Policy Report

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"Vaccine Mandates Aren't the Only Option"

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I. Introduction

As the COVID-19 pandemic disrupted economic and social life for months on end, scientists, health care professionals, policy makers, and governments looked to a vaccine as the solution to the global pandemic. Given the extent of the economic costs globally, it became clear to everyone that expanding vaccine development, manufacturing, and delivery capacity globally would have large benefits, which led most governments to help researchers and firms develop and mass-produce vaccines. Vaccine research and development is a global public good.

Even in the absence of a pandemic, vaccine subsidies are ubiquitous because development of pharmaceuticals and vaccines for infectious diseases, in general, can be very costly and subject to great uncertainty. During a pandemic, however, an early decision to subsidize the development, trial, manufacturing, and delivery of a vaccine has especially large benefits (Ahuja et. al. 2021). This can be accomplished by subsidizing private development, developing contracts that guarantee a market, for example, by guaranteeing a minimum number of purchases (Kremer, Levin, and Snyder 2020). For instance, in the United States, with Operation Warp Speed, the federal government invested $10 billion to fund the development of vaccines and guaranteed it would purchase a minimum amount to encourage production. Most experts, economists, and policy makers have supported government funding or other support for vaccine development.

However, once a vaccine is developed and easily available, there remains the problem of how to incentivize individuals to vaccinate. Everyone vaccinated against a given infectious disease protects themselves but also protects others. Therefore, the marginal social benefit from vaccination is greater than the marginal private benefit, creating the dual problem of underconsumption and free riding by individuals. For both allocative reasons (people will underconsume because they do not internalize all the benefits of the vaccine) and distributive reasons (poor and vulnerable members of society should

not be left out), economists typically suggest a government intervention to correct this problem, usually in the form of a subsidy. Often, vaccines are offered by the government at a price of zero.

In the United States during the pandemic, the federal government has procured vaccines and supplied them to the states, which then either follow or modify the guidelines of the Centers for Disease Control and Prevention (CDC)[1] for prioritizing vaccine allocation. After an initial shortage and difficulties in getting vaccination appointments, by April 19, 2021, individuals residing in the United States who wanted to get vaccinated could do so without waiting.[2] However, providing the vaccine at a price of zero has not led to near-universal adoption. For instance, in most states, a nontrivial proportion of health care workers, who have top priority to receive the vaccine, have refused the vaccine.[3] This suggests that a price of zero is not sufficiently low to ensure optimal vaccine consumption; the vaccines should have a negative price (that is, the government should pay people to get vaccinated). The typical response to this problem is to call for the state to mandate vaccination (Gostin, Salmon, and Larson 2021).

However, not all externalities generate underconsumption and free riding. An inframarginal externality, as defined by Buchanan and Stubblebine (1962), might not require any policy action on efficiency grounds despite the divergence of private and social benefits. An action generates an inframarginal externality if it generates an externality and affects other people's utility but not on the margin. Individuals may engage in behaviors that confer benefits to others who are not paying for these benefits. Private mechanisms might help solve the problems of underconsumption and free riding. We discuss the mechanisms adopted by private firms, private clubs, and civil associations that may generate strong incentives to get vaccinated. We also discuss the institutional roadblocks (state and private) to generating such private incentives.

II. Vaccination and Externalities

In discussing any infectious disease, but especially COVID-19, it is important to understand the nature of externalities. While some authors refer to vaccines and the reduction of disease risk as public goods (Goodkin-Gold et al. 2020, p. 47), it is helpful to start with the more general language of externalities. Externalities can come in the form of net costs (negative externalities) or net benefits (positive externalities) that an individual's behavior imposes on others and that the individual does not account

[1] https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations-process.html
[2] https://www.cnn.com/2021/03/30/health/states-covid-19-vaccine-eligibility-bn/index.html
[3] https://www.latimes.com/california/story/2020-12-31/healthcare-workers-refuse-covid-19-vaccine-access

for. An infectious disease leads individuals to impose negative externalities by increasing the risk of transmission to other members of the society. Getting a vaccine that protects against the same infectious disease is a positive externality.

When any individual gets vaccinated against an infectious disease, this reduces (or eliminates) their chance of getting the disease. But it may also reduce the chance of others getting the disease, as the vaccine recipient is less likely to transmit the disease. Therefore, the social benefit from a dose of a vaccine is higher than the private benefit. In this policy brief, we only discuss the positive externality from getting vaccinated against transmissible diseases, though some of the arguments may apply for negative externalities as well.

Typically, the issue of externalities is described as one of divergence between private and social marginal costs and benefits. In the context of vaccination, this divergence has two consequences. First, vaccinating individuals must incur a cost to enjoy the benefits. This comes in such forms as money, pain, or side effects. Since not all the benefits of the vaccine are internalized, standard neoclassical models conclude that consumption of the vaccine will be lower than the socially optimal amount.

Second, since some of the benefits of the vaccine are externalized but the costs are entirely internalized, once a certain proportion of the population is vaccinated, incentives for free riding may arise. In the standard analysis, externalities and free riding are just "two sides of the same coin" (Cowen, 2002). The reasoning is that if enough other members of the community are vaccinated that herd immunity results, then an individual may receive a substantial part of the benefit (reduced risk of infection) even without vaccinating themselves.

To connect the language of externalities to the language of public goods, when one person bears the cost to get vaccinated, she is *producing* external benefits. Because these benefits are partially nonrivalrous and nonexcludable, in the baseline case she cannot charge the *consumers* of the benefit and may underproduce the public good. While this framing of externalities has critics (Cowen 1985, p. 58), it succinctly frames the collective-action problem a society faces in the case of vaccines. The Pigouvian solution is a subsidy or a mandate for getting vaccinated. This is considered the optimal policy response (for example, Francis 2004, and Goodkin-Gold, Kremer, Snyder, and Williams 2020).

This policy brief, in contrast to the Pigouvian approach and in line with the public choice approach to public health (Leeson and Thompson 2021), focuses on how types of collective action other than Pigouvian subsidies can increase vaccination rates. Some scholars have argued that there may be circumstances in which no government intervention is required and private decentralized solutions to the problem of externalities may emerge (Leeson and Rouanet 2021).

The first is the Coasean solution, in which private individuals pay others to get vaccinated to increase their own protection. Such a solution works well for certain other positive externalities—for instance, contracting with beekeepers to use bees for cross-pollination in orchards. However, given the nature of infectious diseases, in particular COVID-19, the transaction costs present in the Coasean bargains may be prohibitively high outside of the family unit or small groups.

Second, as Demsetz (1967) argues, one possible solution is consolidating all the property rights in the hands of a single owner. A typical example is a commercial property owned by a single entity that can internalize all the spillover benefits generated from the property's use. Since a single owner internalizes the externality, they will charge differential rents for different spillover benefits from the property use. A similar argument can be made for the vaccine, where a single entity such as a firm, an association, a club, or even a government mandates that all employees or patrons must be vaccinated.

For any of these private solutions to work enitrely, the gap between private marginal benefit and social marginal benefit must shrink to zero. Take a well-maintained front yard. This generates a positive externality for the neighbors, not just because it is a beautiful sight but also because it increases their real estate values by increasing their curb appeal (Johnson, Tidwell, and Villupuram, 2020). Because not all the benefits are internalized and because yard maintenance has a cost, standard theory predicts undermaintenance or underinvestment in front yards and curb appeal. But private solutions to the problem exist. One is for a single private entity to internalize the externality (Demsetz 1967, p. 348). This is typically a private developer or a closed group such as a homeowners' association that has rules about how the yard is to be maintained and collects fees to ensure its maintenance. Such entities are clubs in the sense of Buchanan (1965). Another solution is Coasean bargaining between neighbors offering to help with yard work.

However, this standard analysis ignores a third possibility: inframarginal externalities, or externalities may remain even in a Pareto-optimal equilibrium. Take the case of an individual who wants a great-looking front yard and curb appeal. Even though others receive some benefit from the great yard, the individual in question receives enough private benefit that they would not change their behavior just because others also benefit. That is, on the margin, the external benefit to their neighbor does not matter because they maintain their yard in the optimal amount. It is worth considering whether the same is true of vaccines.

III. Vaccination and Inframarginal Externalities

While the world is full of externalities, not all of them are relevant at the margin. In some cases, private marginal benefit diverges from social marginal benefit but the optimal amount of the good gets produced and consumed; that is, an externality exists, but it is inframarginal and not Pareto relevant (Buchanan and Stubblebine 1962).[4] For instance, a vaccinated group creates a positive externality for the whole population. Fewer people will get sick, thereby reducing the chances of transmitting the disease. However, individuals in the general population have strong private incentives to vaccinate themselves. First, vaccination will protect them from the disease. Second, it will help them engage in social activities that were either not possible or too costly because of the transmission risk. Third, it will allow them to participate in social groups and clubs that require participants to be vaccinated; for example, they can work at a grocery store, fly on an airplane, or attend a sports game.

With COVID-19, the impact of infection is not uniform across all individuals and groups. Those with comorbidities, especially heart disease, hypertension, or diabetes, are affected more severely. For the original (Alpha) variant, hospitalizations and fatalities are higher among individuals over sixty-five.[5] For individuals in this age group or with comorbidities or other health conditions, getting vaccinated is likely privately and socially optimal. They get vaccinated to lower the probability of getting hospitalized or dying. It is similar for individuals in occupations that face a much higher risk of contracting the virus, such as Uber drivers or checkout clerks. The private incentives to get vaccinated may be sufficiently high that the benefit to others is not relevant on the margin.

Whether getting a COVID-19 vaccine creates an inframarginal externality or an externality that leads to underconsumption depends on institutional and technological factors. There are many ways to make the net private benefit sufficiently high. One is to lower the private cost of the vaccine. If vaccines can be distributed using a single shot, with painless needles, in the form of nasal or oral drops, or with few side effects, then the net private benefit will increase and the gap between net private benefit and social benefit will shrink. If the net private benefit is positive, given that deciding whether to get vaccinated is binary the vaccine will be consumed and the positive externality will be inframarginal.

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[4] Buchanan and Stubblebine distinguish between inframarginal and irrelevant externalities, a distinction that turns on whether one considers only marginal changes or allows for discrete changes of people's actions. That is an important theoretical distinction but not important for the applications in this policy brief.

[5] https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-age.html

Technological factors are also relevant. In the case of some diseases and their vaccines, the vaccine, while protecting the vaccinated individual, does not eliminate the possibility of transmission. That is, a vaccinated individual could be infected and have almost no symptoms but still transmit the virus. If this is the nature of the vaccine, then either the vaccine generates no positive externality and is like an ordinary private good, or it generates such a small external benefit that the externality is inframarginal in the binary vaccination decision.[6]

Finally, there is an element of uncertainty regarding the risk of infection during a pandemic. Information about new variants in different parts of the world and about the chances of those variants being near an individual is not perfectly known by anyone in the middle of a pandemic. Unlike diseases such as yellow fever that are prevalent in particular geographical areas that an individual can choose to avoid, the novel coronavirus is transmitted globally. The exact expected costs and benefits are not known and not knowable in the middle of a pandemic. This may lead some individuals to vaccinate to cope with the uncertainty. Uncertainty may also have the opposite effect: if the efficacy or safety of the vaccine is uncertain, individuals might not vaccinate.

Related to inframarginal externalities is the issue of herd immunity. Let's say the threshold for herd immunity is a 75 percent vaccination rate. Then, if the incentives are sufficient for 75 percent of the population to get vaccinated, the marginal externality is zero (or approximately zero). A key point Buchanan and Stubblebine (1962) make is that externalities need not be eliminated if the incentives are sufficient.

The greater the divergence between marginal private benefit and marginal social benefit, the more difficult it will be to reach herd immunity because individuals will underconsume. However, underconsumption also means that the public-good free riding aspect of the vaccine is less likely to materialize. Without any outside intervention, there will be either widespread underconsumption or free riding by a small subgroup—but not both. The more people decide to get vaccinated, the more likely getting vaccinated will create the public good of herd immunity and only a small proportion of the population can free ride. In contrast, the larger the subgroup for whom the externality is inframarginal, the easier it will be for the entire group to achieve herd immunity, thereby making it easier for another subgroup to free ride on the public good of herd immunity.

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[6] Even vaccines that don't prevent transmission may have other external benefits during a pandemic. This is because health externalities in a pandemic also have to do with timing of infections and not just the probability of contracting the virus. By getting the vaccine, the individual is still reducing their own chances of hospitalization and is therefore less likely to consume health care services, leaving more of those services to those who are unvaccinated or are suffering from other conditions.

Contrast vaccination with deflecting asteoids, which can bestow benefits on all of humanity the moment even a single individual provides the service. It is almost impossible to exclude anyone on earth from the benefits, and the service is completely nonrivalrous. With vaccines, a single individual consuming the vaccine will not make it a public good. The more people that attempt to free ride on herd-immunity benefits, the less likely it will become a public good.

Institutions may provide incentives to make a vaccine inframarginal. We can consider inframarginal externalities at the individual and societal levels. First, when an individual has sufficient private incentives to take an action, they will do it, even if their action has an externality and affects other people's utility. Suppose Armen takes the vaccine as soon as he can. Even though Armen's action is generating a positive externality for Bonnie, Armen is still consuming the socially optimal amount: one vaccine. Even though there is an externality, private incentives are sufficient that on the margin, Armen does not need to be induced to take the vaccine. But some people do not have sufficient private incentives. As we highlighted in the beginning, some people still won't take the vaccine. For them, their margin is between zero vaccines and one, so there may still be a non-inframarginal externality and thus a gap between private and social benefits.

In addition to marginal versus inframarginal externalities, Buchanan and Stubblebine (1962) distinguish "relevant" from "irrelevant" externalities. Relevant externalities are externalities that Armen imposes on Bonnie such that Bonnie wants to incentivize Armen to change his behavior. This creates space for Coasean bargaining between Armen and Bonnie. The simplest mechanism is one in which Bonnie simply pays Armen some amount to change his behavior. If such trades are available, the pair can reach a Pareto-efficient outcome, even in the face of the externality.

When people cannot directly pay each other to get the vaccine (for whatever reason), what other mechanisms can they resort to? When would we expect these other mechanisms to occur?

IV. Social Arrangements That Make Externalities Inframarginal

The extent of the positive externality of vaccines depends on many factors, but most importantly, it is institutionally contingent. The externality is not some exogenous parameter but depends on institutions, technology, behaviors, and nature of the virus, all at the same time. We need to understand their interplay.

In the case of COVID-19, the negative externality of the disease and the positive externality from the vaccine depend on individuals' interaction in close proximity. Some of our daily interactions take place in public spaces, where we do not voluntarily choose our interactions with strangers. An example is traveling using public transportation such as the New York City subway. One cannot choose whom they travel with on the subway and "may create cross-site externalities by increasing the infection risk of uninfected non-subway riders who later interact with subway riders at another site" (Leeson and Rouanet 2021, p. 1109). Nor can one exclude others from traveling on the subway. But a lot of interactions occur at sites that are privately owned and that individuals visit voluntarily. In the absence of a vaccine, one has the choice to patronize certain grocery stores over others that may be too crowded or to visit at a different hour.

Unlike interactions on public transportation or the grocery store, many voluntary and private interactions are small scale and repeated. We focus mainly on three types: private firms, private clubs, and civil associations. All can incentivize vaccination in order to internalize externalities among their members.

First, take the case of a firm that requires employees to work in close proximity. Here it makes sense for the owner to mandate vaccination for the entire staff to internalize all the benefits of vaccination and ensure that there is neither underconsumption nor free riding. This may sound extreme, but there are a lot of real-world examples in which vaccines are mandated as part of the job. For instance, some hospital wards and nursing homes make flu shots mandatory, and sex workers in the adult-entertainment industry must be vaccinated against hepatitis. There is a voluntary element to these interactions—an individual can always look for another job—but they are mandatory conditional upon working at the particular firm. Another way to think about this is that they are mandatory in the short run, when it may be difficult to find another job, but voluntary in the long run, when exit is possible.

For privately provisioned goods that are consumed collectively—such as airline travel—the mandates may extend beyond employees. Before the existence of a COVID-19 vaccine, some airlines mandated mask wearing and proof of a negative test result in order to travel with them. For international travel, some of these requirements were based on other countries' immigration mandates. But airlines also formulated their own rules for protecting passengers.

A private firm can incentivize vaccination, especially for employees. This is typically done by giving employees time off or having vaccine drives at the workplace, with monetary incentives or

bonuses for getting vaccinated. During flu season, a number of employers incentivize vaccination by providing free vaccines at the workplace and giving employees paid time off to get the vaccine.

Even with vaccine mandates or incentives, the issue of transaction costs arises. Firms or other associations trying to internalize the externality face limitations. Consider the case of a grocery store, such as Trader Joe's. If the owners wish to internalize the externality, they have to deal with two types of groups in close physical proximity: employees and customers. They could mandate that everyone in the store get vaccinated. That would be a blunt policy that might not even be optimal for the purpose of internalizing externalities. For employees, the grocery store owners could provide free or subsidized vaccines or even mandate the vaccine; but for the hundreds of patrons visiting each day, this would be prohibitively expensive, either because it would exclude a lot of patrons or because checking vaccine certificates is too costly.

For customers, there are costs to verifying whether a subsidized individual is vaccinated. Since customers might never show up again because there are lots of other grocery stores, Trader Joe's might not be willing to check vaccine status. And the subsidy that Trader Joe's could provide to the customer (say, in the form of a discount) likely would not be enough to narrow the gap much between private and social marginal benefits. Employees of Trader Joe's are in a different situation. They impose an externality on the store every day they work. They also spend more time in the store than customers do, a relevant consideration for infectious diseases. Moreover, there are likely bigger gains in the relationship between the owners and an employee than between the owners and a customer. All else equal, we would expect Trader Joe's to mandate or subsidize vaccination of employees to a greater extent than they would do the same for customers. And in fact, in January 2021, several retail stores, such as Trader Joe's and Dollar General, announced they would pay workers to get vaccines.[7] In February, Kroger announced it would pay employees $100 to get the vaccine.[8] Other private firms are considering similar incentives. In a recent poll conducted by the Yale Chief Executive Leadership Institute, 72 percent of current and former CEOs signaled an openness to vaccine mandates.[9] And one of the reasons private firms might not mandate the vaccine is legal uncertainty regarding vaccines approved for emergency use.

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[7] https://www.npr.org/2021/01/21/958849642/grocers-have-a-strategy-to-get-their-workers-vaccinated-against-covid-19-pay-the

[8] http://ir.kroger.com/CorporateProfile/press-releases/press-release/2021/Kroger-Announces-New-Vaccine-Payment-for-All-Associates/default.aspx

[9] https://www.cnn.com/2020/12/16/business/ceos-covid-vaccine-mandate/index.html

The second kind of private solution comes through clubs. Buchanan's (1965) theory of clubs explains how individuals and firms can supply goods with a high degree of publicness privately. Club goods are typically excludable but nonrivalrous (or only rivalrous beyond some congestion threshold). It is profitable for firms or individuals to privately supply these collective goods if they can persuade individuals to join the club to share the cost of providing them. The example Buchanan uses is collective goods such as swimming pools. But the same underlying logic applies to the kind of positive externality created by excluding those who are unvaccinated from a club. In other words, one of the club goods or services offered is protection from getting infected by others in the club by insisting on vaccination.

Typically, like firms, clubs have good incentive-alignment mechanisms. Clubs are the residual claimants over the revenues they generate for their services and goods. During the pandemic, assuming a general preference for remaining COVID-free, more individuals are likely to join if they can get benefits, such as protection from disease transmission. Club owners earn profits only if their patrons are willing to pay, and given a preference for protection from infectious diseases, the incentives of club owners and patrons are well aligned. Clubs are also exposed to market discipline—freedom of their patrons to enter or exit—and this puts competitive pressure on their management to cater to the preferences of their patrons. As a result, clubs consider the costs of their mandates to ensure they do not overexclude. The threat of exit is the dominant disciplining mechanism for clubs. Finally, clubs can adapt quickly relative to other providers of collective goods such as the state since they can design contracts and amend contracts for very specific situations.

Take swimming pools, gyms, and exercise studios. They place people in close proximity while exercising and while in common areas and changing rooms. Let us stipulate that patrons are likely to join only if all members take certain precautions. In the absence of a vaccine, this means the club will enforce mask mandates and social-distancing rules. Once a vaccine becomes available, if members have a strong preference for having the group be vaccinated, then the club can mandate vaccines as a condition for inclusion. The transaction costs grocery stores face in checking vaccine records for all their customers may be prohibitively high. But clubs have already solved that problem and only need to add one more requirement for inclusion in addition to their other requirements.

Clubs also have incentives to not overexclude and to cater to the preferences of their clientele. If the patrons are young and healthy and willing to risk some exposure to infection, the clubs may use other kinds of mechanisms to accommodate them. For instance, these clubs may offer certain hours of operation for those who are vaccinated and the other hours for anyone, allowing patrons to take

the appropriate level of exposure to infection risk. In fact, before the availability of a vaccine, many gyms and exercise studios had hours when masks were mandated and hours when no masks were required. Wearing a mask while working out intensely may be a high cost for some patrons, especially those who are young and likely to be asymptomatic or mildly symptomatic. Therefore, clubs have strong incentives to impose mandates that align well with the preferences of their patrons.

While we have laid out a few specific incentive mechanisms that we expect to see in response to a pandemic, we have seen an even wider variety of attempts by different groups to encourage vaccination. These groups recognize that vaccines have relevant externalities and want to incentivize others to change their actions. Table 1 gives just a few examples.

Incentive Given to Vaccinate	**Example**
Lottery for $1m and free groceries for a year	Kroger[10]
Pre-rolled marijuana joint ("Pot for shots")	The Greenhouse[11]
Free donut per day	Krispy Kreme[12]
Free popcorn at movie	Chagrin Cinemas
Free beer	Samuel Adams[13]
Forfeit game in breakout	NFL[14]

Table 1: Real-World Examples of Incentives to Get Vaccinated

None of the examples imply that social, or nongovernmental, mechanisms will reach an optimal allocation. Instead, our argument is simply that social mechanisms turn social benefits into private benefits, allowing people to internalize externalities in creative ways. If a free marijuana joint pushes a person to get vaccinated, they do not need a Pigouvian subsidy. In fact, the subsidy would be wasteful to the extent it is funded by distortionary taxes somewhere else.

V. Conclusion

This policy brief started from the basic premise, widely accepted by economists writing on vaccines, that vaccines generate a positive externality. The private and social marginal benefits of vaccines do

[10] https://www.notion.so/Kroger-offering-1M-cash-prize-free-groceries-for-a-year-to-get-vaccinated-Fox-Business-1f8945d4134f41aaabfc1e896b3293b9#c610bf197a38468aa4c5bb77ae186da4
[11] https://www.greenhousemi.com/pot-for-shots
[12] https://www.cnbc.com/2021/03/31/free-with-covid-vaccine-krispy-kreme-marijuana-beer-and-more.html
[13] https://www.usatoday.com/story/money/food/2021/04/07/national-beer-day-sam-adams-covid-vaccine-incentive-free-beer/7108414002/
[14] https://www.nfl.com/news/nfl-covid-19-outbreaks-unvaccinated-players-forfeit-cancelled-game

not perfectly align. Therefore, there is room for collective action to improve outcomes for everyone involved. The standard policy approach to externalities—which holds that they can be solved through taxes, subsidies, or mandates—is also the standard approach to vaccines.

We departed from most economists by focusing on the types of private institutional arrangements that may encourage uptake rates of vaccines, especially COVID-19 vaccines. We discussed the mechanisms that have been or could be adopted by private firms, private clubs, and civil associations that may generate strong incentives to get vaccinated, relative to a benchmark purely private arrangement. If private groups commit sufficiently to vaccination for members within the group, private incentives are sufficient to turn the vaccination externality into an inframarginal externality, and inframarginal externalities are irrelevant for efficiency considerations. We also discussed the institutional roadblocks (state and private) to generating such private incentives.

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