effects on the economy should be smaller than they would otherwise have been. In the calculations below, we simplify and disregard these effects.

How can the economic costs be measured?

The costs of the pandemic can be described in more or less detail and the some costs are more difficult to measures than others. We have not calculated all of these costs. For

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[5] A study published by the Public Health Agency of Sweden shows that the share of positive test results regarding antibodies, based on blood tests in outpatient case was around 4 to 7 per cent during the period 20 April to 14 June, see Public Health Agency of Sweden (2020b). In Stockholm, which has seen a relatively high level of infection, around 32 per cent of the population showed antibodies in the middle of November 2020, see Dagens Nyheter. (2020). See also Edvinsson (2020) for a discussion of how the percentage infected so far can be estimated. As a press gathering called by the Public Health Agency on 24 November 2020, the chief epidemiologist said that "we do not see any signs that an immunity in the population is slowing down the spread of infection at present".
[6] Based on the so-called effective reproduction number, which describes how quickly the infection spreads, and the efficiency of the vaccine, one can in theory calculate how large a percentage of the population needs to be immune to stop the spread of infection. The calculations become more complicated if one assumes that the vaccine does not provide a lasting protection, see Anderson et al. (2020).
[7] We do not discuss how the costs are divided between different individuals or sectors. The calculations thus do not show that some have been hit harder than others by the crisis.
[8] See the article "The long-term economic effects of the pandemic are uncertain" in the Riksbank's Monetary Policy Report in November, Sveriges Riksbank (2020). This discusses various reasons why the pandemic could have a negative effect on the economy in the longer run.

instance, we do not include the value of the lives that can be saved by a rapid vaccination process.[9] Our simplified approach means instead that we are focusing on the effects that the pandemic and the vaccination programme have on central macroeconomic variables. This means that our starting point is that the effects of the pandemic on the economy can be measured on the basis of its impact on GDP, employment and general government net lending. A large part of the direct and indirect costs described above are thus captured, but we also ignore some of them.[10]

GDP represents the value of what is produced in a country and, somewhat simplified, the income generated. Although it is not a perfect measure of economic welfare, it is probably the most common form of measurement. Employment (or unemployment) complements GDP as a measure of economic activity. General government net lending provides a further perspective on the costs of the pandemic. With GDP as the sole measure of costs, we would be disregarding the fact that the economic downturn would have been much larger without fiscal policy stimulation measures. The public sector could have saved substantial economic resources, or used them for public services or investment, reduced taxes or increased transfers to households if the pandemic had not occurred. The Government assesses, for instance, that the costs of economic measures in 2020 in response to the pandemic amount to almost SEK 200 billion during 2020, or around 4 per cent of GDP.[11] As a comparison, this is roughly equivalent to the expenditure on support to those who are ill and families with children during 2019.[12] Moreover, public revenue from taxes declines when economic activity declines.

Sweden is a small, open economy that is affected to a large degree by developments abroad. As the pandemic has affected large parts of the world at the same time, the negative effects on the Swedish economy have been reinforced.[13] One important consequence of this is that the vaccinations need to be made at around the same pace in Sweden and abroad if one is to attain the economic gains we report in this Commentary.[14]

How can the gains of efficient vaccination be calculated?

To estimate the gains of a rapid vaccination process, we use the conceptual framework shown in Figure 1. We see from the red line in the figure that the pandemic has meant that GDP in Sweden and other countries has been lower in 2020 than was expected prior to the pandemic, which is illustrated by the blue line. We assume that the level of GDP will remain lower than normal as a result of the spread of infection and the restrictions on society that remain as long as the pandemic continues, that is, as long as the share of the population that is immune is too low. When the population is vaccinated, the percentage of those immune

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[9] Between 1 March and 30 November 2020, around 6 800 people in Sweden died as a result of COVID-19, that is, on average around 750 people per month during the period March to November. The total economic value of these lives can be estimated on the base of their remaining life expectancy if they had not died of COVID-19 and the value of further year of life, see for instance Hall et al (2020) and Hultkrantz (2020). Similar calculations are used, for example, to assess how many resources should be invested in increased road safety.

[10] Cutler and Summers (2020) estimate the total economic costs of the pandemic for the United States. Lower GDP comprises around half of the costs. The other half is made up of costs for premature death, long-term reduction in physical and mental health.

[11] See Government Offices of Sweden (2020) Table 1.6.

[12] State expenditure for economic security in the event of illness and disability amounted to SEK 98 billion in 2019. Expenditure on economic security for families and children was SEK 97 billion, see Government Offices of Sweden (2020), table 7.4.

[13] Swedish exports contributed to dampening Swedish GDP during the spring. Factory closures in Europe in particular also contributed to Swedish industries being forced to reduce their output as a result of shortages of input goods.

[14] One way of illustrating this idea is to assume (counterfactually) that Sweden were the only country to implement mass vaccination. The Swedish economy would probably develop better than those in other countries, but poorer than if the other countries also vaccinated their populations. Bhushan and Struyven (2020) present forecasts for how the share of the population vaccinated will develop during 2021 in a number of countries. According to them, vaccination will take place at roughly the same pace in the EU, the United States, Japan, Canada, the United Kingdom and Australia.

increases, and in time becomes sufficiently large to stop the spread of infection. The economy then recovers and GDP returns to its normal level.[15]

To illustrate the gains of rapid vaccination, we compare two scenarios, where vaccination is at different paces. In one scenario, it is assumed that the spread of infection will stop one month earlier than in the other scenario. We can follow how the economic recovery develops along the light blue and yellow lines respectively. We assume that the economic recovery will follow the same path in both scenarios, which is illustrated by these lines having the same slope. We consider this a reasonable assumption as long as it is a question of relatively small differences in vaccination time between the scenarios, for instance, one month.

The size of the gain depends on how large the negative effects of the pandemic are on GDP when immunity is attained (the difference between the blue and red lines). Using our assumptions, the gain corresponds to the pandemic's average effects on GDP per month in 2020.

Figure 1. Conceptual framework to illustrate how the gains of a rapid vaccination are calculated.
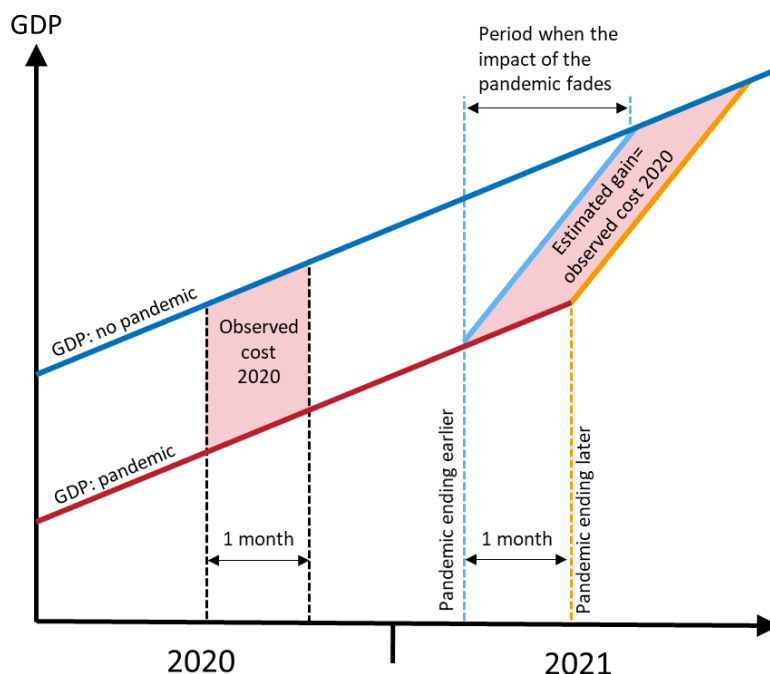
This conceptual framework is of course very simplified. A more sophisticated approach might have been to produce economic forecasts or scenarios under different assumptions of how the vaccination programme is implemented. But this would require detailed assumptions regarding when the vaccination is implemented and how the spread of infection develops, as well as a number of other factors.[16] Here we choose instead to simplify the analysis, for better or for worse. One advantage of doing so is that it is relatively easy to investigate how the calculations would be affected if one made other assumptions.

The most important uncertainty factors in our calculations are how GDP develops during the vaccination period and the size of the long-term effects of the pandemic on GDP. In Figure 1, this entails an uncertainty regarding the red and blue lines for 2021. If the pandemic

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[15] One can assume that vaccination will start at the beginning of 2021. Of course, it is not possible to register with any precision when immunity among the population will be attained. But there will be reliable data on how many have been vaccinated, which will provide a good guidance, and immunity is expected to entail a rapid decrease in the spread of infection. It should have immediately positive effects on economic developments. On the basis of Bhushan and Struyvens' (2020) projections regarding the percentage of vaccinated in different countries, it is probable that immunity will be attained at some point in the second half of 2021.
[16] Another alternative is to study how lower economic activity in service sectors with physical contact affects overall economic developments, see Hafner et al (2020).

means that GDP is lower for long, despite vaccination, this could mean that we over-estimate the benefits of the vaccination taking place one month earlier (lower placement of the blue line).[17] The benefit also depends on how the spread of infection develops and how large the economic consequences will be (higher or lower placement of the red curve). How uncertainty about near term economic developments can affect the calculations is discussed in more detail below.

Benefits in terms of GDP, public finances and employment

The benefits of rapid vaccination are thus calculated on the basis of estimates of what economic costs the pandemic entails. We obtain these costs by comparing the Riksbank's most recent assessment of economic developments in 2020 with the assessment the Riksbank made in February just before the outbreak of the pandemic.[18] We focus on the effects on GDP, but also illustrate the effects on the labour market and public finances to give a broader picture. Roughly, one can say that the blue line in Figure 1 corresponds to the forecast in the February Monetary Policy Report, and the red line to the forecast in the November report.

In the scenarios, a rapid vaccination of the population means that immunity is attained *one month* earlier. It is easy to adjust the calculations below so that they instead give the benefits of the vaccination time being reduced by, for instance, one week by dividing them by 4, or one quarter by multiplying by 3.

During 2020, fiscal and monetary policy have contributed to alleviating the damaging impact of the pandemic on the economy. Without this stimulation, the negative effects on GDP and the labour market reported below would have been much greater.

GDP

The Riksbank's forecast in November for GDP in the year 2020 is around SEK 270 billion lower than in the forecast made in February. Since the start of the pandemic until now, from March to December, the average deviation per month has been around SEK 27 billion, or just over 6 per cent. According to our method, this corresponds to the benefit of shortening the vaccination time by one month.[19]

This estimate is uncertain, though, as we have discussed earlier. The most important uncertainty factor concerns how the spread of infection can develop over the time the vaccination is being implemented. In Figure 1 this means that the red line could become higher or lower in 2021.[20] During 2020, there has been a clear relationship between the spread of infection and economic activity. By using Statistics Sweden's activity index, which estimates GDP on a monthly basis, we can calculate the GDP loss at around SEK 40 billion on average in April and May when the infection was spreading rapidly. For March and September, the GDP loss was instead relatively low, on average around SEK 15 billion. On the basis of this, we assess that the benefits of a raid vaccination can be estimated at between

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[17] The fact that the pandemic has been under way for a long time has two opposing effects to the benefits of rapid vaccination. On the one hand, the risk that the long-term effects on the economy will be greater increases, which could mean that we underestimate the benefits of rapid vaccination. However, this effect is probably small, as the difference in vaccination time between the scenarios is slight. If GDP does not return to the level forecast prior to the pandemic, on the other hand, this could mean that we are over-estimating the benefits. Our assessment is that this in general indicates that we are over-estimating the benefits somewhat.

[18] See Sveriges Riksbank (2020a) and (2020b).

[19] Please note, however, that this total benefit is spread out over time, see Figure 1. It thus does not mean that the entire benefit will come during one month. If, for instance, the recovery to a normal situation were to take six months after immunity was attained, then the benefits during this period would be around SEK 4-5 billion per month. If a part of the GDP costs in 2021 is attributable to 2020 because of delayed effects, according to calculations not reported here, the cost per month could instead be estimated at 330/10 = 33 billion per month. However, we choose to simplify here and only use the costs for 2020 as a base.

[20] A rapid spread of infection in 2021 would probably mean that activity was lower, so the red line in Figure 1 would be lower. Conversely, a slower spread of infection and higher activity mean that the red line is higher in 2021 and that the benefits of rapid vaccination will then be less.

SEK 15 and 40 billion, depending on how quickly we can assume that infection spreads before the vaccination process is complete in 2021.

To summarise, we can thus estimate the benefits of shortening the vaccination period by one month at SEK 25 billion after rounding off, or just over half a per cent of annual GDP.[21] However, this can vary between SEK 15 and 40 billion per month, depending on how the infection spreads during 2021, based on the experiences of 2020.

We can also compare our calculations of the benefits in terms of GDP with similar analyses for other countries. Nugroho (2020) reports calculations of the cost of the vaccination in Indonesia being delayed by six months, using a general equilibrium model. The cost is estimated at 44 billion dollars, or around 4 per cent of the country's GDP. Although the assumptions in this analysis differ from ours in several respects, the estimated cost, expressed as a percentage of GDP, is roughly the same.[22]

Public finances

We assess that the effect of the pandemic on public finances corresponds to around SEK 20 billion on average per month with an interval of between SEK 10 and 30 billion. This sum is equivalent to how much lower the public debt will be if the pandemic is shortened by one month. This is an effect that comes in addition to the calculated gain in terms of GDP. It is a rough estimate based on developments in public finances during 2020, compared with the Riksbank's assessment prior to the pandemic. We obtain roughly the same figure if we compare outcomes for general government net lending during the second and third quarters of 2020 with the corresponding period in 2019.

There are factors that indicate the effect could be higher as well as lower. Calculations based on the costs of the Government's measures to deal with the pandemic in 2020 and a normal relationship between GDP developments and automatic stabilisers would imply larger effects.[23] One factor that may indicate smaller effects is that we measure the outcomes for the second and third quarters of 2020 in relation to the corresponding quarter in 2019. This is a period in 2020 when the monthly costs for the Government's reforms are assessed to have been particularly high. It is also probable that other factors than the pandemic have affected the developments in general government finances between 2020 and 2019.[24]

All in all, we think that SEK 20 billion per month is a reasonable assessment of the savings made by the public sector if the pandemic is shortened by one month. This assessment reflects both the actual developments in general government net lending and the assessment that the benefit in terms of GDP amounts to SEK 25 billion and that the need for active fiscal policy declines. The interval of SEK 10-30 billion is constructed on the basis of the interval for the gain in terms of GDP.[25]

Labour market

The pandemic has also had a significant impact on the labour market. Despite substantial targeted measures to alleviate the negative consequences, employment has declined

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[21] In the Commentary, we use SEK billion throughout and round up to the nearest unit of five.

[22] According to our analysis, the cost of a delay of the vaccination in Sweden by six months would be 6*25 = around SEK 150 billion, or just over 3 per cent of GDP. The cost of a delayed vaccination for Indonesia is around six times the country's allocation to combating poverty, which illustrates the damage caused by the pandemic.

[23] With normal assumptions for how GDP affects general government net lending, SEK 25 billion lower GDP means that the costs for the automatic stabilisers amount to around SEK 13 billion. In addition, the Government assessed in the Budget Bill for 2021 that the costs of measures taken so far and measures proposed as a result of the pandemic would entail a SEK 193 billion debit in 2020, which corresponds to around SEK 19 billion per month during the period March to the end of December. According to this calculation, the effect of shortening the pandemic by one month amount to a good SEK 30 billion lower debt in the public sector. However, part of the Government's measures entail transfers within the public sector and lower saving in the general government sector is partly compensated by increased saving in the municipal sector. The final cost of measures such as short-time work and reorientation support are also still uncertain.

[24] Prior to the pandemic, the Riksbank had also assessed that economic activity would slow down somewhat in 2020, which would entail, all else being equal, some deterioration in general government net lending even without a pandemic.

[25] That we round off to the nearest unit of five means that the proportionality in the interval becomes approximate.

substantially and unemployment has risen. At the end of 2020, the effects of the pandemic mean that 130,000 fewer people are employed than was the Riksbank's assessment prior to the pandemic.

We assume that the effects of the pandemic on employment remain unchanged from today's level during the period until immunity is attained, that is, that around 130,000 fewer people are employed. This number could be higher or lower depending on the spread of the infection and its impact on economic activity. High-frequency variations in employment are normally limited, however, and the current conditions for furloughing reduce the need to give notice of redundancy to staff as a result of temporary changes in demand.

Our assumptions entail economic activity recovering to normal levels when the vaccination process is complete, which is illustrated in Figure 1. A more rapid pace of vaccination would, however, mean higher employment and lower unemployment during a period of time. This can be compared with the recovery in GDP according to Figure 1, where the vertical distance between the light blue and yellow lines now instead represents the difference in the number of employed. How the positive effects on employment are broken down over time will depend, among other things, on the speed of the recovery (the slope of the light blue and yellow curves respectively). If, for instance, the recovery takes six (twelve) months, this will correspond to 20,000 (10,000) more people employed per month during the recovery period.

The benefits of vaccination one month earlier can also be described in terms of 130,000 more man-months or monthly salaries.

Efficient vaccination entails major benefits for society

There are several good reason not to allow the vaccination against COVID-19 to be delayed. Continued spread entails a high burden on the medical system, more people dying and a lot of people suffering. In addition, the macroeconomic benefits of rapid vaccination are most probably considerable, as we have shown in this Commentary. Based on the costs during 2020, we estimate that each month that the pandemic can be shortened entails benefits in terms of GDP of around SEK 25 billion and savings for the public sector of around SEK 20 billion. The benefits are less if the pandemic and the economy develop more favourably while the vaccination process is under way in 2021, compared with 2020, but can be greater if developments are poorer. Our estimates assume that fiscal and monetary policy support economic activity during 2021 in about the same way as during 2020.

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