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Copayment Coupons and the Pricing of Prescription Drugs

Pharmaceutical companies have succeeded in boosting demand for high-priced brand-name drugs by offering coupons to offset patient cost-sharing. While consumers who qualify for these coupons enjoy immediate benefits, the practice has frustrated insurers' efforts to manage costs and has increased US drug spending, according to a new study.

In [How Do Copayment Coupons Affect Branded Drug Prices and Quantities Purchased?](#) (NBER Working Paper 29735), [Leemore Dafny](#), [Kate Ho](#), and [Edward Kong](#) estimate the effects of coupon programs on drug utilization and prices. They use Medicare Advantage enrollees as a control group, since by law they are prohibited from using copayment coupons.

Coupons shield consumers from cost-sharing incentives that private insurers rely upon to promote utilization of cost-effective drug therapies, e.g. tiered formularies. For example, the copayment for a generic drug might be only \$5 or \$10, compared with much higher amounts, often a percentage of the actual cost, for brand-name drugs. "Preferred" brands for which an insurer has nego-

tiated a favorable price also typically have lower copays than non-preferred brands.

Copayment coupons and related initiatives by pharmaceutical companies are

Coupons that reduce copayment costs for brand-name drugs undermine insurers' efforts to promote more cost-effective drug therapies.

designed to boost demand for brand-name drugs. Concurrent marketing by representatives of these firms also helps doctors become more familiar with and comfortable prescribing the couponed drugs.

The researchers use two approaches to calculate the impact of coupons on prescrip-

tion drug use. The first draws on data from a large pharmacy benefits manager over the period 2014–17. It focuses on drugs that were not exposed to generic entry during the study

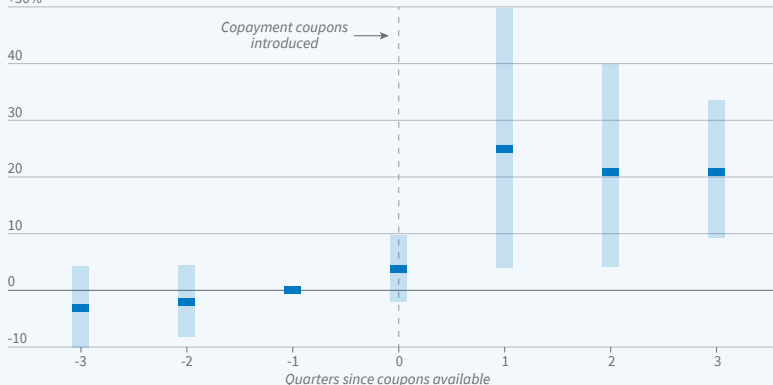
period and that had been on the market without a coupon for at least nine months. Price data are based on what insurers paid after rebates and other discounts.

In the 12 months after coupons were introduced for a drug, individuals covered by commercial insurance plans increased their purchases, as measured by days of the drug supplied, by an average of more than 20 percent compared with those enrolled in Medicare Advantage. The researchers found no differential effect on prices, which they argue may be due to the relatively short post-coupon period of analysis.

The second approach concentrates on prices and spending for a single drug category, disease-modifying therapies for multiple sclerosis. The researchers study claims data for 2009 through 2017 from the Health Care

Drug Copayment Coupons and Quantity Purchased

Difference in quantity of branded drugs sold, commercially insured vs Medicare Advantage enrollees, relative to quarter before coupon introduction +50%



Shaded bars represent 95% confidence intervals
Source: Researchers' calculations using data from a large pharmacy benefits manager and other sources

Cost Institute, which includes claims from a quarter of commercially insured consumers and 35 percent of Medicare Advantage enrollees. They estimate that banning copay coupons would reduce total spending on these drugs by \$950 million, which translates to a reduction in insurer costs of 7.6 percent. They further estimate that the market shares of couponed drugs would fall by 6 to 9 percent if coupons

were no longer used, while those of never-couponed drugs would increase.

For Medicare Advantage enrollees, the coupon ban would lower premiums and out-of-pocket expenses, as copays are typically a percentage of the drug price. For those with commercial insurance, out-of-pocket spending would increase, but the reduction in health insurance premiums could be larger than the

copay increase—up to four times larger if insurers and plan sponsors passed along all drug cost savings to enrollees. The researchers note that a variety of potential mechanisms exist for mitigating the impact of a copay coupon ban on commercially insured consumers, such as a lump-sum transfer to a health savings account for enrollees with costly conditions.

—Steve Maas

Using Machine Learning to Predict Mutual Fund Performance

In **Machine-Learning the Skill of Mutual Fund Managers** (NBER Working Paper 29723) Ron Kaniel, Zihan Lin, Markus Pelger, and Stijn Van Nieuwerburgh use a neural network to predict mutual fund performance. They estimate relationships among a large set of fund attributes to identify the US mutual funds with the best relative performance. They apply their model to predict the best-performing decile of funds each month and to compute portfolio weights for different funds that will produce the maximum return within the top decile.

Investing according to the model's predictions generated a cumulative abnormal return of 72 percent over the 1980 to 2019 period. The decile of mutual funds that was predicted to exhibit the worst returns each month produced a cumulative abnormal return of -119 percent over the same period. The difference between the returns in the best and the worst deciles, 191 percent, was both economically large and statistically significant.

The average mutual fund in the sample of 3,275 funds was almost 14 years old, had \$1.15 billion in assets, and charged a monthly expense ratio of about 0.1 percent. Abnormal returns were those earned in excess of what an investor would expect given a fund's level

of risk. Such returns were estimated by subtracting the monthly Treasury-bill yield from a fund's monthly performance before fees, minus the estimated compensation for sys-

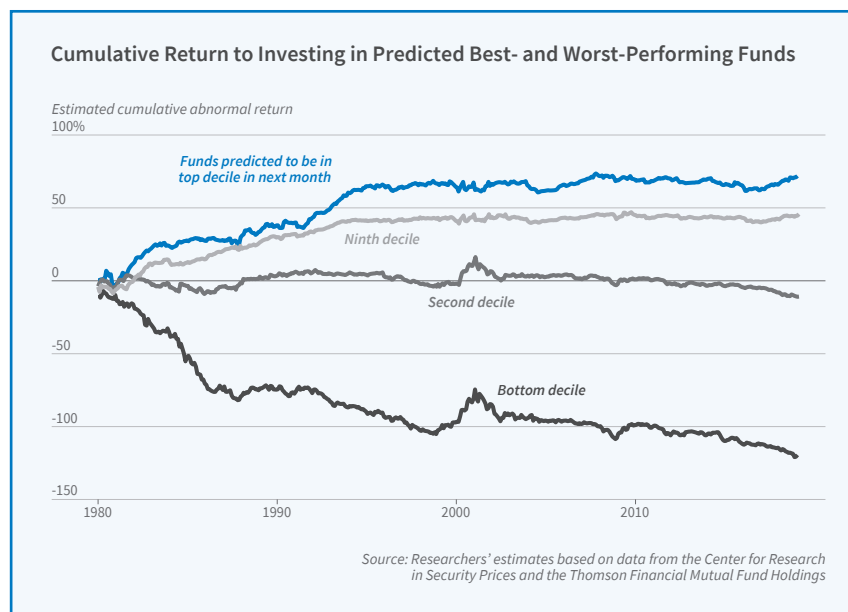
tematic risk factor exposure. Ten to 20 percent of funds in the sample generated positive abnormal returns after fees were subtracted, with most gains accruing from avoiding the

A model that includes interaction effects between investor sentiment, fund flows, and fund momentum has substantial power to predict the best- and worst-performing funds.

erred substantial interaction effects between investor sentiment and both fund flow and fund momentum. A fund's momentum is its mean abnormal return in the preceding 12 months, excluding the most recent month. Flow is the change in total net assets in a month. Abnormal returns were nearly identical when the fund characteristics in the model were pared down to these three attributes.

Periods of above-average investor sentiment drove the strong association between fund momentum, flow, and the next month's abnormal performance. When combined with fund characteristics, the state of the macroeconomy, proxied by the Chicago Fed National Activity Index (CFNAI), predicted the

best and worst performers as well as investor sentiment. Though models that use sentiment and the CFNAI put 78 percent of the same funds in the bottom decile and 74 percent of the same funds in the top decile, the model



worst-performing funds. The average abnormal return was -0.03 percent per month.

The researchers conclude that little can be learned about a fund's performance from the characteristics of the stocks it holds. Their alter-

with sentiment did a better job of predicting funds' actual abnormal returns. Investor sentiment was also better at predicting the relative returns within the top and bottom deciles. Prediction-weighted portfolios created from the top decile of funds earned a cumulative abnormal return of 72 percent. Investing in equally weighted portfolios returned just 48 percent.

The results are consistent with investors

successfully detecting skilled managers and reallocating their investments toward them. They are also consistent with funds and fund families successfully using marketing to attract investors. Fund inflows create buying pressure for the stocks held, raising their prices and lifting fund returns. That demand pressure increases prices further, generating momentum in fund returns. The fact that flows and fund momentum have a much stronger association

with fund performance in high-sentiment periods lends further credence to this marketing-driven channel. However, changes in inflows were gradual and small enough, the researchers found, to take several months before the fund ran into zero marginal abnormal returns. Skill, therefore, leaves a trail in the form of fund return momentum, and investors can exploit this to earn higher returns.

—Linda Gorman

Why Stock Markets Are Less Volatile When the US Is at War

Wars and other periods of conflict typically heighten political uncertainty, but US stock volatility is 33 percent lower than usual in such times. A new study, [Stock Volatility and the War Puzzle](#) (NBER Working Paper 29837), proposes to explain this long-standing conundrum.

War causes the defense share of government spending to rise, sometimes dramatically. This makes the future profitability of a wide swath of companies more predictable and, thus, less volatile, according to researchers [Gustavo S. Cortes](#), [Angela Vossmeier](#), and [Marc D. Weidenmier](#). Constructing a dataset of US defense spending from 1890 to 2017, they find that higher spending predicts lower stock volatility in aggregate and particularly for firms that produce military goods. They also find that analysts' earnings forecasts for such firms became more uniform at the onset of recent conflicts, including that in Afghanistan in 2001 and Iraq in 2003. These effects are not limited to the US

market: higher US defense spending is associated with less volatile world equity markets.

None of the conflicts studied by the researchers were fought in the US, which reduced volatility because the US capital stock was not subject to massive and ongoing

Rising defense spending lowers aggregate stock volatility and narrows the range of analysts' forecasts of profits for defense-related firms, particularly those doing R&D and testing.

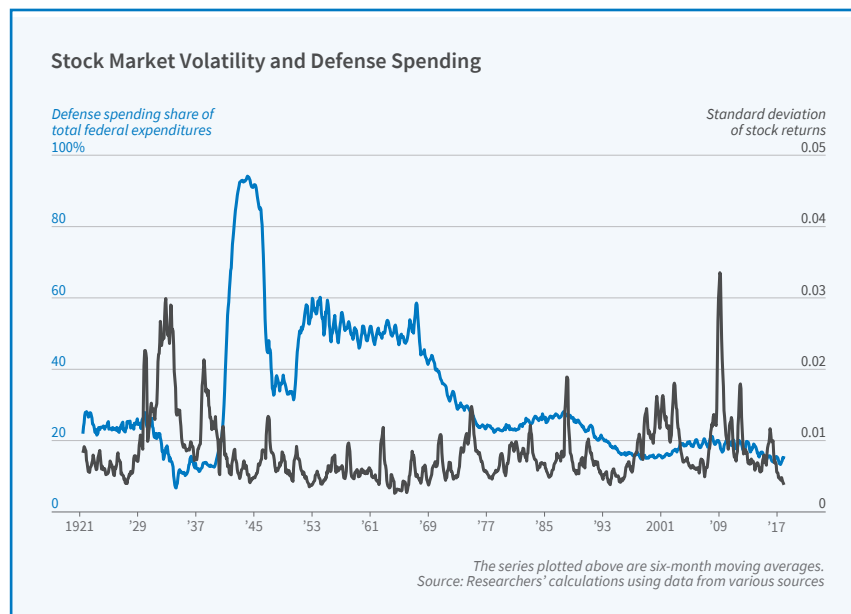
damage. Two wars that were fought on US soil — the War of 1812 and the American Civil War — took place before the sample period.

Different types of military spending affect market volatility in different ways. Spending by the Navy, Air Force, and other non-Army defense units reduces stock volatility more

has the Army, which typically spends more on personnel, operations, and maintenance. This suggests that the other armed services are more involved in contracts, often long-lasting ones, with the private sector.

Some sectors of the economy are more affected by defense spending than others, but nearly all sectors show a decline in volatility when such spending ramps up. Coal and steel stocks become far less volatile and even sectors like clothing and textiles show statistically significant reductions in volatility when defense spending goes up.

The researchers also study how military spending affects analysts' earnings estimates for individual firms. They designate companies with at least 20 percent of their revenues from federal contracts as defense related. Since their firm-specific data start in 1990, they examine the earnings forecasts during the four most recent conflicts: the 1991 Gulf War, the 1998 war in Kosovo, the 9/11 terrorist attacks and ensuing war in Afghanistan, and the 2003 invasion of Iraq.



than Army spending does. Since at least the 1980s, when the US Treasury began detailing how each branch spends its funds, these entities generally have spent a higher share of their budgets on procurement, research and development, and testing and evaluation than

In the first two conflicts, earnings-per-share estimates for defense-related companies did not become more uniform than those for nondefense companies. The 1990s confrontations came at a time when overall US military spending was falling because of the end

of the Cold War. But when military spending began to pick up again in 2001 after 9/11, the differences between defense and nondefense companies showed up almost immediately. After US military forces were deployed in Afghanistan, the range of analysts' quar-

ter-ahead, two-quarters-ahead, and even two-years-ahead earnings forecasts narrowed for defense companies far more than for nondefense companies. A similar pattern occurred following the 2003 invasion of Iraq.

—Laurent Belsie

Engineers and the Industrial Revolution in 19th Century Britain

Why the Industrial Revolution succeeded in generating sustained economic growth has long been a subject of analysis and discussion. The burst of innovation that took place in Britain in the late 1700s had historical precedents, but they all petered out without producing a dramatic economic transformation.

In *The Rise of the Engineer: Inventing the Professional Inventor during the Industrial Revolution* (NBER Working Paper 29751), W. Walker Hanlon finds that sustained technological progress was made possible by changes in the way innovation and design work was done in Britain. He identifies the emergence of the engineering profession as a key contributor to this change.

To study the occupational functions that defined the early engineering profession, Hanlon employs both a qualitative analysis of historical writings and a quantitative textual analysis of information from the *Oxford Dictionary of National Biography*. Examining the biographies of all 439 engineers in the *Dictionary* who were born before 1850, he finds the 20

verb stems most closely associated with engineers. “Design,” “invent,” and “patent” are some of the most common activities associated with engineering, indicating the centrality of invention to the new occupation; “build,” “erect,” “employ,” “lay,” and “supervise” indicate implementation. “Consult,” “report,” and “survey” reflect other functions of early engineers. He

finds little change in these defining characteristics between 1750 and 1850.

The biographical data also indicate a dramatic increase in the number of engineers dur-

Biographical and patent data show sharp increases in the share of inventions and patents attributed to engineers in the early 1800s.

ing that period. By 1850, engineers made up more than 2 percent of all of those who merited a biography, and around 20 percent of all biographies associated with science or technology.

Since reproducible inventions are widely considered to be central to driving economic

The overall number of patents also grew sharply over this period. By the 1860s, engineers produced far more patents than any other occupational group. They also patented across a sub-

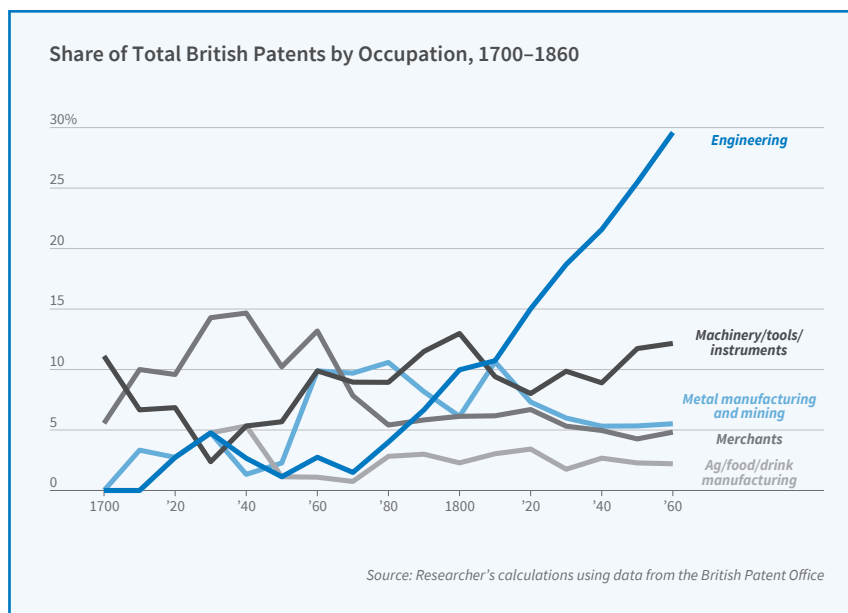
stantially broader set of technology categories than any other type of inventor.

The patent data also show that engineers were fundamentally different from most other types of inventors: they were more productive, their patents were of higher quality, they worked with more coinventors, and they generally achieved greater overall career success.

Hanlon also considers how civil engineering—the field perhaps most closely associated with the engineering profession—professionalized after 1750. He constructs a dataset of 338 major British civil engineering projects, most of which were undertaken between 1600 and 1830. After 1750, these projects were increasingly overseen by experienced engineers at established firms that undertook

numerous major projects. These experts also trained the next generation of civil engineers, most of whom gained extensive experience working for established firms before being awarded major projects of their own.

Hanlon offers a theory of how the professionalization of invention by engineers contributed to the acceleration of economic



growth, Hanlon examines the complete British patent records of 1700–1869, compiles data on just over 8,300 inventors, and groups them into broadly related occupations. In the first decade of the 19th century, an engineer was listed as an inventor on 10 percent of patents. By the 1840s, the share of patents associated with engineers had doubled, and by the 1860s, it had tripled.

growth during the Industrial Revolution. He emphasizes the process through which new technologies are developed, and argues that specialist researchers—in this case, engi-

neers—are more productive at generating new technologies than nonspecialists. This framework integrates Adam Smith’s insight that specialization can increase productivity

in the development of new inventions and designs into a workhorse model of endogenous economic growth.

— Brett M. Rhyme

Computerization’s Impacts on Office Jobs and Salaries

Office and administrative support positions grew from less than 12 percent of US employment in 1950 to a peak of about 17 percent by 1980. By 2019, mass adoption of personal computers had returned the administrative support share to the level of the 1950s.

In **Computerization of White Collar Jobs** (NBER Working Paper 29866) **Marcus Dillender** and **Eliza Forsythe** investigate how the increase in computer use changed hiring requirements and job content. Contrary to popular fears that the use of labor-saving technologies would lead to “technological unemployment,” they find that the adoption of office and administrative support software had a modest positive effect on wages and employment in local labor markets. In general, adopting the new technology increased the skill levels needed for office and administrative support positions. Although overall

employment in office support fell, wages for college-educated women in support positions grew by over 3 percent on average.

Economic theory is ambiguous about the likely labor market effect of adopting a new technology. Increased use of software by office and administrative support employees could increase the productivity of existing workers, leading to relative wage gains. It could also lead to relative wage losses if the technology substitutes for people, decreasing demand for office and administrative support workers. Both effects seem to operate in the office support market.

As technology increased the skill levels needed for office and administrative support positions, overall employment in office support fell and wages for college-educated women in support positions rose.

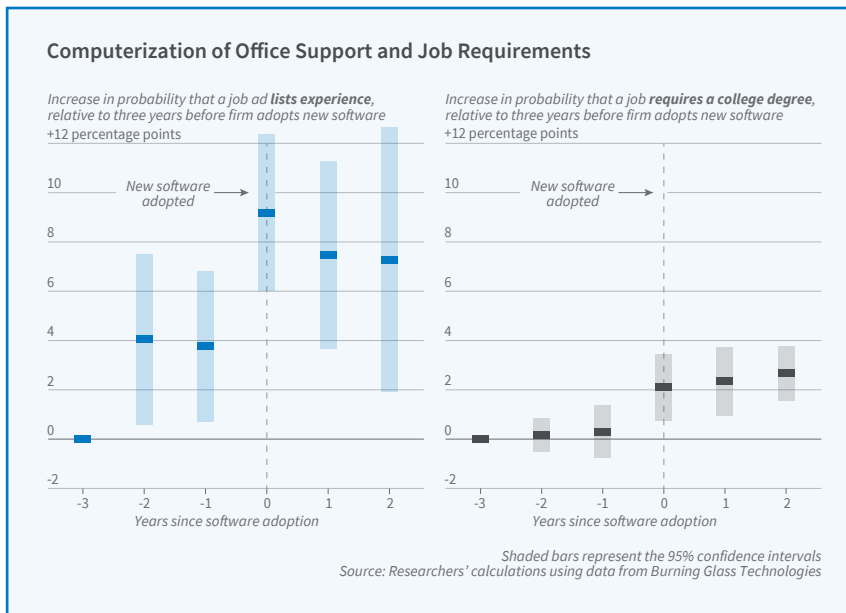
The researchers estimate the change in the skill level needed to operate the technology used in office support jobs by studying 8 million job ads extracted from Burning Glass Technologies’ database. The sample ads were posted in 2007 and from 2010 to 2016. The researchers use the Department of Labor’s O*NET data on

firms that posted those ads added technology requirements to their ads in subsequent years. They asked for more education in the years before they adopted new technology, and they increased their education requirements substantially in the year they adopted new technology and in the subsequent two years. Analysis of the top 1,000 phrases from the job content requirements in the ads, such as typing, data entry, accounting, research, and management, also suggests that new technology adoption broadened job task content. Office and administrative support jobs became more skilled and encompassed cognitive tasks that are harder to computerize.

Results from analysis of local labor markets, defined by commuting zones, suggest that office support workers without college degrees experienced reduced demand for their services. An increase in technology exposure increased the office administrative support wage premium for college graduates by about 5 percent compared to workers without a college degree in similar jobs, and by about 3 percent when compared to nonsupport workers with a college degree.

The researchers did not find any reduction in demand for lower-skill or traditional office support tasks after the adoption of new software technologies, suggesting that office support jobs are likely to remain an important segment of the labor market for the foreseeable future.

— Linda Gorman



job characteristics to identify technologies and classify them into 69 categories. An ad for a secretarial position, for example, might mention proficiency with Microsoft Excel or Corel Quattro Pro, both of which would be in the spreadsheet category. Mentions of educational and experience requirements were also used to measure job skill requirements. Firms were defined using firm name and commuting zone so that different branches of a nationwide business could be treated differently.

About 1 million ads that were posted in 2007 and 2010 did not list any technology requirements for office support workers. The

Estimating Lives Saved by COVID Vaccines

States vary widely in the COVID-19 vaccination rates of their populations, from 48 percent in Alabama to 77 percent in Vermont between November 2021 and February 2022. In [Vaccination Rates and COVID Outcomes across US States](#) (NBER Working Paper 29884), [Robert J. Barro](#) estimates the effectiveness of vaccines in reducing negative COVID outcomes from this state-level variation. He leverages Centers for Disease Control and Prevention data on vaccination rates, cases, hospitalizations, and deaths over the course of the pandemic.

Barro focuses on four periods of roughly three months each. Rates of full vaccination rose over the periods, but at a declining rate. During the first period, March to May 2021, vaccination rates averaged 24 percent. In the three subsequent periods, roughly June to August 2021, September to November 2021, and November 2021 to February 2022, vaccination rates averaged 45, 55, and 61 percent, respectively. The annualized change in the number of COVID cases per capita increased over time, even though vaccination rates also rose. The mean changes in cases per person were 0.05, 0.08, 0.13, and 0.39 during the four periods. The fourth period coincided with the spread of the Omicron variant. The mean annualized change in per capita deaths

due to COVID was 0.0007 in the first period, followed by 0.0006, 0.0017, and 0.0021.

The research finds that vaccinations were very effective in saving lives. The effect was

In late 2021, on average one COVID death was avoided for every 124 full vaccination courses that were delivered, implying a cost per life saved of about \$55,000.

strongest in the September to November period of 2021, when a 14.2 percent rise in the vaccination rate is estimated to have lowered the death rate by 40.6 percent. It took an average of 124 full vaccinations (248 shots) to save one life at this time. At a full cost for two doses of \$222, that implies that the cost of saving one life was around \$55,000. The estimated effect of vaccinations on death rates was smaller in magnitude in the other periods. For example, between December 2021 and February 2022,

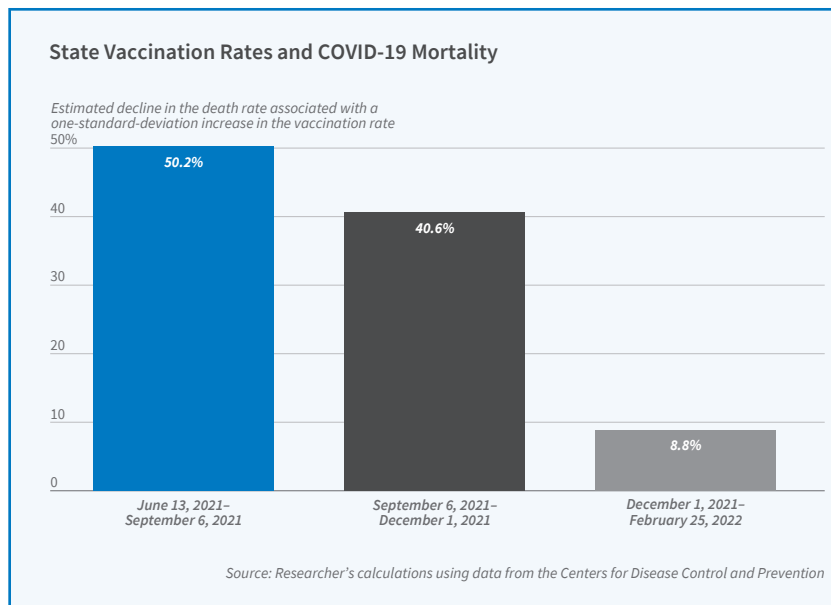
the estimates imply that it took 455 full vaccinations to save one life, and the estimated cost per life saved was \$200,000. This is still far below most estimates of the value of a statisti-

cal life, which are often several million dollars for the United States.

Barro offers three possible explanations for why the effects of vaccinations on COVID-related deaths, hospitalizations, and cases seem to have weakened over time, particularly in the December 2021 to February 2022 period. First, the efficacy of vaccinations wanes over time, although the analysis tried to hold constant this effect. Second, existing vaccines were likely less effective against new forms of the

virus, notably the Omicron variant. And third, the confidence engendered by vaccinations may have led individuals and state governments to relax nonpharmaceutical interventions such as masking and social distancing that were designed to prevent virus spread. The impact of such relaxations may have been reinforced by so-called COVID fatigue, a general decline in self-protective actions taken by many members of the community.

— Brett M. Rhyme



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