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Program Report

Labor Studies

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The Labor Studies Program is one of the largest and most active in the NBER. Its nearly 190 members produce more than 300 working papers in an average year. The breadth and depth of questions addressed by Labor Studies members is immense. Research touches on macroeconomic topics such as unemployment and productivity; institutional factors such as minimum wage regulations, labor unions, and globalization; and technological developments including robotics, artificial intelligence, and algorithmic decision-making. It also includes core human capital subjects such as educational investment, the demand and supply of skills, and wage determination; industrial organization topics such as imperfect competition, rent sharing, and firm-specific wage policies; and social insurance and welfare programs such as unemployment insurance, universal basic income, and in-kind benefit programs such as SNAP, Medicaid, and housing assistance. Program affiliates also study urgent social questions, including race and gender disparities in market opportunities, neighborhood quality, treatment by the criminal justice system, and many other subject domains.

Reflecting their intellectual diversity, two-thirds of Labor Studies Program members are affiliated with two or more NBER programs or major projects. Though the pandemic has curtailed some program activities, it has simultaneously opened new horizons. The online meeting environment has allowed many nonaffiliated scholars to participate in program meetings. Meanwhile, researchers who prefer to audit rather than participate in program sessions can watch meetings streamed live on NBER's YouTube channel. In the post-pandemic world, the program will strive to keep these professional and intellectual doors open.

This brief report summarizes a small subset of topics where research by Labor Studies affiliates is burgeoning, including the role of firms in wage

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determination; the minimum wage; the consequences of advancing technologies for employment and productivity; race and ethnicity in the labor market; and the extent and consequences of racial and ethnic discrimination and segregation. This summary does not do justice to the vast body of recent scholarship by program affiliates, though our hope is that it reveals some important research undercurrents.

Automation, Employment, and Productivity

The role of automation in shaping labor demand, skill requirements, and wage levels has been of intense economic interest for centuries. Even so, this topic has gained further prominence as rapid advances in ubiquitous computing, artificial intelligence, and robotics have imbued machines with the ability to accomplish tasks that require learning, judgment, and dexterity. Labor Studies scholars have taken numerous angles of attack to assess what this has meant for labor markets and to forecast what may lie ahead.

One influential paper in this domain by Daron Acemoglu and Pascual Restrepo explores how the expansion of industrial robotics has affected employment and wages in local labor markets — so-called commuting zones.[1] Harnessing data on industrial robot penetration in other industrialized countries to measure the technological frontier, the researchers calculate predicted robot adoption in the United States within local labor markets based on initial industry structures in those locations. A key finding is that local labor markets with greater exposure to robot adoption saw differential falls in employment-to-population rates (and wages, not pictured) in the 1990s and early 2000s. An independent empirical contribution by George Borjas and Richard Freeman reaches a similar conclusion.[2]

Brad Hershbein and Lisa B. Kahn explore how recessions may accelerate the process of technological change by studying the evolution of skill requirements posted in job vacancies, using a vast database of vacancy postings scraped from the web by Burning Glass Technologies.[3] They show that skill requirements in job vacancy postings differentially increased in metropolitan statistical areas that were hit hardest by the Great Recession, and these increases persisted through at least the end of 2015, long after the recession was over. They interpret this evi-

dence as consistent with adjustment cost models in which adverse shocks accelerate the process of adaptation to new business processes, in this case, so-called routine-task-replacing technologies and the more-skilled workers who complement them. Consonant with these findings, Alex W. Chernoff and Casey Warman argue that the current COVID-19 pandemic may speed the process of automation. They further present evidence that in a large set of countries, the occupations held disproportionately by women are at greater risk of displacement by automation, implying that the post-pandemic labor market may offer fewer of the positions frequently held by women.[4]

Illuminating another facet of the interplay among technological change, demand shifts, and labor market adjustment, Elizabeth U. Cascio and Ayushi Narayan study the impact of the introduction of hydraulic fracturing (fracking) for oil extraction, a technology introduced during the 2000s, on educational investments.[5] Because fracking offers high-paying blue-collar jobs to workers without secondary credentials, it potentially raises the opportunity cost of schooling. As theory would predict — and as many parents would lament — high school dropout rates rose among male teenagers living near shale oil deposits.

What are the long-run implications of advancing automation for skill demands? A theoretical paper by Seth G. Benzell, Laurence J. Kotlikoff, Guillermo LaGarda, and Jeffrey D. Sachs considers how, in an overlapping generation setting, automation can ultimately lead to worker immiseration by reducing capital formation as long-lived, barely depreciating software capital effectively makes high-skill workers redundant.[6] In related work, Anton

Korinek and Joseph E. Stiglitz consider the challenges that artificial intelligence may ultimately pose for income distribution and unemployment.[7] David E. Bloom, Mathew McKenna, and Klaus Prettner place this issue in global perspective by observing that the global labor market will need to absorb roughly three-quarters of a billion new workers between 2010 and 2030.[8] With 91 percent of that growth occurring in low- and lower-middle-income countries, they raise the concern that technological advances may create headwinds because the labor-intensive jobs currently prevalent in developing

countries may be increasingly subject to automation.

While most of the papers above focus on the economic implications of machines substituting for labor, work by David Deming presents evidence that as automation proceeds, the demand for human capabilities is rising on another margin: social and managerial skills.[9] Deming argues that as information technology has replaced workers in routine codifiable tasks, it has magnified the value of social skills that allow workers to specialize and collaborate more efficiently. In a related vein, Gaetano Basso, Giovanni Peri, and Ahmed Rahman provide evidence that low-education US immigrants

have helped blunt the impact of automation on native US workers.[10]

In work that appears prescient in light of the current pandemic, Nicholas Bloom, James Liang, John Roberts, and Zhichun Jenny Ying examine another labor market manifestation of advancing information technology: remote work.[11] Partnering with a large Chinese travel agency, the researchers conduct a large field experiment in which travel agents were randomly offered the option to work from home. Among those offered the work-from-home option, both productivity and worker satisfaction rose. Ironically, promotion rates conditional on performance fell among those working from home, suggesting that not being in the office may also have hidden private costs.

This growing body of theory and evidence on labor market consequences of automation highlights an enduring macroeconomic puzzle raised by Robert Solow: "You can see the computer age everywhere but in the productivity statistics."[12] Though Solow's observation dates to 1987, the puzzle has only deepened since that time — particularly with the pronounced slowdown in measured productivity growth in industrialized countries that Chad Syverson documents took place after approximately 2004.[13] If machines are becoming so much cheaper and faster at accomplishing tasks once requiring expensive labor, why isn't productivity rising more rapidly? Papers by Erik Brynjolfsson, Daniel Rock, and Syverson,[14] among others, confront this puzzle, arguing that these productivity gains are near at hand. Their work makes the case that the productivity benefits of new technologies are masked by substantial unmeasured complementary investments made by technology adopters, such

Industrial Robots and Employment, 1993–2007

Change in employment to population ratio, by commuting zone

Marker size indicates share of 1990 US working age population in corresponding commuting zone

Exposure to robots

Exposure to robots is defined as the national penetration of robots into each industry times the baseline employment share of that industry. Light-gray shading represents 95% confidence interval. Source: Acemoglu D and Restrepo P. NBER Working Paper 23285

Figure 1

as new business processes and business models, novel products, and new human capital. If this explanation is correct, productivity should surge when the unmeasured investment phase slows and these hidden investments begin yielding measurable returns. Alternatively, Acemoglu and Restrepo offer a more skeptical interpretation of the productivity paradox, arguing that many heavily hyped information technologies are barely cheaper or more productive than the labor-using tasks that they displace.[15] These "so-so" technologies, as these researchers label them, have the dual disadvantage of generating substantial worker displacement without yielding much of a productivity payoff. It is premature to know which view of our productivity predicament is correct.

Discrimination and Segregation in the Labor Market

A large body of recent scholarship by Labor Studies researchers brings new ambition, depth, and nuance to research on race and ethnicity in the labor market. Approximately 50 studies have focused specifically on race, discrimination, or segregation. In two studies, Marianne Bertrand and Esther Duflo[16] and David Neumark[17] review and synthesize the growing set of experimental analyses of discrimination.

A number of important articles have harnessed new data sources and state-of-the-art econometric methods to document new facts about racial and ethnic disparities in the labor market, and differences in economic mobility. A common thread in these studies is the degree of persistence in racial and ethnic gaps in economic and social outcomes. Economic gaps have remained immutable since the mid-20th century and have not been closed through individual or intergenerational economic mobility.

Patrick Bayer and Kerwin Kofi Charles decompose changes in the Black-White earnings gap between 1940 and 2010 into parts attributable to changes in the overall wage structure and to changes in the relative ranks of Blacks and Whites

in the earnings distribution.[18] They show that while the median White-Black male earnings gap declined between 1940 and 1970, it has grown substantially in recent decades and was at 1950s levels by the Great Recession. This growth in the gap has been driven by declining labor force participation, and in particular mass incarceration. The position of median Black workers in the White distribution of earnings has hardly improved since 1940, while there have been positional gains for Black workers in the 90th percentile of the earnings distribution.

These conclusions are echoed in Randall Akee, Maggie Jones, and Sonya Porter's work using US tax records to document persistent differences in income shares across the entire income distribution between White households and Black, Native American, and Hispanic households.[19] These differences are highly persistent. One of the breakthroughs in this paper is that by using the universe of tax returns, they can home in on small groups that previously could not be analyzed easily using survey data, notably Native Americans. Raj Chetty, Nathaniel Hendren, Jones, and Porter build on this work by computing measures of intergenerational mobility by race and ethnic group.[20] They find that there has been very limited upward economic mobility of Black Americans and Native Americans, resulting in persistent gaps relative to White Americans over generations. On the other hand, Hispanic Americans have higher intergenerational mobility rates, leading to a convergence in the income gap between them and non-Hispanic Whites across generations.

One of the major themes in the studies on race and ethnicity is discrimination. Economics research has grappled with the topic of racial discrimination at least since Gary Becker's seminal 1957 treatise on this topic.[21] Research in this area has evolved from viewing discrimination as a specific action or transaction (e.g., a biased hiring decision) to a process that affects skills investment, information acquisition and inference, and self-perception, and even directly influences the productivity of the targets of discrimination.

Economists have historically categorized discrimination into two buckets: taste-based discrimination based upon animus (per Becker) and statistical discrimination based upon rational (Bayesian) information forecasting in the face of uncertainty about productivity (per Kenneth Arrow and Edmund Phelps). Recent research underscores why these categories are incomplete and, in some cases, not entirely coherent. Studying the productivity of cashiers in a French grocery store chain, Dylan Glover, Amanda Pallais, and William Pariente show that non-White cashiers perform on average significantly better than do White workers.[22] Yet when assigned to managers who exhibit greater bias, the productivity of non-White workers — measured by absences and throughput — falls. This work calls into question the canonical assumption that discrimination represents unequal treatment for given expected levels of productivity by showing that prejudice can directly affect productivity.

An equally central assumption in the classic statistical discrimination literature is that employers hold rational expectations about worker capabilities, so that disparate treatment of minority and nonminority workers reflects unbiased but imprecise assessments of expected productivity. Challenging this view, J. Aislinn Bohren, Kareem Haggag, Alex Imas, and Devin G. Pope review evidence that statistical discrimination is often rooted in inaccurate information, such as bad statistics or stereotypes, which may of course emanate from prejudiced information sources.[23] This observation is potentially critical for interpreting and redressing discrimination in practice. An employer that makes otherwise statistically sound decisions based on biased information may generate outcomes that are indistinguishable from animus-based discrimination. Yet the appropriate remedy might be to provide accurate information rather than to redress or punish bias. Consistent with a potential role for misinformation, Amanda Y. Agan and Sonja B. Starr show that employers located in neighborhoods with fewer

Black residents appear much likelier to stereotype Black applicants as potentially criminal when they lack criminal record information.[24]

Many other studies provide fresh insights on discrimination. Experimental work by Joanna N. Lahey and Douglas R. Oxley shows how discrimination affects not only beliefs of potential employers but also the amount of attention that they devote to applicants from different race, gender, and age groups.[25] In a resume audit study, Patrick M. Kline and Christopher R. Walters develop new tools for detecting the presence of employer discrimination.[26]

In an innovative experiment, Samantha Bielen, Wim Marneffe, and Naci H. Mocan experimentally manipulate the apparent race of defendants in recorded criminal trials using virtual reality tools. Law students, economics students, practicing lawyers, and judges who are randomly assigned to watch the trials are more likely to recommend conviction of defendants when they are portrayed in virtual reality as minorities.[27]

Benjamin Feigenberg and Conrad Miller reanalyze the classic question of whether there is an equity/efficiency tradeoff in policing activity, specifically in the case of motor vehicle searches.[28] A tradeoff might arise if police are more effective in identifying offenders when permitted to use racial or ethnic profiling to select targets. The obvious cost of that approach is that members of disadvantaged groups — the vast majority of whom are not engaged in illicit conduct — would bear a disproportionate burden of police scrutiny. While models of statistical discrimination imply that this tradeoff exists in theory, Feigenberg and Miller find no such tradeoff in practice, at least in the case of vehicle searches conducted by Texas Highway Patrol troopers. The reason is that search rates by troopers are unrelated to the proportion of searches that detect illicit activity. By implication, the Texas Highway Patrol could equalize search rates across racial groups while increasing search yield without changing the total number of searches conducted.

Three papers look at historical episodes of discrimination in 20th century American history. Lisa D. Cook, Jones, David Rosé, and Trevon D. Logan document racial discrimination in public accommodations during the Jim Crow era.[29] They provide new facts on how the prevalence of nondiscriminatory establishments varied by region; how they were far more likely to be located in redlined neighborhoods within cities; and how their prevalence was positively correlated with measures of material well-being and overall economic activity. Andreas Ferrara and Price V. Fishback show that German immigrants residing in the United States during World War I faced significant anti-German sentiment, particularly in counties with high wartime casualty rates where local newspapers published more anti-German slurs.[30] German immigrants living in these counties were more likely to relocate; those who fled — and the counties that lost them — saw lower incomes for the next several decades.

Anna Aizer, Ryan Boone, Adriana Lleras-Muney, and Jonathan Vogel document beneficial effects of WWII defense production contracts in closing racial wage gaps.[31] In particular, when the federal government awarded wartime production contracts to private firms, Black men in the surrounding metropolitan area were able to move into higher-skilled occupations, generating sizable and enduring earnings benefits. A key figure from their paper is reproduced as Figure 2.

An increasingly prominent topic is

World War II Production and the Black-White Earnings Gap

Change in natural log of average annual wages, from year prior

Black men / White men

Each dot represents a metropolitan area

War expenditures per capita (000s)

Share of workers in skilled occupations

Black men / White men

Change, 1940–50 / Change, 1930–40

War expenditures per capita (000s)

The sample is restricted to metropolitan areas with at least 25 observations, leaving 147 areas for White men and 76 for Black men.
Source: Aizer A, Boone R, Lleras-Muney A, and Vogel J. NBER Working Paper 27689

Figure 2

whether the use of computerized algorithms for high-stakes decisions — such as which candidates receive interviews, which borrowers are granted loans, which defendants are released on bail — introduces the potential for algorithmic discrimination. Danielle Li, Lindsey R. Raymond, and Peter Bergman argue that machine learning algorithms that perform candidate selection for job interviews tend to reinforce past patterns of hiring by seeking candidates who are similar to those previously hired.[32] The researchers show the downside to this approach by building a resume screening algorithm that values exploration — that is, sampling from diverse pools — as well as past practice. Using personnel data from a large firm, they show that this approach improves the quality of candidates selected for an interview, as measured by eventual hiring rates, while also increasing demographic diversity relative to the firm's existing practices. A number of other studies develop tools for detecting bias in algorithms[33,34] and consider how algorithms can be used more effectively.[35]

Minimum Wage

One of the great debates in labor economics has been on the effects of minimum wages on workers and firms. Over the last 10 years, a series of studies by Labor Studies affiliates has advanced this literature considerably. These studies have used new sources of variation in minimum wages from state and local minimum wage laws, new data sources, and new econometric approaches. Studies don't always reach the same conclusions, likely owing to

the different settings, time periods, and methodologies being used. Below we summarize several studies that look at employment and hour margins and that draw disparate conclusions.

Jeffrey Clemens and Michael Wither examine the last increase (at the time of this writing) of the federal minimum wage, which took place over 2008–09.[36] The timing of this increase makes this an especially interesting case since it coincided with the Great Recession, when the labor market may have been more sensitive

State-Level Minimum Wage Changes and Employment Level, 1979–2016

Estimated average employment level change over the 5-year period after a minimum wage change

Cumulative sum of employment changes

Wage relative to new minimum wage, dollars

Light-gray lines represent 95% confidence intervals
Source: Cengiz D, Dube A, Lindner A, and Zipperer B. NBER Working Paper 25434

Figure 3

to wage increases, but it also presents challenges for estimation, as it requires the researchers to carefully control for the business cycle. Using several approaches, including differences in how binding the minimum wage was between states, they estimate that employment fell by 8 percent among workers whose wages before the minimum wage increase were below the new minimum.

Ekaterina Jardim, Mark C. Long, Robert Plotnick, Emma van Inwegen, Jacob Vigdor, and Hilary Wething evaluate a minimum-wage ordinance that raised the minimum wage from $9.47 to $13 in Seattle.[37] They use high-quality administrative data from the state

of Washington that, unlike many other employer-employee matched datasets, include hours of work. Looking at workers employed in low-wage jobs prior to the minimum wage increase, matched to a comparison group of similar workers who were not affected by the minimum wage, they find that the ordinance increased wages, reduced hours of employment, reduced turnover, and reduced the rate of new entries in the workforce.

Doruk Cengiz, Arindrajit Dube, Attila Lindner, and Ben Zipperer examine state-level variation in the minimum wage using a bunching estimator approach.[38] They first use a differences-in-differences estimator to estimate the effect of state-level changes in the minimum wage on employment counts in $0.25 buckets around the old and new minimum wage. They then ask whether employment losses below the new minimum wage are offset by employment gains at the new minimum wage and above it (due to spillovers). They find that these are comparable. This result does not mean that no workers lost their jobs, since it remains possible that the minimum wage induced reallocation between firms.[39] However, their conclusion is that in the aggregate there were no significant losses.

As the literature on the minimum wage has evolved, researchers have explored new outcomes and more nuanced margins of adjustment to these policies, such as crime, infant and worker health, family income, and job search effort. Labor Studies researchers have examined the role of the minimum wage in economic, social, and health outcomes such as crime,[40] criminal recidivism,[41] infant health,[42]
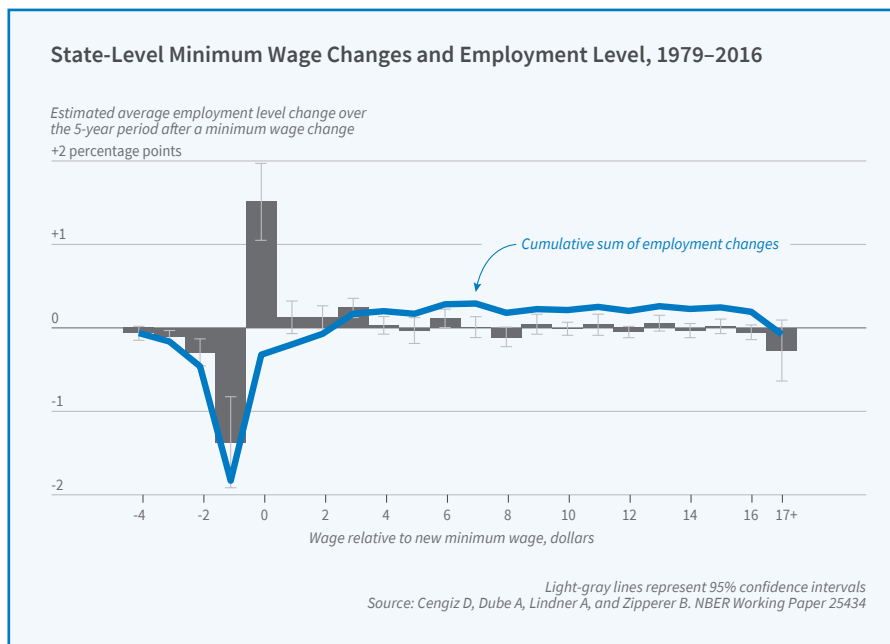
worker health,[43] family income,[44] automation,[45] and job search effort.[46]

Imperfect Competition and Labor Market Concentration

A major theme of Labor Studies researchers has been to test, quantify, and explore the implications of imperfect competition in the labor market. Two broad categories of studies on this topic have been to quantify the firm component of a worker's pay and to test models of monopsony. Less common, but equally valuable, are studies that show direct evidence on imperfect competition, like the anti-competitive behavior found by Alan Krueger and Orley Ashenfelter among major franchisor employers who used "no-poaching of workers agreements."[47]

Since the seminal work of John Abowd, Francis Kramarz, and David N. Margolis in 1994,[48] a growing body of work has sought to measure firm differences in earnings and wages. Evidence that firms pay identical workers different wages is a violation of the law of one price and evidence of imperfect competition in the labor market. Over the last 10 years, there have been numerous studies on firm pay policies, due in part to the availability of large administrative datasets, increased computing power, and more efficient estimation approaches following the influential work of David Card, Jörg Heining, and Patrick Kline.[49] A recent focus has been on developing new econometric approaches to correct biases that arise due to limited mobility of workers between firms. Some researchers, such as Stéphane Bonhomme, Kerstin

Holzheu, Thibaut Lamadon, Elena Manresa, Magne Mogstad, and Bradley Setzler, have argued that the firm component of pay is less important after taking these biases into account,[50] while others find a more important role for firms as well as evidence of positive sorting between high wages and high-wage firms when appropriately correcting estimates for sampling error.[51] Jae Song, David Price, Fatih Guvenen, Bloom, and Till von Wachter find that changes in the allocation of workers across firms had a substantial role in the rise in earnings inequality between 1978 and 2013.[52] Over this period, high-wage workers increasingly sorted into high-wage firms and also increasingly worked with one another. These two trends accounted for two-thirds of the rise in inequality over this period. Notably, the dispersion of firm-specific pay premiums did not increase; rather, workers who earned high wages elsewhere increasingly clustered at firms that paid larger premiums.

A related literature has sought to test the predictions of monopsonistic competition in the labor market. One class of studies has sought to compute measures of labor market concentration. For example, Ioana Marinescu,

Ivan Ouss, and Louis-Daniel Pape calculate labor market concentration measures at the occupation and commuting zone levels in France and find that a 10 percent increase in concentration reduces wages of new hires by 0.9 percent.[53] Their findings accord with other studies that take a similar approach.[54] [55] Matthew Kahn and Joseph Tracy note that geographic variation in market power will affect housing rents in a spatial equilibrium model.[56] They find support for this prediction. A second class of monopsony studies seeks to directly estimate a necessary condition of the monopsony model, which is that the labor supply curve facing the firm is upward sloping. Kory Kroft, Yao Luo, Mogstad, and Setzler use the results from procurement auctions as shocks to a firm's demand curve to effectively trace an upward-sloping labor supply relationship as they observe both employment and average labor earnings increasing following auction wins.[57] Austan Goolsbee and Syverson estimate an upward-sloping labor supply curve in higher education institutions using school-specific labor demand instruments.[58] A third class of studies[59] estimates the negative relationship between wages and separation rates and uses that relationship to quantify the implied elasticity of labor supply facing the firm in a dynamic monopsony model.

The COVID-19 pandemic has resulted in historic disruptions in labor markets and has drawn new attention to many issues that have been long-standing topics of research in the Labor Studies Program. Assessing the impact of closures of nonessential businesses, of emergency relief programs for work-

Market Concentration, Wages, and Employment Level, 2015

ln(Hourly wage)

Each point represents a commuting zone

Log employment concentration (Herfindahl-Hirschman Index)

ln(Employment level)

Log employment concentration (Herfindahl-Hirschman Index)

Source: Marinescu I, Ouss I, and Pape LD. NBER Working Paper 28084

Figure 4

ers and firms, of potentially transformative changes in the geography of work, and of many other extraordinary developments over the past year will be an active subject of prospective research. The lessons of this research will guide future policy in response to economic shocks, and will provide new insights on the basic functioning of labor markets.

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Research Summaries

COVID's Lessons for Future Modeling of Pandemics

Andrew Atkeson

Andrew (Andy) Atkeson is a research associate in the NBER's Economic Fluctuations and Growth and Asset Pricing programs. He is a professor of economics at the University of California, Los Angeles, a consultant at the Federal Reserve Bank of Minneapolis, and has served on the editorial boards of various journals, including the *American Economic Review*, *The Review of Economic Studies*, and *The Quarterly Journal of Economics*.

Prior to arriving at UCLA, Atkeson was at the Federal Reserve Bank of Minneapolis, the University of Minnesota, the University of Pennsylvania, and the University of Chicago. He received his PhD from Stanford University's Graduate School of Business and his BA from Yale University.

Like many economists, over the past year Atkeson has focused on learning as much as he can about epidemiology and COVID-19. He has learned a lot in particular from conversations with Ben Moll, Jim Stock, and Mike Droste, in addition to those with Karen Kopecky and Tao Zha.

During the first half of the 20th century, Americans enjoyed tremendous gains in health and life expectancy as large investments in sanitation, public health, and medicine resulted in the conquest of infectious diseases. Crude annual mortality rates from infectious disease in the United States fell by an order of magnitude: from nearly 800 per 100,000 in 1900 to fewer than 50 per 100,000 by 1960, with the steady downward trend interrupted dramatically by the Great Influenza Pandemic of 1918–19.[1]

But, as the emergence of HIV/AIDS and now COVID-19 as worldwide pandemics has made clear, the threat to health, life, and economic prosperity from infectious disease is far from vanquished.[2]

If there is one lesson economists can take away from the public health and economic disaster of COVID-19, it is that we should strive to have a better understanding of the interaction of behavior and the spread of infectious disease so that we might be better prepared with public health and economic policy tools to contain the damage from the next emergent pandemic. After one year of data on COVID, it is clear that endogenous public and private behavior aimed at slowing disease transmission has played an important role in shaping the evolution of this pandemic and in constraining the potential impact of the policy tools available to improve public health and economic outcomes.

I started working on COVID-19 in early 2020 as the virus emerged in China and led to stringent lockdowns of millions in that country. In my first paper on the topic, I spelled out the implications of a standard epidemiological model for the peak prevalence and long-run impact of the disease here in the United States, using parameters estimated from the early data on COVID-19 from China.[3],[4] Models like this one have been widely used to guide the public health response to COVID-19 around the world.

Three quantitative implications of this standard epidemiological model stand out. First, the model gave dire forecasts for the peak of the first wave of the disease absent drastic efforts to slow transmission. Second, it forecast that if efforts to slow transmission were applied early but were only temporary, this dramatic peak of the first wave would simply be delayed. Cases and deaths would explode again once efforts to slow transmission were relaxed. Third, the model offered dramatic predictions for the long-run impact of the disease: more than two-thirds of the population would experience infections or need to be vaccinated before the pandemic would come to an end.[5]

It is now clear that the first two predictions of this standard model were off by at least an order of magnitude. The model predicted that the portion of the population with active infections at the first peak would range from 10 to 20 percent, or between 33 million and 66 million simultaneous active infections. Given current parameter estimates suggested by the Centers for Disease Control and Prevention for use in modeling COVID-19, this peak of infections would have resulted in a peak of roughly 30,000 to 60,000 deaths in the United States per day.[6] Certainly if anything like this outcome had occurred, the impact of the pandemic on economies worldwide in the spring of 2020 would have been much

larger than what we saw. Nothing of the sort happened anywhere in the world.

Looking at the evolution of the pandemic across a large number of countries worldwide and in US states, Karen Kopecky, Tao Zha, and I document that the second main implication of the standard epidemiological model was also off by a wide margin.[7] While many locations in the world have suffered severe second or third waves of COVID deaths after relaxing costly public measures to control disease transmission, the scale of these waves has been much smaller than predicted from standard models. The growth rates of daily infections and deaths from COVID never returned to the extraordinarily high levels seen in many locations around the world in March 2020.

What about the third prediction, regarding the long-run impact of the disease? Empirically, the question of what percentage of the population has to gain immunity to COVID-19 either through prior infection or vaccination before the pandemic will come to an end is not yet fully resolved. But the available data from locations such as Manaus, Brazil, which has experienced high rates of infection, and Israel, which has high vaccination rates, indicate that the predictions of a standard epidemiological model for the long-run impact of COVID are likely correct.

How does consideration of the impact of behavior on the progression of a pandemic help us understand this relationship between model predictions and observed outcomes? Within economics, Tomas Philipson pioneered the study of the interaction of behavior and the spread of disease in his work on the HIV/AIDS pandemic. In a 1999 chapter summarizing work on that pandemic, Philipson argued for the incorporation into epidemiological models of prevalence-elastic private demand for prevention of the spread of infectious disease.[8] He argued that such models offer two fundamental economic insights into the interaction of behavior and public health. The first of

these is that costly private behavior to prevent disease transmission is self-limiting: as disease incidence falls, private efforts at disease control are relaxed and the disease reemerges. The second is that public interventions aimed at disease control are less beneficial than might be anticipated, given offsetting private responses.

I believe the insight that the demand, both public and private, for costly measures to control disease is self-limiting if it depends on disease prevalence is particularly powerful for understanding where a standard epidemiological model fails and where such a model succeeds in matching the data. Kopecky, Zha, and I argue that the data on the progression of the COVID pandemic across many countries and the US states throughout 2020 conform strikingly well with a core prediction of a simple epidemiological model modified to include prevalence-elastic demand for disease prevention: that after the first phase of the pandemic in which disease grows rapidly, the growth rates of infections and deaths should remain in a relatively narrow band around zero until the pandemic is over.[9], [10] However, according to such a model, the pandemic ends only when, at pre-pandemic patterns of behavior, the fraction of the population that remains susceptible to the disease has fallen, either through infection or vaccination, below the herd immunity threshold given by the inverse of the basic reproduction number measured with pre-pandemic patterns of behavior. That is, the predictions for the long-run impact of COVID-19 made in March 2020 using a standard epidemiological model should continue to hold.[11]

The intuition for this result is simple: if the prevalence of the disease falls toward zero, then the demand for costly disease prevention efforts also falls toward zero, and thus the disease will come back unless the population has already achieved herd immunity measured at pre-pandemic levels of behavior. Given estimates of the basic

reproduction number in the range of 2.5 or now higher with new variants, this herd immunity threshold should kick in when significantly less than 40 percent of the population remains susceptible.

In my most recent paper on COVID-19, I build a parsimonious quantitative epidemiological model with a behavioral response to disease prevalence that might be useful for evaluating the impact of public health interventions and natural shocks such as the emergence of new virus strains on the evolution of epidemics.[12] The challenge here is to find model specifications that can match the magnitude of the waves of disease prevalence that we have seen in many locations around the world in a plausible model with a relatively stable structure over time. I propose such a model and apply it to account for the evolution of the COVID-19 pandemic over the past year in the United States and the United Kingdom. I model the impact of natural shocks to transmission rates due to seasonality and the emergence of new, more transmissible variants of the COVID virus, as well as potential changes in the demand for costly measures to mitigate disease transmission.

I find that this parsimonious model can account for the evolution of the COVID pandemic in these two countries remarkably well. I find that a seasonal decline in transmission rates is an important component of the explanation as to why the prevalence of COVID dropped to such low levels in the summer of 2020 in the United States and the United Kingdom, while declines in the strength of the behavioral response to disease prevalence in the late fall were an important component of the explanation for the large waves of infections and deaths seen in the late fall and winter.

I use this model to generate forecasts for the evolution of the pandemic going forward over the next two years in both the US and UK, with the new, more contagious variant arriving in the model for the United States in

December 2020. The transmission rate for this new variant in the model is set to match measures of the variant B.1.1.7 now prevalent in the United Kingdom. For purposes of comparison with implications of the standard epidemiological model I studied in March 2020, I show these forecasts without consideration of the impact of vaccines on the course of the pandemic. In Figure 1, I show in blue the prediction from the epidemiological model with a behavioral response to disease prevalence for the evolution of daily deaths from COVID-19 in the United States of the period from mid-February 2020 through mid-February 2022. I show data on the seven-day moving average of daily deaths in the United States over the past year in blue. We see in this figure that the behavioral model matches the data on deaths over the past year quite well, and it forecasts, absent vaccines, a continuation of the pandemic well into 2022. The cumulative death toll in this forecast is 1.25 million.

To make the comparison with a standard epidemiological model clear, in Figure 2, I show, again in blue, the prediction of the same model with the behavioral response of transmission to disease prevalence turned off, and the data on daily deaths from the past

year again shown in blue. As is clear from this figure, the standard model overstates the first peak of daily deaths by at least an order of magnitude (these peak at over 30,000/day), but then the pandemic comes quickly to an end in the fall of 2020. The cumulative death toll in this forecast is 1.5 million. This prediction for the cumulative death toll is certainly larger than in the model

with a behavioral response, but the gap between the two models in this dimension is much smaller than their predictions for the initial peak and the time scale of the pandemic.

What is clear from these figures is that an epidemiological model with a response of public and private behavior to disease prevalence gives a dramatically different forecast for the severity of disease peaks, even with a relaxation of mitigation behavior, and for the speed with which the pandemic plays out over time. In this behavioral model, the pandemic takes two and a half years to play out rather than six to nine months. At the same time, the model's implication for the long-run impact of the disease in terms of the portion of the population experiencing it remains the same: a substantial majority of the population must become immune through infection or vaccination for the pandemic to come to an end.

Given these insights on the impact of behavior on the dynamics of the COVID pandemic, what can we learn about the room for policy to impact health and economic outcomes in the face of potentially offsetting private behavioral responses?[13]

A number of NBER researchers have compared the health and economic impacts of the Great Influenza Pandemic

Behavioral Model of Daily Deaths in the US, 2020–2023

Daily deaths

- Actual seven-day moving average
- Behavioral model (projected)

*The behavioral-model forecast for cumulative deaths over this three-year period, **absent vaccines**, is 1.25 million*

Source: Atkeson A. NBER Working Paper 28434

Figure 1

Standard Model of Daily Deaths in the US, 2020–2023

Daily deaths

- Actual seven-day moving average
- Standard model (projected)

*The standard-model forecast for cumulative deaths over this three-year period, **absent vaccines**, is 1.5 million*

Source: Atkeson A. NBER Working Paper 28434

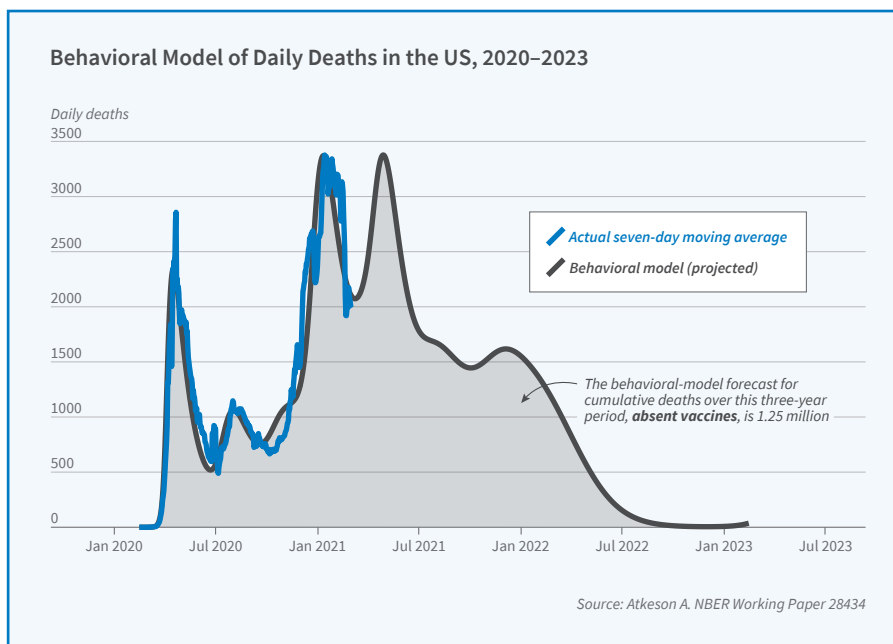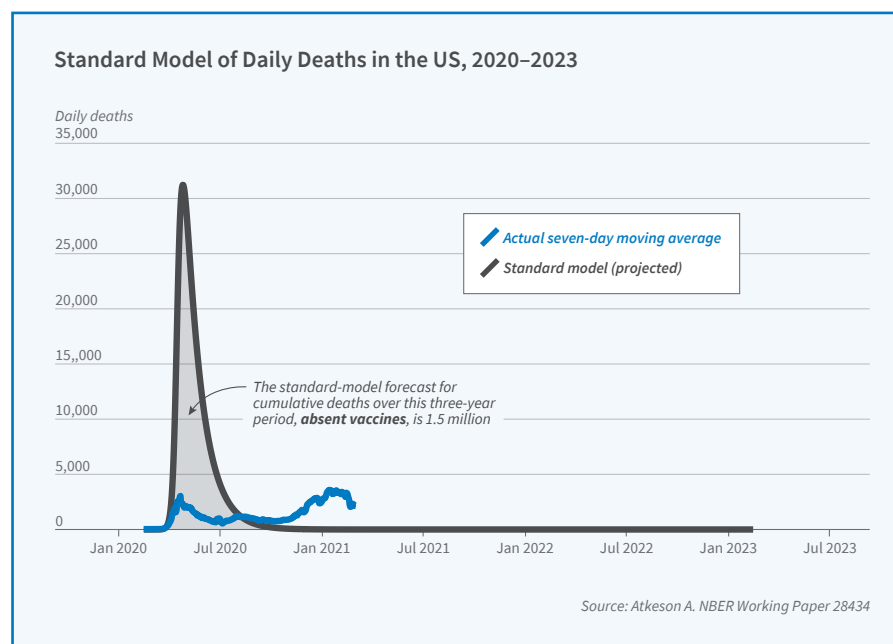**Figure 2**

of 1918–1919 and COVID-19 across regions of the United States and countries around the world. If we take it as a given that the evolution of this pandemic has been shaped by both a public and private prevalence-elastic demand for disease prevention, what relationship should we expect to see in such data? In a comment on a report on the macroeconomic impact of COVID-19 by Jesús Fernández-Villaverde and Charles Jones,[14] I use a simple Susceptible/Infected/Recovered (SIR) model with prevalence-elastic demand for disease prevention to argue that the answer to this question depends on the source of heterogeneity across countries or regions. If countries or regions vary primarily in the transmissibility of the virus holding behavior fixed due to predetermined natural or cultural factors,[15] then one should see higher cumulative deaths associated with larger cumulative losses of economic activity six months or so into the pandemic. Instead, if countries or regions vary primarily in the elasticity of the response of private and public behavior to disease prevalence,[16] then one should see the reverse: higher cumulative deaths from COVID-19 should be associated with smaller cumulative losses of economic activity six months or so into the pandemic. Clearly, then, interpretation of cross-country or cross-regional data on outcomes will depend on good measurement of the sources of heterogeneity across countries or regions, as well as on the timing of the data within the overall evolution of the pandemic.

Many economists have looked at the possibilities for improving both health and economic outcomes through targeted public health measures such as wide-scale testing and contact tracing.[17] In work with Michael Droste, Michael Mina, and James Stock, I seek to quantify those benefits taking into account not only the technological and cost properties of the tests but also the behavioral responses of agents in complying with quarantine and in response to any decline in disease prevalence brought about by the success of testing

and quarantine.[18] While we find substantial economic benefits from such a program, it is clear that behavioral responses are critical to determining this success. Real-world attempts to control COVID-19 with mass testing once the disease was well established have met with mixed results, in large part because of differing behavioral responses to testing.[19]

It is my hope that economists take up the task of developing quantitative economic epidemiological models to help us do a better job with our policy responses the next time we encounter an emergent infectious pandemic.

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[1] "Trends in Infectious Disease Mortality in the United States during the 20th Century," Armstrong G, Conn L, Pinner R. *Journal of the American Medical Association* 281(1), January 1999, pp. 61–66.
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[2] "Emerging Pandemic Diseases: How We Got to COVID-19," Morens D, Fauci A. *Cell* 182(5), September 2020, pp. 1077–1092. See also this September 2019 report from the President's Council of Economic Advisers on the potential public health and economic impact of pandemic influenza. To place the mortality rate from COVID-19 in historical perspective, note that COVID mortality in the United States was roughly 100 in 100,000 in 2020 and may very well reach this level again in 2021. So while mortality from COVID will not reach the levels reached during the 1918–19 influenza pandemic, it will clearly be the most significant short-term increase in mortality from infectious disease in the United States in at least 60 years.
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[3] "What Will Be the Economic Impact of COVID-19 in the US? Rough Estimates of Disease Scenarios," Atkeson A. NBER Working Paper 26867, March 2020.
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[4] Later data from other countries

suggest that COVID progresses at substantially faster rates than initially estimated in China. Thus, if one were to update the analysis in my paper from March 2020, the time scale on the *x* axis of all of the figures would be substantially shortened. In a contemporaneous paper, James H. Stock used a similar standard epidemiological model to arrive at similar forecasts for peak infections and the long-run impact of the disease. "Data Gaps and the Policy Response to the Novel Coronavirus," Stock J. NBER Working Paper 26902, March 2020. His estimates of the time scale of the pandemic are closer to those that have been observed outside of China.
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[5] These implications of a standard epidemiological model for the magnitude of the first peak and the long-run impact of COVID-19 are driven by estimates of the basic reproduction number of the virus (the R_0) from early data in China. "Herd Immunity: Understanding COVID-19," Randolph H, Barreiro L. *Immunity* 52(5), May 2020, pp. 737–741, offers a description of the calculations and considerations involved. Data on the recent emergence of more virulent variants of COVID-19 in the United Kingdom and elsewhere yield higher estimates of this basic reproduction number. Thus, if I were to update this first paper with new parameter estimates, the implications for the peak of active infections and the long-run impact of COVID-19 would be even more dire.
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[6] Note the range of parameter estimates suggested by the CDC in Table 1 here: https://www.cdc.gov/coronavirus/2019-ncov/hcp/planning-scenarios.html.
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[7] "Estimating and Forecasting Disease Scenarios for COVID-19 with an SIR Model," Atkeson A, Kopecky K, Zha T. NBER Working Paper 27335, June 2020. Here we propose a method for estimating epidemiological mod-

els with time-varying transmission rates; "How Deadly Is COVID-19? Understanding the Difficulties with Estimation of Its Fatality Rate," Atkeson, A. NBER Working Paper 26965, April 2020. In this paper I examine some of the challenges in identifying model parameters from aggregate time series data; In "Four Stylized Facts about COVID-19," Atkeson A, Kopecky K, Zha T. NBER Working Paper 27719, August 2020, we describe our findings regarding the evolution of the COVID-19 pandemic through the summer of 2020.
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[8] "Economic Epidemiology and Infectious Diseases," Philipson T. NBER Working Paper 7037, March 1999.
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[9] "Behavior and the Transmission of COVID-19," Atkeson A, Kopecky K, Zha T. Federal Reserve Bank of Minneapolis, Staff Report 618, February 2021.
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[10] "The Economic Consequences of $\hat{R}$ =1: Toward a Workable Behavioral Epidemiological Model of Pandemics," Gans J. NBER Working Paper 27632, July 2020. Joshua Gans reviews the implications of epidemiological models with a prevalence-elastic demand for costly measures to prevent disease transmission and much of the work by NBER affiliates on this topic.
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[11] See "Resurgence of COVID-19 in Manaus, Brazil, despite High Seroprevalence," Sabino E, Buss L, Carvalho M, Prete C, Crispim M, Fraiji N, et al. *Lancet* 297(10273) February 2021, pp. 452–455, and "Vaccines Are Curbing COVID: Data from Israel Show Drop in Infections," Mallapaty S. *Nature* 590(197), February 2021, regarding data from Brazil and Israel on the empirical herd immunity threshold. More complex models that emphasize heterogeneity and the network structure of human interaction potentially offer more optimistic implications for the long-run

impact of COVID. See, for example: "Implications of Heterogeneous SIR Models for Analyses of COVID-19," Ellison G. NBER Working Paper 27373, June 2020; "Socioeconomic Network Heterogeneity and Pandemic Policy Response," Akbarpour M, Cook C, Marzuoli A, Mongey S, Nagaraj A, Saccarola M, Tebaldi P, Vasserman S, Yang H. NBER Working Paper 27374, June 2020; "Pandemic Control in ECON-EPI Networks," Azzimonti M, Fogli A, Perri F, Ponder M. NBER Working Paper 27741, August 2020; "Integrated Epi-Econ Assessment," Boppart T, Harmenberg K, Hassler J, Krusell P, Olsson J. NBER Working Paper 28282, December 2020. Recent research "Immunological Characteristics Govern the Transition of COVID-19 to Endemicity," Lavine J, Bjornstad O, Antia R. *Science* 371(6530), February 2021, pp. 741–745 forecasts that COVID-19 may become endemic if immunity is only temporary, as is the case for other coronaviruses.
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[12] "A Parsimonious Behavioral SEIR Model of the 2020 COVID Epidemic in the United States and the United Kingdom," Atkeson A. NBER Working Paper 28434, February 2021.
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[13] Given the wide variety of public policies to slow COVID transmission worldwide, ranging from strict to none, this finding of a nearly universal decline in the growth of the pandemic suggests that private behavioral responses played a prominent role in limiting peaks of infections and deaths. A great deal of research by NBER affiliates, much of it summarized by Sumheda Gupta and his coauthors in "Mandated and Voluntary Social Distancing during the COVID-19 Epidemic: A Review," Gupta S, Simon K, Wing C. NBER Working Paper 28139, November 2020, documents in detail the importance of costly private efforts to prevent disease transmission in shaping the early phase of this pandemic.
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[14] "Macroeconomic Outcomes and COVID-19: A Progress Report," Fernández-Villaverde J, Jones C. NBER Working Paper 28004, October 2020; "How Should We Interpret the Cross Country or Region Relationship between Cumulative Deaths and Lost Economic Activity from COVID?" Atkeson A. October 2020. Both these papers are forthcoming in Brookings Papers on Economic Activity.
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[15] "What Explains Temporal and Geographic Variations in the Early US Coronavirus Pandemic?" Allcott H, Boxell L, Conway J, Ferguson B, Gentzkow M, Goldman B. NBER Working Paper 27965, October 2020, examines the importance of such factors for explaining the early evolution of the pandemic across many locations. See also "Modeling Infectious Disease Dynamics," Cobey S. *Science* 368(6492), May 2020, pp. 713–714.
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[16] "Social Distancing and Social Capital: Why US Counties Respond Differently to COVID-19," Ding W, Levine R, Lin C, Xie W. NBER Working Paper 27393, June 2020; "Polarization and Public Health: Partisan Differences in Social Distancing during the Coronavirus Pandemic," Allcott H, Boxell L, Conway J, Gentzkow M, Thaler M, Yang D. NBER Working Paper 26946, April 2020; "Inequality and the Coronavirus: Socioeconomic Covariates of Behavioral Responses and Viral Outcomes across US Counties," Brown C, Ravallion M. NBER Working Paper 27549, July 2020.
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[17] See "National COVID-19 Testing Action Plan," The Rockefeller Foundation, as advocated by Paul Romer, as well as "An SEIR Infectious Disease Model with Testing and Conditional Quarantine," Berger D, Herkenhoff K, Mongey S. NBER Working Paper 26901, March 2020; "The Macroeconomics of Testing and Quarantining," Eichenbaum M, Rebelo S, Trabandt M. NBER Working Paper 27104, August 2020; "The Cost of Privacy: Welfare Effects of the Disclosure of COVID-19 Cases,"

Argente D, Hsieh C, Lee M. NBER Working Paper 27220, May 2020; "Testing, Voluntary Social Distancing and the Spread of an Infection," Acemoglu D, Makhdoumi A, Malekian A, Ozdaglar A. NBER Working Paper 27483, July 2020; "Group Testing in a Pandemic: The Role of Frequent Testing, Correlated Risk, and Machine Learning," Augenblick N, Kolstad J, Obermeyer Z, Wang A. NBER Working Paper 27457, July 2020; "A Theory of Voluntary Testing and Self-Isolation in an Ongoing Pandemic," Hellmann T, Thiele V. NBER Working Paper 27941, October 2020.
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[18] "Economic Benefits of COVID-19 Screening Tests," Atkeson A, Droste M, Mina M, Stock J. NBER Working Paper 28031, October 2020.
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[19] The University of Illinois, Urbana-Champaign has conducted one of the largest mass testing campaigns among universities with remarkable results after an initial difficulty with compliance with quarantines. The mass testing pilot conducted in Liverpool, England, had less favorable outcomes due to problems with uptake of testing, as described here.
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The Global Capital Allocation Project

Matteo Maggiori, Brent Neiman, and Jesse Schreger

In recent decades, global flows of assets and goods have grown rapidly relative to GDP and have shifted aggressively during crises such as the global financial crisis and the current pandemic. Corporations and governments increasingly borrow from foreign investors, who face more options for allocating their capital in terms of asset class, currency, and geography. A sense of "who owns what" around the world, and why, is required to understand what these trends mean for the global economy. Our research aims to expand this understanding and explores the key elements driving global capital allocation.

Our work demonstrates the preference of investors for assets denominated in their own currency and details the consequences of this home currency bias for firm financing around the world. We find that the global demand for dollar-denominated assets implies that American firms have special access to global markets because they do not need to borrow in foreign currency to borrow from foreign investors. In recent work, we restate bilateral investment positions around the world by unwinding investments made in tax havens such as the Cayman Islands. This new map of capital allocation shows much larger bond investments by large developed countries in emerging economies such as Brazil, China, and Russia. The use of tax havens by large Chinese firms distorts our understanding of China as a global creditor. Finally, we organize the accompanying tools and data so that other users in academia and among policymakers can build on them.

Matteo Maggiori is an associate professor of finance at Stanford University's Graduate School of Business. His research focuses on international macroeconomics and finance. He is a cofounder and director of the Global Capital Allocation Project.

Maggiori's research topics have included the analysis of exchange rate dynamics, global capital flows, the international financial system, the role of the dollar as a reserve currency, tax havens, bubbles, expectations and portfolio investment, and very long-run discount rates. His work combines theory and data with the aim of improving international economic policy.

Maggiori is a research associate affiliated with the NBER's International Finance and Macroeconomics, Asset Pricing, and Economic Fluctuations and Growth programs, and a research affiliate at the Center for Economic Policy Research. He received his PhD from the University of California, Berkeley. Among a number of honors, he is the recipient of the 2021 Fischer Black Prize for the best financial economist under age 40, a 2019 Guggenheim Fellowship, and the 2019 Carlo Alberto Medal for the best Italian economist under age 40.

Brent Neiman is the Edward Eagle Brown Professor of Economics at the University of Chicago's Booth School of Business. He conducts research on international macroeconomics, finance, and trade.

Neiman is a cofounder and director of the Global Capital Allocation Project and director of the Initiative on International Economics at the Becker Friedman Institute. He is an executive board member of Chicago Booth's Initiative for Global Markets, a research associate in the NBER's International Finance and Macroeconomics and International Trade and Investment programs, a research fellow at the Center for Economic Policy Research, and an associate editor of the *American Economic Review*, *The Quarterly Journal of Economics*, and the *Journal of International Economics*. He previously served as the staff economist for international finance on the White House Council of Economic Advisers and worked at the Federal Reserve Bank of Chicago and McKinsey and Company.

He has been the recipient of an Alfred P. Sloan Research Fellowship in Economics, was named an Emerging Leader by the Chicago Council on Global Affairs, and has been a corecipient of the Economics in Central Banking Award and the AQR Insight Award. Neiman was awarded the Thouron Fellowship, which funded his graduate studies at Oxford, after earning both a Bachelor of Science in economics and a Bachelor of Applied Science from the University of Pennsylvania. He earned a master's degree from Oxford University and completed his PhD in economics at Harvard University.

Microdata in International Macro

In recent years, large-scale data collection by public institutions and commercial data providers has made it possible to go beyond aggregate statistics to reach a better understanding of how capital is allocated globally. Our work uses security-level holdings from mutual funds worldwide, US insurance companies, and the Norwegian sovereign wealth fund, together with various firm and security-level datasets on corporate ownership chains around the world, to better understand key patterns and determinants of global portfolio investment.

Cross-Border Financing and Tax Havens

In recent research with Antonio Coppola, we use these data to restate bilateral investment positions after taking into account the fact that companies often borrow from international investors through affiliates in tax havens and other financing centers.[1] For example, official data show that the Cayman Islands account for 14 percent of all for-

European Union Bond Holdings Reallocated from Tax Havens to BRICS, 2017

British Virgin Islands	$25B
Cayman Islands	$23B
Ireland	$23B
Luxembourg	$45B
Netherlands	$47B
Other Tax Havens	$22B

| Brazil $70B |
| China $78B |
| India $10B |
| Russia $72B |
| South Africa $8B |

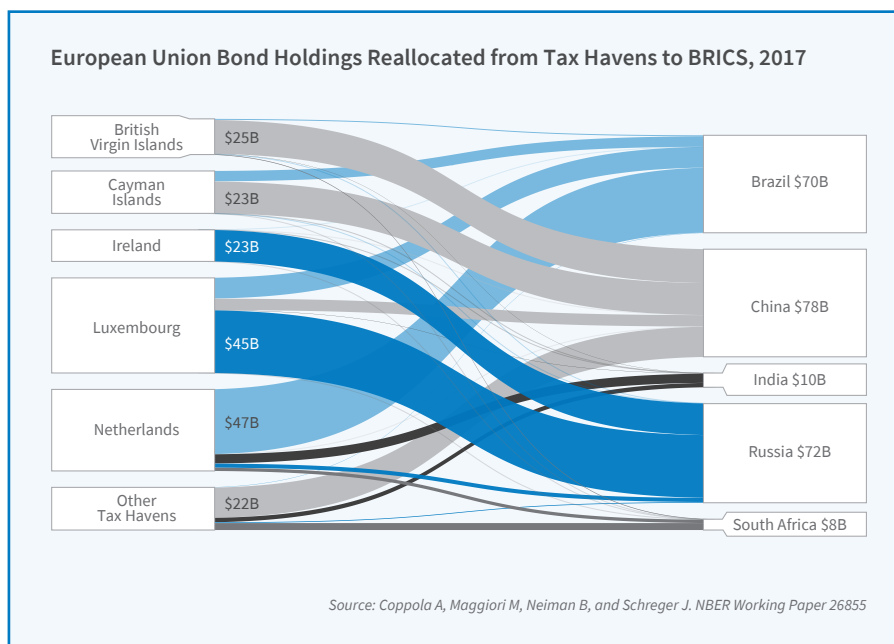Source: Coppola A, Maggiori M, Neiman B, and Schreger J. NBER Working Paper 26855

Figure 1

eign stock and bond positions held by American investors, a staggeringly large share for a country with a GDP of only about $5 billion. These positions clearly reflect the fact that companies with operations in third countries often raise money from Americans using foreign financing affiliates. Researchers have been long aware of this problem, but a key contribution of our work is to provide a way to reallocate these positions and associate them with the country of the financing affiliate's parent company rather than with the country of the shell company, as in official statistics.

Using microdata on investor holdings, we look security-by-security at the differences between the country where the immediate issuer is based and the country where the issuer's parent company is located. We then apply the resulting patterns of reallocation that we find in our micro positions to the aggregate positions reported by the IMF or US Treasury. For example, we find that about 8 percent of European Monetary Union (EMU) investment positions in the Cayman Islands in bonds reflect issues from firms whose ultimate parents are based in Brazil, such as a Cayman Islands-based affiliate of Petrobras, the Brazilian energy giant. Our procedure, therefore, assumes that about 8 percent of all bond positions held by EMU investors in the Cayman Islands, as reported by official statistics, should instead be associated with Brazil.

Applying this procedure, we find that developed country investors have significantly more bond positions in large emerging markets than are shown in the official data. Figure 1 shows, for example, how this procedure generates a reallocation of bond positions for the EMU from tax havens to Brazil, Russia, India, China, and South Africa. This pattern generally holds across all developed investor countries that we analyze.

We also find that developed coun-

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Schreger is a cofounder and director of the Global Capital Allocation Project, a faculty research fellow at the NBER, a research affiliate at the Center for Economic Policy Research, and an associate editor of the *Journal of International Economics*. He has been the recipient of a Sloan Research Fellowship and the AQR Asset Management Institute Young Researcher Award, and has been a corecipient of the Economics in Central Banking Award and the AQR Insight Award.

He received his PhD in political economy and government from Harvard University and his BA in economics and international relations from the University of Pennsylvania.

tries have far larger equity investment positions in China than are shown in official data. Many large and prominent Chinese firms, such as Tencent and Alibaba, issue equity through affiliates listed in the Cayman Islands as part of a structure designed to circumvent Chinese inward investment restrictions. We show that over the last 15 years, China's net foreign assets have undergone a substantial adjustment, leading China today to be only half as large a creditor as the official data report. This adjustment, due to valuation effects, had previously gone unnoticed, despite intense academic and policy interest, because of the complexity of the offshore corporate structures.

Home-Currency Bias and the International Role of the Dollar

In addition to shedding light on the geography of economic linkages, our work highlights factors that play a critical role in shaping investor portfolios. Figure 2 shows a dichotomy between the currency of corporate bonds purchased by domestic residents and foreign investors in each country. For all countries but the United States, domestic investors lend in the domestic currency but foreign investors do not. The United States is different in that both residents and foreigners finance US firms in dollars. Instead of lending in the borrower's
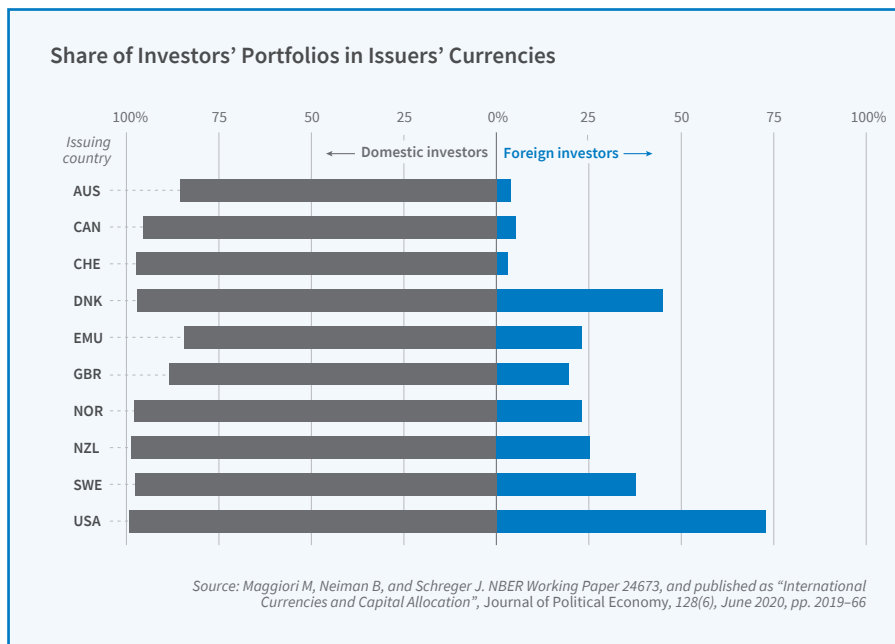
Share of Investors' Portfolios in Issuers' Currencies

Source: Maggiori M, Neiman B, and Schreger J. NBER Working Paper 24673, and published as "International Currencies and Capital Allocation", *Journal of Political Economy, 128(6), June 2020, pp. 2019–66*

Figure 2

currency, investor portfolios are characterized by home-currency bias, the tendency to overweight bond securities denominated in the investor country's home currency.[2] Canadian investors, for example, hold a disproportionately large share of the Canadian dollar bonds issued by European companies. We demonstrate that, for bonds, a home-currency indicator has greater explanatory power for the pattern of global security holdings than a home-country indicator does.

For the majority of companies that issue bonds only in their local currency, this means that they less commonly raise money from foreign investors than from domestic investors, and it conveys a financing advantage to the typically larger firms that issue bonds in multiple currencies. US companies are exceptional in this regard. While small firms in most countries that issue only local-currency bonds rarely place their bonds in foreign portfolios, the dollar bonds issued by US firms make up a large share of foreign investors' portfolios. Our results suggest a novel benefit of issuing in an international currency like the US dollar: it opens up the capital account for small- and medium-sized firms that borrow by issuing local currency bonds.
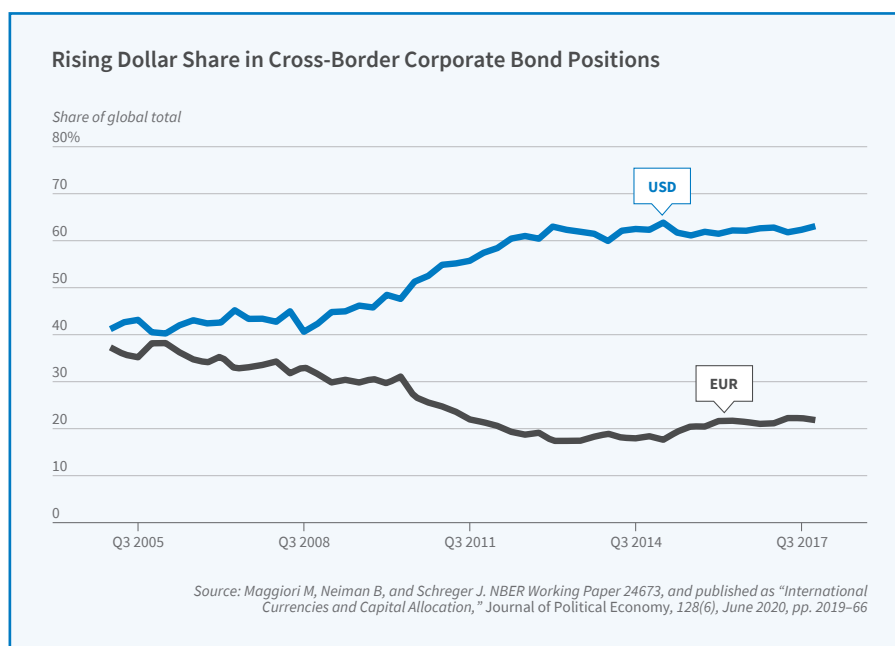
Given that the United States was at the center of the global financial crisis of 2008 and the subsequent rhetoric and policies on US trade restrictions, one might wonder if the global role of the dollar declined since 2009. Figure 3 shows, instead, that the use of the dollar to denominate bonds held cross-border has increased significantly. Whereas before the crisis the dollar was used to denominate roughly 40 percent

Rising Dollar Share in Cross-Border Corporate Bond Positions

Source: Maggiori M, Neiman B, and Schreger J. NBER Working Paper 24673, and published as "International Currencies and Capital Allocation," *Journal of Political Economy, 128(6), June 2020, pp. 2019–66*

Figure 3

of cross-border corporate bond positions — where the issuer and borrower reside in different countries — that share rose to more than 60 percent by the end of 2017.

There has also been a decline during this period in the role of the euro in denominating corporate bonds held by foreign investors. In another study, we consider a number of different roles of international currencies, including their use invoicing trade, in global foreign exchange trading, as central bank reserves, and as an anchor or reference currency. In each of these dimensions, growth in use of the euro generally lags, and at best equals, that of the dollar.[3]

In addition to the rising use of the dollar as the international currency after the global financial crisis, changes emerged around that same time in the dynamics of the dollar's value. In a recent study with Andrew Lilley, we show that whereas the contemporaneous correlation of the US dollar's value and measures of global risk appetite such as the change in equity market returns and

implied volatility was close to zero in monthly data spanning 1990–2007, the dollar's value subsequently closely co-moved with these measures.[4] In addition, in the period following the crisis, the dollar's value closely co-moved with US purchases of foreign bonds, a rare example of a high-frequency connection between exchange rates and portfolio quantities.

Data on Global Portfolios

To further advance the study of global capital markets, our Global Capital Allocation Project website provides a number of tools as well as summary data that we hope will make it easier for other researchers to work on these issues. The growing scale and continuing shifts in cross-border financial linkages make it more important than ever to better document and understand the drivers of global capital allocation.

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The Economic Effects of Social Networks

Johannes Stroebel and Theresa Kuchler

Researchers have long understood that social interactions can shape many aspects of social and economic activity, including migration, trade, job-seeking, investment behavior, product adoption decisions, and social mobility.[1] Traditionally, however, it has been challenging to analyze and quantify the economic effects of social interactions, in large part because of the absence of large-scale and representative data on social networks.

Over the past years, we have worked with deidentified data on social connections from Facebook to expand our understanding of the role of social networks across a large number of settings in economics and finance. Facebook is unique in its scale and coverage: at the end of 2020, the social network had 2.8 billion active users globally and 258 million active users in the United States and Canada, providing a rare opportunity to measure real-world social networks at population scale. Here we review some of our findings from this body of work, which uses both deidentified individual-level data and publicly available aggregated data on social connections between geographies.

Shaping Beliefs and Behaviors in the Housing Market

In a first series of papers, we studied the effect of social interactions in the housing market. In a paper with Michael Bailey and Rachel Cao, we showed that individuals are more likely to consider housing a good investment — and are in fact more likely to actually purchase a house — if their friends experienced larger recent house price increases.[2]

This project started from the observation that different people living in the same neighborhood can be exposed

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Stroebel conducts research in finance, macroeconomics, real estate economics, and climate finance. He has won numerous awards, including the AQR Asset Management Institute Young Researcher Prize and the Brattle Award for the best paper published in *The Journal of Finance*. He has also won an Alfred P. Sloan Research Fellowship in Economics. Stroebel is an associate editor of the *Journal of Political Economy, The Review of Economic Studies, Econometrica,* and *The Journal of Finance*.

Professor Stroebel read philosophy, politics, and economics at Merton College, Oxford, where he won the Hicks and Webb Medley Prize for the best performance in economics. In 2012, he earned a PhD in economics at Stanford University, where he held the Bradley and Kohlhagen Fellowships at the Stanford Institute for Economic Policy Research.

Theresa Kuchler is an associate professor of finance at New York University's Stern School of Business, and a research associate in the NBER's Corporate Finance Program. She conducts research in the areas of household finance, behavioral finance, and social networks, often involving large micro datasets.

Specifically, she has studied the role of present bias for debt paydown using transaction-level account data. More recently, she has focused on how individuals form expectations about aggregate outcomes and the role of social networks in forming expectations and influencing financial decisions. Ongoing research further explores the role of social networks in shaping individual decisions.

Before joining NYU, Kuchler earned a PhD in economics at Stanford University. Prior to attending Stanford, she received a diploma in business economics from the University of Mannheim and spent a year as a Fulbright visiting student in the economics department of the University of California, Berkeley.

to very different housing market experiences through their social networks. Consider two neighbors living in New York, Amy and Ben. Amy has many friends who live in San Diego, a housing market that has been booming over the past decade, and therefore often hears her friends talk about rising house prices. Ben has more friends living in Chicago, which has seen much lower house price growth, and hears far fewer stories about fast house price growth. We investigated whether the different stories that Amy and Ben hear from their friends affected whether they considered buying a house in New York to be a good investment.

To measure people's housing market beliefs, Facebook conducted an online survey of some of its users in Los Angeles. We found that individuals living in the same zip code often disagreed substantially in their expectations about future local house price growth. We then matched individuals' survey responses to deidentified data on the location of their Facebook friends, and discovered that individuals with friends living in areas of the US where house prices had recently gone up were more optimistic about Los Angeles housing market investments than individuals with friends in parts of the country where house prices had not done so well. Importantly, all of this effect was concentrated among the subset of people — comprising about half of our sample — who had told us in the survey that they regularly talked with their friends about housing market developments.

After showing that friends' house price experiences influence the way people perceive housing market investments, we investigated whether social interactions with their friends also affected people's decisions to buy a house. We found that individuals whose friends experienced larger recent house price increases were more likely to transition from renting to owning. They also bought larger houses and paid more for a given house. These results highlight that individuals' investment decisions are not made in a social vacuum. What they hear from their friends affects how attractive they perceive an asset to be, even if the experience of those friends arguably does not contain a lot of information that is relevant for the true valuation of the asset.

In follow-on work with Bailey and Eduardo Dávila, we showed that social interactions, through influencing housing market beliefs, also affect individuals' leverage choices in the mortgage market.[3] Specifically, we found that individuals whose friends had experienced recent house price declines — and who were thus more pessimistic — chose smaller down payments and higher leverage in an attempt to shield their savings from possible declines in house prices.

Peer Effects in Product Adoption

We next explored the role of social interactions for product adoption decisions, which can be affected by peers for a variety of reasons, for instance, because social interactions provide information or because of the importance of consumption externalities, such as a desire to keep up with the Joneses. Together with Bailey, Drew Johnston, and Arlene Wong, we studied how a new phone purchase by a friend affected a person's own phone purchasing probability.[4] We focused on purchases of new phones, since the Facebook data include information on device use from mobile-active users, allowing us to identify new phone purchases for an individual and her social network.

To separately identify the role of peer effects from common preferences and common interactions, we exploited variation in friends' phone purchases after a random phone loss. We found that having a friend who purchased a new phone following such a random phone loss had a substantial and long-lasting effect on a person's own probability of getting a new phone. Figure 1 shows the effect of having a friend purchase a new phone in prior and subsequent four-week periods. Quantitatively, having one extra friend purchase a new phone increases an individual's own probability of purchasing a new phone over the next four months by 0.6 percentage points, relative to a baseline probability of buying a new phone over this horizon of about 14.6 percent.

We also found that positive peer effects were largest for the same device and brand purchased by the peer: when your friend buys a new iPhone, this primarily increases your own probability of buying an iPhone. In addition, we showed that some of these incremental same-brand purchases come at the expense of purchases from compet-

Random Phone Loss and Effect of Friend's Phone Purchase

Change in probability of purchasing a new phone, associated with having a friend purchase a new phone

Weeks before and after phone loss

Light-blue bars represent 95% confidence intervals
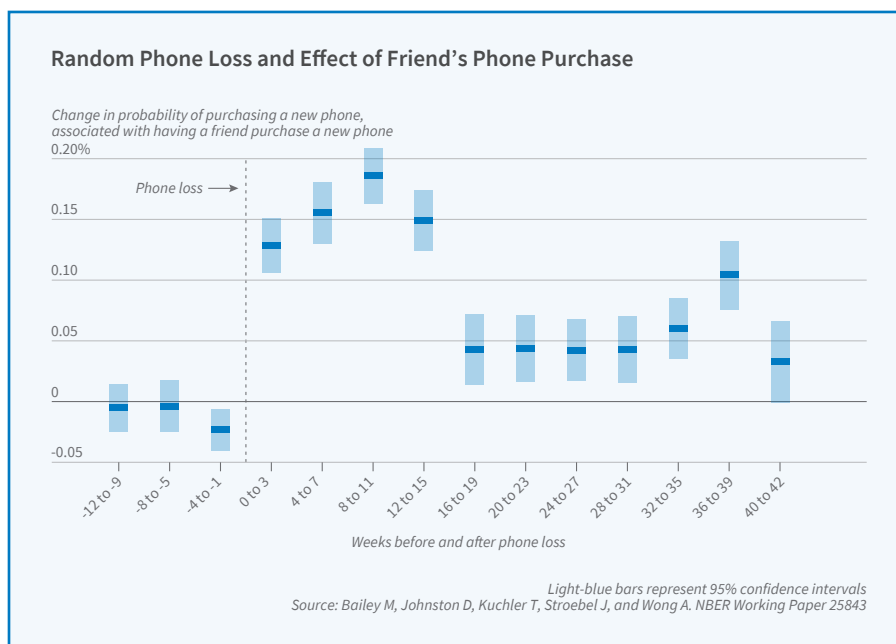*Source: Bailey M, Johnston D, Kuchler T, Stroebel J, and Wong A. NBER Working Paper 25843*

Figure 1

ing brands: some people who are induced by their friends to buy a new iPhone would have otherwise bought a Samsung Galaxy, while others would not have bought a new phone at all.

These across-brand demand spillovers highlight the important competitive implications for firms of peer effects: losing a customer to a competitor does not only mean missing out on positive peer effects that this customer could have had, but may also lead to future losses of other customers through competitive peer effects. Our evidence also suggests that social learning contributes substantially to the observed peer effects: when a friend purchases a new phone, their purchase allows the individual to learn about the features of the specific phone their friend purchased, making them more likely to buy that specific model.

Social Interactions and Public Health Behavior

More recently, we studied the effects of social interactions on behavior in the public health domain. Together with Bailey, Johnston, Martin Koenen, and Dominic Russel, we showed that social network exposure to COVID-19 cases shaped individuals' beliefs and behaviors concerning the coronavirus.[5] In particular, we showed that individuals with friends in areas with worse COVID-19 outbreaks reduced their mobility more than otherwise similar individuals with friends in less-affected areas. The effects on social distancing behavior are large and long-lasting. We also showed that individuals with higher friend-exposure to COVID-19 were more likely to publicly post in support of social distancing measures and less likely to be members of groups advocating reopening the economy. These findings suggest that friends can influence individuals' beliefs about the risks of the disease and thereby induce them to engage in mitigating public health behavior.

The Social Connectedness Index

While our research working with deidentified individual-level data on social networks has documented the importance of social interactions across a number of important
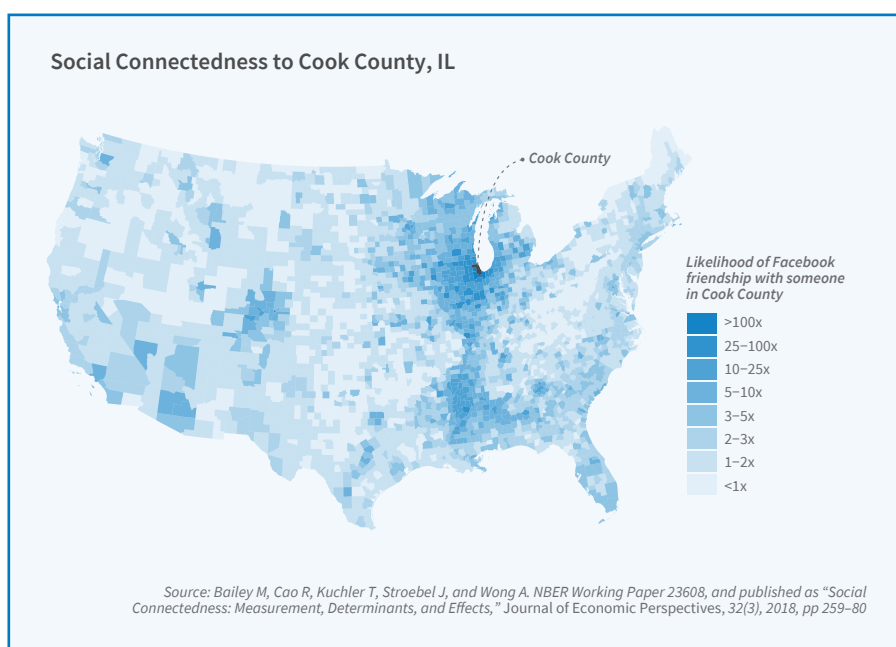

Social Connectedness to Cook County, IL

• Cook County

Likelihood of Facebook friendship with someone in Cook County

>100x
25–100x
10–25x
5–10x
3–5x
2–3x
1–2x
<1x

Source: Bailey M, Cao R, Kuchler T, Stroebel J, and Wong A. NBER Working Paper 23608, and published as "Social Connectedness: Measurement, Determinants, and Effects," Journal of Economic Perspectives, 32(3), 2018, pp 259–80

Figure 2, Panel A

settings, many interesting outcome variables are not observed in the Facebook data. In the second strand of our research agenda, we therefore work with data on the geographic structure of social networks, which can be matched with outcomes of interest observed at various levels of geographic aggregation.

To facilitate such research, we worked with Bailey, Cao, and Wong to develop the Social Connectedness Index (SCI), a measure of the relative social connectedness between pairs of geographies.[6] Formally, the SCI between two locations i and j is given by:

$$Social\ Connectedness\ Index\_(i,j) = \frac{FB\_Connections\_(i,j)}{(FB\_Users\_i * FB\_Users\_j)}$$

Here, FB_Users_i and FB_Users_j are the number of Facebook users in each location, and $FB\_Connections\_(i,j)$ is the number of Facebook friendship connections between users in the two locations. The interpretation of the SCI is that if it is twice as large, a given Facebook user in i is about twice as likely to be connected with a given Facebook user in j.

The SCI has global coverage and is available at many levels of geographic aggregation, including between US counties and global subnational regions. (The SCI data can be downloaded for free and without usage restrictions from https://data.humdata.org/dataset/social-connectedness-index)

The SCI reveals many interesting patterns of social connectedness, such as the role of past migration flows. Panel A of Figure 2 shows the social connectedness to Cook County, Illinois — home to the city of Chicago — of other US counties. Darker shades correspond to stronger social connectedness. Besides the strong social connections to counties near Chicago, a salient pattern is the strong social links between Chicago and Southern counties around the Mississippi River. These connections capture present-day links caused by the Great Migration, the long-term movement of African Americans from the South to the urban North between 1916 and 1970.

Similarly, Panel B of Figure 2 shows the social connections to Kern County, California, home to the city of Bakersfield. Again, past migration patterns show up strongly in shaping Kern County's present-day social connected-

ness. A strong cluster of links between Kern County and Oklahoma is a testament to the long-lasting effects of the Dust Bowl migrants who fled Oklahoma in the 1930s for Bakersfield and other parts of the western United States. More recently, the strong links to McKenzie County, North Dakota, and surrounding counties are likely a result of the connections between oil workers from Kern County — a major oil-producing region — and workers in the Bakken oil fields.

The SCI also shows the effects of international migration patterns into the United States on present-day friendship links. An example: Figure 3 shows the social connectedness of US counties to Norway. There are strong social links to areas in Minnesota and Wisconsin, likely related to the large immigration of Norwegians to these states in the late 19th and early 20th centuries.

In addition to the just-described examples, the SCI is available at various levels of geographic aggregation and reveals interesting patterns in the determinants and effects of social connectedness. We explore this in a number of papers.

Together with Bailey and Patrick Farrell, we explore the structure of urban social networks within New York City and find that social connectedness is strongly determined by the structure of public transit networks.[7]

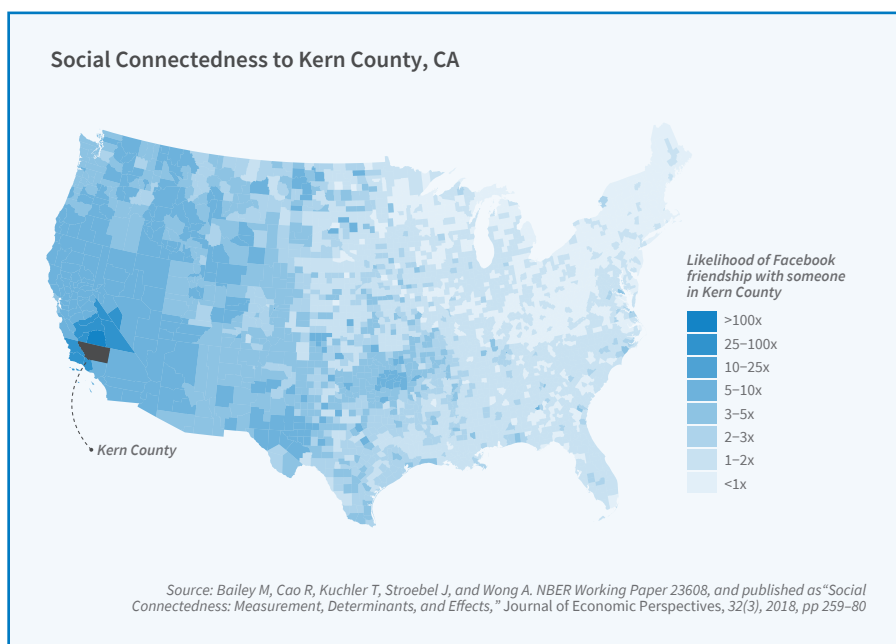With Bailey, Johnston, Russel, and Bogdan State, we study the structure

Social Connectedness to Kern County, CA

Likelihood of Facebook friendship with someone in Kern County

>100x
25–100x
10–25x
5–10x
3–5x
2–3x
1–2x
<1x

• Kern County

Source: Bailey M, Cao R, Kuchler T, Stroebel J, and Wong A. NBER Working Paper 23608, and published as "Social Connectedness: Measurement, Determinants, and Effects," Journal of Economic Perspectives, 32(3), 2018, pp 259–80

Figure 2, Panel B

of social networks across European regions and find that social connectedness declines strongly at country borders and increases in migration flows.[8] Importantly, we also find that historical borders and unions — such as those of the Austro-Hungarian Empire, Czechoslovakia, and eastern and western Germany — shape present-day social connectedness over and above today's political boundaries and other controls, highlighting again the importance of historical forces in determining present-day social connectedness.

Social Connectedness and Economic Outcomes

In addition to exploring determinants of social connections, we also worked with the SCI data across a number of projects to understand the effects of these social connections on a wide range of outcome variables. In the original paper introducing this index, we showed that social connectedness strongly correlates with economic outcomes such as migration and patent citations, as well as cross-state trade flows in the United States. In more recent work with Russel, we documented that the SCI data can help improve forecasting models for infectious diseases such as COVID-19.[9]

In work with Yan Li, Lin Peng, and Dexin Zhou, we studied the role of social connections in the investment decisions of professional investors.[10] We first showed that these investors are

Social Connectedness to Norway

Likelihood of Facebook friendship with someone in Norway

>100x
25–100x
10–25x
5–10x
3–5x
2–3x
1–2x
<1x

Source: Bailey M, Cao R, Kuchler T, Stroebel J, and Wong A. NBER Working Paper 23608, and published as "Social Connectedness: Measurement, Determinants, and Effects," Journal of Economic Perspectives, 32(3), 2018, pp 259–80
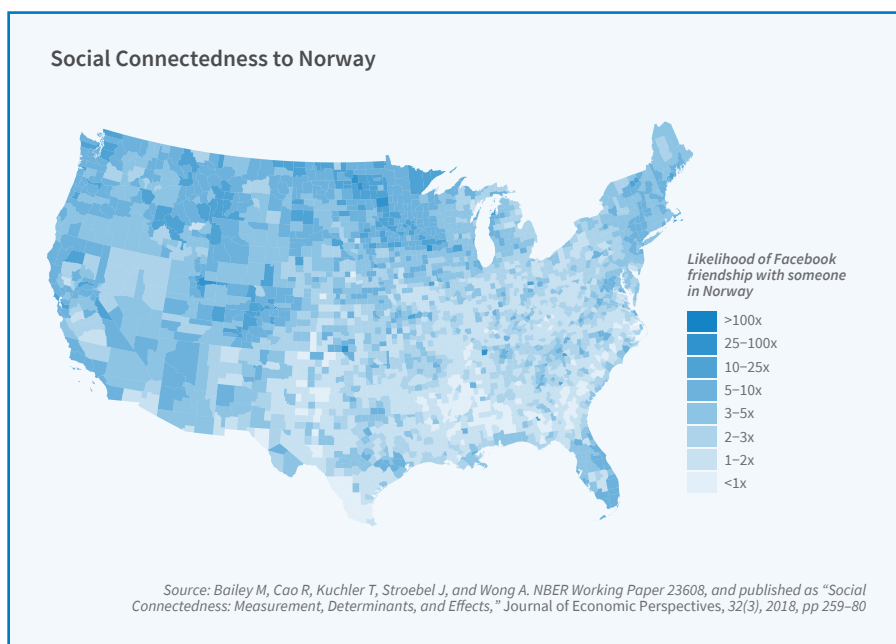
Figure 3

more likely to invest in firms located in regions to which the investor's location has stronger social ties. This effect of social proximity on investment behavior is distinct from the effect of geographic proximity. In fact, we find that stronger social networks between geographically closer locations explain the pervasive home bias in mutual fund investments found in earlier work. The effect of social connections is largest for firms with low market capitalization and little analyst coverage. We found no evidence that investors generate differential returns from investments in locations to which they are socially connected. These results suggest that social networks increase investments through raising investors' awareness of firms — in particular small and informationally opaque firms — that they may not otherwise know about. It is particularly interesting to find such effects of social networks on investment choices among professional investors, not just among less sophisticated retail investors.

Importantly, we find that the response of investment decisions to social connectedness aggregates up to influence equilibrium capital market outcomes: firms in locations with stronger social ties to places with substantial institutional capital — that is, firms with high *social proximity to capital* — have higher institutional ownership, higher valuations, and higher liquidity. These effects of social proximity to capital on capital market outcomes are largest for small firms with little analyst coverage. Our results therefore suggest that the social structure of regions affects firms' access to capital and contributes to geographic differences in economic outcomes.

In work with Bailey, Abhinav Gupta, Sebastian Hillenbrand, and Robert Richmond, we used the international SCI data — both across countries and across subnational regions in Europe — to explore the effect of social connectedness on international trade flows.[11] We found that two countries trade more when they are more socially connected, especially for goods about which information frictions may be large. The social connections that predict trade in specific products are those between the regions where the product is produced in the exporting country and the regions where it is used in the importing country. Once we controlled for social connectedness, the estimated effects of geographic distance and country borders on trade declined substantially. These findings suggest that social connectedness can alleviate information frictions to international trade.

Since the public release of the SCI data, other researchers have used it to study the role of social interactions across a wide range of topics, including peer effects in program participation, stock market participation, bank lending, consumption spillovers, voting choices, and the adoption of flood insurance. We hope that the wide availability of the data encourages even more researchers to join the exciting study of how social interactions affect economic activity.

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Economic Lessons from Natural Disasters

Tatyana Deryugina

Direct economic damage from extreme weather events has been growing faster than GDP for decades, and projections indicate that this trend will continue. The impacts of natural disasters clearly extend beyond the physical damage they cause. They can have both short- and long-term effects on income, health, family formation, and many other aspects of victims' lives. In the aggregate, natural disasters could affect fiscal outcomes and the functioning of important services such as the health-care system.

I have dedicated my work in this area to improving our understanding of some of these impacts and the channels through which they do or do not materialize. Two key themes of my findings are that (1) despite short-run declines in physical health and incomes in the aftermath of a natural disaster, individuals and places are fairly resilient in the medium and long run along these dimensions; and (2) the medium- and long-run effects depend on conditions in affected areas, such as local wage rates and the health of local populations. Additionally, my studies of natural disasters have helped shed light on economic phenomena more generally. For example, this research has demonstrated that place of residence matters substantially for one's longevity, and has generated estimates of the speed with which the US health-care system recovers from temporary disruptions of varying magnitudes.

Transfers to Disaster Victims

In one study, I consider all hurricanes that made landfall in the United States in the period 1979–2002 and estimate how they affect county-level economic outcomes as well as transfers from the federal government into a given county in the decade following landfall.[1] For a typical hurricane, there is no discernible loss in average earnings, while the employment rate falls by 0.6–0.8 percentage points 5 to 10 years

Tatyana Deryugina is an associate professor of finance at the University of Illinois and a research associate in NBER's Environment and Energy Economics Program. She is a coeditor of the *Journal of the Association of Environmental and Resource Economists* and the NBER journal *Environmental and Energy Policy and the Economy.*

Deryugina's research focuses on environmental risk. She has studied the economic costs of both natural and man-made environmental shocks, including hurricanes, climate change, hazardous substance spills, and air pollution. Her work includes evaluating the impacts of Hurricane Katrina on the long-run labor market outcomes and survival of residents of New Orleans; estimating the social costs of acute air pollution exposure; and assessing the effect of temperature on the US economy. She has also investigated how farmers adjust their crop insurance choices in anticipation of disaster assistance, how scientific opinions affect laypersons' beliefs about climate change, and how building energy codes and electricity prices affect energy consumption.

Deryugina holds a PhD in economics from MIT, and a BA in applied mathematics and a BS in environmental economics from the University of California, Berkeley.

Hurricane Effects on Fiscal Transfers, Wages, and Employment
Relative to year before hurricane

(A) *Per capita transfers from government*

(B) *Per capita transfers from business*

(C) *Average wages*

(D) *Adults employed*

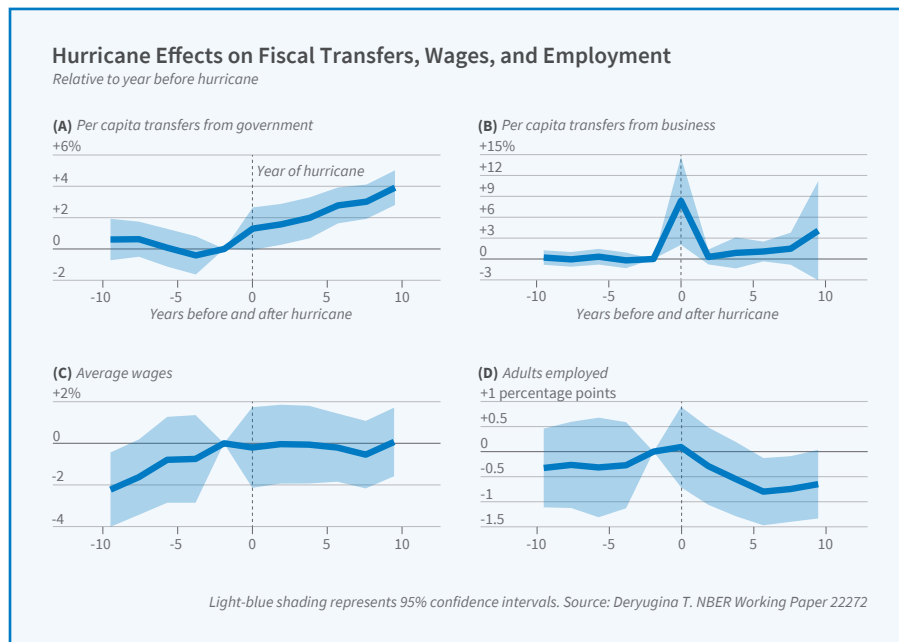*Light-blue shading represents 95% confidence intervals. Source: Deryugina T. NBER Working Paper 22272*

Figure 1

after the hurricane (Figure 1, Panels C and D). Yet transfers from the federal government through programs that are not explicitly disaster-related — such as unemployment insurance, public medical benefits, and income maintenance payments — increase substantially and persistently (Figure 1, Panel A). The net present value of these transfers is $780 to $1,150 per capita for the average hurricane and nearly $1,700 per capita for the strongest hurricanes, Category 3 or higher. This substantially exceeds the transfers that are formally labeled as disaster aid, which total $155 to $160 per capita for the average hurricane and $400 to $425 per capita for the strongest hurricanes. By contrast, transfers from businesses to individuals, which likely comprise private insurance payments, add relatively little to the total: $22 to $24 per capita for the average hurricane and $85 per capita for the strongest. These findings demonstrate that the fiscal costs of hurricanes are much higher than previously thought, and suggest that social safety nets could be important determinants of recovery.

Earnings losses are also larger for stronger hurricanes. Category 1 hurricanes cause an estimated earnings loss of just under $500 per capita in net present value in the decade after a landfall, while Category 3 and stronger hurricanes cause earnings losses that exceed $4,300 per capita in net present value. While transfers also increase with hurricane strength, the rate of increase is substantially lower than that of earnings losses: the weaker the hurricane, the larger the increase in non-disaster transfers relative to estimated earnings losses. Thus, the US population appears to be much better insured against weaker natural disasters than against major catastrophes.

Natural disaster victims also benefit from charitable donations. Extreme events sometimes attract donations from across the country or even the world. But do such donations come at the expense of other causes? Benjamin Marx and I study this question in the

context of lethal tornadoes in the United States.[2] Using anonymized Internal Revenue Service data, we find that individuals living in the same state as tornado victims but outside of directly affected areas increase their total charitable donations by about $2 million per fatality, implying that the supply of charitable donations is not fixed.

Hospital Systems during Natural Disasters

Widespread reductions in both elective and emergency health care use during the COVID-19 pandemic have raised concerns about the long-run financial viability of affected hospitals, casting into question their ability to recoup pandemic-related revenue shortfalls. Jonathan Gruber, Adrienne Sabety, and I use Medicare administrative data to investigate the short- and long-term effects of hurricanes on the health-care system itself.[3] We find substantial reductions in elective health care usage in hurricane-affected counties during landfall months, with larger declines in areas that are hit by stronger hurricanes. Starting a few months after a hurricane, we find small increases in elective health-care use, suggesting that some forgone care is indeed rescheduled. The capacity of providers to provide the lost care later, however, does not appear to be a function of initial hurricane strength. This implies that there are capacity constraints in the US health-care system that prevent quick provision of the lost care. Our work suggests that, because the disruptions created by hurricanes are shorter than those created by the pandemic, hospitals will find it difficult to provide a large share of the lost health care in the latter case.

Effects of Hurricane Katrina on Victims' Economic Outcomes

Focusing research exclusively on areas impacted by natural disasters is unlikely to yield a complete picture of

disasters' impacts because disaster victims may relocate. In that case, even if a place seems to recover from a particular disaster, affected individuals may not. The ability to track individuals over time and space with minimal attrition is essential for understanding how a typical individual, rather than a typical place, is affected by extreme events.

Using anonymized tax data, Laura Kawano, Steven Levitt, and I studied the long-run effects of Hurricane Katrina, which caused over $150 billion in damage, on the economic outcomes of its New Orleans victims.[4] We compare the outcomes for tax filers who initially resided in New Orleans with those for tax filers who initially resided in one of 10 similar US cities, tracking individuals in our sample over time regardless of where they may have moved.

We find that the initial earnings losses caused by the hurricane were substantial. Victims' annual wage income fell by over $1,500 in 2005 — a huge drop considering that the hurricane made landfall late in the year — and by about $2,200 in 2006 (Figure 2, Panel A). The share of individuals with no wage income increased by more than 2 percentage points (Figure 2, Panel B), and in 2005, the number of tax-filing New Orleans households receiving unemployment payments increased by over 25 percentage points as special rules were put in place to help those who lost income because of Katrina's damage (Figure 2, Panel C).

Remarkably, given the hurricane's initial destructiveness, the income losses had disappeared by 2007, and by 2010 the hurricane's victims were out-earning the control group by almost $3,000 annually. These gains persisted through 2013, the last year for which we had data. Correspondingly, Hurricane Katrina victims were less likely to be receiving unemployment in the longer run. Income from self-employment increased (Figure 2, Panel D). We also found evidence that individuals used retirement accounts to cope with the financial shock of the
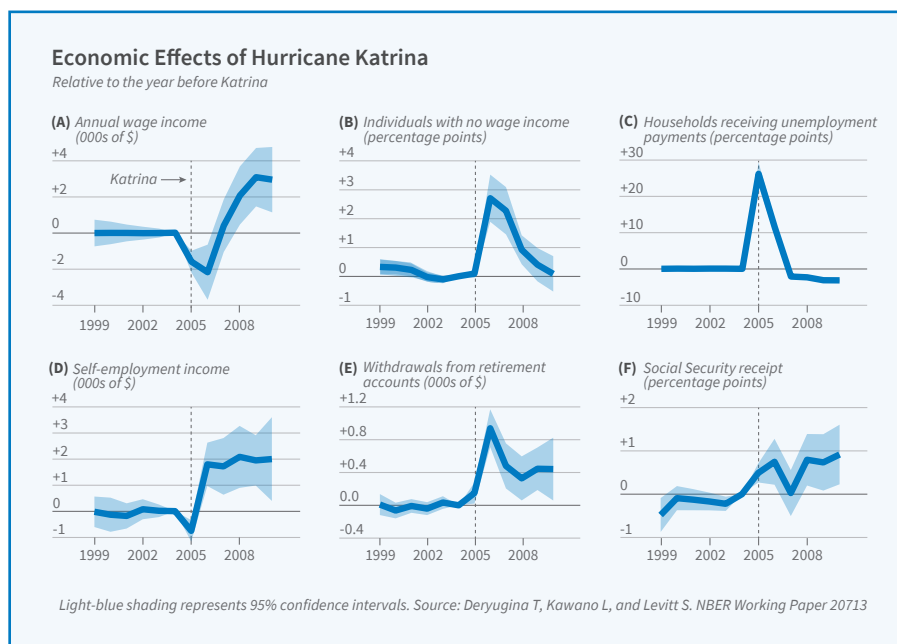
Economic Effects of Hurricane Katrina
Relative to the year before Katrina

(A) *Annual wage income (000s of $)*

(B) *Individuals with no wage income (percentage points)*

(C) *Households receiving unemployment payments (percentage points)*

(D) *Self-employment income (000s of $)*

(E) *Withdrawals from retirement accounts (000s of $)*

(F) *Social Security receipt (percentage points)*

Light-blue shading represents 95% confidence intervals. Source: Deryugina T, Kawano L, and Levitt S. NBER Working Paper 20713

Figure 2

disaster: the number of households taking withdrawals from retirement accounts increased substantially and persistently, totaling about $2,800 per household in the post-hurricane period (Figure 2, Panel E). But there was no corresponding increase in retirements, as measured by Social Security payment receipts, suggesting that individuals used these funds to smooth consumption rather than for earlier retirement (Figure 2, Panel F).

These averages could obviously mask substantial heterogeneity. We find that individuals residing in the most-damaged New Orleans ZIP codes suffered larger earnings losses in the short run; their long-run earnings gains were close to zero and statistically nonsignificant. Those whose incomes fell below the New Orleans median in 2004 also experienced smaller long-run gains, as did those who were younger than 25 in 2004 or who returned to New Orleans after being displaced. On net, young lower-income individuals living in highly damaged neighborhoods appeared to have suffered both short-term and long-term earnings losses as a result of the hurricane.

The average increase in earnings is surprising, given the devastation caused by the hurricane. We identify two chan-

nels that are likely responsible for this effect. First, wages in New Orleans rose following the hurricane, partly reflecting a post-Katrina increase in the cost of living. Second, because the New Orleans economy was in relative decline prior to Katrina, displaced individuals generally relocated to higher-wage areas. We thus show that the indirect economic impacts of natural disasters sometimes more than offset their direct effects along some dimensions. More generally, the net economic effects of natural disasters appear to depend on the strength of the economy in affected localities.

Effects of Hurricane Katrina on Long-Run Mortality

Another dimension of natural disasters about which we know little is their long-run health impacts. If natural disasters impair the long-run health of their victims, then the societal cost of natural disasters will likely be much higher than we currently imagine. David Molitor and I use administrative data from Medicare to investigate the long-term mortality effects of Hurricane Katrina on elderly and long-term-disabled people who lived in New Orleans at the time of the hurricane.[5]

We compare the mortality of these individuals with the mortality of Medicare beneficiaries initially living in the same 10 cities that I used in my earlier study of the effects of Hurricane Katrina on victims' earnings. In the short run, the hurricane had a devastating impact on the elderly and long-term-disabled victims, increasing their 2005 mortality by over half a percentage point, or 10 percent of mean annual mortality. These mortality increases were concentrated among individuals who were 75 years of age or older in 2004. Those with Alzheimer's/dementia were also much more likely to die in the immediate aftermath of the hurricane.

Surprisingly, we find that the hurricane improved longer-term survival for members of this vulnerable group, inclusive of the initial mortality increase. We did not find any specific group that experienced an increase in long-run mortality among those considered, suggesting that the survival improvements were quite broad. The relocation of victims to areas with better mortality outcomes explains most of this improvement, echoing conclusions reached in my earlier work. Addressing a longstanding research question in the health literature, we conclude that a person's place of residence has a causal effect on how long she or he lives.

What do these findings regarding Hurricane Katrina victims mean for other events? New Orleans was performing relatively poorly economically and along public health dimensions prior to the hurricane, which almost surely factored into the long-term improvements in incomes and longevity. The implication is that extreme events that displace victims from more prosperous areas have the potential to cause long-term harm to health and economic well-being.

It is worth noting that these findings do not imply that victims' welfare improved because of the hurricane. Income and longevity are surely important components of well-being, but there are others. We might interpret our findings to mean that individ-

uals who lived in New Orleans were so attached to it for one reason or another that they were willing to forgo a longer life expectancy and higher earnings to live there. In that case, understanding why people are so attached to a given place is paramount.

Perhaps New Orleans offers unique amenities that its residents value. It could be that individuals value their social networks but, holding those constant, would be equally happy in similar locations elsewhere. Residents may lack information about other locations and remain in a given place with suboptimal living conditions simply to avoid risk. Or perhaps people simply become accustomed to the place where they live and are reluctant to move. Identifying the contributions of each of these mechanisms represents an important avenue for future research.

1 "The Fiscal Cost of Hurricanes: Disaster Aid versus Social Insurance," Deryugina T. NBER Working Paper 22272, May 2016, and *American Economic Journal: Economic Policy* 9(3), August 2017, pp. 168–198.
Return to Text
2 "Is the Supply of Charitable Donations Fixed? Evidence from Deadly Tornadoes," Deryugina T, Marx B. NBER Working Paper 27078, May 2020.
Return to Text
3 "Natural Disasters and Elective Medical Services: How Big Is the Bounce-Back?" Deryugina T, Gruber J, Sabety A. NBER Working Paper 27505, July 2020.
Return to Text
4 "The Economic Impact of Hurricane Katrina on Its Victims: Evidence from Individual Tax Returns," Deryugina T, Kawano L, Levitt S. NBER Working Paper 20713, November 2014, and *American Economic Journal: Applied Economics* 10(2), April 2018, pp. 202–233.
Return to Text
5 "Does When You Die Depend on Where You Live? Evidence from Hurricane Katrina," Deryugina T, Molitor D. NBER Working Paper 24822, December 2019, and *American Economic Review* 110(11), November 2020, pp. 3602–3633.
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Annual Report of Awards to NBER Affiliates

John M. Abowd was named a fellow of the American Association for the Advancement of Science, recognizing his contributions to the statistical understanding of US population dynamics.

Katharine Abraham was elected a member of the American Academy of Arts and Sciences and was also named a Distinguished Fellow of the American Economic Association.

Viral Acharya won the Erasmus Research Institute of Management (ERIM) Top Article Award 2020 for his paper "Whatever It Takes: The Real Effects of Unconventional Monetary Policy" with Tim Eisert, Christian Eufinger, and Christian Hirsch.

Eric Budish won the Western Finance Association Two Sigma Award for the Best Paper on Investment Management for his paper "Quantifying the High-Frequency Trading 'Arms Race': A Simple New Methodology and Estimates" with Matteo Aquilina and Peter O'Neill.

David Autor won the 25th Anniversary Special Recognition John Heinz Award.

Christiane Baumeister and **James D. Hamilton** received the inaugural *Journal of Monetary Economics* Best Paper Award for "Inference in Structural Vector Autoregressions When the Identifying Assumptions Are Not Fully Believed."

Ernst R. Berndt received the 2020 Julius Shiskin Memorial Award for Economic Statistics from the Business and Statistics Section of the American Statistical Association, the National Association for Business Economics, and the Washington Statistical Society.

Steven Berry, James Levinsohn, and **Ariel Pakes** were named Citation Laureates of the Web of Science for their paper, "Automobiles in Market Equilibrium."

Sandra Black was elected to the Executive Committee of the American Economic Association.

Nicholas Bloom was elected as a CES Distinguished Fellow.

Marcus Brunnermeier was awarded the 2020 Gustav Stolper Prize and was elected Vice President of the American Finance Association.

David Card and **Philip Oreopoulos** won the 2020 Doug Purvis Memorial Prize from the Canadian Economics Association for coediting the *Journal of Labor Economics* special issue on "Small Differences II: Public Policies in Canada and the United States."

Anne Case was elected to the National Academy of Sciences.

Kerwin Kofi Charles was elected Vice President of the American Economic Association.

Gabriel Chodorow-Reich was awarded an Alfred P. Sloan Research Fellowship.

Tatyana Deryugina, Garth Heutel, Nolan H. Miller, David Molitor, and **Julian Reif** received the 28th Kenneth J. Arrow Award from the International Health Economics Association for the Best Paper in Health Economics.

Thomas Dee, Emily Penner, and Bill Sanderson received the 2020 Community Outcomes and Impact Award from the International Association for Research on Service-Learning and Community Engagement.

Francis X. Diebold won the 2020 Richard Stone Prize in Applied Econometrics for his paper "Estimating Global Bank Network Connectedness" with Mert Demirer, Laura Liu, and Kamil Yilmaz.

Marisa Domino, Edward C. Norton, Jangho Yoon, Gary Cuddeback, and **Joe Morrissey** won the Willard Manning Award in Mental Health Policy and Economics Research for their paper "Putting Providers at Risk through Capitation or Shared Savings."

Dave Donaldson was elected a member of the American Academy of Arts and Sciences.

Susan Dynarski received a Carnegie Fellowship, honoring high-caliber scholarly research in the humanities and social sciences on important, enduring issues confronting society.

Amy Finkelstein was named a Corresponding Fellow of the British Academy and received a MERIT Award from the National Institutes of Health.

Jordi Galí was named a Foreign Honorary Member by the American Economic Association and received the Saint George's Cross from the Government of Catalonia.

Claudia Goldin received the 2020 Erwin Plein Nemmers Prize in Economics from Northwestern University.

Michela Giorcelli won the 2020 Kiel Institute for the World Economy Excellence Award in Global Economic Affairs recognizing "the brightest young researchers in global economic affairs."

Jonathan Gruber received a Guggenheim Fellowship.

Jonathan Gruber was awarded the Emergent Venture Prize for his paper "Adaptive Control of COVID-19 Outbreaks in India: Local, Gradual, and Trigger-based Exit Paths from Lockdown" with Anish Agarwal, Abdullas Alomar, Sam Asher, Luis M. A. Bettencourt, David Kaiser, Clement Imbert, Anup Malani, Paul Novosad, Stuti Sachdeva, Arnab Sarker, Devavrat Shah, Dennis Shen, Satej Soman, and Vaidehi Tandel.

John Haltiwanger received the 2020 Global Award for Entrepreneurship Research for "advancing our understanding of job creation and destruction, productivity growth and the role of small businesses."

David Hirshleifer was elected a Fellow of the American Finance Association.

Sabrina T. Howell received the AQR Asset Management Institute Young Researcher Award, the *Review*

of Financial Studies Referee of the Year Award, and the *Review of Finance* Distinguished Referee Award.

Kirabo Jackson received the biennial David N. Kershaw Award and Prize, recognizing professionals under the age of 40 who have made distinguished contributions to the field of public policy.

Rucker Johnson was inducted into the National Academy of Education in recognition of his contributions to research on education equity**.**

Damon Jones, David Molitor, and Julian Reif received the National Institute for Health Care Management's annual Health Care Research Award for their paper "What Do Workplace Wellness Programs Do? Evidence from the Illinois Workplace Wellness Study."

Loukas Karabarbounis was awarded the Germán Bernácer Prize, recognizing the best European economist under age 40 in macroeconomics and finance, for "research on the interaction between labor and capital market imperfections and macroeconomic outcomes."

Leonid Kogan received the 2020 Western Finance Association NASDAQ Award for the best paper on asset pricing for his paper "Common Fund Flows: Flow Hedging and Factor Pricing" with Winston Wei Dou and Wei Wu.

Ralph Koijen and **Stijn Van Nieuwerburgh** won the TIAA Institute Paul A. Samuelson Award for Outstanding Scholarly Writing on Lifelong Financial Security for their paper "Combining Life and Health Insurance."

The late **Edward Lazear** was honored by the Society of Labor Economists, which created the annual Edward P. Lazear Prize to recognize individuals who have made significant contributions in the field of labor economics, devoted a portion of their careers to the benefit of civil society, and actively helped to shape public policy.

W. Bentley MacLeod was elected incoming president of the American Law and Economics Association.

Matteo Maggiori received the 2020 Fischer Black Prize, awarded biennially to an outstanding financial economist under age 40 by the American Finance Association.

Matteo Maggiori, Brent Neiman, and Jesse Schreger received the 2020 Central Banking Award in Economics for their Global Capital Allocation Project.

Anup Malani was awarded the Emergent Venture Prize for a series of COVID prevalence and seroprevalence studies in India.

Edward Miguel was elected a member of the American Academy of Arts of Sciences.

Emi Nakamura was elected to the Executive Committee of the American Economic Association.

Nathan Nunn received the Jan Söderberg Family Prize in Economics and Management.

Guillermo L. Ordoñez won the Western Finance Association Elsevier Sponsored Award for Best Paper on Financial Institutions for his paper "Interbank Networks in the Shadows of the Federal Reserve Act" with Haelim Anderson and Selman Erol.

Lindsay Page received the 2020 American Educational Research Association Early Career Award for a distinguished program of cumulative educational research within the first decade after receiving a doctoral degree.

Lubos Pastor and **Robert Stambaugh** won the 2020 Jacobs Levy Center Outstanding Paper Prize for their paper "Sustainable Investing in Equilibrium" with Lucian Taylor.

Lubos Pastor won the BlackRock Research Award for the best paper at the 2020 Australasian Finance and Banking Conference for "Mutual Fund Performance and Flows during the COVID-19 Crisis" with Blair Vorsatz.

Valerie Ramey was awarded the R.K. Cho Economics Prize from Yonsei University in South Korea.

Dani Rodrik received the 2020 John Kenneth Galbraith Medal from the Agricultural & Applied Economics Association, and the Princess of Asturias Award for Social Sciences.

Christina Romer was selected as the President-elect of the American Economic Association (AEA).

Nancy Rose was awarded the Carolyn Shaw Bell Award by the AEA's Committee on the Status of Women in the Economics Profession for furthering the status of women in the economics profession.

Anya Samek received the 2020 Vernon L. Smith Ascending Scholar Prize from the International Foundation for Research in Experimental Economics.

Hannes Schwandt was named one of Germany's "Top 40 under 40" by *Capital*, a German monthly business magazine.

Joseph Shapiro received the Energy Article of the Year Award from the American Energy Society for his paper "The Environmental Bias of Trade Policy."

Kelly Shue received the Western Finance Association WRDS Best Paper Award for her paper "The Gender Gap in Housing Returns" with Paul Goldsmith-Pinkham.

Clemens Sialm was awarded an Honorary Doctorate of Economics by the University of St. Gallen in Switzerland.

David Slusky received the Otto Eckstein Prize, recognizing the best article published in the *Eastern Economic Journal* in the 2017–18 period.

Stefanie Stantcheva was awarded the Elaine Bennett Research Prize, recognizing outstanding research contributions, by the AEA's Committee on the Status of Women in the Economics Profession.

Chad Syverson was elected a Fellow of the Econometric Society.

Laura Veldkamp was named an honorary fellow of the Society for the Advancement of Economic Theory.

Annette Vissing-Jorgensen received the Skandia Award from the Thule Foundation in Sweden for outstanding research on long-term savings with relevance for banking, insurance, and financial services.

Heidi Williams was elected a Fellow of the Econometric Society.

Owen Zidar was awarded an Alfred P. Sloan Research Fellowship.

Cecilia Rouse Confirmed as Chair of President Biden's Council of Economic Advisers

The US Senate on February 2 confirmed Cecilia Rouse, an active member of the NBER community for the past three decades, as chair of President Biden's Council of Economic Advisers (CEA). Rouse was an NBER Research Associate from 1992 until 2014 and a member of the NBER Board of Directors from 2014 until her resignation following her confirmation. Her nomination won overwhelming bipartisan support, passing by a vote of 95-4.

At the time of her nomination by the President, Rouse was dean of Princeton University's School of Public and International Affairs and the Lawrence and Shirley Katzman and Lewis and Anna Ernst Professor in the Economics of Education at the university. She served previously as a member of the CEA and on the staff of the National Economic Council.

Rouse is the 15th current or former NBER Research Associate to serve as CEA chair.

Cecilia Rouse

Adair Morse

Adair Morse Named Deputy Assistant Secretary of Capital Access at the Department of the Treasury

NBER Research Associate Adair Morse of the University of California, Berkeley's Haas School of Business is serving as deputy assistant secretary of capital access in the US Department of the Treasury's Office of Domestic Finance. She is on leave from Berkeley and from the NBER, where she is an affiliate of the Corporate Finance Program. Morse holds the Solomon P. Lee Chair in Business Ethics and an associate professor of finance at Berkeley, and a fellow of the Berkeley Center for Law and Business.

Catherine Wolfram Joins Treasury as Deputy Assistant Secretary for Climate and Energy Economics

Catherine Wolfram, the director of the NBER's Environment and Energy Economics Program for the last five years, and who also is an affiliate of the Industrial Organization Program, has been named the inaugural deputy assistant secretary for climate and energy economics at the US Department of the Treasury. Wolfram is on leave from the NBER and from the Haas School of Business at the University of California, Berkeley, where she is the Cora Jane Flood Professor of Business Administration.

Catherine Wolfram

Danny Yagan

Danny Yagan Becomes Associate Director for Economic Policy at the Office of Management and Budget

Danny Yagan, a research associate in the NBER's Public Economics Program and an associate professor of economics at the University of California, Berkeley, has become associate director for economic policy at the federal Office of Management and Budget. He is on leave from Berkeley and the NBER. At Berkeley, Yagan is a faculty associate of the Burch Center for Tax Policy and Public Finance and faculty codirector of the Taxation and Inequality Initiative of the Berkeley Opportunity Lab.

Conferences

Machine Learning in Health Care

An NBER conference on Machine Learning in Health Care, supported by the National Institute on Aging, took place online on January 15. Research Associate David M. Cutler and Faculty Research Fellow Timothy Layton of Harvard University organized the meeting. These researchers' papers were presented and discussed:

- **Suproteem Sarkar**, Harvard University; **N. Meltem Daysal**, University of Copenhagen; **Sendhil Mullainathan**, University of Chicago and NBER; **Ziad Obermeyer**, University of California, Berkeley; and **Mircea Trandafir**, University of Southern Denmark, "Preventive Care through a Richer Policy Space: A Machine Learning Approach to Breast Cancer Screening"

- **Kelli R. Marquardt**, University of Arizona, "Mis(sed) Diagnosis: Physician Decision-Making and ADHD"

- **Jill E. Furzer**, University of Toronto, "Diagnostic Errors in Child Mental Health: Assessing Treatment Selection and Its Long-Term Consequences"

- **Angela Kilby**, Northeastern University, "Algorithmic Fairness in Predicting Opioid Use Disorder Using Machine Learning"

- **Adelina Yanyue Wang**, NBER, "The Impact of Alternative Types of Elder Care Providers: Stratified IV Analysis with Machine Learning Using Nursing Home Exits"

Summaries of these papers are at www.nber.org/conferences/machine-learning-health-care-spring-2021

New Developments in Long-Term Asset Management

An NBER conference on New Developments in Long-Term Asset Management took place online January 21–22. Research Associates Monika Piazzesi of Stanford University and Luis M. Viceira of Harvard University organized the meeting, which was supported by Norges Bank Investment Management. These researchers' papers were presented and discussed:

- **Camille Gardner**, New York University, and **Peter Blair Henry**, New York University and NBER, "Global Infrastructure: Potential, Perils, and a Framework for Distinction"

- **Daniel Greenwald**, MIT; **Martin Lettau**, University of California, Berkeley and NBER; and **Sydney C. Ludvigson**, New York University and NBER, "How the Wealth Was Won: Factor Shares as Market Fundamentals" (NBER Working Paper 25769)

- **Patrick Bolton**, Columbia University and NBER, and **Marcin Kacperczyk**, Imperial College London, "Global Pricing of Carbon-Transition Risk"

- **Juliane Begenau**, Stanford University and NBER, and **Emil Siriwardane**, Harvard University, "How Do Private Equity Fees Vary across Public Pensions?"

- **Patrick Augustin**, McGill University; **Mikhail Chernov**, University of California, Los Angeles and NBER; **Lukas Schmid**, University of Southern California; and **Dongho Song**, Johns Hopkins University, "The Term Structure of CIP Violations" (NBER Working Paper 27231)

- **Lucian A. Bebchuk**, Harvard University and NBER, and **Doron Y. Levit**, University of Washington, "Should Short-Term Shareholders Have Less Rights?"

- **Ralph S. J. Koijen**, University of Chicago and NBER, and **Motohiro Yogo**, Princeton University and NBER, "Exchange Rates and Asset Prices in a Global Demand System" (NBER Working Paper 27342)

- **Anil K Kashyap**, University of Chicago and NBER; **Natalia Kovrijnykh**, Arizona State University; **Jian Li**, University of Chicago; and **Anna Pavlova**, London Business School, "Is There Too Much Benchmarking in Asset Management?" (NBER Working Paper 28020)

Summaries of these papers are at www.nber.org/conferences/new-developments-long-term-asset-management-spring-2021

The Rise in Cardiovascular Disease Mortality

An NBER conference on The Rise in Cardiovascular Disease Mortality took place online on February 5. Research Associates Anne Case and Angus Deaton of Princeton University organized the meeting, which was supported by a grant from the National Institute on Aging. These researchers' papers were presented and discussed:

- **Anne Case**, "International Trends in Cardiovascular Disease Mortality: Has This Engine of Progress Ground to a Halt?"

- **Renee Y. Hsia**, University of California, San Francisco; **Yu-Chu Shen**, Naval Postgraduate School and NBER; and **Harlan Krumholz**, Yale University, "Racial Disparities in the Regionalization of Care for Patients with ST-segment Elevation Myocardial Infarction (STEMI)"

- **David M. Cutler**, Harvard University and NBER, "Understanding Differences in Heart Disease Trends by Education"

- **Paul Novosad**, Dartmouth College; **Charlie Rafkin**, MIT; and **Sam Asher**, Johns Hopkins University, "Mortality Change among Less-Educated Americans"

- **Adam Leive**, University of Virginia, and **Christopher J. Ruhm**, University of Virginia and NBER, "Education Gradients in Mortality Trends by Gender and Race" (NBER Working Paper 28419)

- **Joanna Aleksandra Kopinska**, Sapienza University of Rome; **Vincenzo Atella**, Università degli Studi di Roma "Tor Vergata"; and **Jay Bhattacharya** and **Grant Miller**, Stanford University and NBER, "The Changing Relationship between Bodyweight and Longevity in High- and Low-Income Countries"

- **Effrosyni Adamopoulou** and **Eleftheria Triviza**, University of Mannheim, and **Elisabetta Olivieri**, Bank of Italy, "Eating Habits: The Role of Early Life Experiences and Intergenerational Transmission"

Summaries of some of these papers are at: www.nber.org/conferences/rise-cardiovascular-disease-mortality-spring-2021

COVID-19 and Health Outcomes

An NBER conference on COVID-19 and Health Outcomes took place online on February 10. Research Associates Jonathan S. Skinner of Dartmouth College and David M. Cutler of Harvard University organized the meeting, which was supported by a grant from the National Institute on Aging. These researchers' papers were presented and discussed:

- **Francis Annan**, Georgia State University, and **Belinda Archibong**, Columbia University, "The Value of Communication during a Pandemic"

- **Yulya Truskinovsky**, Wayne State University, and **Lindsay Kobayashi** and **Jessica Finlay**, University of Michigan, "Caregiving in a Pandemic: COVID-19 and the Well-Being of Family Caregivers over 55 in the United States"

- **Randall Akee**, University of California, Los Angeles and NBER; **Luis E. Quintero**, Johns Hopkins University; and **Emilia Simeonova**, Johns Hopkins University and NBER, "Pandemic Protocols, Native Health: Health Care Access from American Indian Reservations during COVID-19"

- **Francesco Bianchi**, Duke University and NBER; **Giada Bianchi**, Harvard Medical School; and **Dongho Song**, Johns Hopkins University, "The Long-Term Impact of the COVID-19 Unemployment Shock on Life Expectancy and Mortality Rates" (NBER Working Paper 28304)

- **Janet Currie**, Princeton University and NBER; **Molly Schnell** and **Hannes Schwandt**, Northwestern University and NBER; and **Jonathan Zhang**, Princeton University, "The Epidemic within the Pandemic: Drivers of Overdose Deaths during COVID-19"

- **Michael Bailey**, Facebook; **Drew M. Johnston** and **Martin Koenen**, Harvard University; **Theresa Kuchler** and **Johannes Stroebel**, New York University and NBER; and **Dominic Russel**, New York University, "Social Distancing during a Pandemic: The Role of Friends"

Summaries of some of these papers are at www.nber.org/conferences/covid-19-and-health-outcomes-spring-2021

Economics and Politics of Mega-Firms

An NBER conference on the Economics and Politics of Mega-Firms took place on February 19 online. Research Associates Chad Syverson of the University of Chicago and John Van Reenen of the London School of Economics organized the meeting, which was supported by the Smith Richardson Foundation. These researchers' papers were presented and discussed:

- **Marianne Bertrand**, University of Chicago and NBER; **Matilde Bombardini** and **Francesco Trebbi**, University of California, Berkeley and NBER; **Raymond Fisman**, Boston University and NBER; and **Eyub Yegen**, University of Toronto, "Investing in Influence: Investors, Portfolio Firms, and Political Giving"

- **Bruno Pellegrino**, University of Maryland, "Product Differentiation and Oligopoly: A Network Approach"

- **Kilian Huber**, University of Chicago, "Are Bigger Banks Better? Firm-Level Evidence from Germany"

- **Ezra Oberfield** and **Esteban Rossi-Hansberg**, Princeton University and NBER, and **Pierre-Daniel Sarte** and **Nicholas Trachter**, Federal Reserve Bank of Richmond, "Plants in Space" (NBER Working Paper 27303)

- **Antonio Falato**, Federal Reserve Board; **Hyunseob Kim**, Cornell University; and **Till M. von Wachter**, University of California, Los Angeles and NBER, "Shareholder Power and the Decline of Labor"

- **Philippe Aghion**, London School of Economics; **Antonin Bergeaud**, Banque de France; **Timo Boppart**, IIES, Stockholm University; **Peter J. Klenow**, Stanford University and NBER; and **Huiyu Li**, Federal Reserve Bank of San Francisco, "A Theory of Falling Growth and Rising Rents"

- David Baqaee, University of California, Los Angeles and NBER, and Emmanuel Farhi, Harvard University and NBER (deceased), "The Darwinian Returns to Scale" (NBER Working Paper 27139)

- **Diana Van Patten**, Princeton University, and **Esteban Méndez-Chacón**, Central Bank of Costa Rica, "Multinationals, Monopsony and Local Development: Evidence from the United Fruit Company"

Summaries of these papers are at www.nber.org/conferences/economics-and-politics-mega-firms-spring-2021

Program and Working Group Meetings

Industrial Organization

Members of the NBER's Industrial Organization Program met February 12–13 online. Faculty Research Fellow Thomas R. Covert of the University of Chicago and Research Associates Ginger Zhe Jin of the University of Maryland and Ali Yurukoglu of Stanford University organized the meeting. These researchers' papers were presented and discussed:

- **Andrew Butters** and **Jackson Dorsey**, Indiana University, and **Gautam Gowrisankaran**, University of Arizona and NBER, "Soaking Up the Sun: Battery Investment, Renewable Energy, and Market Equilibrium"

- **Michael Ostrovsky**, Stanford University and NBER, "Choice Screen Auctions" (NBER Working Paper 28091)

- **Tuba Tuncel**, HEC Montréal, "Should We Prevent Off-Label Drug Prescriptions? Empirical Evidence from France"

- **Jie Bai**, Harvard University and NBER; **Panle Jia Barwick** and **Shanjun Li**, Cornell University and NBER; **Shengmao Cao**, Stanford University, "Quid Pro Quo, Knowledge Spillover, and Industrial Quality Upgrading: Evidence from the Chinese Auto Industry" (NBER Working Paper 27644)

- **Daniel Björkegren** and **Samsun Knight**, Brown University, and **Joshua Blumenstock**, University of California, Berkeley, "Manipulation-Proof Machine Learning"

- **Joerg Claussen**, University of Munich; **Christian W. Peukert**, HEC Lausanne; and **Ananya Sen**, Carnegie Mellon University, "The Editor and the Algorithm: Returns to Data and Externalities in Online News"

- **Chiara Farronato**, Harvard University and NBER; **Jessica Y. Fong**, University of Michigan; and **Andrey Fradkin**, Boston University, "Dog Eat Dog: Measuring Network Effects Using a Digital Platform Merger" (NBER Working Paper 28047)

- **Matthew Backus**, Columbia University and NBER; **Christopher Conlon**, New York University; and **Michael Sinkinson**, Yale University and NBER, "Common Ownership and Competition in the Ready-To-Eat Cereal Industry" (NBER Working Paper 28350)

- **Navdeep S. Sahni** and **Charles Y. Zhang**, Stanford University, "Are Consumers Averse to Sponsored Messages? The Role of Search Advertising in Information Discovery"

Summaries of these papers are at www.nber.org/conferences/industrial-organization-program-meeting-spring-2021

Economic Fluctuations and Growth

Members of the NBER's Economic Fluctuations and Growth Program met online on February 26. Research Associates Mariacristina De Nardi of the University of Minnesota and Jonathan A. Parker of MIT organized the meeting. These researchers' papers were presented and discussed:

- **Daniel Lewis**, **Davide Melcangi**, and **Laura Pilossoph**, Federal Reserve Bank of New York, "Latent Heterogeneity in the Marginal Propensity to Consume"

- **Alexandr Kopytov**, University of Hong Kong; **Nikolai Roussanov**, University of Pennsylvania and NBER; and **Mathieu Taschereau-Dumouchel**, Cornell University, "Cheap Thrills: The Price of Leisure and the Global Decline in Work Hours" (NBER Working Paper 27744)

- **Christian vom Lehn**, Brigham Young University, and **Thomas Winberry**, University of Pennsylvania and NBER, "The Investment Network, Sectoral Comovement, and the Changing US Business Cycle" (NBER Working Paper 26507)

- **Adrien Bilal**, University of Chicago, and **Hugo Lhuillier**, Princeton University, "Outsourcing, Inequality, and Aggregate Output"

- **Brian Fabo**, National Bank of Slovakia; **Martina Jančoková**, European Central Bank; **Elisabeth Kempf**, University of Chicago; and **Lubos Pastor**, University of Chicago and NBER, "Fifty Shades of QE: Comparing Findings of Central Bankers and Academics" (NBER Working Paper 27849)

- **Ricardo Reis**, London School of Economics, "The Constraint on Public Debt When $r < g$ but $g < m$"

Summaries of these papers are at www.nber.org/conferences/efg-research-meeting-winter-2021

NBER Books

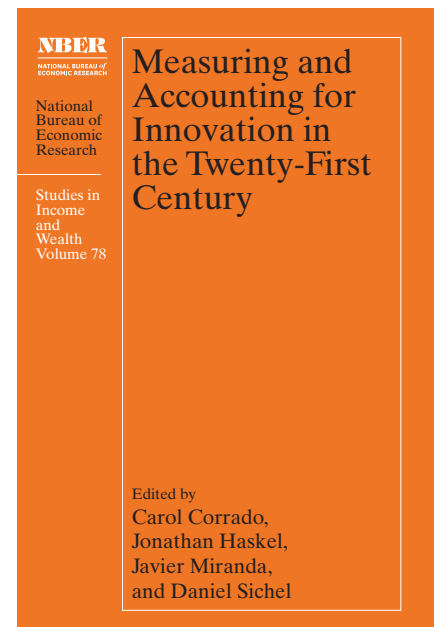# Measuring and Accounting for Innovation in the Twenty-First Century

Carol Corrado, Jonathan Haskel, Javier Miranda, and Daniel Sichel, editors

Measuring innovation is challenging both for researchers and for national statisticians, and it is increasingly important in light of the ongoing digital revolution. National accounts and many other economic statistics were designed before the emergence of the digital economy and the growing importance of intangible capital. They do not yet fully capture the wide range of innovative activity that is observed in modern economies.

This volume examines how to measure innovation, track its effects on economic activity and prices, and understand how it has changed the structure of production processes, labor markets, and organizational form and operation in business. The contributors explore new approaches to, and data sources for, measurement — such as collecting data for a particular innovation as opposed to a firm, and the use of trademarks for tracking innovation. They also consider the connections between university-based R&D and business startups, and the potential impacts of innovation on income distribution.

The research suggests potential strategies for expanding current measurement frameworks to better capture innovative activity, such as more detailed tracking of global value chains to identify innovation across time and space, and expanding the measurement of the GDP impacts of innovation in fields such as consumer content delivery and cloud computing.

NBER
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National Bureau of Economic Research

Studies in Income and Wealth Volume 78

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