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The Economics of Digitization

Shane Greenstein*

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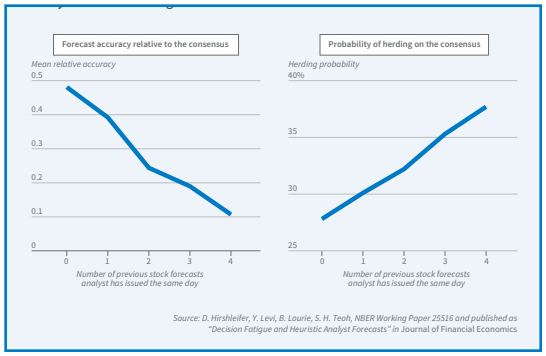

The NBER Economics of Digitization Project, established in 2010 with support from the Alfred P. Sloan Foundation, provides a forum for disseminating research and fostering collaboration among economists exploring the enormous changes that digitization has brought to transaction costs, media functions, product personalization, and many other facets of modern life. These activities have helped to define a community of scholars.

This report summarizes studies presented at project meetings over the last several years. It focuses on the role of digitization in new goods, digital platforms and algorithms, and online privacy. This research represents only a small subset of the work that has been presented and discussed.

New Goods

Digitization has led to drastic declines in transaction costs — search costs, replication costs, communications costs, tracking costs, and verification costs. Though such declines often go unrecorded, Avi Goldfarb and Catherine Tucker offer a taxonomy of studies of digitization organized around declines in such costs.[1] Many new goods take advantage of these dramatically lower transaction costs.

Digitization has restructured the supply of digital goods and services in creative industries, such as movies, music, and television. Yet, it has not eliminated the unpredictable appeal of these new goods. Luis Aguiar and Joel Waldfogel explore the consequence of unpredictability for measuring the welfare benefit of new products, using recent developments in recorded music as an illustration.[2] New products have surprising appeal, and as firms explore the unpredictable outcomes, their exploration creates a long tail of realized appeal in the market. The researchers quantify the effects of new music on welfare, and show that a tripling of the number of new products between 2000 and 2008 added substantially to consumer surplus and over-

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all welfare. Importantly, this analysis differs from one with retrospective biases that presumes firms anticipate the long tail.

Some digital services have taken advantage of trivial replication and personalization costs to scale up to supply enormous numbers of customers. Many of these digital services are "free" goods, and it seems likely that standard procedures for GDP accounting do not measure the output accurately. Erik Brynjolfsson, Avinash Collis, and Felix Eggers propose a new approach to measuring consumer benefits from digital goods such as Facebook, Wikipedia, and online search .[3] Their study uses massive online

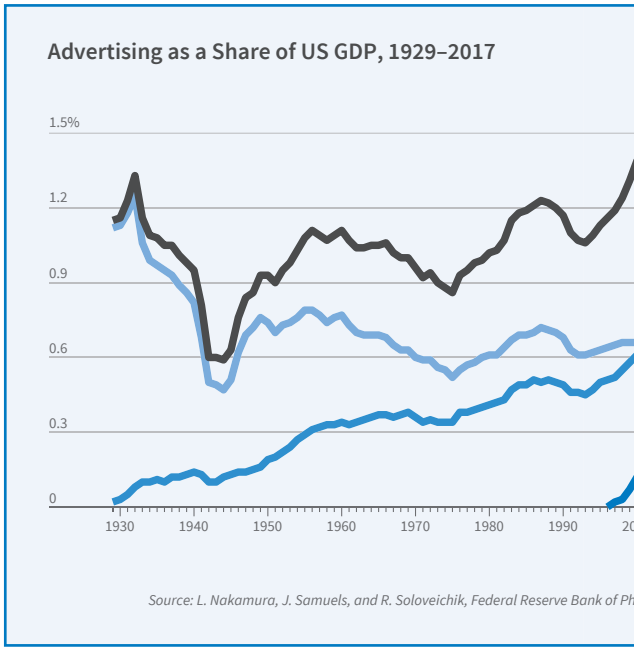
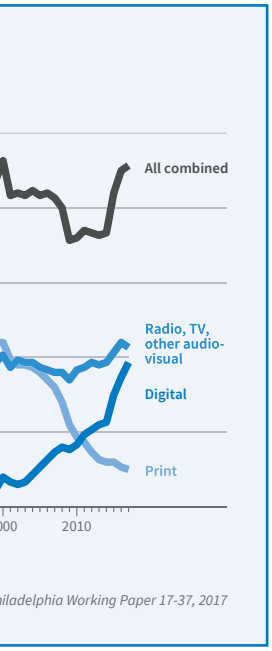


Figure 1

choice experiments to measure consumers' willingness to accept compensation for losing access to these digital goods. The results indicate that digital goods have created large gains in well-being. Their demonstration suggests that querying a large, representative sample of users could provide cost-effective supplements to existing national income and product accounts.

While unpriced services contribute little directly to GDP by traditional methods, many are supported by advertising. Figure 1 shows advertising as a percentage of GDP, heightening the importance of accounting for its reallocation across media. Leonard Nakamura, Jon Samuels, and Rachel Soloveichik develop an experimental methodology that values "free" digital content through the lens of production accounting, the framework of the national accounts.[4] They estimate that the contribution of "free" digital content to US GDP has accelerated in recent

years, particularly since online advertising increased after 2005. However, this explosion is partially offset by a decrease in advertising in newspapers, which also served as a major source of content and advertising until recently. Including these adjustments for growth and decline, real GDP growth would have grown at 1.53 percent a year from 2005 to 2015 rather than the official growth rate of 1.42 percent; 0.11 percentage points faster. From 1995 to 2005, real GDP growth would have grown 0.07 percentage point faster, and in the earlier period, from 1929 to 1995, 0.01 percentage point faster.



Of the many new goods enabled by digitization, those related to social media have been among the most controversial because of their capacity to facilitate the spread of misinformation, polarize political debate, and potentially to foster depression. Hunt Allcott, Luca Braghieri, Sarah Eichmeyer, and Matthew Gentzkow conduct a randomized experiment of Facebook users.[5] They ask users to deactivate Facebook for the four weeks before the 2018 US midterm election, resulting in reduced online activity along with increased offline activities such as watching TV alone and socializing with family and friends; reduced factual news knowledge and political polarization; increased subjective well-being; and a large, persistent reduction in post-experiment Facebook use. Deactivation also reduced post-experiment valuations of Facebook, which, the researchers argue, suggests that traditional metrics may overstate consumer surplus.

Another controversial experiment in new goods is Google Books, a Google-organized searchable digital repository of all pre-existing books and periodicals. Critics argued it violated copyright and decreased book sales. Defenders stressed that it made knowledge available, and proposed it would increase book sales by lowering the cost of sampling. What impact did Google Books have before copyright lawsuits hampered the project? Abhishek Nagaraj and Imke Reimers track the timing of the digitization of individual books from Harvard University's libraries.[6] They find that Google books hurt loans within Harvard but increased sales of physical editions by about 35 percent, especially for less-popular works. They conclude that, rather than harming all copyright holders, mass digitization could have significantly increased the diffusion of historical works.

Platforms and Algorithms

Digital platforms have been deployed widely in the economy, transforming many markets. One common operating model provides one service at a price of zero, while raising revenue through related services, such as automated auctions for advertising. Another common operating model facilitates the match of supply and demand from different participants using algorithms. A number of studies examine the impact of these arrangements.

Digital platforms have emerged to manage "gig work" for rideshare driving. This involves workers supplying flexibility to the platform, providing service when demand is high, which can be attractive to workers who value flexibility. M. Keith Chen, Judith A. Chevalier, Peter E. Rossi, and Emily Oehlsen use data on hourly earnings for Uber drivers and document ways in which drivers utilize real-time flexibility.[7] Drivers' reservation wages vary, as illustrated by their start and stop times in Figure 2. Their results indicate that, while the Uber relationship may have other drawbacks, Uber drivers benefit significantly from real-time flexibility, earning more than twice the surplus they would earn in less-flexible arrangements. If required to supply labor inflexibly at prevailing wages, they also would reduce the hours they supply by more than two-thirds.

How can a platform build enough trust to facilitate transactions between strangers thousands of miles apart? Moshe A. Barach, John Horton, and Joseph Golden examine money-back guarantees, which create a direct financial stake for the platform in seller performance.[8] They consider whether these might be effective at steering, even as they align buyer and platform interests in creating a good match. They conduct an experiment in which an online labor market guaranteed

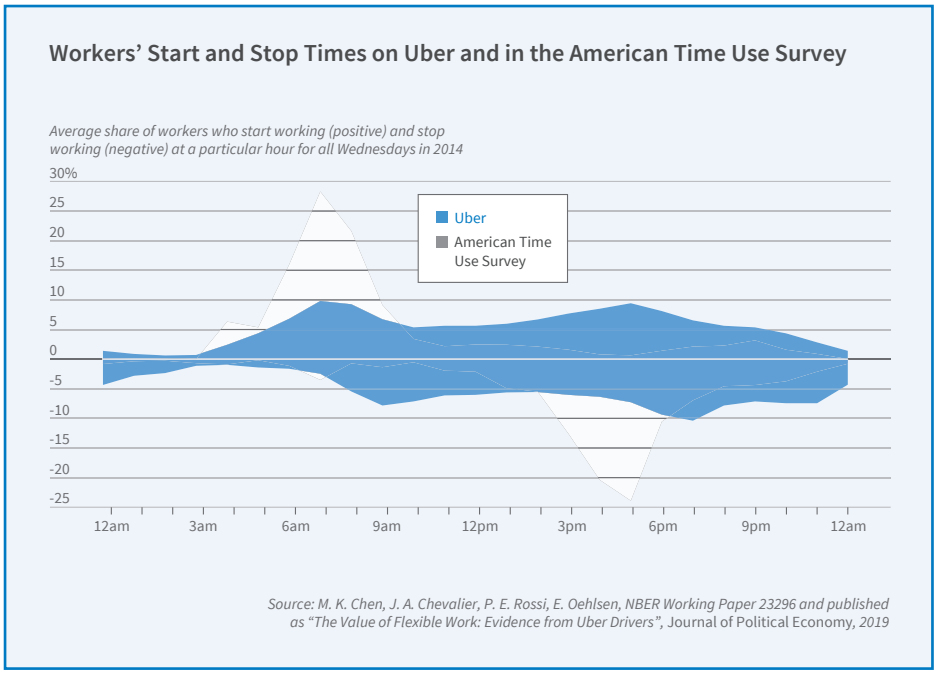


Figure 2

some sellers for some buyers. The presence of a guarantee steered buyers to these sellers, but offering guarantees did not increase sales overall, suggesting financial risk was not determinative for the marginal buyer. The researchers conclude that buyers viewed the platform's decision to guarantee as informative about relative seller quality.

Negotiation receives attention in the study by Matthew Backus, Thomas Blake, Bradley Larsen, and Steven Tadelis.[9] Their study examines patterns of behavior in bilateral bargaining situations using a rich and detailed dataset that describes back-and-forth bargaining occurring in over 25 million listings from eBay's Best Offer platform. They demonstrate that several patterns in the data can be explained by existing theoretical models. These include interactions ending quickly, interactions ending in agreement after some delay, and stronger bargaining power or better outside options improving a player's outcome. Other robust patterns, however, remain unexplained by existing theories. These include negotiations resulting in delayed disagreement, gradually changing offers that are reciprocal, and "splitting the difference" between the two most recent offers. These robust patterns call for new explorations in the theory of bargaining. The researchers have made the data available for additional experiments.[10]

Platforms have changed many aspects of the travel markets, permitting more informed matches of supply and demand prior to travel. Chiara Farronato and Andrey Fradkin study the effects on the accommodation industry of enabling peer supply through Airbnb.[11] They analyze the impact by estimating a model of competition between flexible and dedicated sellers — peer hosts and hotels. They estimate the model using data from major US cities and quantify the welfare effects of Airbnb on travelers, hosts, and hotels. They show that the welfare gains from this activity are concentrated in locations (e.g., New York) and times (e.g., New Year's Eve) when capacity constraints bind availability of hotel rooms. This occurs because peer hosts are responsive to market conditions, expand supply as hotels fill up, and keep hotel prices down as a result. Figure 3 shows the researchers estimates for the varying costs of Airbnb rentals at different times, illustrating the importance of accommodating variability in demand.

Online platforms also can serve as new sources of information for economic analysis. Edward Glaeser, Hyunjin Kim, and Michael Luca investigate whether data from Yelp can improve measurement of changes to a neighborhood and the local economy.[12] Combining Yelp and census data, they find that gentrification, as measured by changes in the education, age, and racial composition within a ZIP code, is strongly associated with increases in the numbers of grocery stores, cafés, restaurants, and bars in the area, with little evidence of crowd-out of other categories of businesses. A leading indicator of housing price changes is change in the local business landscape, particularly the entry of Starbucks, and coffee shops more generally. Each additional Starbucks that enters a ZIP code is associated with a 0.5 percent increase in housing prices.

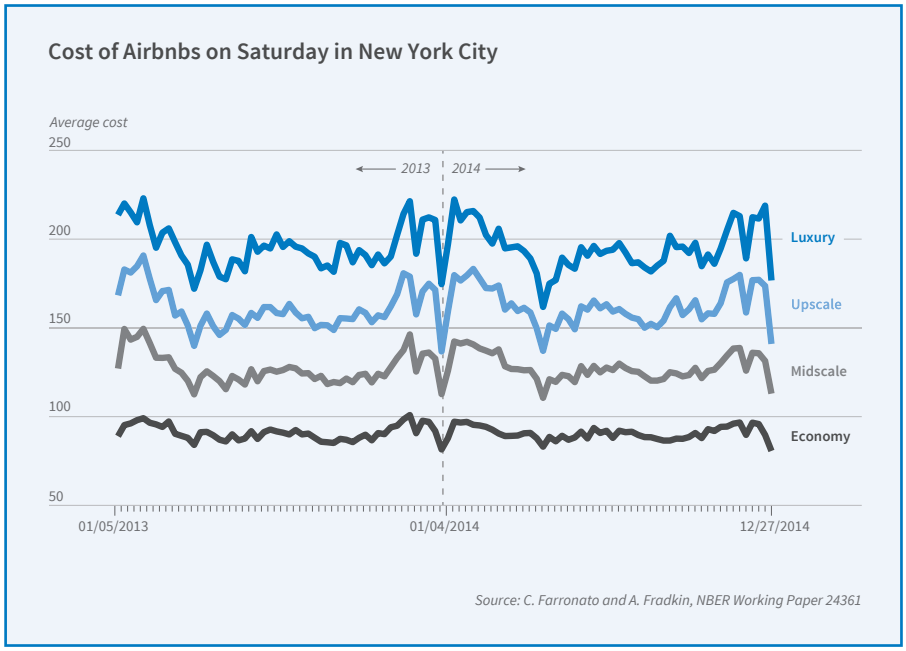


Figure 3

Do the advertising algorithms reflect common notions of fairness and appropriate business decision-making? Can automated processes in advertising lead to gender biases? Anja Lambrecht and Catherine Tucker conduct a field test of how an algorithm delivered ads promoting job opportunities in the science, technology, engineering, and math (STEM) fields.[13] The researchers created an ad that was explicitly intended to be gender-neutral in its delivery. Empirically, however, fewer women saw the ad than men. This happened because younger women are a prized demographic and are more expensive to show ads to. An algorithm that simply optimizes cost-effectiveness in ad delivery will deliver ads that were intended to be gender-neutral in an apparently discriminatory way. The researchers show that this empirical regularity extends to other major digital platforms.

Online Privacy

A reduction in costs of verifying user identity has made it far easier to track identities of consumers across the internet. Though these shifts have enhanced productivity for sellers of advertising and electronic services, they have also increased privacy concerns. In May 2018, the European Union began enforcing the General Data Protection Regulation (GDPR), which endowed EU citizens with new personal data rights, imposed new responsibilities on firms, and enabled users to opt out of common tracking technologies altogether. The unprecedented scale and scope of the GDPR make it the most important regulatory effort since the commercialization of the internet.

Samuel Goldberg, Garrett Johnson, and Scott Shriver examine the short-run consequences for a firm's cost of collect-

ing consumer data.[14] They examine the impact of the GDPR on European web traffic and e-commerce sales using web analytics data from a diverse set of 1,508 firms that use the Adobe Analytics platform. Using a difference-in-differences approach, they show that recorded page-views and recorded revenues fall by about 10 percent for EU users after the GDPR's enforcement deadline. The extensive margin drives these changes as users' average time on sites and average page views per visit stay constant.

Do consumer privacy decisions have externalities for other consumers, and, therefore, the firms that supply them and advertise to them? Guy Aridor, Yeon-Koo Che, and Tobias Salz study the effects of the GDPR on the ability of firms to collect consumer data, focusing on the online travel industry.[15] They conclude that the GDPR enabled privacy-conscious consumers — approximately 12.5 percent of their sample — to substitute away from less-efficient privacy protection. The remaining consumers become more observable for a longer period of time, and the average value of the remaining consumers to advertisers increased. These two changes came close to offsetting each other.

Jian Jia, Ginger Zhe Jin, and Liad Wagman examine the short-run, unintended impact of the GDPR on investment in new and emerging technology firms.[16] Their findings indicate negative post-GDPR effects on ventures within the EU compared with their US counterparts. The negative effects manifest in the overall dollar amounts raised across funding deals, the number of deals, and the dollar amount raised per individual deal.

As many countries contemplate their own versions of data protection and privacy regulations, there is a growing need for additional analysis and measurement of the GDPR. Current empirical work focuses on the short-run impact on suppliers and users. As policymakers craft their approaches, there will be a need to research the longer-run implications.

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Behavioral Biases of Analysts and Investors

David Hirshleifer

Financial analysts and stock market investors alike are subject to behavioral biases. Objective analyst forecasts can potentially help correct investor misperceptions. On the other hand, biased forecasts can reinforce or incite investor misperceptions. Furthermore, data on analyst behavior provide a rich window of insight into the nature of psychological bias among an important and incentivized group of professionals, since ex post information is available about the accuracy of analyst forecasts under different conditions. Analyst behavior also provides insights into the sources of stock market mispricing.

As a possible example of analyst psychological bias, consider decision fatigue, defined as the tendency for decision quality to decline after an extensive session of decision-making. Whether decision fatigue exists has been a topic of controversy as part of the greater replication crisis in experimental psychology. My collaborators Yaron Levi, Ben Lourie, Siew Hong Teoh, and I provide a test of whether decision fatigue affects a set of skilled financial professionals in the field.[1] Specifically, we test whether decision fatigue causes stock market analysts to be more heuristic in their forecasting.

Decision Fatigue, First Impressions, and Analyst Forecasts

Analysts cover multiple firms and need to periodically revise forecasts. They often issue several forecasts in a single day, which requires analysis and judgment.

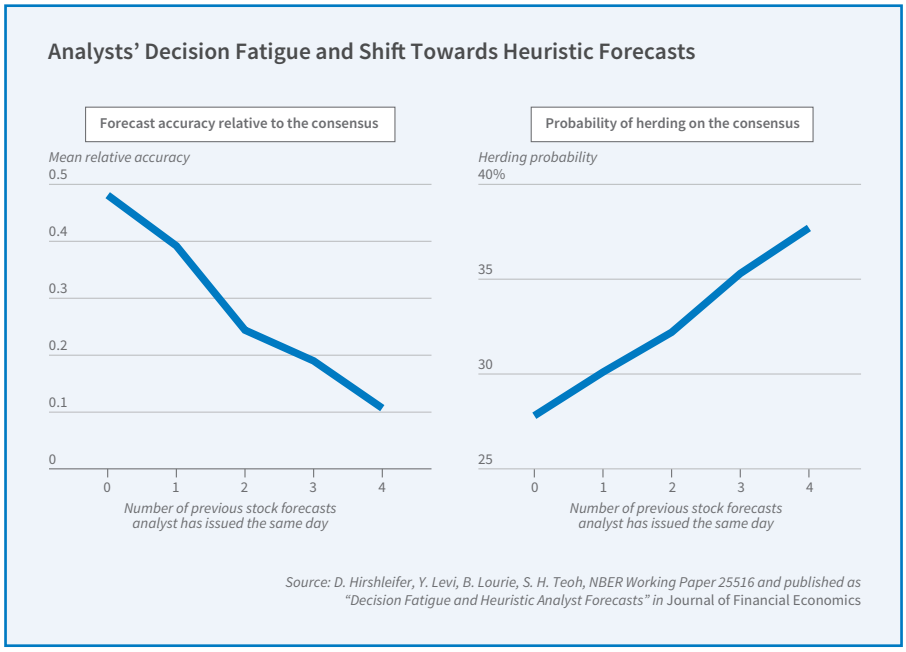

Figure 1

Consistent with decision fatigue [as seen in Figure 1], forecast accuracy declines over the course of a day as the number of forecasts the analyst has already issued increases (controlling for time). Furthermore, the more forecasts an analyst issues, the higher the probability that the analyst forecasts more heuristically by herding on the consensus forecast, self-herding (reissuing the analyst's own previous outstanding forecast), and forecasting a round number. Nevertheless, we find no evidence that the stock market is inefficient in the sense of failing to adjust for analyst decision fatigue.

Analyst behavior also provides insight into whether skilled professionals are subject to first-impression bias, the tendency for a decision maker, in making evaluations, to place undue weight on early experiences. For example, psychologist Solomon Asch found that if a person is described as "intelligent, industrious, impulsive, critical, stubborn, [and] envious," people form a more positive impression of that person than when the descriptors are provided in the reverse order. First-impression bias is closely related to confirmation bias, also studied in behavioral economics.

Lourie, Thomas Ruchti, Phong Truong, and I test whether an analyst's forecasts about a firm, and related behaviors, are tilted toward the first impression that the equity analyst forms.[2] We measure this first impression by the firm's abnormal stock return in the year before the analyst issues his or her first forecast for that firm. During this period, the analyst develops an understanding of the firm's operations, management, governance, and competitive positioning.

In a sample of 1,643,089 firm-analyst observations over 1984–2017, we find that an analyst's first impressions of a firm have a lasting positive association with the analyst's future forecasts for that firm relative to the consensus forecast. Analysts with positive first impressions also issue higher price targets — predicted levels of stock prices — and are more likely to issue a buy recommendation. The opposite patterns hold for negative first impressions. These first-impression effects persist, on average, for 36 months after the analyst starts to follow a stock. Furthermore, the stock market only partly adjusts for first-impression bias; an analyst's first impression about a firm can be used to predict future returns.

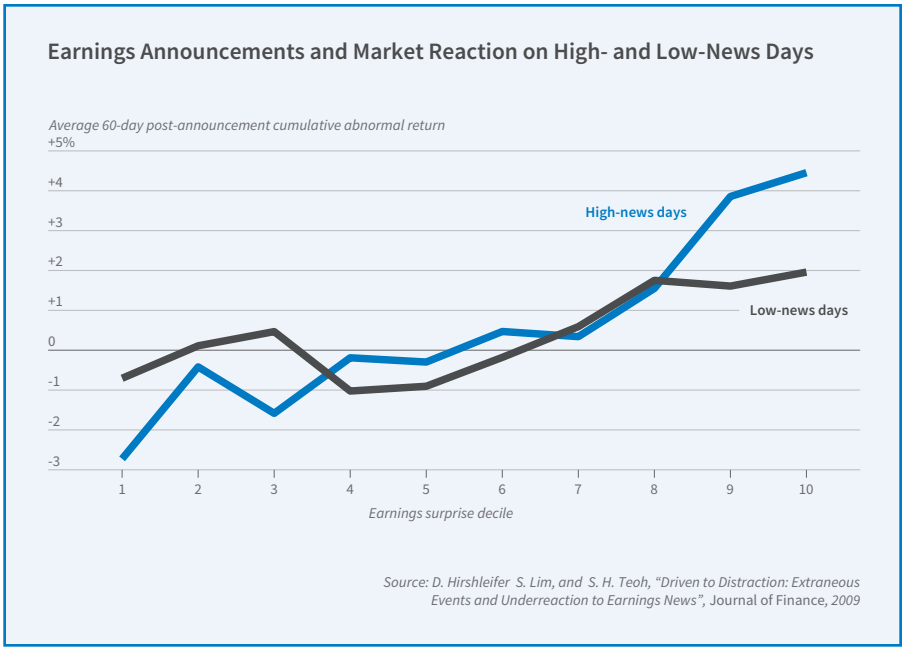

Figure 2

Past research has provided evidence suggesting that investors or other decision makers put greater weight on recent events than on earlier events. Analyst first-impression bias contrasts notably with such findings. We therefore investigate the comparative weights analysts place on first impressions versus more recent impressions. We find a U-shaped relationship between impressions and time. Analysts appear to place greater weight on recent experiences and on their earliest experiences relative to intermediate experiences.

As the example of first impressions illustrates, the stock market sometimes fails to fully incorporate relevant publicly available information items. A possible reason for this is that investors have limited attention. Sonya Lim, Teoh, and I have shown that, owing to limited attention, investors sometimes neglect relevant public information signals, which causes stock mispricing and induces return predictability.[3] For example, if investors do not fully incorporate the information in earnings news, the stock price will tend to underreact to earnings surprises, a phenomenon known as post-earnings-announcement drift (PEAD). Consistent with limited attention, we find that when investors are distracted by a larger number of earnings announcements occurring on the same day, the stock market reaction to the earnings surprise is more sluggish, and PEAD is stronger.[4] As seen in Figure 2, the greater the earnings surprise (by decile), the higher the post-event return from trading days 2 through 61, which is PEAD. The slope of this relationship is much steeper on high-news days, indicating much stronger PEAD.

Although earnings surprises positively

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In his Presidential Address to the American Finance Association, he argues for an emerging paradigm, *social economics and finance*, which studies how biases in the social transmission of ideas, information, and behavior affect markets and prices. His research interests also include behavioral economics and finance.

He is Merage Chair and Distinguished Professor of Finance at the Paul Merage School of Business, University of California, Irvine, and soon begins service as coeditor of the *Journal of Financial Economics*. He is a fellow and former president of the American Finance Association, and has served as executive editor of the *Review of Financial Studies*, director of the American and Western Finance Associations, and coeditor and associate editor of several leading finance, economics, and business journals.

Hirshleifer's research encompasses how investor and manager psychological bias affects financial markets, the roles of information and feelings in securities markets, social transmission of ideas and behaviors, and the determinants of risk premiums. His work appears in finance, economics, management, psychology, and biology journals. His research awards include the Smith Breeden Award for outstanding paper in the *Journal of Finance*. He has been keynote or plenary speaker at conferences internationally. He was previously on the faculties of the Ohio State University, the University of Michigan, and UCLA. His PhD is from the University of Chicago.

In his spare time, he composes classical music and sight-reads on the piano.

predict returns, I have recently developed a framework in which it may sometimes, conditionally, predict returns negatively.[5] Consider a stock market price bubble period. During the upswing, the stock is overpriced and is, on average, growing more overpriced. The arrival of earnings news tends to partly correct the overpricing, so on average the announcement-date return is negative. But since the bubble is still growing, on average the post-event return is positive — a reversal. This novel implication merits empirical exploration.

Stock market underreaction to publicly available information is not limited to earnings news. For example, there is also evidence that the stock market does not fully incorporate information about a firm's historical effectiveness in innovative activity. It is tempting for investors to assess the prospects for a firm's innovative activities based on the exciting projects at hand, rather than the cold and abstract information contained in statistics of past performance. Daniel Kahneman and Dan Lovallo call this the temptation to take the "inside view." Nevertheless, Po-Hsuan Hsu, Dongmei Li, and I find that past innovative efficiency (IE), the ratio of patents or citations to R&D expenditures, is a positive predictor of future return on assets and cash flows. Consistent with investor inattention, IE is a strong positive predictor of future returns after standard controls.[6] A long-short trading strategy based on this effect earns a high Sharpe ratio, and is profitable after adjusting for well-known factors.

Furthermore, the market does not seem to fully incorporate the information on the originality of the firm's historical innovative activity. By "originality" we mean the range of knowledge built on by the firm in its recently granted patents, measurable by using the citations of the firm's patents to other patents. This interpretation is based on the idea that innovation is recombinant, and that patents that draw knowledge from a wide range of technology classes tend to deviate more from more typical within-class technological trajectories.

Hsu, Li, and I find that greater innovative originality strongly predicts persistently higher and less-volatile profitability.[7] Consistent with investor neglect, innovative originality also predicts higher abnormal stock returns after standard controls. Also consistent with mispricing and limited investor attention, the return predictive power of innovative originality is stronger for firms with greater valuation uncertainty, lower investor attention, and greater sensitivity of future profitability to innovative originality. These findings suggest that innovative originality acts as a competitive moat that is undervalued by the market.

Momentum Spillovers and Return Anomalies

Limited investor attention also offers a possible explanation for a wide array of anomalies based on cross-firm return predictability. These involve underreaction by one firm to the publicly observable returns of a similar or linked firm. Usman Ali and I call these effects "momentum spillovers" across firms.[8] Past research has documented such return lead-lag relationships among stocks of firms in the same industry, firms that are geographically close, firms that are linked along the supply chain, firms with similar technologies, and single- and multi-segment firms operating in the same industries.

These findings raise two key questions. The first is whether this panoply of effects can be unified by a stronger measure of firm linkage or relatedness. If so, this suggests that there is a single underlying force driving these effects. It also provides a means for future empirical studies to control for momentum spillovers in a parsimonious way. The second question is whether the effect is exacerbated by the complexity of firm linkages.

Our evidence indicates that what we call connected-firm momentum unifies all the momentum spillover anomalies. This is based on identifying firm connections by shared analyst coverage. Stock analysts generate costly information, so they have a strong incentive to make effective use of complementary information about linked or related firms. They therefore tend to cover firms that are strongly related in relevant ways, regardless of whether this relevance is derived from industry, geography, supply chain, technology, or other sources.

Furthermore, shared analyst coverage sharpens measurement and allows for more refined testing in several ways. First, it uniquely identifies linked firm pairs; most previous studies aggregate stocks into much wider buckets, such as industry or geographical region. Second, studies that do examine specific firm pairs use specialized contexts, whereas analyst peers are available for the majority of publicly traded firms throughout the globe. Third, since the number of shared analysts of a pair of firms is not a binary variable — in contrast, for example, with whether two firms are in the same industry — the strength of linkage can be measured by the number of shared analysts.

We first verify that analyst co-coverage does identify fundamental relatedness. We find that firm fundamentals such as sales and profit growth are strongly correlated with current and lagged fundamentals of analyst-linked peer firms. These correlations are much higher than the corresponding correlations using other linkage proxies.

We further find that analyst linkages are associated with extremely strong momentum spillovers. A value-weighted long-short portfolio based on quintiles of stocks that are predicted by peers to have high versus low returns generates a five-factor — market, size, value, momentum, and short-term reversal factors — alpha of 1.19 percent per month ($t = 6.71$). As seen in Figure 3 on the next page, this portfolio continues to generate positive returns over the subsequent 11 months; its cumulative return is 3.21 percent by one year after portfolio formation. An equal-weighted long-short portfolio generates roughly double this alpha and cumulative 12-month return.

We then perform spanning and cross-sectional tests to see whether the various momentum spillover effects from different studies are really one unified effect. In both types of tests, the other forms of momentum spillovers become insignificant or even negative after controlling for connected-firm momentum. A similar point applies almost universally in international markets as well. So the growing collection of momentum spillover effects is really just one effect, and presumably has one underlying driver. The leading candidate is investor neglect, when evaluating one firm, of the performance of linked or related firms.

We further find that analyst forecasts are sluggish in reacting to the information in

the forecast revisions of analyst-linked firms in the preceding month. This may derive from either analyst psychological bias or agency problems. It also suggests that analysts are not a full remedy for the inattention of investors to the information provided by analyst-linked firms.

If momentum spillovers are driven by limited analyst or investor attention, then we expect spillovers to be stronger when attention and cognitive processing is more costly. This is likely to be the case when firm linkages are more complex. For example, updating is a harder problem when news from a greater number of linked firms needs to be monitored. So one way of measuring complexity is the number of analyst links a firm has to other firms. The theoretical literature on social networks refers to this as degree centrality. This literature also offers a subtler notion, eigenvector centrality, which iteratively reflects the extent to which a firm is linked to other firms that are in turn heavily linked. Using both measures, we find that the return lead-lag relationship between the returns of connected firms is stronger when the firm is more central in the analyst coverage network.

An even more ambitious goal than integrating momentum spillover effects is to see whether return predictability in general can be organized as depending upon just a few common factors. Kent Daniel, Lin Sun, and I argue that stock mispricing comes in two main forms: short-horizon and long-horizon mispricing.[9] Inattention to earnings-related news, as with PEAD, generates short-horizon mispricing. Such mispricing tends to self-correct within a year as subsequent earnings news arrives. Long-horizon mispricing is reflected in long-term overreactions and corrections, perhaps induced by investor overconfidence.

To capture short-horizon underreaction, we use a return factor based upon earnings news. To capture long-horizon overreaction, we use a return factor based upon firms' financing activity — new issues and repurchases. The long-horizon factor exploits the information in managers' decisions to issue or repurchase equity to exploit persistent mispricing. We provide a theoretically motivated risk-and-behavioral three-factor model by adding the market factor to the earnings factor and the financing factor. We find that this three-factor model outperforms other proposed factor models in explaining a broad range of return anomalies. This finding provides guidance for future theoretical work by suggesting that most well-known stock market anomalies are derived from just two main sources.

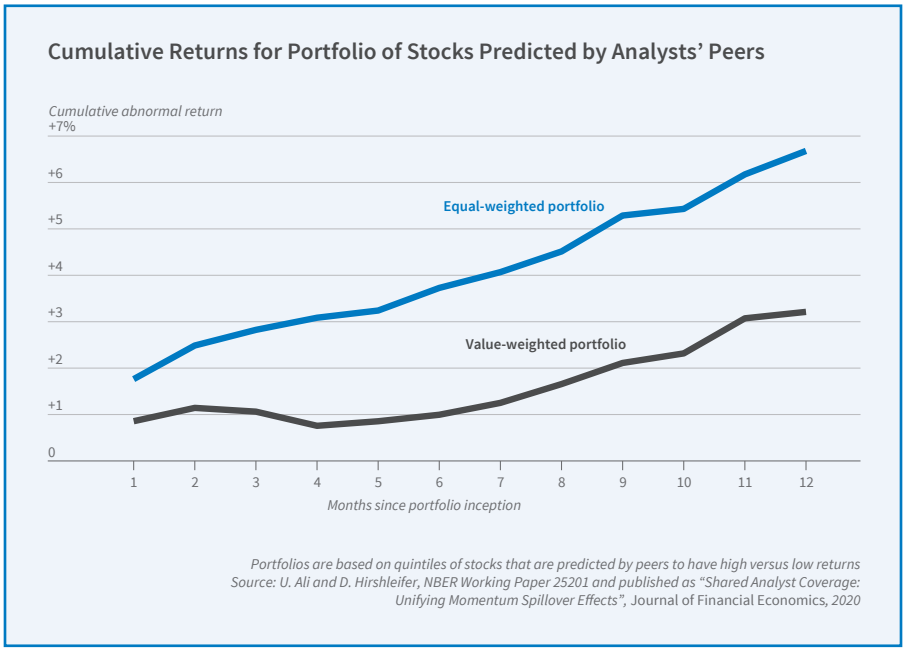

Figure 3

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Patient Care under Uncertainty in Normal and COVID-19 Times

Charles F. Manski

Over the past 10 years, I have increasingly focused my research on patient care under uncertainty. By uncertainty, I do not only mean that clinicians make probabilistic rather than deterministic predictions of patient outcomes. I mean that available knowledge may not suffice to yield precise probabilistic predictions. A patient may ask: "What is the chance that I will develop disease X in the next five years?" "What is the chance that treatment Y will cure me?" A credible response may be a range, say, 20 to 40 percent, or at least 50 percent. While most of my research appears in technical journals, in a recent book, *Patient Care under Uncertainty*, I present a largely verbal summary to make the findings accessible to a broader audience.[1]

Choice under Uncertainty and Econometrics

I often consider the choice between surveillance and aggressive treatment.[2] For patients with treated localized cancer who are at risk of metastasis, surveillance may mean scans, and aggressive treatment may be chemotherapy or immunotherapy. For patients with COVID-19, surveillance may mean self-care at home, and aggressive treatment may mean hospitalization. Aggressive treatment may reduce the risk of disease development or the severity of disease that does develop. However, it may generate health side effects and financial costs beyond those associated with surveillance.

I have had no formal training in medicine. The contributions that I feel able to make concern the methodology of empirical medical research, also called evidence-based medicine. This lies within the expertise of econometricians, statisticians, and decision analysts. For example, in recent work with Anat Tambur and Michael Gmeiner, I have developed new methods for predicting the graft-survival outcomes of patients who receive kidney transplants, given observation of organ quality, patient age, and the degree of genetic match between donor and patient.[3]

Research on medical treatment response and risk assessment shares a common objective: probabilistic prediction of patient outcomes conditional on observable patient attributes. Development of methodology for probabilistic conditional prediction has long been a core concern of econometrics. Prediction methods may be called regression, actuarial prediction, statistical prediction, machine learning, predictive analytics, or artificial intelligence.

Statistical imprecision and identification problems limit the predictive power of empirical research. Statistical theory characterizes the inferences that can be drawn about a study population by observing a sample. Identification analysis studies inferential problems that persist when sample size grows without bound. My research has focused mainly on identification, which often is the dominant difficulty.[4]

A fundamental identification problem in the analysis of treatment response is the unobservability of counterfactual treatment outcomes. Another important problem is characterization of external

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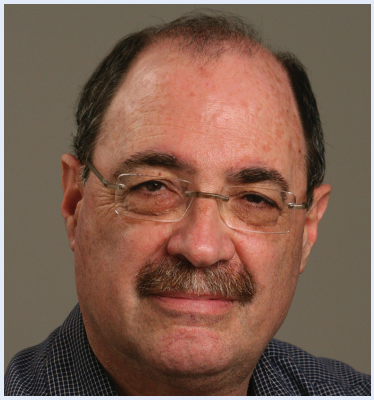
Manski's research spans econometrics, judgment and decision, and analysis of public policy. He is an author of numerous books including *Patient Care under Uncertainty* (2019), *Public Policy in an Uncertain World* (2013), *Identification for Prediction and Decision* (2007), *Social Choice with Partial Knowledge of Treatment Response* (2005), *Partial Identification of Probability Distributions* (2003), *Identification Problems in the Social Sciences* (1995), and *Analog Estimation Methods in Econometrics* (1988), and coauthor of *College Choice in America* (1983). He has served as director of the Institute for Research on Poverty (1988–91).



Manski is an elected Member of the National Academy of Sciences, an elected Fellow of the American Academy of Arts and Sciences, the Econometric Society, the American Statistical Association, and the American Association for the Advancement of Science, a Distinguished Fellow of the American Economic Association, and a Corresponding Fellow of the British Academy.

validity, that is, the feasibility of extrapolation from study populations to patient care. There are also many common problems of imperfect data quality, including measurement errors and missing data.

Credible research may be able to bound the probability that an event will occur, but not to make precise probabilistic predictions, even with large data samples. This situation is known as partial rather than point identification. Study of partial identification differs from the traditional focus of econometrics on point estimation. The latter requires strong assumptions. Partial identification, instead, begins by posing weak assumptions that should be credible in the applied context under study. Weak assumptions commonly yield estimates of ranges, "set estimates," rather than point estimates. Studies of partial identification aim to determine the set estimates that result when available data are combined with specified assumptions.

I am concerned with the implications of identification problems for decision-making. How might one choose between treatment A and treatment B when one cannot credibly identify the sign, let alone the magnitude, of the average treatment effect of A versus B? There is no optimal way to choose, but I suggest that there are reasonable ways. For example, in recent work with Rachel Cassidy, I have combined partial identification analysis with decision theory to study diagnosis and treatment of tuberculosis when existing diagnostic tests have uncertain accuracy.[5] Our methodology should also be applicable to diagnosis and treatment of COVID-19.

Some of my work has been critical of methodologies that are used widely in medical research. I have warned against use of the statistical theory of hypothesis testing to design and analyze randomized trials, instead recommending the application of statistical decision theory.[6,7] While the common view is that empirical research on treatment response should solely or predominantly use evidence from randomized trials, I have argued that both trial findings and observational data are partially informative when interpreted with credible assumptions.[8,9]

My research bears on treatment choices that arise in the context of the coronavirus pandemic. Because of its current relevance, and because it illustrates my research strategy, I therefore focus the remainder of this summary on this new work.

Estimating the COVID-19 Infection Rate

Accurate characterization of the time path of the coronavirus pandemic has been hampered by a serious problem of missing data. Confirmed cases have been measured by rates of positive findings among persons who have been tested for infection. Infection data are missing for persons who have not been tested. The persons who have been tested differ from those who have not been tested. Criteria used to determine who is eligible for testing typically require demonstration of symptoms associated with the presence of infection or close contact with infected persons. This gives reason to believe that some fraction of untested persons are asymptomatic or pre-symptomatic carriers of the COVID-19 disease.

Bounds on COVID-19 Infection Rates

State	*Cumulative infection rate*	*Infection-fatality ratio*
Illinois	0.004–0.053	0.000–0.033
New York	0.017–0.618	0.001–0.049
Italy	0.006–0.471	0.001–0.077

Estimates as of April 24, 2020
Source: C. F. Manski and F. Molinari, NBER Working Paper 27023

Figure 1

In addition, the measurement of confirmed cases is imperfect because the prevalent nasal swab tests for infection are not fully accurate. Combining the problems of missing data and imperfect test accuracy yields the conclusion that reported cumulative rates of infection are lower than actual rates. Reported rates of infection have been used as the denominator for computation of rates of severe disease conditional on infection, measured by rates of hospitalization, treatment in intensive care units, and death. Presuming that the numerators in rates of severe illness conditional on infection have been measured accurately, reported rates of severe illness conditional on infection are higher than actual rates.

Various research teams have put forward point estimates and forecasts for infection rates and rates of severe illness. These are derived in various ways and differ in the assumptions they use to yield specific values. The assumptions vary substantially and so do the reported findings. No assumption or estimate has been thought to be sufficiently credible to achieve consensus across researchers. Rather than reporting point estimates obtained under strong assumptions that are not well-justified, I find it more informative to determine the range of infection rates and rates of severe illness implied by a credible spectrum of assumptions.

To this end, Francesca Molinari and I have brought to bear econometric research on partial identification.[10] We explain the logic of the identification problem, determine the identifying power of some credible assumptions, and then combine available data with these assumptions to bound the cumulative infection rate for the coronavirus.

We focus on the cumulative infection rate from the beginning of the pandemic until specified dates. Our most important assumption is that the rate of infection among untested persons is lower than the rate among tested persons. Using this and other assumptions, we bound the population infection rate in Illinois, New York, and Italy over the period March 16 to April 24, 2020.

Bounding the Predictive Values of Antibody Tests

COVID-19 antibody tests have imperfect accuracy. Unfortunately, there has been a lack of clarity on the meaning of reported measures of accu-

racy. For risk assessment and clinical decision-making, the rates of interest are the positive and negative predictive values of a test. Positive predictive value (PPV) is the chance that a person who tests positive has been infected. Negative predictive value (NPV) is the chance that someone who tests negative has not been infected.

The medical literature regularly reports two key statistics: sensitivity and specificity. Sensitivity is the chance that an infected person receives a positive test result. Specificity is the chance that a non-infected person receives a negative result. Knowledge of sensitivity and specificity permits one to predict the test result given a person's true infection status. These predictions are not directly relevant to risk assessment or clinical decisions, where one knows a test result and wants to predict whether a person has been infected. Given estimates of sensitivity and specificity, PPV and NPV can be derived if one knows the prevalence of the disease, the overall rate of illness in the population. However, there is considerable uncertainty about the prevalence of COVID-19.

I have recently studied the problem of inference on the PPV and NPV of COVID-19 antibody tests given estimates of sensitivity and specificity and credible bounds on prevalence.[11] I explain the methodological problem and show how to estimate bounds on PPV and NPV. I then apply the findings to some tests authorized by the US Food and Drug Administration, using the estimated bounds reported above on the infection rate in New York State. I find narrow bounds for NPV and wide bounds for PPV, given the current limited knowledge of prevalence. The table gives illustrative findings for one test.

COVID-19 Policy Assessment

My analysis of the epidemiological modeling used to predict the time path of the pandemic under alternative policies has emphasized two points.[12] First, integrated assessment of COVID-19 policy should consider the full health, economic, and social impacts of alternative policy options. Most epidemiological models, however, only consider the direct impacts on the health-care system. Since its inception a century ago, epidemiology has mainly been a subject studied by quantitative researchers with backgrounds in medicine and public health. Researchers with these backgrounds have found it natural to focus on health concerns. They tend to view the economy and social welfare as matters that may be important but that are beyond their purview.

Performance Measures: COVID-19 Antibody Detection Test in NY State

Measure	*Estimate*
Sensitivity	88.0%
Specificity	98.8%
Positive Predictive Value (PPV) assuming prevalence of 5%	79.4%
Negative Predictive Value (NPV) prevalence of 5%	99.4%
PPV assuming prevalence range of 1.7–61.8%	55.9–99.2%
NPV assuming prevalence range of 1.7–61.8%	83.6–99.8%

Results correspond to Wadsworth Microsphere Immunoassay Pan-Ig Test
Source: C. F. Manski, NBER Working Paper 27226

Figure 2

Second, even within the traditional focus of epidemiology on disease dynamics, there is limited basis to assess the accuracy of the models that have been developed and studied. In this setting, forthright communication of uncertainty in the findings of research that aims to inform public policy is important.[13] In a study of the problem of formulating vaccination policy against infectious diseases, I noted the general absence of communication of uncertainty in epidemiological modeling.[14]

The underlying problem is the dearth of empirical evidence to specify realistic epidemiological models and estimate their parameters. In our modern interconnected society, epidemiologists have been largely unable to learn from randomized trials. Modeling has necessarily relied on observational data. Attempting to use the limited available evidence, epidemiologists have developed models that are sophisticated from mathematical and computational perspectives, but whose realism is unclear. Authors have typically provided little information that would enable assessment of the accuracy of the assumptions they make about individual behavior, social interactions, and disease transmission.

Looking ahead toward integrated assessment of COVID-19 policy, I see lessons to be learned from research on climate policy. Climate research was at first a subject for study by earth scientists. With backgrounds in the physical sciences, these researchers find it natural to focus on the physics of climate change rather than on behavioral responses and social impacts. Over the past 30 years, the study of climate policy has broadened with the development of integrated assessment models, with major contributions by economists. As a result, we now have a reasonably sophisticated qualitative perspective on how our planet and our social systems interact with one another, albeit with a less than adequate ability to make credible quantitative predictions. My hope is that epidemiologists will emulate the efforts of climate researchers to develop integrated assessment models and to improve the credibility of their quantitative modeling.

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Economic Effects of Repealing the US Possessions Corporation Tax Credit

Juan Carlos Suárez Serrato

Tax havens are a matter of increasing concern for voters and policymakers across the world. The Organisation for Economic Co-operation and Development, which reports that $250 billion in public revenues disappears annually due to tax avoidance, in 2013 launched the Inclusive Framework on Base Erosion and Profit Shifting (BEPS), now in its implementation phase with the collaboration of 135 countries and jurisdictions.[1] Debates about corporate and individual tax avoidance now occupy a prominent position in the political discourse of rich countries. In developing countries, which rely more heavily on corporate income taxes for revenues, policymakers are keen to find ways to curtail the effects of BEPS on their public finances. [2]

Much of the public discussion and research on profit-shifting focuses on whether attempts to curb it can be effective or will simply result in firms and individuals diverting their avoidance efforts toward new tax havens. Less work has been done to clarify what happens to the real economy when such efforts do indeed "bite," that is, when they manage to rein in profit-shifting. This is the question I tackle in a recent set of papers on section 936 of the US tax code, a provision that credited US multinationals for taxes on income originating in Puerto Rico and other US possessions. This provision, known as the US Possessions Corporation Tax Credit, was used by US corporations to shift profits to affiliates in US possessions until the measure was repealed in the Small Business Job Protection Act of 1996.

In a first paper, Daniel Garrett and I examine which corporations were exposed to section 936 and whether they reacted to its repeal by finding new tax havens to which to shift profits.[3] In a second paper, I examine the real economic effects linked to the repeal.[4] I develop my predictions of firm responses to the elimination of this potential mechanism for profit-shifting based on Joel Slemrod's hierarchy of behavioral responses to tax policy.[5] In this hierarchy, once firms have exhausted their financial or accounting options to respond to tax changes — in this case by moving "paper profits" across tax havens in response to the implementation of profit-shifting provisions — such changes can spark adjustments to firms' margins of production and real economic performance. In other words, the standard tradeoffs between tax revenue and real economic activity will apply. A full accounting of the costs and benefits of limiting firms' access to tax havens therefore includes both corrections to fiscal distortions from profit-shifting as well as real economic effects on domestic investment and employment.

Section 936 provided unique tax planning benefits to US multinationals with operations in US possessions. First, US firms were able to immediately repatriate income without paying corporate income taxes. In contrast, firms with operations in other low-tax jurisdictions were only able to delay paying US corporate taxes on the income earned in these locations.[6] Second, historical rules had allowed US firms to transfer intellectual property to affiliates in Puerto Rico without paying taxes. By paying royalties on pat-

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Suárez Serrato's research studies how taxes and government spending affect economic growth and welfare. His work bridges insights from public finance with other fields including labor, trade, development, industrial organization, and urban economics.

His studies of the US economy examine how federal spending affects local economic growth, welfare, and inequality; who benefits from state corporate tax cuts; the aggregate consequences of disparate state tax systems; how subsidies for municipal bonds affect the borrowing cost of local governments; and how tax incentives for investment affect employment and worker earnings. His research on the Chinese economy studies the efficacy of meritocracy in the selection of political leaders, whether firms respond to tax incentives for R&D by manipulating expenses, and how corporate tax incentives affect investment and firm growth. His research on international taxation studies which measures are effective at curbing profit shifting to tax havens, and how these policies affect domestic economic activity.

Suárez Serrato received a PhD in economics from the University of California, Berkeley and a BA in economics and mathematics from Trinity University. He was previously a postdoctoral fellow at the Stanford Institute for Economic Policy Research.

Suárez Serrato was born in Mexico and immigrated to San Antonio, Texas. He lives in Durham, North Carolina, with his wife and son.

ents and other intangible property to possessions' affiliates, US firms could shift the location of their profits and reduce their tax payments. A year before their repeal, section 936 tax credits totaled $5 billion in 2017 dollars — more than the total annual local wages paid by section 936 affiliates in Puerto Rico. Concerned about its potential for abuse as an avenue for profit-shifting, US lawmakers decided in 1996 to phase out this tax credit over the next 10 years.

Garrett and I study the firms that made use of this tax credit. Consistent with earlier findings from Harry Grubert and Slemrod,[7] we find that large, profitable, R&D-intensive firms, particularly pharmaceutical firms, were more likely to have an establishment in Puerto Rico. Many US pharmaceutical companies had Puerto Rican subsidiaries. These characteristics are consistent with other studies[8] that find that larger, more profitable firms with high levels of intangible assets are more likely to have links to tax havens.

Following on studies finding that news related to firms' access to tax havens influences investor valuations,[9] we use an event study to examine the reaction of stock prices of exposed firms to the announcement of the section 936 repeal and find that these multinationals experienced an average 1.4 percent reduction in their cumulative average returns, with more R&D-intensive firms being more affected.

Next, we assess whether exposed firms reacted to this shutdown of one avenue for profit-shifting by looking for substitutes, that is, by expanding to new tax havens. We look for mentions of tax haven countries in firms' SEC financial filings and find that prior to the repeal, exposed firms had tax planning strategies similar to those of non-exposed firms. We find that after the repeal, exposed firms showed a small increase (2.8 percent) in the number of mentions of new tax havens in their filings, but this increase is neither statistically nor economically significant. In other words, tax havens seem not to be easily substitutable, and firms' demand for tax havens appears to be quite inelastic.

Having established that the section 936 repeal effectively shut down this important avenue for profit-shifting by exposed firms, in my second paper I explore the question of whether there were economic effects for those firms and the regions in which they are located. Considering that the repeal effectively functioned as a tax increase on affected firms and raised their cost of capital, I present analytical results suggesting that firms will react with adjustments to their inputs to production — capital and labor. I establish that section 936-exposed firms were not on a differential trend from comparable firms prior to the repeal, but by 2006, the last year of the phase-out period, they had reduced their total investment by about 10 percent relative to other firms. The firms also diverted investments to their foreign affiliates, with the foreign investment share increasing by 12.3 percent on average. Both the reduced overall investment and the diversion of investment to other foreign subsidiaries led to an overall reduction in the domestic investment of firms exposed to section 936 relative to other similar firms. The findings on firm-level employment are similar: relative to the employment levels of comparable firms in the same industries and regions, exposed firms saw their domestic employment levels reduced by about 6.7 percent over the Possession Tax Credit phase-out period.[10]

These findings on the firm-level effects of the section 936 repeal raise the question of whether the loss of this implicit tax subsidy among exposed firms may have had either compensatory procompetitive or depressive spillover effects in the regional markets in which the firms are located. I therefore study the associated real economic outcomes at the industry-county level. I use a geographic measure of the level of exposure to section 936 to compare places that were less exposed to those with greater exposure to the tax reform. I find that, starting with the section 936 repeal in 1996, more-exposed counties experienced slower employment growth through the duration of the 10-year phase-out. Moving from the 5th percentile of counties — those with almost no exposure — to the mean level of exposure implies a 7 percentage point decrease in industry-county-level employment growth by 2006, from 23 percent to 16 percent [See Figure 2, next page].

I find evidence of a range of other spillovers whereby the effects of the section 936 repeal on real economic activity propagated at the local level. For example, for each person laid off from a firm affected by the tax credit repeal in a county with an average level of section 936 exposure, the county lost an additional 3.6 jobs, roughly consistent with the local employment multipliers calculated by Enrico Moretti.[11] I also exam-

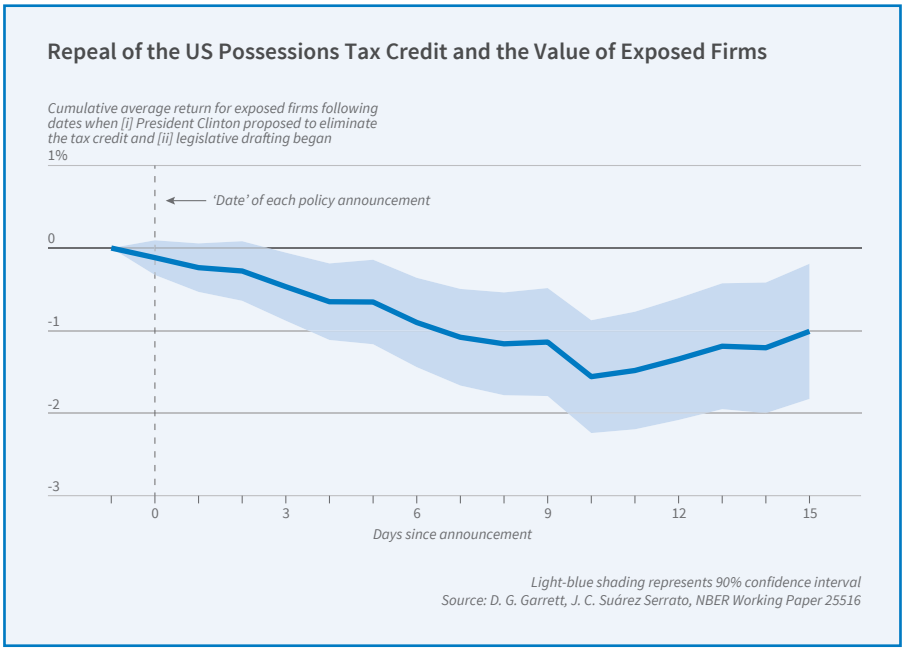
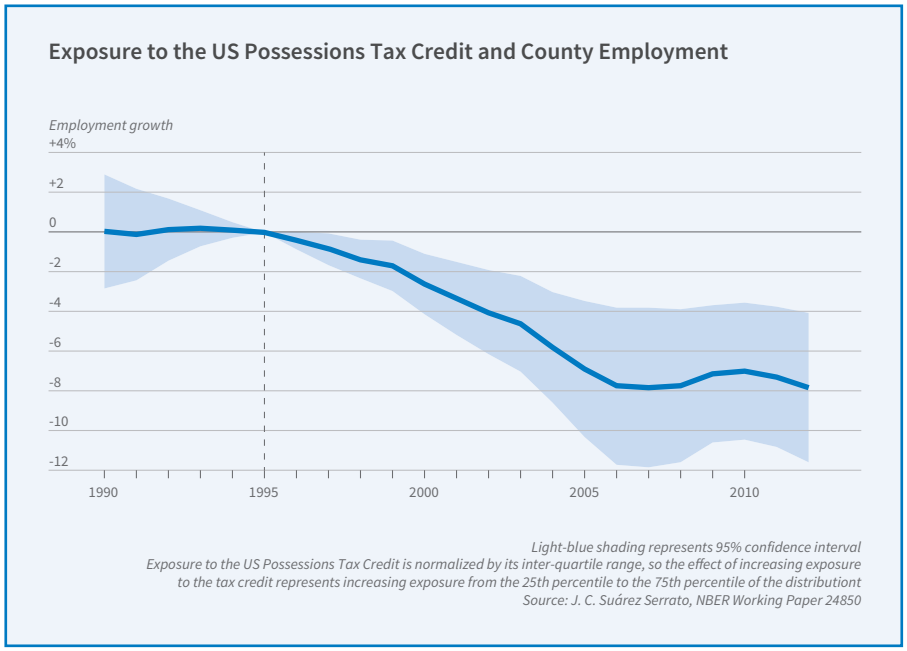


Figure 1

ine wage rates, rental costs, and home values and find contemporaneous declines on all of these indicators. For instance, there is a 1 percent reduction in wage growth for places at the 75th percentile of section 936 exposure relative to wage growth levels at the 25th percentile, with low-skilled workers, who are concentrated in the most-affected nontradable sectors, seeing greater decreases in their wages. Rental costs and home values show declines of similar magnitude — 1.8 percent and 2.5 percent, respectively — during this period. Last, considering the findings on unemployment and wage growth, I surmise that counties with higher exposure to the tax credit repeal may have increased workers' need for unemployment insurance and income replacement programs. Using Bureau of Economic Analysis data on per capita government transfers at the county level, I find that moving from the 25th to 75th percentile of repeal exposure implies an increase of 25.7 percent in government unemployment transfers and of 10.2 percent in income replacement transfers for 2004–08.

Altogether, these findings paint a picture of the repeal of section 936 as a measure that delivered a substantive shock to real economic activity across the country in the communities where section 936-reliant firms were based. Thus, while efforts to curb profit-shifting through accounting and financial maneuvers may increase US tax revenue, the very success of such measures may trigger sharp adjustments to firms' real margins of production and have long-lasting spillovers onto the local economies in which they operate.

The author thanks Samantha Eyler-Driscoll, who helped develop a preliminary version of this report.



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Medical Spending and Savings of Aging Households

Mariacristina De Nardi

Members of older households face the prospect of living longer than expected and incurring large medical expenses. My research on old age aims at better quantifying these risks, studying their implications for savings, consumption, and welfare, and evaluating the extent to which current government programs insure older people.

The first part of my research on these topics focuses on elderly singles, who comprise about 50 percent of people aged 70 or older. The second part extends the analysis to include elderly couples. The third focuses on the effect of health risk on older households' resources and the utility that they derive from consumption in various states of health, considering both couples and singles.

Risk, Savings, and Insurance among Singles

Eric French, John Bailey Jones, and I study the population of retired single people.[1] We use high-quality data from the Health and Retirement Study (HRS) to construct a rich model of out-of-pocket medical spending and use an estimated structural model to assess its importance for retirement savings. We uncover several novel findings.

First, average out-of-pocket medical expenses rise rapidly with age and permanent income, especially after age 90 [Figure 1].

Second, older people with high permanent income hold more wealth and spend it more slowly. Figure 2 displays the median assets of surviving individuals, conditional on birth cohort and permanent-income quintile. It shows that singles with high permanent income (set of top lines) hold significant amounts of wealth well into their 90s, that those with the lowest permanent income never save much (bottom lines, often flush against the horizontal axis), and that those in the middle draw down their assets at a moderate rate (intermediate set of lines). Thus, even at older ages, richer people save more, a finding first documented by Karen Dynan, Jonathan Skinner, and Stephen Zeldes for the whole life cycle.[2]

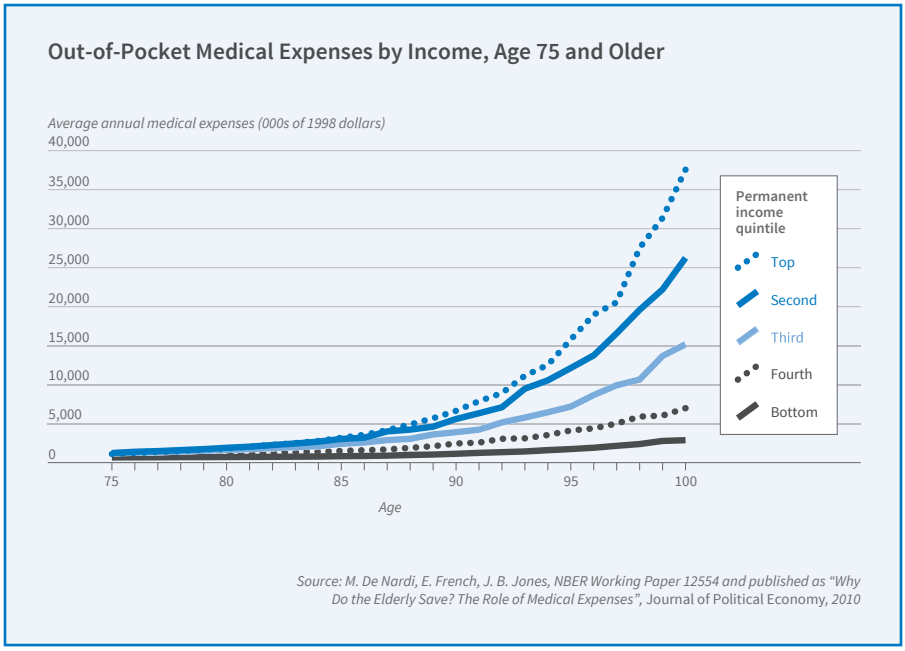

Figure 1

Third, longevity increases with income and varies greatly across observable characteristics. At age 70, people in the top permanent-income quintile typically live three and a half years longer than those in the bottom quintile. In addition, we find that while a 70-year-old man in poor health in the bottom income quintile is estimated to live only six more years, a 70-year-old woman in good health and in the top income quintile can be expected to live 17 more years.[3]

These differences in mortality are important not only to understand older individuals' saving behavior, but to properly measure savings themselves. Because male, unhealthy, low-income people die younger, at older ages our sample is increasingly composed of women, people with high lifetime earnings, and those who had good health at younger ages. Failing to account for this mortality bias would lead us to understate asset draw-down by over 50 percent. To account for this, we explicitly model mortality bias in our structural model, where people who are rich, healthy, and female have higher rates of survival.

Fourth, we use an estimated structural model to evaluate how medical expenditures affect the saving of elderly singles. Our model predicts that, absent all out-of-pocket medical expenses, the median assets of those in the highest permanent-income quintile would fall by 64 percent between the ages of 74 and 84, instead of the 23 percent that we observe. Thus, out-of-pocket medical expenses are an important reason why high-permanent-income people hold large savings later in life. Out-of-pocket medical expenses that rise very rapidly with age and income provide the elderly with a strong incentive to save, and medical expenses that rise with permanent income encourage the rich to be more frugal.

We also use our structural model to show that the government-provided consumption floor — mainly Supplemental Security Income (SSI) and Medicaid — affects saving decisions at all levels of income. This is not surprising, given the size of our estimated medical needs for the old and income-rich; even wealthy households can be financially decimated by medical needs in very old age.

In subsequent work, French, Jones, and I focus on the role of Medicaid in insuring against old-age risks and determining savings.[4] Although Medicare assists the great majority of people over 65, its beneficiaries are still responsible for insurance premia and copays. Furthermore, Medicare does not cover extended nursing home stays. These expenses are covered out of pocket or, for those with low income and assets or those made financially destitute by catastrophic medical spending, by Medicaid.

We start by documenting new facts on Medicaid recipiency after age 70. We use HRS data to show that, while the Medicaid recipiency rate in the bottom permanent-income quintile is around 70 percent throughout retirement, the recipiency rate of higher permanent-income retirees is initially very low but increases with age, reaching 20 percent for the top quintile by age 95. Thus, even high permanent-income people become Medicaid recipients if they live long enough and develop expensive medical conditions. We use the Medicare Current Beneficiary Survey to show another important fact; namely, that conditional on receiving Medicaid transfers, high-income people receive larger transfers than low-income people.

We then develop and estimate a lifecycle model of consumption and medical spending. Individuals face uncertainty about their health, life span, and medical needs, including nursing home stays. The model accounts for Medicare, SSI, and Medicaid. Consistent with program rules, we model two pathways to Medicaid: one for the lifelong poor and one for people impoverished by large medical expenses.

The model shows that the current Medicaid system provides different kinds of insurance to households with different resources. Households in the lower permanent-income quintiles are much more likely to receive Medicaid transfers, but the transfers that they receive are on average relatively small. Households in the higher permanent-income quintiles are much less likely to receive any Medicaid transfers, but when they do, these transfers are large and correspond to severe and expensive medical conditions. Medicaid is thus effective for the poorest, but also offers valuable insurance to the rich against catastrophic medical conditions, which are the most difficult to insure through saving and in the private market.

Our estimates imply that with moderate risk aversion and realistic lifetime and medical needs risk, the value that most retirees place on Medicaid insurance exceeds the actuarial value of their expected payments. On the other hand, we find that a Medicaid expansion would be valued by most retirees at less than its cost. These comparisons suggest that there would be limited demand for expanding the current Medicaid program.

Bequests, Expense Risks, and Savings

Our previous work has focused on elderly singles. Much less is known about the reasons couples save. Is it to make sure that the surviving spouse can live comfortably after one dies? To leave bequests to heirs other than the surviving spouse? To pay for future medical expenses? And how do these saving motives interact?

Rory McGee, Rachel Rodgers, French, Jones, and I collect evidence on these issues by documenting how

Mariacristina De Nardi is a faculty research fellow in the NBER's Public Economics Program. She is the Thomas Sargent Professor of Economics at the University of Minnesota and a consultant at the Opportunity and Inclusive Growth Institute of the Federal Reserve Bank of Minneapolis. Before that, she worked at the Federal Reserve Bank of Chicago, the Federal Reserve Bank of Minneapolis, and at University College London.

She is an Economic Theory Fellow of the Society for the Advancement of Economic Theory, a Fellow of the European Economic Association, a fellow of the Center for Economic and Policy Research, an Institute for Fiscal Studies International Fellow, and a coordinator for the Markets Group at Human Capital and Economic Opportunity Global Working Group.

She is an editor at the *Review of Economic Dynamics*. She serves on the Carnegie-Rochester-New-York-University Public Policy Conference Advisory Board, on the *American Economic Journal: Economic Policy* editorial board, and on the *Journal of Economic Literature* board of editors. She also co-organizes the HELP! (HEaLth and Pandemics) Econ Working Group.

Her research focuses on savings, inequality, human capital, health and medical expenses, the role of household and government insurance, and entrepreneurship.

De Nardi grew up in Italy. She received her bachelor's degree from the University of Venice in 1993 and her PhD from the University of Chicago in 1999. She lives in Minneapolis with her husband and daughter, and with her son when his university is closed due to the pandemic. She loves plants and gardening.

assets change when a household member dies.[5] Using a matching estimator, we find that when the last person in a household dies, his or her assets fall, relative to survivors, by about $20,000. When one member of a couple dies, household assets fall, relative to intact couples, by around $90,000. End-of-life expenses, mostly medical, are sufficient to explain the asset declines measured for singles, but fall short of explaining the declines observed for couples. Bequests from dying spouses to non-spousal heirs such as children are more than sufficient to explain the remainder.

In ongoing work, French, Jones, McGee, and I extend our modeling of old age risks and saving behavior to include couples.[6] We use HRS data to document that the savings of singles stay roughly constant or fall during retirement, but the savings of couples stay constant or increase until one of the spouses dies. In addition, we find that savings drop sharply leading up to the death of each spouse and, by the time the second spouse dies, a large fraction of the wealth of the couple has vanished. These facts are consistent with the findings of James Poterba, Steven Venti, and David Wise.[7]

We then develop and estimate a structural model in which people face longevity, health, and medical expense risks, and potentially care about their surviving spouse and other heirs. Our results for singles reinforce earlier findings: most singles mainly save to self-insure against future medical expenses.

Our preliminary results for couples uncover several new findings.

First, the desire to leave assets to the surviving spouse is an important reason why couples at all permanent income levels hold assets at very advanced ages. If couples did not care about the welfare of their surviving spouse, at age 94 the median assets of couples in the top permanent-income tercile would be 30 percent lower, the median assets of couples in the middle-income tercile would be 50 percent lower, and the median assets of couples in the lowest permanent-income tercile would be 75 percent lower.

Second, the desire to leave bequests to heirs other than one's spouse has large effects on the savings of couples with high permanent income but almost no effects on the savings of couples at the low and middle permanent-income levels. At age 94, couples in the highest permanent-income tercile would hold 20 percent fewer assets if they did not have a bequest motive toward non-spousal heirs.

Third, while the savings of both couples and singles in the lowest and middle permanent-income terciles are mostly driven by medical expenses, the interaction of medical expenses, including those borne by the surviving spouse after a death, and bequest motives has large effects on the savings of couples with higher permanent income. For instance, the median assets of couples in the top permanent-income tercile would be about 90 percent lower if they did not face medical expenses and had no desire to leave a bequest, but the changes for those in lower permanent-income terciles would be much smaller.

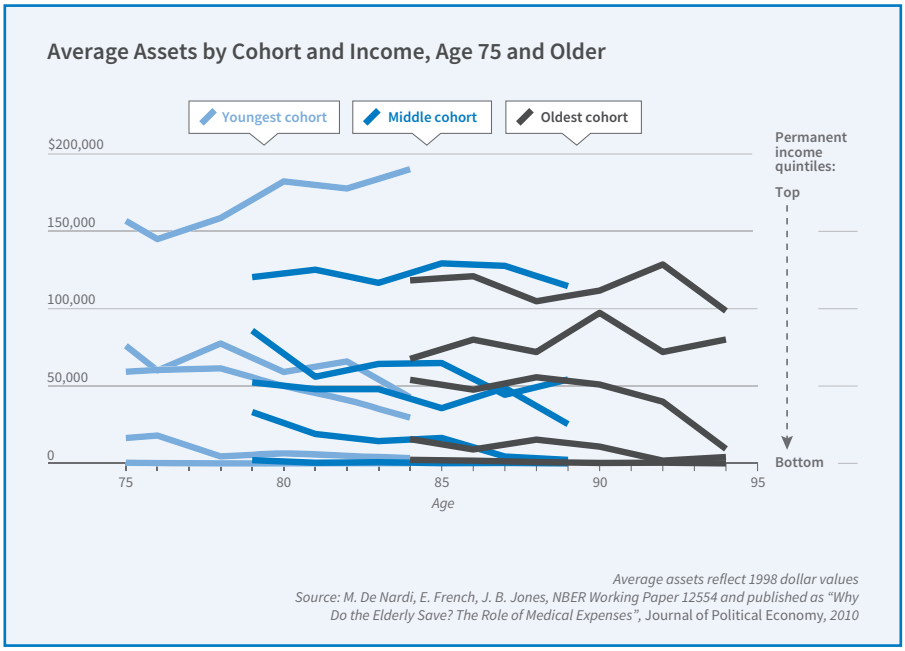

Figure 2

Health Risk, Resources, and Utility from Consumption

Importantly, my previously discussed research either assumes that health has no effect on the utility that one derives from non-medical consumption or fails to identify its effect. Richard Blundell, Margherita Borella, Jeanne Commault, and I use the HRS and the Consumption and Activities Mail Survey to study whether, in old age, consumption fluctuates because of shocks to available resources, or because health shocks affect the marginal utility that a household derives from consumption.[8] The effects of health on available resources have also been studied by Edward Morrison, Arpit Gupta, Lenora Olson, Lawrence Cook, and Heather Keenan; by Poterba, Venti, and Wise; and by Carlos Dobkin, Amy Finkelstein, Raymond Kluender, and Matthew Notowidigdo.[9]

The main findings are the following: first, after age 65, even temporary changes in income and health are associated with changes in consumption. A 10 percent temporary drop in income comes with a 1 percent drop in nondurable consumption, and a one-standard-deviation temporary drop in health is associated with a 2 percent drop in nondurable consumption. Thus, temporary ill health is associated with drops in consumption.

Second, most of the effect of temporary changes in health comes from the change in marginal utility from consumption. More specifically, a temporary health shock that reduces the health index by one standard deviation reduces nondurable consumption by 2.8 percent. About 0.3 percent of this decline is the result of the change in resources, while the rest is the result of a health-induced shift in the marginal utility generated by consumption.

Third, we show that after a health shock, richer households only adjust their consumption of luxury goods, mostly because the marginal utility from consuming them declines. Poorer households also experience a hit in resources, but then adjust their consumption of both necessary and luxury goods.

Our findings inform the extent to which existing government programs help insure against the large risks that households face during old age, as well as the reasons households save. They therefore illustrate how policy reforms would affect both their savings and their welfare.

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[3] "Life Expectancy and Old Age Savings," De Nardi M, French E, Jones JB. NBER Working Paper 14653, January 2009, and the *American Economic Review* 99(2), May 2009, pp. 39–75.
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[4] "Medicaid Insurance in Old Age," De Nardi M, French E, Jones JB. NBER Working Paper 19151, June 2013, revised December 2015, and the *American Economic Review* 106(11), November 2016, pp. 3480–3520.
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[5] "Medical Spending, Bequests, and Asset Dynamics around the Time of Death," Jones JB, De Nardi M, French E, McGee R, Rodgers R. NBER Working Paper 26879, March 2020.
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[6] "Couples' and Singles' Savings after Retirement," De Nardi M, French E, Jones JB, McGee R. Mimeo.
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[7] "The Composition and Drawdown of Wealth in Retirement," Poterba J, Venti SF, Wise DA. NBER Working Paper 17536, October 2011, and the *Journal of Economic Perspectives* 25(4), Fall 2011, pp. 95–118.
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[8] "Why Does Consumption Fluctuate in Old Age and How Should the Government Insure It?" Blundell R, Borella M, Commault J, De Nardi M. NBER Working Paper 27348, June 2020.
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[9] "Health and Financial Fragility: Evidence from Car Crashes and Consumer Bankruptcy," Morrison ER, Gupta A, Olson L, Cook L, Keenan H. University of Chicago Coase-Sandor Institute for Law and Economics research paper, 665, November 2013; "Longitudinal Determinants of End-of-Life Wealth Inequality," Poterba J, Venti SF, Wise DA. NBER Working Paper 23839, September 2017, revised May 2018, and *Journal of Public Economics* 162, June 2018, pp. 78–88; "The Economic Consequences of Hospital Admission," Dobkin C, Finkelstein A, Kluender R, Notowidigdo MJ. NBER Working Paper 22288, May 2016, revised August 2016, and *American Economic Review* 108(2), February 2018, pp. 308–352.
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New Director Elected to NBER Governing Board

Helena Foulkes

The NBER Board of Directors elected Helena Foulkes as a new at-large member at its April 2020 meeting. The former CEO of the Hudson's Bay Company (HBC), a Toronto-based retail conglomerate, Foulkes led the firm through significant transformation and to a successful privatization in March 2020.

Prior to joining HBC, she spent 25 years at CVS Health, most recently as president of CVS Pharmacy and as executive vice president of CVS Health. She led both the strategic vision and the operations for all aspects of the company's retail business and was the principal architect of the company's becoming a recognized leader in the healthcare industry.

Foulkes graduated from Harvard College and holds an MBA from the Harvard Business School. She has received numerous professional honors, including being named among *Fortune* magazine's Most Powerful Women in Business and *Fast Company*'s Most Creative People in Business. Foulkes is a director of The Home Depot and serves on the Harvard University Board of Overseers.

Amy Finkelstein and Heidi Williams Named Codirectors of Health Care Program

Amy Finkelstein, the John and Jennie S. MacDonald Professor of Economics at MIT, and Heidi Williams, the Charles R. Schwab Professor of Economics and Professor of Law (by courtesy) at Stanford University, are the new codirectors of the NBER's Health Care Program, succeeding Jonathan Gruber of MIT, who had directed the program since 2009. The program was launched in 2000 under the leadership of Alan Garber, who is currently provost of Harvard University, to study the markets for health care services, health insurance, and the provision of medical care. The new codirectors have studied a wide range of issues related to these program focus areas.

Finkelstein's research straddles the fields of health economics and public finance, focusing on market failures and government intervention in insurance markets, and on the economics of health care delivery. Her work has earned her many honors, including the American Economic Association's Elaine Bennett Research Prize and John Bates Clark Medal, and a MacArthur Foundation Fellowship. An NBER affiliate since 2001, she received her undergraduate degree from Harvard College; an MPhil in economics from Oxford University, where she was a Marshall Scholar; and a PhD in economics from MIT. From 2008–2020, she served as a codirector of the NBER's Public Economics Program, and she is the cofounder and coscientific director of J-PAL North America, a research center at MIT that encourages and facilitates randomized evaluations of important domestic policy issues.

Williams' research combines health economics and the economics of innovation, with a particular focus on the drivers of technological change in the health care sector. She has studied the links between intellectual property protection, market size, and the rate and direction of innovative activity, including the allocation of private-sector R&D spending across potential treatments for various illnesses. Williams is also a MacArthur Foundation Fellow.

Williams has been an NBER affiliate since 2010. She received her undergraduate training at Dartmouth College; an MSc in development economics from Oxford University, where she studied as a Rhodes Scholar; and a PhD in economics from Harvard University.

Amy Finkelstein

Heidi Williams

Christopher Carpenter Named Director of Health Economics Program

Christopher Carpenter

Christopher Carpenter, the E. Bronson Ingram Chair and Professor of Economics at Vanderbilt University, is the new director of the NBER's Health Economics Program. He succeeds Michael Grossman of the City University of New York, who has directed the program for more than four decades.

Carpenter's research focuses on how public policies affect health and family outcomes. He has studied the determinants and consequences of youth substance abuse and a variety of other health-related behaviors, including seatbelt and bicycle helmet use, the take-up of cancer screening, and vaccination. Carpenter has also analyzed the consequences of legal access to same-sex marriage in the United States. He serves on the board of directors of the American Society of Health Economists and chairs the American Economic Association's Committee on the Status of LGBTQ+ Individuals in the Economics Profession.

Carpenter has been an NBER affiliate since 2005. He received his undergraduate degree from Albion College and his PhD from the University of California, Berkeley.

The Health Economics Program traces its roots to the activities of the NBER's Center for Economic Analysis of Human Behavior and Social Institutions, which was launched in 1972 under the direction of Victor Fuchs. The program focuses on the determinants of health status and human health capital.

Melissa Dell Wins John Bates Clark Medal

NBER Research Associate Melissa Dell of Harvard University has been named this year's recipient of the John Bates Clark Medal, which is awarded by the American Economic Association to the American economist under the age of 40 who has made the most substantial contribution to economic thought and knowledge.

Dell has made path-breaking contributions in political economy and development economics, highlighting the important role that institutions play in economic development. Her research ranges widely, documenting, for example, the centuries-long economic legacy of colonial institutions in Peru, the impact of the Mexican drug war on local economies, and the effects of bombing and other interventions on the military and political activities of insurgents during the war in Vietnam. The award citation notes that "through her pioneering careful and creative data collection and empirical work, Dell has advanced our understanding of the role state and other institutions play in the daily lives and outcomes of ordinary people." The full citation for her award may be found at https://www.aeaweb.org/about-aea/honors-awards/bates-clark/melissa-dell

Dell is an affiliate of three NBER programs: Development Economics, Development of the American Economy, and Political Economy. A native of Oklahoma, she holds three degrees in economics: an AB from Harvard College, an MPhil from Oxford University where she was a Rhodes Scholar, and a PhD from MIT.

Melissa Dell

New Research Associates, Faculty Research Fellows Named

The **NBER Board of Directors** appointed 16 research associates at its April 2020 meeting. Five of the research associate appointees were previously faculty research fellows; one is a former research associate whose appointment was renewed.

Research associates must be tenured faculty members at North American colleges or universities; their appointments are recommended to the board by directors of the NBER's 20 research programs, typically after consultation with a steering committee of leading scholars. The new research associates are affiliated with 16 different colleges and universities; they received graduate training at 13 different institutions.

Forty-five faculty research fellows were appointed by the NBER president, also on the advice of program directors and steering committees, and following a call for nominations in January. They must hold primary academic appointments in North America. The new faculty research fellows are affiliated with 26 different colleges and universities; they received their PhDs from 25 different institutions.

As of May 1, 2020, there were 1,257 research associates and 341 faculty research fellows.

The names and affiliations of the newly promoted and newly appointed NBER affiliates, along with the names of the universities where they received PhDs, are listed below. Entries in italics indicate research associates who were previously faculty research fellows. * indicates renewed research associate appointment.

Research Associates

Marcella Alsan, Harvard University
Children

D. Mark Anderson, Montana State University
Health Economics

Esteban Aucejo, Arizona State University
Economics of Education

Resul Cesur, University of Connecticut
Health Economics

Patricia Cortes, Boston University
Labor Studies

Kerem Cosar, University of Virginia
International Trade and Investment

Itay Goldstein, University of Pennsylvania
Corporate Finance

* Mark Grinblatt, University of California, Los Angeles
Asset Pricing

Mario Macis, Johns Hopkins University
Health Economics

Melissa McInerney, Tufts University
Aging

Kaivan Munshi, Yale University
Development Economics

Christian Opp, University of Rochester
Asset Pricing

Natalia Ramondo, University of California, San Diego
International Trade and Investment

David Slusky, University of Kansas
Health Care

Adam Storeygard, Tufts University
International Trade and Investment

David Thesmar, MIT
Corporate Finance

Faculty Research Fellows

Naoki Aizawa, University of Wisconsin-Madison
Health Care

David Baqaee, University of California, Los Angeles
International Finance and Macroeconomics

Natalie Bau, University of California, Los Angeles
Children

Peter Bergman, Columbia University
Economics of Education

Asaf Bernstein, University of Colorado
Development of the American Economy

Vivek Bhattacharya, Northwestern University
Industrial Organization

Giulia Brancaccio, Cornell University
Industrial Organization

Anna Cieslak, Duke University
Asset Pricing

Faculty Research Fellows

Jeffrey Denning, Brigham Young University
Economics of Education

Marcus Dillender, University of Illinois
Health Economics

Britta Glennon, University of Pennsylvania
Productivity, Innovation, and Entrepreneurship

Samuel Hartzmark, University of Chicago
Asset Pricing

Gabriel Kreindler, Harvard University
Development Economics

Theresa Kuchler, New York University
Corporate Finance

Ashley Langer, University of Arizona
Environment and Energy Economics

Juliana Londoño-Vélez, University of California, Los Angeles
Public Economics

Corinne Low, University of Pennsylvania
Labor Studies

Sara Lowes, University of California, San Diego
Development Economics

Matt Marx, Boston University
Productivity, Innovation, and Entrepreneurship

Steven Mello, Dartmouth College
Law and Economics

Antony Millner, University of California, Santa Barbara
Environment and Energy Economics

Corina Mommaerts, University of Wisconsin-Madison
Aging

Jack Mountjoy, University of Chicago
Labor Studies

Cormac O'Dea, Yale University
Aging

Cecilia Parlatore, New York University
Asset Pricing

Diego Perez, New York University
International Finance and Macroeconomics

Jacopo Ponticelli, Northwestern University
Corporate Finance

Pascual Restrepo, Boston University
Economic Fluctuations and Growth

Natalia Rigol, Harvard University
Development Economics

Raffaele Saggio, University of British Columbia
Labor Studies

Anya Samek, University of Southern California
Aging

Hannes Schwandt, Northwestern University
Children

Bradley Shapiro, University of Chicago
Industrial Organization

Na'ama Shenhav, Dartmouth College
Children

David Silver, Princeton University
Health Care

César Sosa Padilla, University of Notre Dame
International Finance and Macroeconomics

Maria Sviatschi, Princeton University
Development Economics

Alisa Tazhitdinova, University of California, Santa Barbara
Public Economics

Richard Townsend, University of California, San Diego
Productivity, Innovation, and Entrepreneurship

Angela Vossmeyer, Claremont McKenna College
Development of the American Economy

Laura Wherry, University of California, Los Angeles
Health Care

Guo Xu, University of California, Berkeley
Political Economy

David Yang, Harvard University
Development of the American Economy

Shuang Zhang, University of Colorado
Environment and Energy Economics

Eric Zou, University of Oregon
Environment and Energy Economics

NBER Researchers Tapped for Leading Policy Roles

Two NBER research associates have taken leave from their academic and NBER posts to serve in important policy positions.

Kevin Milligan, a professor of economics at the Vancouver School of Economics of the University of British Columbia and a research associate in the Aging and Public Economics programs, has accepted a position advising the Privy Council of Canada, a role that involves advising the Prime Minister and Cabinet.

Carmen Reinhart, the Minos A. Zombanakis Professor of the International Financial System at Harvard University's Kennedy School of Government and a research associate in the International Finance and Macroeconomics and Monetary Economics programs, is the new chief economist of the World Bank. A number of NBER researchers have previously served in this role, including Stanley Fischer, Pinelopi Goldberg, Anne Krueger, Martin Ravallion, Paul Romer, Joseph Stiglitz, and Lawrence Summers.

NBER Books

Tax Policy and the Economy, Volume 34

Robert A. Moffitt, editor

This volume presents five new studies on current topics in taxation and government spending. Katherine Baicker, Mark Shepard, and Jonathan Skinner explore implementation aspects of a Medicare-for-All program which provides a uniform health insurance benefit to all; they contrast it with a program providing a basic benefit that can be supplemented voluntarily. John Beshears, James Choi, Mark Iwry, David John, David Laibson, and Brigitte Madrian examine the design and feasibility of firm-sponsored "rainy day funds," short-term savings accounts for employees that they can use when faced with temporary periods of high expenditure. Robert Barro and Brian Wheaton investigate the impact of taxation on choice of corporate form, the formation and legal structure of new businesses, and indirectly on productivity in the economy. Jonathan Meer and Benjamin Priday examine the impact of the 2017 federal income tax reform, which reduced marginal tax rates and the incentive for charitable giving, on such giving. Casey Mulligan analyzes the impact of the Affordable Care Act on whether firms employ fewer than 50 employees, the employment threshold below which they are exempt from the requirement to provide health insurance to employees.

Conferences

35th Annual Conference on Macroeconomics

The NBER's 35th Annual Conference on Macroeconomics took place online April 2–3. Research Associates Martin S. Eichenbaum of Northwestern University and Erik Hurst of the University of Chicago organized the meeting. Research Associate Jeremy C. Stein of Harvard University delivered a keynote address. These researchers' papers were presented and discussed:

- **George-Marios Angeletos**, MIT and NBER; **Zhen Huo**, Yale University; and **Karthik Sastry**, MIT, "Imperfect Expectations: Theory and Evidence"
- **Esteban Rossi-Hansberg**, Princeton University and NBER, and **Pierre-Daniel Sarte** and **Nicholas Trachter**, Federal Reserve Bank of Richmond, "Diverging Trends in National and Local Concentration" (NBER Working Paper 25066)
- **Per Krusell**, Stockholm University and NBER; **Joachim Hubmer**, University of Pennsylvania; and **Anthony A. Smith Jr.**, Yale University and NBER, "Sources of US Wealth Inequality: Past, Present, and Future"
- **Fatih Guvenen**, University of Minnesota and NBER; **Greg Kaplan**, University of Chicago and NBER; and **Jae Song**, Social Security Administration, "The Glass Ceiling and the Paper Floor: Gender Differences among Top Earners, 1981–2012"
- **Adam Guren**, Boston University and NBER; **Alisdair McKay**, Federal Reserve Bank of Minneapolis; and **Emi Nakamura** and **Jón Steinsson**, University of California, Berkeley and NBER, "What Do We Learn from Cross-Regional Empirical Estimates in Macroeconomics?" (NBER Working Paper 26881)
- **Peter J. Klenow**, Stanford University and NBER, and **Huiyu Li**, Federal Reserve Bank of San Francisco, "Innovative Growth Accounting"

Summaries of these papers are at www.nber.org/conferences/2020/Macro20/summary.html

Agricultural Markets and Trade Policy

An NBER conference on Agricultural Markets and Trade Policy took place online April 30–May 1. Research Associate Dave Donaldson of MIT organized the meeting, which was sponsored by the Economic Research Service of the US Department of Agriculture. These researchers' papers were presented and discussed:

- **Rocco Macchiavello**, London School of Economics, and **Pepita Miquel-Florensa**, Toulouse School of Economics, "Buyer-Driven Upgrading in GVCs: The Sustainable Quality Program in Colombia"
- **Jisang Yu**, **Nelson B. Villoria**, and **Nathan P. Hendricks**, Kansas State University, "The Incidence of Foreign Market Accessibility on Farmland Rental Rates"
- **Gopinath Munisamy**, University of Georgia; **Feras A. Batarseh**, George Mason University; and **Jayson Beckman**, US Department of Agriculture, "Machine Learning in Gravity Models: An Application to Agricultural Trade"

- **Thomas Hertel** and **Uris Baldos**, Purdue University, and **Keith Fuglie**, US Department of Agriculture, "Trade in Technology: A Potential Solution to the Food Security Challenges of the 21st Century"
- **Robert C. Feenstra**, University of California, Davis and NBER, and **Chang Hong**, University of California, Davis, "China's Import Demand for Agricultural Products: The Impact of the Phase One Trade Agreement"
- **Kjersti Nes**, Joint Research Centre, European Commission, and **K. Aleks Schaefer**, Michigan State University, "Retaliatory Use of Public Standards in Trade"
- **Christophe Gouel**, INRAE, "The Impact of Global Warming on Agriculture: A Critique of the Ricardian Approach from a General Equilibrium Perspective"
- **Martin Fiszbein**, Boston University and NBER, and **Will Johnson**, Dartmouth College, "Agricultural Productivity, International Trade, and Structural Change"
- **Colin A. Carter**, University of California, Davis, and **Sandro Steinbach**, University of Connecticut, "The Impact of Retaliatory Tariffs on Agricultural and Food Trade"
- **Ishan B. Nath**, University of Chicago, "The Food Problem and the Aggregate Productivity Consequences of Climate Change"
- **Heitor S. Pellegrina**, New York University Abu Dhabi, and **Sebastian Sotelo**, University of Michigan, "Migration, Specialization and Trade: Evidence from the Brazilian March to the West"
- **David Laborde**, **Abdullah Mamun**, **Will Martin**, **Valeria Piñeiro**, and **Rob Vos**, International Food Policy Research Institute, "Modeling the Impacts of Agricultural Support Policies on Emissions from Agriculture"
- **Farid Farrokhi**, Purdue University, and **Heitor S. Pellegrina**, New York University Abu Dhabi, "Global Trade and Margins of Productivity in Agriculture"

Summaries of these papers are at www.nber.org/conferences/2020/AMs20/summary.html

Energy Use in Transportation

An NBER conference on Energy Use in Transportation took place online June 11–12. Research Associates Meghan R. Busse of Northwestern University and Christopher R. Knittel of MIT, and Kate S. Whitefoot of Carnegie Mellon University organized the meeting, which was sponsored by the Alfred P. Sloan Foundation. These researchers' papers were presented and discussed:

- **Arik Levinson**, Georgetown University and NBER, and **Lutz Sager**, Georgetown University, "Do Car Buyers Undervalue Future Fuel Savings? Post-Purchase Evidence"
- **Fiona Burlig**, University of Chicago and NBER; **James B. Bushnell**, University of California, Davis and NBER; **David S. Rapson**, University of California, Davis; and **Catherine Wolfram**, University of California, Berkeley and NBER, "Cars of the Future, Today? Estimating the Contribution of Electric Vehicles to California's Residential Electricity Demand"
- **James B. Bushnell** and **Erich Muehlegger**, University of California, Davis and NBER, and **David S. Rapson**, University of California, Davis, "Energy Prices and Electric Vehicle Adoption"

- **Connor R. Forsythe**, **Akshaya Jha**, **Jeremy J. Michalek**, Carnegie Mellon University, and **Kate S. Whitefoot**, "Externalities of Policy-Induced Scrappage: The Case of Automotive Regulations"

- **Matthew B. Bruchon** and **Jeremy J. Michalek**, Carnegie Mellon University, and **Inês Azevedo**, Stanford University, "Effects of Internalizing Air Emissions Externalities on Optimal Ride-Hailing Fleet Technology Composition and Operations"

- **Rhiannon Leigh Jerch**, Temple University; **Panle Jia Barwick** and **Shanjun Li**, Cornell University and NBER; and **Jing Wu**, Tsinghua University, "Road Rationing Policies and Housing Markets"

Summaries of these papers are at www.nber.org/conferences/2020/EUTs20/summary.html

International Seminar on Macroeconomics

The NBER International Seminar on Macroeconomics took place online June 18–19. Research Associates Jeffrey A. Frankel of Harvard University and Hélène Rey of the London Business School organized the meeting. These researchers' papers were presented and discussed:

- **Stefanie Stantcheva**, Harvard University and NBER; **Yazan Al-Karablieh**, Harvard Kennedy School; and **Evangelos Koumanakos**, University of Ioannina, "Improving Tax Compliance: Setting Target Taxable Margins for Greek Firms"

- **Fernanda Nechio**, Central Bank of Brazil; **Bart Hobijn**, Arizona State University; and **Adam Shapiro**, Federal Reserve Bank of San Francisco, "Using Brexit to Identify the Nature of Price Rigidities"

- **Tomas Williams**, George Washington University; **Fernando Broner** and **Alberto Martin**, CREI; and **Lorenzo Pandolfi**, CSEF, "Winners and Losers from Sovereign Debt Inflows"

- **Refet S. Gürkaynak**, **A. Hakan Kara**, **Burçin Kısacıkoğlu**, and **Sang Seok Lee**, Bilkent University, "Monetary Policy Surprises and Exchange Rate Abnormalities"

- **Ethan Ilzetzki** and **Keyu Jin**, London School of Economics, "The Puzzling Change in the International Transmission of US Macroeconomic Policy Shocks"

- **Kalina Manova**, University College London; **Davin Chor**, Dartmouth College and NBER; and **Zhihong Yu**, Nottingham University, "Growing Like China: Firm Performance and Global Production Line Position"

- **Maurice Obstfeld**, University of California, Berkeley and NBER; **Eugenio M. Cerutti**, International Monetary Fund; and **Haonan Zhou**, Princeton University, "Covered Interest Parity Deviations: Macrofinancial Determinants"

- **Stephanie Schmitt-Grohé** and **Martín Uribe**, Columbia University and NBER, "Reviving the Salter-Swan Small Open Economy Model"

Summaries of these papers are at www.nber.org/conferences/2020/ISOM20/summary.html

Program and Working Group Meetings

Asset Pricing

Members of the NBER's Asset Pricing Program met April 10 online. Research Associates Andrea L. Eisfeldt of the University of California, Los Angeles and Stijn Van Nieuwerburgh of Columbia University organized the meeting. These researchers' papers were presented and discussed:

- **Anna Cieslak** and **Hao Pang**, Duke University, "Common Shocks in Stocks and Bonds"
- **Itamar Drechsler**, University of Pennsylvania and NBER, and **Alexi Savov** and **Philipp Schnabl**, New York University and NBER, "The Financial Origins of the Rise and Fall of American Inflation"
- **Yang Liu**, University of Hong Kong; **Lukas Schmid**, Duke University; and **Amir Yaron**, University of Pennsylvania and NBER, "The Risks of Safe Assets"
- **Lubos Pastor**, University of Chicago and NBER; **Robert F. Stambaugh**, University of Pennsylvania and NBER; and **Lucian A. Taylor**, University of Pennsylvania, "Sustainable Investing in Equilibrium" (NBER Working Paper 26549)
- **Mathias Kruttli** and **Brigitte Roth Tran**, Federal Reserve Board, and **Sumudu W. Watugala**, Cornell University, "Pricing Poseidon: Extreme Weather Uncertainty and Firm Return Dynamics"
- **Antonio Coppola**, Harvard University; **Matteo Maggiori**, Stanford University and NBER; **Brent Neiman**, University of Chicago and NBER; and **Jesse Schreger**, Columbia University and NBER, "Redrawing the Map of Global Capital Flows: The Role of Cross-Border Financing and Tax Havens" (NBER Working Paper 26855)

Summaries of these papers are at https://www.nber.org/conferences/2020/APs20/summary.html

Financial Economics of Insurance

Members of the NBER's Insurance Working Group met April 24 online. Research Associates Benjamin R. Handel of the University of California, Berkeley, Ralph S. J. Koijen of the University of Chicago, and Motohiro Yogo of Princeton University organized the meeting. These researchers' papers were presented and discussed:

- **Katherine R.H. Wagner**, Yale University, "Adaptation and Adverse Selection in Markets for Natural Disaster Insurance"
- **Naoki Aizawa**, University of Wisconsin-Madison and NBER, and **You Suk Kim**, Federal Reserve Board, "Government Advertising in Market-Based Public Programs: Evidence from the Health Insurance Marketplace"
- **Bo Becker** and **Marcus Opp**, Stockholm School of Economics, and **Farzad Saidi**, Boston University, "Regulatory Forbearance in the US Insurance Industry: The Effects of Eliminating Capital Requirements"
- **Laura Abrardi**, Politecnico di Torino, and **Luca V. A. Colombo** and **Piero Tedeschi**, Università Cattolica del Sacro Cuore, "The Value of Ignoring Risk: Competition between Better Informed Insurers"
- **Weiling Liu**, Northeastern University, and **Jessica Liu**, Cornerstone Consulting, "The Effect of Political Frictions on Long-Term Care Insurance"
- **Ishita Sen**, Harvard University, and **Varun Sharma**, London Business School, "Internal Models, Make-Believe Prices, and Bond Market Cornering"
- **Carles Vergara-Alert**, IESE Business School, and **Richard Stanton**, **Nancy Wallace**, and **Paulo Issler**, University of California, Berkeley, "Mortgage Markets with Climate-Change Risk: Evidence from Wildfires in California"
- **Markus K. Brunnermeier**, Princeton University and NBER; **Rohit Lamba**, Pennsylvania State University; and **Carlos Segura-Rodriguez**, Banco Central de Costa Rica, "Inverse Selection"

- **David Schoenherr**, Princeton University; **Janis Skrastins**, Washington University in St. Louis; **Dimas M. Fazio**, London Business School; and **Bernadus Doornik**, Banco Central do Brasil, "Unemployment Insurance as a Subsidy to Risky Firms"
- **Nicola Gennaioli**, Bocconi University; **Rafael La Porta**, Brown University and NBER; **Florencio Lopez-de-Silanes**, SKEMA Business School and NBER; and **Andrei Shleifer**, Harvard University and NBER, "Trust and Insurance Contracts"
- **Yizhou Jin**, University of California, Berkeley, and **Shoshana Vasserman**, Stanford University, "Buying Data from Consumers: The Impact of Monitoring Programs in US Auto Insurance"

Summaries of these papers are at www.nber.org/conferences/2020/INSs20/summary.html

Behavioral Finance

Members of the NBER's Behavioral Finance Working Group met May 15 online. Research Associate Nicholas C. Barberis of Yale University organized the meeting, which was sponsored by Bracebridge Capital and Fuller & Thaler Asset Management. These researchers' papers were presented and discussed:

- **Rawley Z. Heimer**, Boston College; **Zwetelina Iliewa**, Max Planck Institute for Research on Collective Goods; **Alex Imas**, Carnegie Mellon University; and **Martin Weber**, Universität Mannheim, "Dynamic Inconsistency in Risky Choice: Evidence from the Lab and Field"
- **Daniele D'Arienzo**, Bocconi University, "Maturity Increasing Over-reaction and Bond Market Puzzles"
- **Devdeepta Bose** and **Colin F. Camerer**, California Institute of Technology; **Henning Cordes**, and **Judith Schneider**, University of Munster; and **Sven Nolte**, Radboud University, "Decision Weights for Experimental Asset Prices Based on Visual Salience"
- **Pedro Bordalo**, University of Oxford; **Nicola Gennaioli**, Bocconi University; **Rafael La Porta**, Brown University and NBER; and **Andrei Shleifer**, Harvard University and NBER, "Expectations of Fundamentals and Stock Market Puzzles"
- **Hongqi Liu**, Chinese University of Hong Kong, Shenzhen; **Cameron Peng**, London School of Economics; **Wei A. Xiong**, Shenzhen Stock Exchange; and **Wei Xiong**, Princeton University and NBER, "Resolving the Excessive Trading Puzzle: An Integrated Approach Based on Surveys and Transactions"
- **Itzhak Ben-David**, Ohio State University and NBER; **Jiacui Li**, University of Utah; **Andrea Rossi**, University of Arizona; and **Yang Song**, University of Washington, "Style Investing, Positive Feedback Loops, and Asset Pricing Factors"

Summaries of these papers are at www.nber.org/conferences/2020/BFs20/summary.html

Environmental and Energy Policy and the Economy

Members of NBER's Environmental and Energy Policy and the Economy Program met May 21 online. Research Associates Matthew Kotchen of Yale University and James H. Stock of Harvard University and Program Director Catherine Wolfram of the University of California, Berkeley organized the meeting, which was sponsored by the Alfred P. Sloan Foundation. These researchers' papers were presented and discussed:

- **Robert S. Pindyck**, MIT and NBER, "What We Know and Don't Know about Climate Change, and the Implications for Policy"
- **Adele Morris** and **Siddhi Doshi**, Brookings Institution, and **Noah Kaufman**, Columbia University, "Revenue at Risk in Coal-Reliant Counties"

- **Joseph E. Aldy**, Harvard University and NBER; **Matthew Kotchen**, **Mary F. Evans**, Claremont McKenna College; **Meredith Fowlie**, University of California, Berkeley and NBER; **Arik Levinson**, Georgetown University and NBER; and **Karen Palmer**, Resources for the Future, "Co-Benefits and Regulatory Impact Analysis: Theory and Evidence from Federal Air Quality Regulations"
- **Tatyana Deryugina**, **Nolan H. Miller**, **David Molitor**, and **Julian Reif**, University of Illinois at Urbana-Champaign and NBER, "Geographic and Socioeconomic Heterogeneity in the Benefits of Reducing Air Pollution in the United States"
- **Oliver Browne**, The Brattle Group; **Ludovica Gazze**, University of Chicago; and **Michael Greenstone**, University of Chicago and NBER, "Do Conservation Policies Work? Evidence from Residential Water Use"
- **Shaikh M. Eskander**, **Sam Fankhauser**, and **Joana Setzer**, London School of Economics, "Lessons from Global Trends in Climate Change Legislation and Litigation"

Summaries of these papers are at www.nber.org/conferences/2020/EEPEs20/summary.html

Chinese Economy

Members of the NBER's Chinese Economy Working Group met June 8–10 online. Research Associates Nancy Qian of Northwestern University, Shang-Jin Wei of Columbia University, and Daniel Xu of Duke University organized the meeting. These researchers' papers were presented and discussed:

- **Michael Greenstone**, University of Chicago and NBER; **Guojun He**, Hong Kong University of Science and Technology; **Ruixue Jia**, University of California, San Diego and NBER; and **Tong Liu**, Hong Kong University of Science and Technology, "Can Technology Solve the Principal-Agent Problem? Evidence from China's War on Air Pollution"
- **Jianjun Miao**, Boston University; **Shenzhe Jiang**, Beijing University; and **Yuzhe Zhang**, Texas A&M University, "China's Housing Bubble, Infrastructure Investment, and Economic Growth"
- **Jin Xie** and **Kang Shi**, Chinese University of Hong Kong; and **Jenny Xu**, Hong Kong University of Science and Technology, "Large Shareholders and Sticky Prices: Evidence from a Corporate Governance Reform"
- **Hui Chen**, MIT and NBER; **Zhuo Chen**, Tsinghua University; **Zhiguo He**, University of Chicago and NBER; **Jinyu Liu**, University of International Business and Economics; and **Rengming Xie**, CITIC Securities, "Pledgeability and Asset Prices: Evidence from the Chinese Corporate Bond Markets"
- **Xuan Li**, Hong Kong University of Science and Technology, "The Costs of Workplace Favoritism: Evidence from Promotions in Chinese High Schools"
- **Chun-Yu Ho**, University of Albany; **Marc Rysman**, Boston University; and **Yanfei Wang**, Renmin University, "Demand for Performance Goods: Import Quotas in the Chinese Movie Market"
- **Jie Bai**, Harvard University and NBER; **Shengmao Cao**, Stanford University; and **Panle Jia Barwick** and **Shanjun Li**, Cornell University and NBER, "Quid Pro Quo, Knowledge Spillovers and Industrial Quality Upgrading"
- **Filipe R. Campante**, Johns Hopkins University and NBER; **Davin Chor**, Dartmouth College and NBER; and **Bingjing Li**, National University of Singapore, "The Political Economy Consequences of China's Export Slowdown" (NBER Working Paper 25925)
- **Francesco D'Acunto**, Boston College; **Michael Weber**, University of Chicago and NBER; and **Jin Xie**, Punish One, Teach A Hundred: The Sobering Effect of Punishment on the Unpunished"
- **Jaya Wen**, University of Pennsylvania, "The Political Economy of State Employment and Instability in China"

Summaries of these papers are at www.nber.org/conferences/2020/CEs20/summary.html

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