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ECON 439

Assignment #2: Summary of Literature

Vaccination programs have a history of success in both the developed and developing worlds. They provide policy makers a powerful tool to combat diseases and invest in public health. While the assertion that vaccination is a public health threat has been thoroughly and widely disproven by the scientific community policy makers are still left with the difficult question of how best to allocate public health dollars. They must decide what populations to target their vaccine programs towards and what percentage of inoculation is necessary to achieve their goals. The answers that policy makers arrive at fundamentally shape global public health.

*Demand for Government Services and Herd Immunity*

The best studied effect of the implementation of vaccine programs is their healthcare cost savings. Nichol and Goodman present a rather traditional method for evaluating the costs and cost savings of vaccination. Using administrative claims data for 65+ year olds in 6 separate groups over 6 years they gathered data on influenza vaccination status, influenza related hospitalizations, demographics, and relevant comorbidities. The analysis finds a statistically significant reduction in hospitalizations for those that were identified with comorbidities. It also found a reduction in mortality for the entire vaccination group. By applying a cost benefit analysis Nichol and Goodman concluded that the reduction in healthcare costs was greater than the cost of influenza vaccinations for those in the age group 65 to 74 (p.63).

In order to best inform policy decisions the assessment of the benefits of vaccination needs to be expanded beyond the simple costs associated with lost productivity and medical bills.

Damn, Eichner, Rose, Knuf, Wutzler, and Liese developed a simulation of the German population that expands our understanding of the benefits of vaccination by including productivity loss by caretakers of sick children, lost in quality of life due to complications and the cost of over the counter drugs used for influenza treatment. The model uses estimations for drug and vaccine price, vaccine effectiveness, and medical services along with census data to model the effects of differing levels of intranasaly administered live attenuated influenza vaccine for 2 to 17 year olds. This model is used to evaluate the efficacy of the German childhood vaccination program and finds that 60% of the hospitalizations averted by the program are those of adults (p.479). Depending on the perspective used for assessing social costs the study finds that each additional quality-adjusted life year(QALY) has a cost that ranges from 2,265 euros to actually being an entirely cost saving strategy (p.485). From any cost assessment perspective the LAIV distribution program studied is very cost effective.

Studies into the effectiveness of vaccines aren't limited to the seasonal flu vaccine. Claes and von der Schulenburg adapt a Markov model to study the heard immunity effects of the heptavalent pneumococcal conjugate vaccine that has been recommended as a general infant vaccination since 2006 (p.25). They built this model using data from Erhebungseinheit für seltene pädiatrische Erkrankungen in Deutschland (ESPED) to track the rate of invasive pneumococcal disease (IPD) in minors and data from North-Rhine Westphalian hospitals to track the rate of IPD for adults. One significant problem with this data set is the under reporting of IPD in Germany because it is not common to culture patients suffering from IPD symptoms, so ultimately Claes and von der Schulenberg are forced to use a factor of 2.7 which brings IPD reports to what would be expected in the population as revealed by countries like the United States that cultures patient's bacterial infections more regularly. Indirect cost accounting is

similar to the Damn, Eichner, Rose, Knuf, Wutzler, and Liese paper taking into account lost productivity of the patient and a caretaker if the patient is a child. The paper demonstrates that even before considering the heard immunity effects the PCV program is cost effective, and thus the protection of vulnerable adult populations can just be seen as an extra benefit of an already successful program (p.35).

*Beyond the Health Benefits*

Bloom, Canning, and Weston's analysis expands the scope of the cost benefit analysis of vaccines even further. Assessing data from Gavi's program to extend childhood vaccination into low income countries they find that vaccine deployment in the developing world results in higher economic growth. Also they used data from the Cebu Longitudinal Health and Nutritional survey (CLHNS) to show that higher rates of vaccination also result in higher IQ scores in children. They calculate that for each year of life expectancy that was added labor productivity increased by 4% (p.32). By increasing life expectancy birth rates drop as families realize that they need to have less children in order to reach their ideal family size resulting in better opportunities for the next generation because they are able to receive more support from their parents. Also because the children are free from preventable diseases that can cause permanent physical or mental damage they are more able to become productive. Another effect that contributes to economic growth as a result of longer life expectancy is the increase in retirement savings that can be used to invest and spur growth. The income effect of vaccine programs in developing nations already delivers a return on investment of 12 to 18 percent and that is before other effects such as averted medical costs have been taken into account (p.35). The rate of return for vaccination would certainly be higher if the effects outlined in the previous section were included in this particular analysis.

*Forces Resisting Vaccination Growth*

Considering all relevant effects vaccination investment competes favorably with the rate of return almost all public policies, including education (Bloom, Canning, and Weston, p.36). Yet despite that the growth of vaccine use has stagnated and even reversed in some areas. There are many factors that contribute to the stagnation, the most obvious of which is that all the easily accessible populations have already been vaccinated meaning that the cost per vaccination has risen (p.21). These populations are often in areas with high political instability. This is compounded with the fact that most unvaccinated populations are in developing nations where the market for vaccines must operate on lower margins, driving vaccination investment down further. Also falling public trust in vaccination has led to tighter regulation on vaccine production, making developing vaccines more expensive driving up the cost of the vaccines once produced (p.23).

Alfonso, Ding, and Bishai's research demonstrates another force working against vaccination especially in the developing world. Using health expenditure panel data gathered from 2010 to 2011 on 137 World Health Organization members from the National Health Accounts, they evaluated the income elasticity of health expenditure and particularly vaccine expenditure. If income elasticity were high then rapidly rising GDP's of developing nations would drive up vaccine adoption. Unfortunately the exact opposite was found; the income elasticity of vaccine expenditure is pretty low and lags behind other types of healthcare spending significantly. The data presented by Bloom, Canning, and Weston shows that in fact the exact opposite may be true. That is to say that vaccine use effectively drives up GDP but GDP growth doesn't lead to vaccine adoption. This indicates that some form of intervention to encourage vaccine use is financially prudent.

*The Pitfalls of Marketplace Intervention*

Despite government intervention into the vaccine marketplace seeming to be the correct choice it is often cited as a hindrance to the goal of mass vaccinations (Bloom, et.al). Danzon and Pereira use data on the entry and exit of vaccine manufactures from the FDA and data from the CDC on the amount, prices, and types of vaccines that they have been purchasing and they found that larger government purchases of vaccines drove down prices while driving down prices. This would be the predicted effect but the data also suggested that the government purchases also caused companies to exit from the market partially or entirely. This is because the price drop in the long term exceeded the value of shipping higher volume.

This reveals that the natural equilibrium in the vaccine market is only one or very few firms producing any type of vaccine. This is partially because any competing vaccine would be almost completely substitutable (Danzon and Pereira). Furthermore very high entry costs prevent competing firms from entering a market even once it is vacated. The barrier to entry is high due to intense regulation, high cost facilities, and demand that is both limited and high risk as at most each customer will only use the product once and demand is subject to shifting government policy and public opinion. The limited production capacity has led to shortages in the seasonal flu vaccine, exposing vulnerable populations to risk (p.240).

Another issue with government intervention into the vaccine market is revealed by Finkelstein. Data on preclinical trials, new clinical trials, and FDA approvals is collected from the NDA Pipeline, a business publication and combined with data from the United States Patent and Trademark Office (USPTO) in order to gather an understanding of when pharmaceutical companies invest in vaccine research and development. It turns out that when the government announces a sudden influx of support for a vaccine for any certain type of pathogen the industry

tends to over respond with research and development funding. This research and development funding rarely leads to new products that and usually are almost entirely wasteful ventures (p.557). What is occurring is government policy to support the deployment of current medical technologies namely vaccines are leading pharmaceutical companies to view development of vaccines for diseases where vaccines already exist as more attractive leading to wasteful research and development. The research finds that for every dollar of expected annual market revenue stimulates 6 cents of additional research budget for the same disease. Notably the wasteful innovation isn't a problem in the influenza market because it's highly dynamic.

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