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The Positive Externalities of Vaccines. The case of COVID-19 and annual flu vaccination programs

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Key concepts: Externalities; public health; pareto optimality; marginal private/external benefit; marginal private/external cost.

Vaccines have been a cornerstone of public health for over a century, contributing to the prevention and control of a wide range of infectious diseases. Beyond their direct benefits to individuals, vaccines generate positive externalities that benefit society as a whole.

The COVID-19 pandemic brought the importance of vaccines to the forefront of global public health discussions. Vaccines have been instrumental in controlling the spread of the virus and mitigating its impact. However, many vaccination programs have long been established to protect against other diseases such as the annual flu vaccination program.

In this case study, we will explore the economic impact, social benefits, and their role in reducing the burden on healthcare systems.

In 2019/2020 we faced across the globe the threat of a highly contagious and deadly infectious disease, COVID-19. Many scientists and laboratories worked very hard to get a highly effective and readily available vaccine for the entire population which will allow protect us against the virus. Although in this case, there was a health economics crisis and they were working against the clock to provide a vaccine, vaccines were commonly used to protect citizens from other common widespread viruses such as flu. In the following paragraphs we will analyse the positive affects of vaccines.

If we analyse the recent case of COVID-19, vaccines significantly reduce the transmission of the virus, by lowering the number of infections and severe cases, the burden on healthcare systems was reduced. This resulted in less strain on hospitals, and a decrease in long-term care needs. When individuals are vaccinated, they become less likely to contract and spread the disease, leading to a lower incidence of illness. This results in reduced healthcare costs, as fewer people require medical treatment and hospitalization.

If a significant proportion of the population immunized against the infectious disease, this leads to increased labour productivity as fewer people take sick days, leading to improved economic growth. Vaccinations also can modify individual workers behaviour, for example, the vaccination campaign during the pandemic of COVID-19 played a very important role in restarting mobility, and re-opening job places, but it also changed employee’s behaviour towards prevention measures. Even though COVID-19 continues to spread after being vaccinated, the risk of getting the disease, or its effects decrease, and the COVID-19 vaccine appeared to have a positive impact on employment behaviour (Moshbah, 2022).

Similar to the employment effect we could think about a positive effect on education. In the UK, The Medical Research Council began a vaccination trial of 56,000 school children in 1950, following the success of the trial the vaccination of the children widespread quickly. This just didn’t have a positive effect on the health system overall, reducing epidemic and pandemic diseases, but vaccinated children and adolescents are less likely to miss school due to illness. This leads to higher school attendance rates and better educational outcomes. Improved education, in turn, enhances future earning potential and contributes to society's overall well-being (see for example: Rodrigues and Plotkin, 2020).

The widespread vaccination program in a country, results also in a high level of herd immunity. This means that even individuals who cannot receive vaccines due to medical reasons, such as allergies or weakened immune systems, are protected indirectly. Herd immunity prevents outbreaks and protects vulnerable populations, reducing the burden on healthcare systems. Hospitals and healthcare facilities experience lower patient loads, freeing up resources and medical staff to address

other health concerns. This, in turn, leads to shorter wait times, improved access to care, and overall higher healthcare quality. Following from this point, vaccinating a given proportion of the population leads to what we call positive externalities in consumption in economics. A positive externality arises when one party makes another party better off but does not receive any compensation for doing so. For example, think about the flu vaccination program, if a person gets vaccinated this will make better off those in her inner circle, even if they don't get vaccinated. The vaccinated person will be less likely to get the disease and so transfer it to others, if the disease is spread less easily then there will be fewer severely ill people due to the disease which will reduce the burden on the health care system.

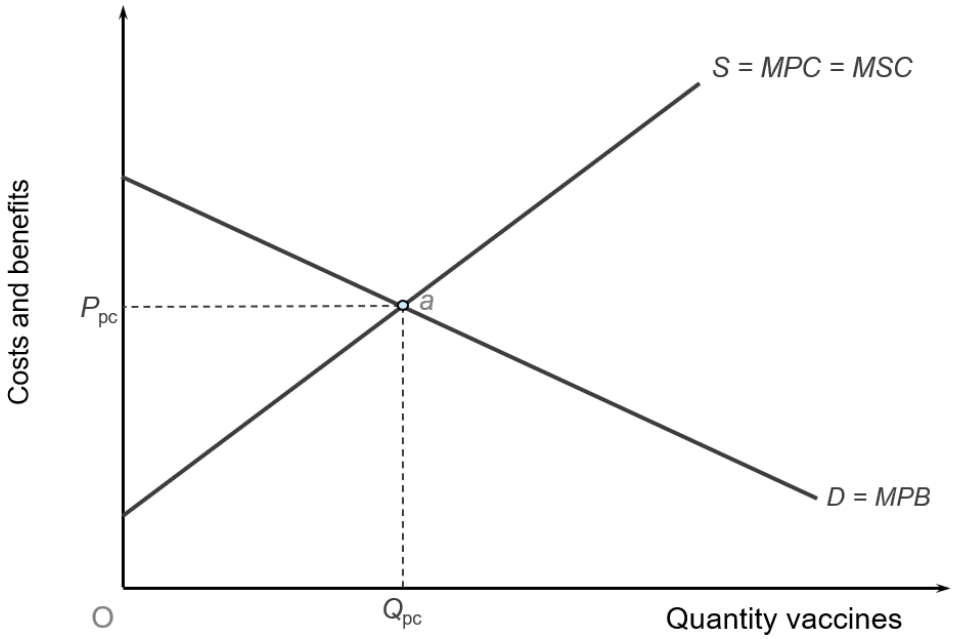
Vaccines are usually provided for free, i.e. they are a public good, a good provided by the government that doesn't exclude anyone and its free to, in this case, acquire. To see why lets start by studying what happens if vaccines are provided privately.

A rational individual will choose to do an activity if the gain (benefit) from it exceeds the cost (sacrifice) involved, i.e. if the additional benefit gained [marginal benefit – MB] exceeds any sacrifice [marginal cost – MC] in terms of opportunity cost[1]. A person will keep doing an activity until their Marginal benefit equals their Marginal cost, as it is only then when no further gain can be made. This situation is known as Private Efficiency. In terms of society, Social Efficiency will be achieved when the Marginal Benefit to Society (MBS) equals the Marginal (opportunity) Cost to Society (MCS). This situation is called Pareto Optimal[2]. For example, assume that the MBS is higher than the MCS we can move to another situation in which everyone will be better off by increasing the level of activity (increasing the level of production or consumption). On the other hand, if the MBS is less than the MCS then the society will gain from a decrease in the activities (decreasing the level of production or consumption).

[1] Understanding opportunity cost is essential in decision-making processes, as it highlights the trade-offs involved in allocating scarce resources. By recognising the value of the forgone activities, individuals and businesses can make more informed choices that maximise their overall wellbeing or economic efficiency.
[2] A Pareto Optimal situation happens when it is impossible to make anyone better off without making someone else worse off.

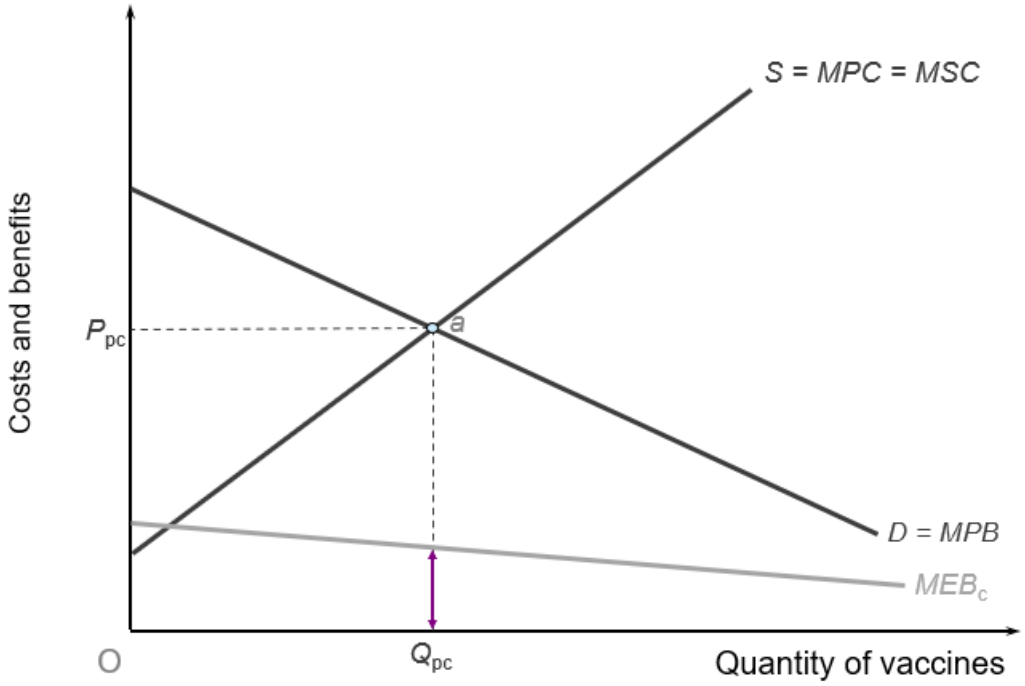
Now, we are going to look at these concepts graphically. Figure 1 represents the market equilibrium of cost and benefits of providing and consuming a vaccine with respect to the quantity of vaccines consumed. In this case, vaccinations are a positive externality in consumption and so the demand of the good equals the marginal private benefit (MPB) and the supply equals the marginal private cost (MPC) and the marginal cost to society (MCS). Point a represents the market the market equilibrium where P_{PC} is the “price” of the vaccine, which involves the cost and benefits of producing it, and Q_{PC} is the quantity of vaccines consumed.

Figure 1: Private market equilibrium



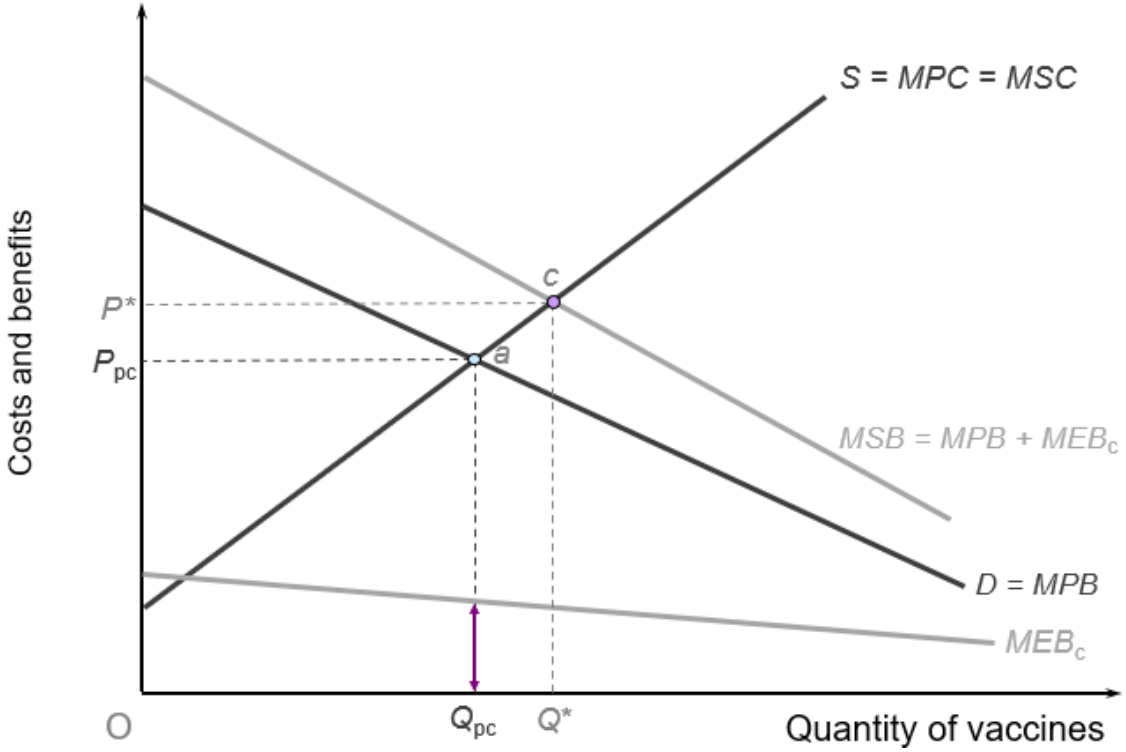
As in this case the vaccine is provided privately but there is a benefit to society from consuming it, the private market produces a smaller quantity than is socially desirable. There is a external benefit of consumption, if more people gets vaccinated other people benefits, we called this a Marginal External Benefit (MEB). The MEB will be decreasing as additional positive effects on third parties (non vaccinates people) are diminishing as more of the activity takes place if most of the population gets vaccinated you directly (not indirectly) benefit from the action. Figure 2 represents the MEB in the private market equilibrium (Figure 1).

Figure 2: Marginal External Benefit (MEB)



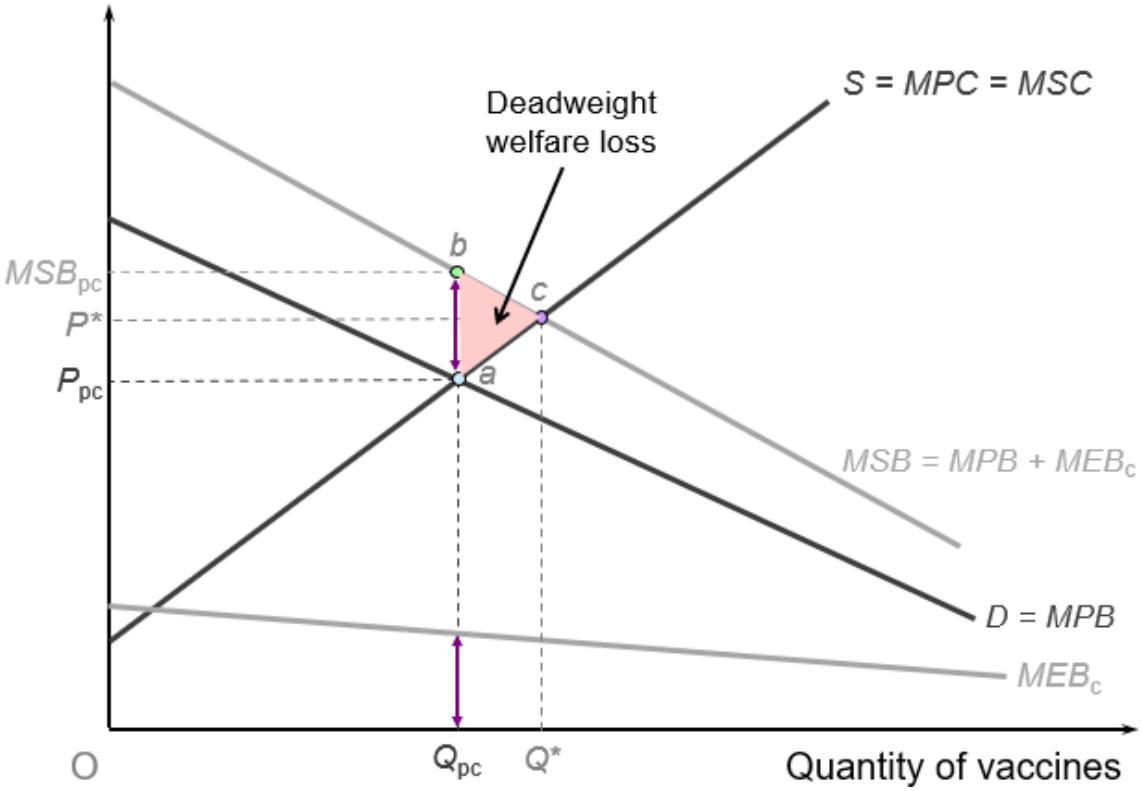
The Marginal Benefit to Society (MBS) will then be equal to the Marginal Private Benefit (MPB) plus the Marginal External Benefit (MEB) (Figure 3). Figure 3 shows that if vaccines are provided by the private market the consumption quantity is Q_{PC}, however if we consider the MEB, then we see that the optimum level of consumption in the society is Q* which is higher than the quantity provided by the private market, and so there is an underproduction of this good.

Figure 3: Optimal level of consumption



As we can see in Figure 3, the optimum level of output produced in the private market (Q_{PC}) is below the social efficiency level of production (Q*), and so there is a deadweight loss caused by this under-consumption. The Deadweight Loss (DWL) is the loss of potential economic value that occurs when the market doesn’t reach an efficient outcome. Figure 4 represents the DWL.

Figure 4: The deadweight loss caused by under-consumption.



To correct for this under-provision, governments often play a crucial role in providing vaccines as a public good. They may fund research and development, purchase vaccines, and distribute them to the population. This intervention is motivated by the Marginal External Benefit from consuming vaccines, i.e. by the recognition that individual decisions to get vaccinated have broader societal implications.

To sum up, vaccination programs yield substantial positive externalities that extend beyond the direct health benefits for individuals. These externalities encompass reduce healthcare costs, can have positive effect in the labour market and education, and enhanced global public health. Understanding and harnessing the positive

externalities of vaccines is crucial for policymakers and economists seeking to build stronger and more resilient societies.

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